LAI & FLENSBURG

GATE WAYS

COMPARING DIGITAL COMMUNICATION SYSTEMS

IN NORDIC WELFARE STATES

NORDICOM

GATE WAYS

COMPARING DIGITAL COMMUNICATION SYSTEMS IN NORDIC WELFARE STATES

Gateways
Comparing Digital Communication Systems in Nordic Welfare States
Signe Sophus Lai & Sofie Flensburg

ISBN (PRINT): 978-91-88855-83-1
ISBN (PDF): 978-91-88855-84-8
ISBN (EPUB): 978-91-88855-87-9

This work is Open Access and available to read free of charge and without registration requirement at www.nordicom.gu.se/en/publications/gateways

DOI: 10.48335/9789188855848

CITE THIS WORK:
Lai, S. S., & Flensburg, S. (2023). *Gateways: Comparing digital communication systems in Nordic welfare states*. Nordicom, University of Gothenburg.
https://doi.org/10.48335/9789188855848

PUBLISHED BY:
Nordicom, University of Gothenburg
Box 713
SE 405 30 Göteborg, Sweden

www.nordicom.gu.se/en

GRAPHIC DESIGN BY: Karin Andén
COVER BY: Jeppe Sophus Lai
COVER IMAGE GENERATED WITH: DALL-E 2
VISUALISATIONS MADE WITH: RAWGraphs by DensityDesign, Calibro & Inmagik

GATE WAYS

COMPARING DIGITAL COMMUNICATION SYSTEMS

IN NORDIC WELFARE STATES

SIGNE SOPHUS LAI & SOFIE FLENSBURG

An ode to doing things together

This book is dedicated to collaborative work. It is by no means a result of the individual achievements that are so often celebrated in academia, nor a compromise between different strategic interests. On the contrary, it is a love child between two PhD dissertations that were equally collaborative projects, even if the rules only allowed for one name typed on each cover. The idea was conceived in the spring of 2018, when we were faced with a common challenge of making sense of the changing digital communication environment. It grew in tumultuous times of a global pandemic, several parental leaves, and applications for (the same) jobs, and it came into the world in the form of this book, written in a small allotment garden on the outskirts of Copenhagen.

The collaborations that went into the book stretch far beyond the two of us as authors, and it would never have been possible to write it without the support and backing of our families and friends. Thank you to Mads and Jesper for being true feminists and to our kids – Lea, Filuca, Jonatan, and Uma – for not giving a rat's ass. We are also eternally grateful for grandparents cheering us on and saving us when the family logistics came tumbling down – and for friends, who opened that extra bottle of wine and listened to endless rambling about cables, third parties, and competition policies.

Thank you to all the wonderful people that inhabit our local research environment in the Center for Tracking and Society, and who have supported and motivated the work, provided critical, thought-provoking, and generous feedback, and made us laugh along the way. "The People's Internet" project, led by Klaus Bruhn Jensen and Rasmus Helles, inspired early thoughts on how to compare communication systems and encouraged us to walk down unfamiliar routes. The "Datafied Living" project, led by Stine Lomborg, secured a platform for our continued collaborations, and opened up possibilities for discussing the contents of the book with the wider research community. In particular, we want to thank Marko Ala-Fossi and Lars Gjesvik for valuable background knowledge and discussions on the national contexts, and Stephen Bülow for technical assistance and enthusiastic cheers along the way. A big thanks also goes to Jeppe Sophus Lai for making the front cover into a piece of art in yellow. And finally, we thank the editorial team at Nordicom – Josefine Bové, Kristin Clay, Karin Andén, and Karin Zelano – for encouraging us to write the book in the first place, reading through chapter drafts and undecipherable figures, and making the publishing process smooth and safe.

Above all, this book is an ode to doing things together: to counter notions of the lone wolf researcher – the solitary PhD, the one PI, and the unique Professor – and favour the stuff that only grows when we truly collaborate.

Copenhagen, 12 October 2023
Signe Sophus Lai & Sofie Flensburg

Contents

Preface

In everyday discussions and public debates, the Internet is often referred to as the interfaces that meet us on our screens, facilitating exchanges of communication content in the form of sound, images, or text. Recent years have seen a growing interest in the hazards of the digital as they manifest in the spread of fake news, algorithmic bias, hate speech, troll armies, harmful content, privacy violations, and the like. Alongside this so-called tech backlash, a political momentum has arisen with policymakers eager to challenge the power of Big Tech but also lacking the sufficient regulatory and legislative tools to do so.

With this book, we provide an alternative way of understanding the Internet and how it intersects with society. We argue that to understand the problems and changes that occur at the frontend – the interfaces that meet us when we click on a website or open a mobile app – we need to understand what happens at the backend. We must acknowledge that the Internet is, above all, a physical network made up of cables, servers, terminals, radio wave signals, and data packages destined for IP addresses worldwide. In other words, the Internet is an infrastructure consisting of physical resources that are built, owned, and controlled for a multitude of purposes.

By identifying the underlying components and systems that allow data to travel to and from disparate devices and local networks, we can begin to understand the foundations on which digital societies are built. We can also identify how they are controlled and by whom. In doing so, we see that Google is not only a search engine, Facebook is not only a social network, and Amazon is not only an online marketplace. Rather, these corporations are powerful infrastructure owners controlling critical assets across the digital value chain – from fibre-optic submarine cables to operating systems, third-party tools for collecting and monetising data, and beyond. As are other and lesser-known market actors inhabiting the complex and global digital ecosystem.

From this perspective, the recent political momentum is overshadowed by an earlier and more subtle, but pivotal technological momentum in which society has become critically and irrevocably reliant on the Internet to support our everyday lives and basic forms of government. In the context of the Nordic welfare states, renowned for their redistribution of goods and strong state involvement, this momentum has, in a curious catch-22, led to national welfare institutions promoting and pushing digitalisation processes, but simultaneously eroding the material and historical foundation for the welfare state.

By going digital, the Nordics have gradually surrendered their infrastructural power over to stakeholders that are unaffected by welfare policies and do not fit into the institutional and regulatory frameworks designed in and for the analogue age. In this book, we call this a waltz – between Big Tech and welfare states – when we perhaps should more aptly call it a boxing match that was decided before it even started. We show that the degree of disruption and globalisation varies, but also that the fundamental reconfigurations of the material ground that welfare states are built on, and thus the structural conditions for organising and governing societies, are forever changed.

INTRODUCTION

Wait a minute

Wait a minute, Mr. Postman. Please Mr. Postman, look and see. Is there a letter in your bag for me? Please, please Mr. Postman. Because it's been a mighty long time. Since I heard from this boyfriend of mine. There must be some word today. From my boyfriend so far away.

THE MARVELETTES, 1961

In 1955, John F. Kennedy sat down with pen and paper to write a letter to his long-distance love, Gunilla von Post, who lived in Stockholm. Properly sealed and stamped, the then-senator of Massachusetts put the envelope in a mailbox from where the United States Postal Service collected it, transported it to a central post office, and then loaded it onboard an airplane that transported it across the Atlantic Ocean. Once the letter arrived safely in Sweden, the Swedish postal service took over and ultimately delivered it to the home address of Gunilla. While the content of this scandalous correspondence might seem more thrilling than its distribution history, it nevertheless provides insights into the communication environment of the 1950s: Communicating in writing was largely an activity performed by hand that entailed a significant latency between sender and receiver, reflecting the physical distance between them. National public monopolies managed the services and systems that enabled people to communicate across distances, and state bodies and policies regulated the maintenance, pricing, and delivery times.

Fast-forward to today. A similar love letter would likely take a different and even perhaps lengthier route, albeit one that lasts for just two milliseconds. If Kennedy's Swedish lover were to reply with a latency of about 70 years, she would probably have picked up her smartphone, tablet, or personal computer and typed her declaration of love in an e-mail or as an instant message. The words and sentences would be broken down to bits of data by her preferred application that would take over the function of a mailbox as a

hub for a local distribution network. The access network would send the letter on to regional grids – organised much like traditional postal codes, where individual networks obtain a specific number – and keep track of numerous (IP) addresses used to connect senders and receivers. Like legacy postal services, the local routes and networks exchange data at central locations and buildings, from where the letter would be sent onwards, through submarine pipes crossing below the Atlantic Ocean rather than through the air above it, until it reached the shores of North America. On safe ground, other regional network providers would take over, forwarding this datafied love letter between local network operators, until it would finally reach its receiver through a broadband connection or Wi-Fi router, individual IP address, and the communication application installed on the receiving device.

The two scenarios described above emphasise how mediated communication, regardless of the specific technology used, relies on physical infrastructures that enable communication to travel through various gateways and across time and space. They also illustrate how the Internet's takeover as a common and dominating technology for communication entails a significant shift in the material and institutional conditions for communicating. As digital services increasingly replace analogue media, new infrastructures become key societal resources. These infrastructures are most often owned and governed by global market actors that are not easily incorporated into existing policy frameworks and whose terms of services are often more influential than legislation. While state authorities played a key role in the analogue communication systems of the past, digital communication systems are generally less transparent, less monitored, and less regulated by laws and policies.

Taking this historical reconfiguration as a point of departure, we embark on an investigation of how the structural conditions for Internet-based communication are developing in a small and peculiar corner of the world: the Northern tip of Europe. Focusing on infrastructures, markets, and states as structuring forces that enable and constrain our basic capabilities, we ask the following question:

> How are digital communication systems in Denmark, Finland, Norway, and Sweden shaped, organised, and controlled at the intersection between welfare state traditions and new infrastructural conditions?

In answering this, we pay particular attention to the different material infrastructures that serve as gateways for Internet-based communication in the largest Nordic countries, and to the new gatekeeper positions that have emerged. More specifically, we zoom in on the infrastructural dependencies, economic relations, and institutional clashes between so-called Big Tech corporations and the Nordic welfare states (Esping-Andersen, 1990).

What we (think we) know

Much has been said about the societal impact of the Internet since its inception 50 years ago: from the hype around "global villages" (McLuhan, 1964) and "network societies" (Castells, 2011), the alternative reality of "cyberspace" (Gibson, 1984), "information revolutions" (Robins & Webster, 1999), and the celebration of the Internet as a place where "no one knows you're a dog" (Turkle, 1995), to later warnings about the rise of "surveillance capitalism" (Zuboff, 2019) and "post-truth" societies (McIntyre, 2018). It is evident that the spread of the Internet and digital communication technologies have contributed to societal change around the world – exemplified by the Arabic Spring and the protests in Hong Kong, where global communication infrastructures enabled social mobilisation processes and decentralised information dissemination. Big Tech's circumvention of established regulation and tax payments, opaque business models, and ubiquitous data collection are other examples of the emergence of a new (digital) world order. Be it in the context of authoritarian regimes or liberal democracies, the material transformations of the communication environment trigger a "crisis of control" (Beniger, 1986) and disturb established bureaucratic modes of governance.

From a Northern European perspective, two contradicting understandings of the societal consequences of digitalisation prevail: One line of argument considers the commercial and global governance of the Internet as a threat to the Nordic welfare regimes of the twentieth century, promoting a public discourse on the ubiquitous power of global Big Tech corporations and the challenges they pose to cornerstone institutions and regulatory frameworks. Another argues that the Nordic welfare state models are resilient and adaptable to technological changes, and that the "democratic corporatist media systems" (Hallin & Mancini, 2004), or the "media welfare states" (Syvertsen et al., 2014), continue to prevail. While the latter draws on established analytical models and empirical indicators – developed in and for the analogue media environment – the former often lacks empirical evidence and systematic monitoring to support its claims.

The public and scholarly debates exhibit an abundance of references to globalisation, market and regulatory disruption, and institutional coherency or change. Yet, there is a dearth of empirical baselines for confirming or falsifying assumptions, diagnostics, and hyped utopian and dystopian understandings of the relationship between society and (digital) technology. Unlike the technologies and institutions that Internet-based services replace (e.g., postal services, print news, telephony, or broadcasting), the infrastructural arrangements of digital markets are largely black-boxed. There is limited research evidence for the market dominance of Big Tech and a lack of analytical frameworks that cut across the complex digital value chains. As we argue throughout this book, the opaqueness surrounding digital market assets, revenue streams, and competition strategies serves as a foundation for the regulatory apathy that has characterised Internet policy and regulation

for years. The success of current and future political initiatives is, as such, highly reliant on systematic empirical studies.

Following the urgent need for theoretical approaches, methodological frameworks, and empirical data that can increase our understanding of contemporary digital ecosystems, this book contributes to an emerging field of research focusing on the political economy of Internet infrastructures (Alizadeh & Farid, 2017; Benkler, 2019; Fuchs, 2011; Plantin & Punathambekar, 2019; Sadowski, 2020; Tang, 2020; Winseck, 2017). Combining a materialist infrastructural approach with institutional theory, we provide empirical and comparative analyses of contemporary digital communication systems across the four largest Nordic countries: Denmark, Finland, Norway, and Sweden. Representing highly acclaimed welfare states in the twentieth century, the Nordic communication systems of the past have been characterised by a remarkable degree of public regulation, funding, and ownership of critical infrastructures. Despite recent critiques of digital market structures and the power of Big Tech, Nordic governments and the EU have encouraged digitalisation and actively contributed to establishing some of the most developed Internet infrastructures in the world. Digitalisation is thus closely linked to economic growth strategies, citizens use Internet-based tools and services across all spheres of life, and key welfare services rely on massive data collection and algorithmic decision-making (Andreassen et al., 2021).

While sharing historical and institutional characteristics, there are significant geographical differences between the four largest Nordic countries: Mountainous Norway with its fjords, Sweden with its long distances and abundance of forest, sparsely populated Finland in the east, and small, densely populated, flat, and centrally located Denmark have had very different preconditions for moving into the digital era. The institutional similarities and material differences make these countries critical cases (Flyvbjerg, 2006; Yin, 2009) for examining the interplay and interdependencies between Internet infrastructures and political economies. By focusing on these four contexts, we can study how infrastructural and geopolitical conditions on the one hand, and welfare policies on the other, have framed the development and organisation of the Internet.

This is, in other words, a book about what we *think* we know. We map, measure, and compare the impact of, respectively, classic welfare institutions and global Big Tech corporations, and scrutinise the ways power is obtained and enacted through control of key infrastructural resources. We seek material, economic, and political explanations for the structural similarities and differences between the largest Nordic countries and discuss how Internet infrastructures and political economies mutually shape one another. In doing so, we dismiss both utopian and dystopian preconceptions and instead look at our contemporary societies as they currently appear – basing our assessments about the future on open-ended questions and empirical findings rather than persistent theoretical and popular assumptions.

Biases of digital media

This book is both inspired by – and is a timely alternative to – existing frameworks for studying media and communication structures across societal contexts. From a theoretical perspective, our fundamental research questions draw on the legacies of political economy by focusing on the interplay and interdependencies between evolving societal power structures and communication technologies (Babe, 1995; Garnham, 1979; Hesmondhalgh, 2021; Innis, 2007; Mansell, 2004). Like political economists before us, we investigate the institutionalisation and monopolisation of power empirically and comparatively, aiming to understand the ways political and commercial interests shape – and are shaped by – changes in material communication environments.

While building on decades of media and communication research in terms of our basic theoretical outset and motivation, we apply an alternative methodological and analytical strategy for answering our research question: We argue that the immensely popular analytical dimensions, variables, and typologies for comparing media systems take historical and analogue conditions for granted and ultimately lead to anachronistic research results that view current societies in "the rear-view mirror" (Ala-Fossi, 2020: 146). To ensure the validity of our research results, we need to acknowledge that the altered conditions for communicating also influence the ways communication structures can be studied. Studies of contemporary and future interplays between historically anchored institutional arrangements and the ever-evolving development of digital communication technologies must therefore continuously reconsider and update their empirical entry points and measurement systems, while critically assessing their strengths and weaknesses.

Beyond its empirical and theoretical contributions, this book thereby provides insight into the multitudes of methodological challenges that follow the ongoing evolution of the Internet. To mention just a few, the analytical chapters (Chapters 3–6) point to the insufficiency of tools for comparing data traffic in access networks, the absence of databases containing information on data centres, the shortcomings of existing measurement systems for analysing web and app use, and the lack of official and established libraries for intercepting third-party data ecosystems. These challenges can be traced back to several important biases in contemporary digital media and communication studies that have fostered a lack of research into 1) digital markets and business models beyond legacy media sectors; 2) the broader ecosystems of applications beyond websites – most notably, the mobile app environment; and 3) Internet infrastructures beyond user interfaces and software technologies controlled by so-called platform companies. Put differently, the analyses of the book constitute a pushback against persistent tendencies of mediacentrism, webcentrism, and platformcentrism.

Mediacentrism

Mediacentrism refers to the favouring of legacy media institutions and the specific content they carry (e.g., news articles and television programmes) rather than the broader digital ecosystem and its entanglements of old and new actors. Mediacentrism is expressed in the void between arrays of case studies of legacy institutions (Bruun, 2019; Daccak, 2021; Lassen & Sørensen, 2021; Nikunen & Hokka, 2020; Sjøvaag et al., 2016) and sectoral analyses of public service media, newspaper markets, and media systems (Benson et al., 2012; Horsti & Hultén, 2011; Lund et al., 2009; Nord, 2008; Ohlsson, 2015; Sjøvaag et al., 2016, 2019). It is also evident in a tendency to focus on the repercussions of digitalisation, datafication, and platformisation for legacy media institutions (Enli et al., 2019; Kleis Nielsen & Ganter, 2018; Knudsen et al., 2017; Lindskow, 2016; Møller Hartley et al., 2021; Sirkkunen et al., 2021), rather than for the broader society and its individuals. Perhaps as a result of the global – often American – origins of Big Tech corporations, research into the power of these *new* gatekeepers in the Nordic contexts are, by comparison, still scattered and outnumbered by studies of legacy media.

The studies mentioned above reflect the important position of legacy institutions in the Nordic societies, and the close bonds between them and the Nordic welfare state models. As this book testifies to, public service media are highly used across the region, and it is likely that these institutions have an even higher presence in the Nordics compared with other contexts. There are also more practical explanations for focusing on legacy media, such as the continued systematic and official monitoring of newspapers, broadcasters, and telcos that is contrasted by the deficiency of digital measurement systems. Without official traffic monitoring or publication of reliable top-lists, researchers are struggling to sample and pinpoint relevant cases beyond the individual enclaves of news media, public broadcasting, and telecommunications. The preference for analysing legacy institutions is thus related to issues of obtaining (researcher) access and quality data, but it also reflects scientific traditions and a tendency to underestimate the declining role of traditional media institutions and the growing power of new, less accessible corporations.

Giving up this bias is not without its challenges, which is most likely what gives it strength and endurance. However, mediacentrism in research has repercussions for both market regulation and policy developments. Without studies that target the broader digital ecosystems as well as dependencies between old and new market actors, the policy focus will remain on already thoroughly regulated national institutions. This bias is thus self-reinforcing across scientific and political domains: Analyses that presume legacy media are still independent systems (and markets) tend to reproduce existing methodological approaches (e.g., analyses of news content) and analytical indicators (e.g., readership numbers or funding for content production), which often leads them to confirm ideas of continuity. Researchers thereby

avoid engaging with difficult and troublesome methodological issues, thus overlooking important mechanisms and structures entangling these institutions in broader infrastructures and market arrangements.

Webcentrism

Related to the first bias, webcentrism refers to a persistent and historically rooted focus on websites as the main arenas for digital communication, making them a default object of legislative and scholarly attention. As we argue throughout this book, the slide from web- to app-based communication, following the introduction and saturation of smartphones and other mobile devices, has not been fully addressed or acknowledged. This is evident in the dominance of studies focusing on web traffic and web cookies over studies of app usage and tracking (Flensburg & Lai, 2022). Although web monitoring leaves many researchers wanting more (reliable measures, quality panels, etc.), it is nothing compared to the (lack of) resources for monitoring and studying apps. While tools for studying website data flows or measuring web traffic and user flows have been developed in both academic (e.g., www.webxray.org) as well as commercial (e.g., www.comscore.com) research settings, apps require the advance of new methods designed for unpacking app infrastructures or understanding user interactions with apps. Being closed-off systems built according to new and often unknown principles, mobile apps pose several methodological challenges that previous studies have tackled when it comes to the web.

Mirroring the scholarly bias towards web-based communication, regulatory initiatives are also grounded in historical attention to websites and web cookies and an absence of regulation targeting mobile third-party services or requiring notices like the ones that meet us whenever we open a website and are asked to "accept all cookies". Furthermore, mobile-app ecosystems are organised differently than web environments, raising a wide range of scholarly as well as regulatory questions related to, for instance, the power of operating systems and app stores. The walled gardens that currently frame the ever-growing usage of mobile apps can be considered a direct result of this inattention that has allowed Apple and Alphabet (Google) to position themselves as providers of entire mobile ecosystems (Lai & Flensburg, 2021). Since these market arrangements have increasingly been built into the very infrastructures of mobile communication – and the wide range of societal services that rely on them – they are difficult to challenge and require significant investment in building sustainable tools for research and regulatory interventions.

One strand of research that pushes back against this bias can be collected under the nascent field of app studies (Dieter et al., 2019; Gerlitz et al., 2019), which has contributed with the establishment of a research agenda around apps as well as various methodological entry points. Reflecting the bias towards individual platforms, studies in this vein often focus on a single

app (Facebook Messenger, Candy Crush, etc.) or category of apps (dating, policing, etc.), thereby leaving space for more comprehensive engagement with the app ecology at large (for exceptions, see, e.g., Binns et al., 2018a; Blanke & Pybus, 2020; Kollnig et al., 2022a). Providing detailed insights into the data flowing to and from mobile apps, these studies rarely follow the data to the broader digital ecosystem and the infrastructures they are embedded in (Flensburg & Lai, 2023). This leads us to the last of the biases, namely the predisposition of research, regulation, and public debate to focus on the user interfaces and software programs that make up just one (albeit important) layer of the Internet and digital communication systems.

Platformcentrism

Platformcentrism refers to a bias towards application- and content-providing platforms, with only a minimum of studies accounting for the remaining parts of the infrastructure and value chain. These remaining parts include backbone components (Plantin & Punathambekar, 2019; Starosielski, 2015), Internet service provision (see, e.g., Nothias, 2020), and third-party data services (see, e.g., Binns et al., 2018b; Lai & Flensburg, 2021). The Internet's backbone can, in many ways, be regarded as a black-boxed network which in turn challenges the tracing of the infrastructure ownership. Following these structures and their entanglements in the growing infrastructural portfolios of large platforms is a difficult, yet necessary, task if we are to understand (future) control mechanisms and power structures beyond the provision of a single online retail store, social network, or search engine.

While platform studies demonstrate deep awareness of the multi-sidedness of digital markets (e.g., the synergies between providing content services and serving ads) and the programmability and technological underpinnings of mundane digital activities (Bogost & Montfort, 2009; Parker et al., 2016), many studies continue to focus on the application and content side of the digital market. Exploring the digital ecosystem from the perspective of individual services, platform studies have provided detailed accounts of how particular platforms, such as Facebook Messenger (Nieborg & Helmond, 2018) or Airbnb (van Dijck, 2014), are designed and controlled. As argued in recent work that aimed to combine infrastructural and platform studies (Plantin et al., 2018; Plantin & Punathambekar, 2019), the infrastructural perspective encourages researchers to look beyond the particular services supplied and investigate the hidden vertical and horizontal integrations that ground platform power.

In regulations, the emphasis on platforms and processes of platformisation risks supporting a limited view of the contemporary activities and business models of the platforms in question. During extensive lobbying campaigns aiming to influence the final version of the European Union's Digital Services Act, Big Tech corporations have consistently emphasised issues of content

distribution and moderation (think of fake news, information silos, etc.), allegedly to avoid regulatory interventions into their core business, namely that of data-based advertisement (Lomas, 2022). To understand the implications of these companies extending their businesses well beyond the confines of their original platforms, we need systematic studies of buy-ups and business expansions. One example of this would be Alphabet owning both the largest mobile operating system (Android) and the most comprehensive app store in the world (Play Store), while also laying down large fibre cables to connect otherwise unconnected parts of the globe with Internet and offering tools and services to build and monetise all kinds of digital applications. Another would be the ubiquitous webstore Amazon, whose cloud-service (AWS) is hosting and powering increasingly larger parts of the global Internet – from Netflix's library and its recommendation algorithm to the Danish state's official communication platform for daycare institutions and schools, Aula (www.aula.dk).

Taken together, the three research biases have important spill-over effects: The lack of monitoring and research deficiencies are interchangeable and connected in ways where one reinforces the other. The comprehensive monitoring of traditional media and telecommunication markets rests on well-established policy agendas, just as the lack of interventions into the mobile market and backbone infrastructures reflects a reactiveness and inertia of political regulation. Had we carried out the study in contexts that are not as transparent, economically stable, and thoroughly digitalised as those of the Nordic region, these challenges would stand out even more: In places where connectivity is scarce and the barriers to entry into the digital markets are nearly insurmountable, research and regulation equally suffer.

Agenda

Addressing the biases of existing models and analytical approaches, we develop a novel framework for identifying, assessing, and systematically monitoring continuously evolving digital communication environments. To do so, we take a step back to look at the gateways that mediated communication pass through in highly digitalised contexts, as well as the new institutions that gatekeep them. Illustrating this epistemic change of perspective, we leave the concept of a *media* system and instead employ that of a digital *communication* system (Flensburg & Lai, 2019, 2020a) as an overarching conceptual framework for investigating the structural conditions surrounding Internet-based communication. While institutions such as the press and public broadcasters or dominant platform corporations are important components of such systems, we do not assign them privileged positions as a priori objects of study (Flensburg, 2020). Instead, we enquire into the structures that frame individuals' basic communication *capabilities* (Jensen, 2021; Lai, 2021; Sen, 1980) – that is, how their communications are enabled and constrained, and by whom.

This perspective originates in the capability approach (Nussbaum, 2000; Sen, 1980), a normative and people-centred framework about social justice, freedom, and well-being. Importantly, the employment of the approach in this book does not mean that we empirically study individuals and their subjective doings and beings. Rather, we align the study with the normatively (or ethically) individualistic, but ontologically non-individualistic, outlooks of the approach (Robeyns, 2003: 65), viewing societal (macro) structures from the perspective of the humans that inhabit them. The shift from media systems to communication systems thereby entails a shift in perspective from asking why specific institutions (e.g., the press) have developed differently across societal settings to asking why the conditions for communicating (digitally) vary across contexts. It also entails considering the institutionalisation of communicative power as dependent on the historical context and the communication technologies available at any given point in time, thereby recasting infrastructures as a more explicit dimension in structural analysis.

The concept of infrastructure refers to the material resources and systems that ground essential societal activities – such as mediated communication – regardless of the specific types of symbolic content that travels in and through them (Sandvig, 2013). In this perspective, the role of the press as a key gatekeeper for public communication is concurrent with the historical period where print was the dominating technology for mediating asynchronous one-to-many communication (Bar & Sandvig, 2008). The privileged position of the press as a cornerstone institution in democratic societies is thus not a universal truth but is rather rooted in historical and material conditions. The emergence of the Internet reconfigured these material conditions and disturbed the institutional order, placing new infrastructural resources and institutions at the centre of the communication system while pushing established ones to the periphery. If we are to understand the forces that structure contemporary digitalised and datafied societies, we therefore need to investigate the material resources that ground digital communication in the first place, and by whom they are controlled.

Inspired by the recent "turn to infrastructure" in communication research (Hesmondhalgh, 2021), we map, analyse, and compare the various layers of the Internet that together both enable and constrain digital communication. Specifically, we focus on access networks, backbone networks, applications, and data as critical gateways linking the chain of events that follow from *any* digital communication activity. For each of these analytical layers, we study the infrastructural arrangements (e.g., broadband subscriptions, in- and outgoing submarine cables, usage of various types of content services, and data harvesting and distribution) across the four national settings to assess the degrees of digitisation of the infrastructure and digitalisation of communication. Based on the infrastructural investigations, we map ownership structures as they cut across the same analytical layers (e.g., leading providers

of broadband, backbone networks, apps and websites, and data services) to assess how disrupted and globalised the Nordic markets are. We then approach the role of the Nordic (welfare) states by looking into the degrees of state facilitation and intervention (e.g., broadband strategies, backbone policies, application regulation, and data governance) across the same four layers.

Through these enquiries, we answer calls coming from the fields of political economy of communication (Mansell, 2004) and critical data studies (Kitchin & Lauriault, 2014) for empirical investigations of contemporary digital environments. Our goal is to document and scrutinise the implicit, naturalised, and often hidden power structures that condition our mundane use of the Internet, as well as the greater organisation of the largest Nordic societies. We approach these questions on a macro-level, cutting across sectors that are typically studied and regulated in isolated silos, which also translate into competing research or policy areas. In doing so, we approach the inherent convergence (Jenkins, 2006) and intermediality (Jensen, 2008) of digital communication and strengthen the foundation for future research as well as regulation.

We are aware that macro-studies leave little room for nuance and provide limited insight into how digitalisation and datafication processes play out in practice – within specific institutions or in the everyday lives of individual citizens. Our analyses necessarily omit accounts of specific decision-making procedures and governance practices, thereby downplaying individual agency and lived experiences. By focusing on (macro) structures rather than (micro) processes, our findings can be said to paint a rather simplistic picture of a highly complex reality. Our focus on material infrastructures and political economies can also be considered to underestimate cultural aspects as forces of change or stability. Yet, as important as deep case studies, ethnographic fieldwork, process tracings, and so forth are, they too can benefit from broader perspectives that emphasise the underlying structural arrangements and material conditions. As illustrated by the success of media system analyses, such typologies provide a valuable backdrop for understanding and interpreting more particular tendencies, activities, and conflicts. In other words, our goal is to establish a baseline for future studies that can go into depth with the general and top-level findings of this book and examine their consequences for individuals and institutions.

Narrative

This book consists of eight chapters. In Chapter 1, we outline the theoretical background for our analyses and establish the conceptual framework for studying and comparing digital communication systems. In Chapter 2, we present the Digital Communication System Matrix as a foundation for empirical analysis and operationalise it through key variables, indicators, and

measures. We also discuss the methodological issues and concerns related to analysing contemporary media and communication structures. Chapters 3–6 are structured according to the four analytical layers (access networks, backbone networks, applications, and data), and we present the empirical and comparative analyses of the four countries. In Chapter 7, we discuss the role of infrastructures, markets, and states in shaping the Nordic communication environments and the consequences of new methodological challenges to research. Finally, in the concluding Chapter 8, we synthesise the findings of the book, assess the implications of digital communication systems for human freedom, equality, and welfare, and offer perspectives for future research and policy.

The introductory anecdote of the scandalous love letter serves as a consistent narrative throughout the book. By tracing a hypothetical and tremendously delayed reply from Kennedy's Swedish lover, we follow the digital and datafied message as it embarks on a transatlantic journey through a multitude of local and global networks and gateways, interacting with a range of stakeholders and regulatory regimes that shape the underlying control mechanisms of its route.

PART I

DEPARTURES

CHAPTER 1

Follow the data

Technological systems, even after prolonged growth and consolidation, do not become autonomous; they acquire momentum. Momentum does not contradict the doctrine of social construction of technology, and it does not support the erroneous belief in technological determinism. The metaphor encompasses both structural factors and contingent events.

HUGHES, 1987: 76

In 1973, the Norwegian town of Keller connected to the US-based Arpanet via satellite, placing the Northern corner of Europe as a critical hub in the nascent geography of what would later become the global Internet (Hetland, 1999). Instituting the rise of the digital communication systems studied in this book, this first gateway to the original network of networks, and the following addition of numerous fibre-optic data highways, enabled the Internet to migrate from its American origins to the societal structures of Denmark, Finland, Norway, and Sweden and the everyday lives of Nordic citizens. Supported by a rapid and successful diffusion of digital devices, network connections, and Internet-based services, the Nordics evolved within the course of a few decades from analogue to digital societies – and they are, by now, among the most well-connected regions in the world. In other words, the Internet has gained momentum (Hughes, 1994) as a general-purpose technology (Naughton, 2016) that supports a wide range of mundane activities and societal functions (Edwards, 2002).

As Thomas P. Hughes (1987) noted in the quote cited above, significant infrastructural evolutions, like electrification and digitalisation, call for nuanced understandings of the interplay between technological innovations and societal arrangements. While the breakthrough of the Internet was indeed dependent on the invention of computers, the build-out of network architectures, and improvements in data processing, these technologies were also promoted by government policies, economic interests, and sociocultural

norms. As we elaborate further in the book's analytical chapters, the Nordic welfare states initiated, encouraged, facilitated, and funded a wide range of infrastructure projects, following historically rooted principles of universality and decommodification (Esping-Andersen, 1990). Yet, the tremendous success of these strategies also altered the material conditions that grounded fundamental welfare ideologies and policy frameworks, leading to a disruption of established modes of governance, institutional logics, and business models.

The combination of comprehensive digitalisation processes and strong welfare state traditions means that the Nordic countries are critical cases (Flyvbjerg, 2006) for studying how new technological conditions merge and clash with established institutional structures. The adoption of technologies developed in and for an American context in the welfare systems of Northern Europe offers a unique occasion for studying how institutional structures shape the infrastructural development of the Internet – and vice versa. By studying the structural implications of these evolutionary processes, we gain insight into both the historical path dependencies and the disruptive potentials of (digital) technologies. Our analyses thereby touch upon and provide an empirical contribution to heated and long-lasting theoretical discussions about the interplay between technologies and societies.

Addressing these classic theoretical enigmas and relating them to our research questions, we in this chapter review and discuss existing literature that addresses the relationship between (new) communication technologies and (old) institutional arrangements. Before embarking on our empirical exploration of the infrastructure, market, and state forces that influence (digital) communication capabilities in Denmark, Finland, Norway, and Sweden, we discuss existing frameworks and approaches across media and communication studies. In doing so, we pay particular attention to comparative typologies used to assess how communication environments are shaped and controlled across contexts. Drawing on established political economist approaches of "following the money" in economic circuits (DeFleur, 1971; Ettema & Whitney, 1994), we argue for an alternate strategy of "following the data" as it travels across boundaries within digital communication systems, regulations, and research on its path between senders and receivers (Flensburg & Lai, 2023). This chapter thereby establishes a theoretical foundation for operationalising the concept of a digital communication system as an epistemic strategy for capturing the complex infrastructural, economic, and political arrangements that structure contemporary digital societies.

Epistemic crossroads

The key concept we employ in this book – digital communication system – unites classic questions and approaches from political economy and media ecology with contemporary infrastructure and critical data studies.

In developing and conceptualising the notion of a digital communication system, we apply theories about the interplay between societal power and transforming communication environments (Innis, 2007; Mansell, 2004) to the empirical realities identified and discussed by recent studies of Internet and data infrastructures (Hesmondhalgh, 2021; Parks et al., 2015; Plantin & Punathambekar, 2019). In doing so, we contribute to and develop a research agenda focusing on the evolution and institutionalisation of the Internet as a common and increasingly dominant societal infrastructure. As this chapter's main argument, we unfold how this historical transformation of the underlying material conditions for communicating (and for researching communication) calls for epistemic adjustments of established models for analysing and comparing media and communication structures.

The legacies of media systems

As briefly mentioned in the introduction, our analyses of digital communication systems stand on the shoulders of decades of research concerned with exploring and comparing national media structures (Brüggemann et al., 2014; Hallin & Mancini, 2004, 2012, 2017; Hardy, 2010; Humphreys, 1996; Humprecht et al., 2022; Mancini, 2020; Siebert et al., 1963; Syvertsen et al., 2014). Focusing on the press, media system analyses investigate how the societal organisation and control of political communication outlets (such as newspapers and broadcast media) are shaped at the intersection between market interests, cultural norms, social development, and state governance. This research provides valuable typologies for understanding how and why journalism has evolved differently across contexts, while also serving as a key point of reference for studies addressing broader power structures surrounding national media markets and regulation (see, e.g., Curran et al., 2011; Humprecht et al., 2020; Jungherr et al., 2020; Psychogiopoulou, 2012, 2014; Street, 2010; Tenove, 2020; Van Aelst et al., 2017).

According to Daniel C. Hallin and Paolo Mancini in their seminal book, *Comparing Media Systems: Three Models of Media and Politics* (2004) – and the numerous utilisations of its analytical framework and empirical approaches – Denmark, Finland, Norway, and Sweden are clear-cut examples of so-called democratic corporatist media systems (see Benson et al., 2012; Brüggemann et al., 2014; Enli et al., 2018; Humprecht et al., 2022; Nord, 2008). In comparison with more liberal and polarised contexts (e.g., the US or Mediterranean countries such as France, Italy, and Spain), the large Nordic countries have been characterised by early penetration of mainstream media evolving in parallel with the introduction of democracy, a political culture characterised by collaboration between political stakeholders, and strong involvement of the (welfare) state in the distribution of economic and material resources (Hallin & Mancini, 2004: 143–197). A high consumption of news and flourishing advertisement revenues have been combined with

institutionalised state involvement in the form of various support schemes, balancing the fine act of structural regulation while refraining from day-to-day editorial control (Syvertsen et al., 2014).

Hallin and Mancini's original study, published in 2004, paid limited attention to the Internet, yet multiple studies have used it as a key reference for comparing digitalised or hybrid media systems (see Hallin & Mancini, 2017; Mancini, 2020; Mattoni & Ceccobelli, 2018). Focusing on "Nordic media in the digital era", Trine Syvertsen and colleagues (2014: 120) argued "that there is a high degree of continuity regarding the empirical realities of how the media systems operate, whether we are speaking of user patterns, institutions, or content". Media institutions have supposedly adapted to the changes following digitalisation and have "successfully adjusted their strategies to digital and global markets" (Syvertsen et al., 2014: 122–123). Other studies have opposed "the continuing validity of *Comparing Media Systems*" (Ohlsson, 2015: 62), arguing that the press has been economically weakened, former bonds between the press and the political sphere have eroded, state involvement in the media market has diminished, and public service broadcasters have lost former monopoly positions.

Regardless of whether they confirm existing assumptions or point to deviations, studies of the political and economic structures surrounding mediated communication in the Nordics continue to focus on legacy news institutions as empirical entry points, reflecting the mediacentrism bias, discussed in the introductory chapter. They thereby neglect to consider the fundamental transformation of the broader communication environment, as pointed out by several critics of Hallin and Mancini's work (Bennett, 2015; Hardy, 2010; Norris, 2009). Looking at contemporary media and communication structures in "the rear-view mirror" (Ala-Fossi, 2020: 146), media system analyses tend to reproduce "an old notion of the public sphere in which a system of well-connected institutions […] maintain the information gates through which citizens receive news and ideas about who they are and how society is working" (Bennett, 2015: 162). In doing so, they conveniently overlook "the 800-pound gorilla in the room" – new information and telecommunication technologies – making it appear "as though journalism and the media systems are frozen in the mid-twentieth century" (Norris, 2009: 332).

Following this line of argument, empirical studies applying the indicators and variables of *Comparing Media Systems* circumvent questions about how transformations in the broader media and communication environment (such as the introduction of the Internet) affect the continued validity of the original framework (Flensburg, 2020). Few studies actively engage in epistemic discussions about how contemporary, digitalised media systems can be defined and delimited (for exceptions, see Chadwick, 2017; Mattoni & Ceccobelli, 2018). By continuing to focus on newspaper circulation, legacy media regulation (e.g., public service broadcasting policies and news subsidies),

and journalistic autonomy, most studies bypass important structuring forces, such as news media's competition with and increasing reliance on digital intermediaries (Nielsen & Ganter, 2018), as well as the growing importance of third-party data tracking and advertisement (Helles et al., 2020; Helles & Flyverbom, 2019; Sørensen & Van den Bulck, 2020). These studies thereby neglect to consider the fundamental difference between analogue and digital distribution in the form of new infrastructural dependencies, altered value chains, and regulatory disruption.

While Nordic scholars largely rely on media system frameworks for assessing the mutual shaping of political systems and communication media (Enli et al., 2018; Jakobsson et al., 2021; Kammer & Hjarvard, 2015; Nord, 2008), alternative approaches are beginning to emerge on a global scale (Gillwald & Simon, 2012; Hunt, 2014; Simon, 2012; Vendil Pallin, 2017). Based on a comparative study of Internet ideologies and data governance, Kieron O'Hara and colleagues (2021: 237) have suggested a typology of four geopolitical Internets: American, European, Chinese, and Russian. These ideal typical Internet regimes are characterised by varying degrees of openness and restrictions; different ideological emphases on state control and innovation freedom; and different network designs. By including dimensions and analytical perspectives that are overlooked by media system scholars, *Four Internets* (O'Hara et al., 2021) takes an important step towards identifying, characterising, and comparing how digital communication is institutionalised and controlled across contexts. However, much like early attempts to identify media systems (e.g., Siebert et al., 1963), O'Hara and colleagues' book is an explorative investigation of specific cases and thus does not present a systematic empirical framework for testing, validating, or falsifying existing as well as emerging typologies. In other words, it does not provide an alternative to the dimensions, indicators, and variables of *Comparing Media Systems*.

To sum up, existing studies of national media systems provide an important source of inspiration and a historical backdrop for understanding the rise of digital communication systems. However, research also needs to acknowledge that models and theoretical typologies developed in and for the analogue age are insufficient at best, and misleading at worst, when applied to contemporary digital environments. By reproducing variables and indicators without considering their ability to produce valid knowledge about the forces that shape contemporary communication flows, media system analyses become blind to the more fundamental and historical shifts in the ways media and communication are organised and controlled. It is, in other words, time to take a step back and reconsider not only the institutional position of the press, but also the very definition and delimitation of what kind of "system" we study and how we approach it.

Institutions & individuals

In developing and maturing analytical and methodological approaches that address questions similar to those raised by media system analysists, there is an urgent need for answers that consider the contemporary empirical realities. While acknowledging the legacies of media systems in pointing out the important links between communication media, market power, and policy, we argue that an epistemic turn in the way knowledge is produced is long overdue: away from analysing the structural conditions of (analogue) media *institutions* as proxies for public enlightenment and democratic debate and towards approaching digital communication environments from the perspective of *individuals* as ultimate ends of studying communication structures.

The conceptual move from (analogue) *media* to (digital) *communication* systems epitomises this change of perspective. Building on the broader concept of a communication system (Jensen & Helles, 2022), it represents a (macro) approach to investigating the overarching institutional arrangements that frame mundane communicative activities while also emphasising the historical and material contexts they evolve in. That is, the concept of a communication system recalls "the simple, but crucial fact that each communication technology is a material resource whose distinctive features help to explain the media institutions and communicative practices that have emerged, or which may emerge in the future" (Jensen, 2013: 216). We thus view communication systems, on the one hand, as universally referring to the organisation and control of communication technologies available in any given time and space (Finnemann, 2005). On the other hand, the specific components of these systems (and thereby the methodological and empirical conditions for studying them) are inseparably tied to the concrete communication infrastructures of a given societal and historical context.

The concept of a communication system thereby emphasises how various communication media enable and constrain human activities and societal organisation (Hutchby, 2001), while also creating distinctive material preconditions for developing business models, regulatory frameworks, and other institutional arrangements. We cannot transfer empirical indicators and measures directly from one system to another; instead, we need to consider what the concrete system is made up of and how it can be studied empirically. Going further, we must consider how different gatekeepers of communication rise and fall – become essential and peripheral in the communication system – in close connection to the evolution of different material infrastructures for communicating (Innis, 2007).

Digital communication systems thus refer specifically to contexts where the Internet has evolved into a common and dominating infrastructure for transporting communication content across time and space. Emphasising the material features of Internet distribution, the concept provides a theoretical and analytical lens for understanding the altered conditions for controlling,

monetising, and regulating communication. It entails an openness towards the types of institutions that have emerged – or might emerge in the future – by insisting on investigating the underlying material resources *before* identifying the actors that control them. That is, if we are to make sense of and be able to critically discuss the business models and disruptive effects of global Big Tech corporations or the continuous influence of welfare state institutions and logics, we must first map out the grounds on which these power battles are being fought. To do so, we need to develop a strategy for identifying how human agency is enabled and constrained through the organisation and control of basic societal resources. The capability approach, introduced briefly in the introduction to this book, offers a strategy for doing exactly that.

A capability approach

Pioneered by Amartya Sen (1995) and Martha Nussbaum (2000), the capability approach pushes a research agenda that is fundamentally concerned with what individuals are capable of and why – including how institutional and material arrangements in different societal settings enable and constrain these capabilities. While the units of normative judgement are individuals and, as properties of individuals, their capabilities, it is a central principle of the approach that individuals are not independent from the structural contexts of their everyday lives. Capabilities are thus "not just abilities residing inside a person but also the freedoms or opportunities created by a combination of personal abilities and the political, social, and economic environment" (Nussbaum, 2011: 20).

Closely related to the literature on digital divides (Mansell, 2002, 2017b; Mihelj et al., 2019; Norris, 2001), the capability approach emphasises that peoples' capabilities cannot be assessed by simply measuring their access to news media or high-speed Internet connections, their skills and knowledge, or their ability to purchase devices and services. Instead, it considers how these activities are enabled and constrained by a wide range of factors (Robeyns, 2005) – be they personal (e.g., relating to physical constraints, literacy, and gender), social (including norms, policies, discriminating practices, and power relations), or environmental (as in geographical, infrastructural, and other physical arrangements) (Robeyns, 2016).

The smartphone provides an example with which we can explain the relationship between individuals and these factors. The interest that individuals have in smartphones is generally not in their technical nature or material make-up of processors and batteries, but rather the capabilities they offer, for example, connecting with others across time and space through text messages. The extent that smartphones can contribute to this functioning, however, depends on personal factors (e.g., literacy and ability to use the device), social factors (e.g., existing cultural traditions and policies that foster different digital literacies), and environmental factors (the availability of a physical infrastructure, e.g., a telephone network or a mobile broadband connection) (Lai, 2021: 25–26).

The capability approach – and our application of it – is thus normatively (or ethically) individualistic, but ontologically non-individualistic (Robeyns, 2003: 65). For the purpose of analysing digital communication systems, this approach first and foremost serves as a practical tool for readjusting the research scope by not giving any institutions, sectors, or legislative schemes priority status as objects of analysis. Instead, we ask how individuals' digital agency is enabled and constrained by the material and social arrangements that prevail in a given setting, and we scope our analysis according to these empirical realities. That is, we start our investigation from a (hypothetical) individual residing in a particular context and ask how her abilities to communicate are framed by the material environment and institutional arrangements that prevail. In doing so, we move beyond assumptions about how specific types of technologies, institutions, and regulations influence human capabilities and, instead, open up for assessing infrastructures, market actors, and modes of governance that de facto influence how communication environments are shaped.

Refraining from analysing personal (micro) structures, our adaptation of the capability approach focuses on the social and environmental (macro) structures that frame human communication within different contexts. While such analyses cannot provide comprehensive and sufficiently nuanced accounts of how individuals' capabilities are enabled and constrained in *practice*, they do provide a crucial backdrop for understanding and comparing individual media repertories (Hasebrink & Domeyer, 2012) and user patterns (Miller et al., 2016). By *not* empirically starting from individuals as a way of approaching societal structures, but rather moving in the reverse direction, we contribute to ongoing efforts to understand how varying structural conditions frame life in digitalised and datafied societies.

In contrast to previous theoretical and philosophical applications of the capability approach in media and communication studies (Couldry, 2019; Hesmondhalgh, 2017; Jensen, 2021), our use of the approach is closer to the empirical interventions conducted in the field of global development studies (Kleine, 2013). The mappings and comparisons of the large Nordic countries provide empirical grounds for discussing how the Internet influences basic capabilities by enquiring into the structural implications of (individual) digital communication. As a means for opening up for a broader discussion of the legitimacy and desirability of the current state of digital communication systems, we identify the underlying resources that support mundane uses of the Internet and map out the ways they are controlled. Through this approach, we can cut across historical and bureaucratic classifications (such as the definition of "media") that constrain our ability to understand and monitor emergent power structures and control mechanisms.

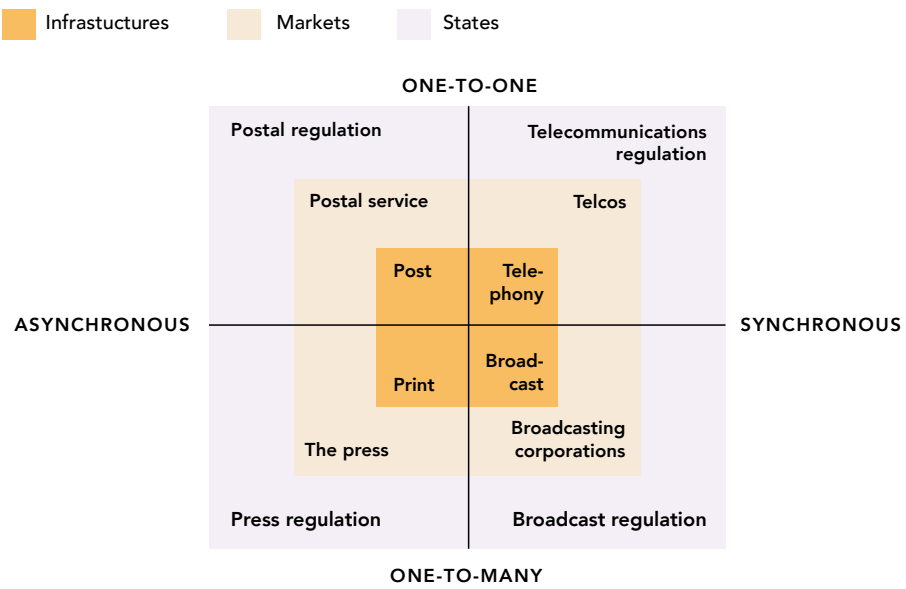
The approach also motivates us to ask ourselves the basic "so what" question of *why* our findings are important, and more specifically how the current state of digital communication systems impacts peoples' everyday

lives. That is, while applying a macro perspective in our studies of digital communication structures and focusing on infrastructures, markets, and states as analytical dimensions, we return to the individual as a guiding motive for our investigations. Individuals are, in effect, both a means and an end for studying digital communication systems.

Structuring forces of digital communication

To unfold how the theoretical conceptualisation of a (digital) communication system frames our analytical approach to studying the structural forces that enable and constrain human capabilities, Figure 1.1 illustrates the analogue communication system prevailing prior to the Internet (Flensburg, 2021; see also Bar & Sandvig, 2008). Creating a historical backdrop for our analyses, the figure emphasises four infrastructures, post, print, telephony, and broadcast (in the innermost squares), surrounded by distinct markets (the middle squares) and different forms of state regulation (outermost squares). The horizontal and vertical axes represent different modes of communication, namely asynchronous and synchronous distribution and one-to-one and one-to-many communication (see also Jensen & Helles, 2017). As illustrated in Figure 1.1, the analogue communication system was characterised by each communication technology being "distinguished [...] by the number of message receivers (one, a few or many); by the nature of interactivity, if any, between sender and receiver; and by the difference between synchronicity and asynchronicity" (Braman, 2004: 158).

FIGURE 1.1 The analogue communication system



Source: adapted from Flensburg, 2021 (inspired by Bar & Sandvig, 2008)

The figure illustrates how the technological distinctions of each type of communication infrastructure supported the development of equally distinct media and communication sectors that were characterised by a clear division of labour between key gatekeepers: The postal system handled asynchronous one-to-one communication, the press mediated asynchronous one-to-many communication, telecommunication operators carried synchronous one-to-one communication, and broadcasters distributed synchronous one-to-many communication (Bar & Sandvig, 2008). By owning, developing, and supplying vital infrastructural resources for each mode of communication (e.g., postal routes, printing presses, copper wire networks, and electromagnetic frequencies), these gatekeepers gained key societal positions that were legitimised and mandated by various legislative frameworks. News media and broadcasting policies were broadly concerned with establishing the conditions for institutions circulating and mediating public information and debate, while postal policies and telecommunication regulation focused on laying out the rules for providers of one-to-one communication between individual senders and receivers. The regulations and policies depicted in the outer squares of Figure 1.1 were, in other words, developed for and directed towards the gatekeeping institutions, reflecting the professional codes and norms of each sector as well as the physical features of the underlying technology.

Figure 1.1 thereby illustrates how the institutional order of the pre-digital communication system rested on a material basis of analogue communication technologies that have been disrupted by the rise of the Internet as a common and converging infrastructure. Alongside the gradual shift from analogue to digital distribution, old gatekeepers (e.g., newspaper publishers, broadcasters, and postal service operators) are losing their former privileged positions as suppliers of different forms of mediated communication and are being pushed to the periphery of the communication system. In parallel, new actors are gaining significant positions by ensuring network peering (i.e., allowing operators of access and backbone networks to exchange content) or supplying operating systems and other forms of fundamental software infrastructure. The activities, market assets, and infrastructural power of these digital gatekeepers cut across and go beyond the sectoral divides of the analogue communication system, thereby challenging established institutional arrangements and regulations.

While the material core of the analogue communication system is irrevocably dissolved, its institutional logics continue to live on in regulatory frameworks and policies. Regulators, policymakers, and even industry stakeholders and researchers tend to start from the outer layers of the model, discussing how regulatory frameworks and legacy business models originating in the analogue system can be amended to fit the new digital reality. By not fully acknowledging the extent and implications of the material transformation, they fall short in addressing the fundamental challenges that digitalisation raises, and they allow the new gatekeepers to fly "under the radar" of public

monitoring and regulation (Flensburg, 2021). In effect, our change of epistemic strategy is illustrated by shifting the focus to the centre of the figure and outlining the physical resources that are taking the place of former (analogue) infrastructures, their ownership, and the ways they are (not) regulated.

In the course of developing and substantiating the concept of a digital communication system, we first establish and elaborate on infrastructures as the material foundation for communication, then we consider how power is accumulated through the ownership and control of these critical resources, and finally we discuss the role of governments and state authorities in organising, distributing, and regulating access to and control of communication infrastructures. In doing so, we approach the evolution, organisation, and control of digital communication systems from three theoretical entry points – emphasising, respectively, infrastructures, markets, and states as key structuring forces of communication – and discuss how they relate to one another. This ultimately aids us in operationalising them as overarching analytical dimensions that can ground the selection of empirical indicators and measures.

Infrastructures

When using the concept of infrastructures, we refer to the material resources and systems such as sewers, electrical grids, traffic systems, and various types of distribution networks that together support a wide range of mundane activities and basic societal functions (Edwards, 2002). *Communication* infrastructures thus broadly comprise technologies that enable us to send, receive, and store information across time and space, as illustrated in the core of Figure 1.1. Similar to traffic networks and other large-scale supply systems, these infrastructures span local routes, uniting individual households, regional exchange hubs, national freeways, and global super-highways. Like cartographers drawing up vast traffic networks, the goal of infrastructure researchers is not so much to understand the cargo being transported (in the case of the Internet, the bits of data containing various forms of communication content), but rather to make sense of the conditions for travelling. Applying an infrastructural perspective thus entails "turning away from the symbolic and investigating the structural – this is the Internet not as 'what people say with it' but as 'how it works'" (Sandvig, 2013: 90).

Directing attention to the physical manifestations of (digital) communication, a growing cohort of media and communication researchers have in recent years taken a "turn to infrastructure" (Hesmondhalgh, 2021; Musiani et al., 2016; Plantin & Punathambekar, 2019). Examples include studies of vast data centres, where the abstract idea of "the cloud" (Peters, 2016) materialises in endless arrays of server racks (Velkova, 2016), minute software packages of mobile apps (Gerlitz et al., 2019), extensive networks of fibre-optic submarine cables (Starosielski, 2015), or cemeteries of technological waste (Parks,

2015; Thylstrup, 2019). Across the broad and diverse field of infrastructure studies, scholars adhering to this concept share a determination to investigate "the basic, the boring, the mundane, and all the mischievous work done behind the scenes" (Peters, 2016: 33). In fact, many researchers define the very concept of infrastructure as technologies residing "in a naturalized background, as ordinary and unremarkable to us as trees, daylight, and dirt" (Edwards, 2002: 185), only becoming "visible upon breakdown" (Star & Ruhleder, 1996: 113).

Coming out of science and technology studies, a large fraction of the field investigates the situatedness and constant maintenance of technological systems, arguing that "analytically, infrastructures appear only as a relational property" (Star & Ruhleder, 1996: 113). In this view, infrastructures are not "things" in and of themselves, but only become "real infrastructure in relation to organized practices" (Star, 1999: 380). Following this line of argument, studies ask not *what*, but *when* an infrastructure is, and they seek their answer in ethnographic case studies of particular infrastructural settings (see, e.g., Harris, 2015; Parks, 2015; Star, 1999; Velkova, 2020). This theoretical approach also entails the consideration of infrastructures as more than physical systems, namely as "the whole array of organizational forms, practices, and institutions that accompany, make possible, and inflect the development of new technology, their related practices, and their distributions" (Bowker et al., 2009: 103).

Refraining from going into a heated theoretical discussion of how (not) to define infrastructure (see, e.g., Hesmondhalgh, 2021; Lee & Schmidt, 2018), we employ a more narrow and conventional use of the concept than what is outlined above. When analysing infrastructures, we take a stand opposite to "the relationists" (Sandvig, 2013), and emphasise that infrastructures are in fact physical "things" that exist regardless of how they are used in practice. As an emergent alternative to the dominant understanding of infrastructures in science and technology studies (Hesmondhalgh, 2021), this conceptualisation is theoretically informed by medium theory (Meyrowitz, 2019) and political economy (Babe, 1995; Garnham, 1979, 2011; Mansell, 2004; Mazepa & Mosco, 2016; McChesney et al., 2003; Mosco, 2014).

Here, communication infrastructures constitute the constant components that senders and receivers rely on, regardless of how or when they are used (McLuhan & Fiore, 2001). These components can be controlled by a variety of stakeholders, who operate on the basis of various types of business models. The infrastructures might not be transparent to individuals, regulators, and researchers, but they nonetheless make up the physical environment that shapes how communication plays out (Lum, 2006; Postman, 1974; Scolari, 2012). As multiple historical examples show, the control of these key means of communication and their inherent affordances (Hutchby, 2001) is closely entangled with the ways societies are governed – and the evolution of new

infrastructures often co-occur with political reconfigurations of power (Innis, 2007). Yet, infrastructural resources and institutional arrangements are separate units of analysis that call for different methodological interventions.

From this perspective, institutional structures legitimise the distribution of goods and uphold societal order (Chang, 2002). They are neither naturally given nor inevitable outcomes of the features and properties of the physical world, but reflect the interests of the actors that institute and control them – and in doing so, shape the material environment. To understand these mechanisms and their implications, we investigate how material resources are turned into market assets or societal goods and how this institutionalisation in turn influences the ways infrastructures are developed (Mansell, 2017a). That is, by distinguishing between the infrastructural resources that ground and are shaped by economic and political power structures and the institutional arrangements that control the distribution of them, we sensitise ourselves to alternatives and establish a baseline for critical discussion.

As we elaborate further in the following chapter, we distinguish between four infrastructural layers of the Internet that enable and constrain digital communication: access networks, backbone networks, applications, and data. Inspired by and resembling established models for describing the basic components and protocols of the Internet, these layers constitute a value chain that pre-empts and shapes all activities that can be carried out by means of the Internet. Similar to the analogue gatekeepers outlined in Figure 1.1, access to the global Internet and the abundance of services available through it is guarded by the actors controlling the value chains that allow data to travel. By mapping out how individual devices and local Internet connections intersect with extensive fibre-optic cables, peering junctures, server racks, and third-party facilities, we can begin to make sense of the ways contemporary communication activities are controlled, by whom, and for what ends (Andrejevic, 2011: 279).

Markets

We employ the same strategy for investigating markets as we do for infrastructures and ask how markets enable and constrain human capabilities – and thereby shape communication systems. As mentioned, we approach markets as political economies that organise and control the distribution of key societal resources (Garnham, 2011; Hardy, 2014; Mosco, 2009; Wasko, 2004). Political economists – like infrastructure scholars – emphasise contexts over texts by enquiring into the structural conditions for communicating and "the justice of the current distribution of communicatory power" (Babe, 1995: 64). Focusing specifically on market structures, business models, and economic incentives, studies in this vein remind us that "if resources are scarce, and if power is unequally distributed in society, then the key issue is how these scarce resources are allocated and controlled, and with what consequences for human action" (Mansell, 2004: 98).

Seen through the lens of political economy, markets are socially constructed arenas where societal power is maintained, negotiated, and exerted. In opposition to mainstream economics, political economy counters ideas about "free" or "open" markets, arguing that these concepts serve as imaginaries that establish and confirm the capitalist system as ideal or naturally given (Chang, 2002). The dominating market ideology legitimises existing privileges and social structures rather than opening up for critical discussions acknowledging that "the establishment and distribution of property rights and other entitlements that define the 'endowments' that market participants have [...] is a highly political exercise" (Chang, 2002: 549).

Within (legacy) media and communication studies, political economy constitutes an established and broad research field centred around critical studies of media production, distribution, and advertisement. Reflecting the sectoral organisation of the analogue communication system illustrated in Figure 1.1, research has contributed with thorough analyses of media conglomerates and power asymmetries in the realms of news (Hardy, 2019), broadcasting (Webster, 2014), telecommunications (Babe, 1995), and media industries more broadly (Noam, 2009, 2016). Focusing on powerful media institutions, these studies uncover central mechanisms inherent in controlling assets across value chains as well as capacities of the political system to influence the media – and vice versa (Freedman, 2008; Winseck, 2008; Winseck & Jin, 2011; Winseck & Pike, 2007). Seeking to unravel the economic circuits that underpin and sustain communicative power, political economists often apply a "follow the money" strategy (DeFleur, 1971). Mapping and linking sites of monetary exchange, studies have shed light on the underlying value chains supporting (legacy) media production and distribution, thereby allowing for explanations of how some media companies gain dominant market positions and continuously expand their communicative power (Wasko, 2004, 2011).

As discussed earlier, the transition from analogue to digital distribution pushes the attention of political economists towards what used to be "new media" (Mansell, 2004), and how new types of market actors establish, maintain, and intensify their power through ongoing processes of infrastructuralisation (Plantin & Punathambekar, 2019). With the Internet being "one of today's most important forms of world property" (Mazepa & Mosco, 2016: 163), political economists agree that there is an urgent need for investigating how this critical infrastructure is organised and controlled. Stressing the interplay between material affordances and features of digital technologies on the one hand, and institutional arrangements and power structures on the other, a growing body of studies pose the basic question of "who controls the Internet" (Hunt, 2014; Ruiz & Barnett, 2015). In the process of looking for answers, scholars have ventured into explorative mappings of opaque "ownership stakes" (Winseck, 2019) and "hidden levers of Internet control" (DeNardis, 2012) as a means of investigating how digital

power structures are built into the infrastructures that undergird our digital lives (Mansell, 2017a: 5).

A recent wave of "critical data studies" (Dalton & Thatcher, 2014; Hepp et al., 2022; Iliadis & Russo, 2016; Kitchin & Lauriault, 2014) promotes questions about digital power by probing the emergence of new and dominant institutions that build their digital empires on ubiquitous and comprehensive processes of datafication. Yet, despite calls for more "empirical research to underpin and flesh out critical data studies" (Kitchin & Lauriault, 2018: 18), these discussions are often theoretical or ethical in nature (Flensburg & Lomborg, 2021). When empirical studies do surface, they come in the form of interviews and surveys emphasising user understandings and imaginaries (Bucher, 2017; Tupasela et al., 2020), and they largely refrain from studying the infrastructural arrangements and commercial activities that are most often invisible to users.

There is, in other words, a scarcity of empirical studies applying classic political economist approaches of following the money and mapping ownership structures to the study of Internet infrastructures (for exceptions, see Munn, 2020; Winseck, 2017, 2019). While the rise of the Internet has paved the way for new markets and competition structures for Internet backbone provision (Munn, 2020; Winseck, 2017), platforms supplying services free of monetary charge (Helmond, 2015; Parker et al., 2016), and (relatedly) data brokering (Binns et al., 2018b; Blanke & Pybus, 2020), few studies "connect the dots" between the different links of the digital value chain through empirical investigation and monitoring of vertical as well as horizontal market structures.

Contributing to the cross-pollination of classic political economy and contemporary infrastructure studies (Hesmondhalgh, 2021), we suggest adjusting the strategy of "follow the money" to "follow the data" (Flensburg & Lai, 2023). This enables us to map out infrastructural dependencies in and across the digital ecosystem to uncover how access networks depend on backbone systems when exchanging data with other network operators, or how providers of online services rely on externally provided tools for data processing, storage, and distribution. We can also begin to shed light on and question the various economic transactions involved in exchanging data between different layers of the Internet; for example, access networks charging users but paying other operators for routing and peering; applications putting up paywalls and selling ads but also paying for content delivery networks, cloud solutions, or analytics; and third-party services offering tools and services "free of charge" while monetising them in other ways.

As is evident throughout the analytical chapters of the book, the early stages of digitalisation were characterised by a coexistence and relatively equal competition between legacy telcos, device manufacturers, and software developers, yet the latter has now come out as victorious (Kushida, 2015). For instance, the same telecommunication institutions that insured the spread of

the Internet are now seeing their formerly lucrative business models eradicated by the development of infrastructures capable of substituting core services like telephony and television distribution – only at higher speeds and with lower costs (Farooq & Raju, 2019). Evolving into powerful global platforms, Big Tech corporations provide the operating systems, application infrastructures, and basic tools and services for data processing, while simultaneously profiting from collecting, processing, and distributing user data for the purpose of online advertisement (van Dijck et al., 2018; Helmond, 2015; Nieborg & Helmond, 2018; Poell et al., 2019). These tilting power imbalances are amplified by the corporations increasingly moving beyond their original markets and investing in infrastructures such as submarine data cables and broadband networks (Plantin et al., 2018).

To interpret these evolving power structures, we draw inspiration from the work of Michael Mann (1984), and specifically the concept of "infrastructural power". Taking his point of departure in nation-states, Mann distinguishes between despotic and infrastructural power, where the first refers to the ability of exerting direct power over individuals (e.g., by imprisoning them), while the latter refers to the ability to "penetrate and centrally coordinate the activities of civil society through its own infrastructure" (Mann, 1984: 190). Infrastructural power is thus manifested in the organisation of the physical world (the design of buildings, networks, code, and so forth), providing a physical basis for institutional power exerted through the establishment and enforcement of policies, legislation, and so forth.

While originally developed to understand the means of state government, we apply the concept as a lens for addressing political and economic power in a broader sense, particularly for understanding the ways infrastructures are organised and controlled in contemporary digital communication systems. That is, infrastructural power is not universally confined to specific institutions but is rather a form of governance enacted in and through the design of the material environment that enables and constrains human capabilities. Contemporary examples of this include cloud service suppliers shutting down the servers of particular services to block information flows (DeNardis, 2012); operating system and app store suppliers curating end-users' access to different services and setting up the terms and conditions that app-developers must comply with (Nieborg et al., 2020; Poell et al., 2019); highly used application programming interfaces being closed with significant consequences for the businesses (and researchers) relying on them (Bruns, 2019); and conflicts over the right to use specific domain names (Merrill, 2016; Musiani, 2016; Sandvig, 2013). Infrastructural power is, however, not only manifested in the concrete *exertion* of digital power, but also in much more subtle ways through the architectures and structural arrangements that frame digital communication.

This adaptation follows the same logic that led us away from focusing on institutionally anchored media systems and towards an understanding of

communication systems as ecosystems that evolve in relation to historical and geopolitical circumstances. By shedding light on the underlying dependencies and cross-sectoral market strategies, we can further our understanding of how a handful of corporations perpetually extend and maintain their market dominance. This, in turn, can qualify policy and regulatory attempts to oversee and ultimately influence the structural conditions of digital communication.

States

Having established how material infrastructures make up the basic technological foundation for (digital) communication, and how market actors gain power through owning and controlling these resources, we now turn to the last of the structuring forces, namely states. Focusing on the *political* in political economy, states – like markets – constitute social arenas where power is accumulated, maintained, exercised, and negotiated. Establishing and enforcing official rules for the use and distribution of societal goods, state authorities play key roles in the organisation of digital communication systems – be it through keeping an arms-length and allowing the market to "run itself", through active facilitation and funding, or through regulation and intervention (Majone, 1994, 1997). State policies can thus provide explanations for why infrastructures and markets evolve in certain ways within different historical or national contexts.

Assessing and analysing state regulation and intervention, media and communication policy research roughly follows two overlapping and mutually informing trajectories: one studies the *outcomes* of policy (political agreements, acts and laws, regulatory frameworks, and so on) while the other focuses on the *processes* of policymaking and regulation (political negotiations, implementations, and enforcements) (Puppis & Just, 2012: 16). Following the first line of enquiry, scholars have examined the ideological and political underpinnings of policy regimes (Syvertsen, 2004), the laws and regulations dealing with information technologies (Braman, 2004), and the goals and values inscribed in communication policies across historical periods (van Cuilenburg & McQuail, 2003). Such studies have often identified path dependencies or continuities in the ways new technologies are institutionalised reflecting historical ideologies and discourses, but they have also pointed to critical junctures where regulatory regimes are transformed and new policy paradigms developed.

The latter strand has typically provided in-depth case studies of how policymaking and politics, in a broader sense, play out in practice and under the influence of various stakeholders (Donders et al., 2019; Picard, 2020; Van den Bulck & Donders, 2014). Turning to processes of gover*nance* rather than govern*ment* (Donges, 2007; Puppis, 2010), scholars within this research tradition emphasise the need to look beyond state policies to include the "formal and informal, national and supranational, centralized and dispersed"

political arenas (Freedman, 2008: 14). Focusing on digital infrastructures in particular, governance scholars argue that:

> In an era in which nation-bound laws regarding content no longer neatly comport with the globally dispersed and decentralized architecture of the global Internet, [studies need] to encompass how governance is enacted through technical design, private industry policies, and national laws and international treaties. (DeNardis & Musiani, 2016: 5–7)

Nation-states and state legislation, as such, constitute a relatively limited force in the shaping of digital communication systems. As unfolded in numerous case studies of domain-name politics (Claffy et al., 2016; Merrill, 2016; Musiani, 2016), copyright enforcement (De Filippi & Bourcier, 2016; Schruers, 2016), and privacy measures (Laprise, 2016; Sargsyan, 2016), contemporary Internet governance starts before and goes way beyond state government. With the Internet being a global infrastructure that enables the transfer of data and information across and between continents and regulatory regimes, its control mechanisms are undeniably influenced by a wide range of multi-national and cross-institutional (formal as well as informal) arrangements. Nonetheless, numerous recent incidents also suggest that political systems play an increasingly determining role in the shaping of different Internet regimes (O'Hara et al., 2021).

Examples of this include the "great firewall of China" (Ensafi et al., 2015; Griffiths, 2021; Zhang, 2020), Russia's control of Internet infrastructures as a means for censoring information flows (Esq, 2022; Sivetc, 2021; Vendil Pallin, 2017), and multiple network shutdowns initiated by state authorities in connection to military conflicts (Access Now, 2022; Benjamin, 2022; Björksten, 2022). As another sign of political influence on digital infrastructures and markets, recent European Union efforts enhance regulation of the digital sphere through increased data protection (European Parliament & The Council, 2016), anti-trust cases against dominant market actors (European Commission, 2017, 2018), and most recently, the passing of the Digital Services Act (European Commission, 2022). This suggests that a European Internet regime might be developing as an alternative to the American one (O'Hara et al., 2021). In this regard, the analyses of this book are a first step towards investigating if the Nordic region – as a result of its strong welfare state traditions – also constitutes an emergent Internet regime.

As mentioned, the Nordic countries are often associated with a specific type of welfare model, which extends into the spheres of media and communication. Throughout the twentieth century, Nordic state institutions have established, owned, financed, and regulated vital parts of the media and communication sectors: Postal systems have been organised as public monopolies; telecommunication networks and services have largely been built and supplied by state-owned institutions and rigorously monitored;

public service institutions have dominated the market for broadcasting; and newspapers have been heavily subsidised and subject to institutionalised self- and co-regulation (Enli et al., 2018; Enli & Syvertsen, 2020). These arrangements – referred to as characteristic of media welfare states (Syvertsen et al., 2014) – reflect broader ideologies and political traditions of the Nordic welfare model (Hilson, 2020), favouring a strong, tax-funded public sector and a distribution of goods that evens out economic and social divides (Esping-Andersen, 1990).

In these welfare regimes, universality and decommodification are key values and steering principles, meaning that basic societal services (healthcare, education, communication, etc.) are considered public goods rather than commercial assets. As a result, state institutions have been actively engaged in building, running, and maintaining the underlying societal infrastructures that have been deemed too vital to leave in the hands of private enterprises. The rapid and comprehensive spread of the Internet across Denmark, Finland, Norway, and Sweden can also be considered in relation to these historical logics, as these governments have invested heavily in digitalising social services, establishing and ensuring network coverage, and stimulating Internet use in various ways (Randall & Berlina, 2019). Yet, as also discussed previously, changing infrastructural conditions and emergent business models can alter the foundation for and effects of existing policies and regulatory practices. Infrastructures and markets are "both the outcome as well as the instrument of regulation", in that they "set the frame for both media communication as well as further communication policy and technology development" (Katzenbach, 2012: 29).

A growing body of research points to an implicit (re)commodification of welfare states as they become dependent on commercial Internet infrastructures and their providers (Dencik, 2021; Dencik & Kaun, 2020; Fourcade & Gordon, 2020). Through the increasing datafication of core welfare functions (Andreassen et al., 2021), states are infiltrated in complex ecosystems that are controlled by global enterprises and subject to little democratic scrutiny. This indirect commercialisation of the welfare state is not only a continuation of existing policies of privatisation, but it also "embeds social welfare within an ecosystem that endlessly perpetuates this reconfiguration" (Dencik, 2021: 62). Or, to put it differently, the transformation of the material foundation for key societal functions potentially entails a relocation of infrastructural power – away from the state and towards commercial enterprises and market logics. Amidst this reconfiguration of the basic building blocks of the welfare state and its governance, there is an urgent need for empirical investigations of the Nordic states' continued or weakened role in organising basic communication resources.

When enquiring into "the role of the state" as a structuring force in digital communication systems, the analytical approaches to studying communication policies and governance mentioned earlier risk falling short. Emphasising the

discourses, values, and incentives of official documents, classic policy analyses do not provide insight into the *effects* of policies on, in this case, infrastructural development and market arrangements. In turn, tracing decision-making processes and stakeholder analyses can surely provide important knowledge on why policies are established and how they are enforced, but it will typically be linked to specific cases and issues and thus be less suited for assessing and comparing the role of the state on a more general level. While acknowledging that there are many details and nuances to policymaking and regulatory processes, a narrower focus on relatively fixed units of analysis for determining the role of the state allows for macro-level comparisons across contexts.

Rather than trying to understand legislative details and ideological discourses in depth or studying the governance of Internet infrastructures in all its complexity, we seek to assess the efficacy of various forms of state facilitation and interference. Using the strategy of starting at the material core (as illustrated in Figure 1.1), we set out to identify the key modes of state interference – or lack thereof – in the organisation and control of basic communication resources. In doing so, we make a strategic selection of indicators that in no way addresses the complexity of the ways states – or other governance bodies – influence digital communication in practice. Like the discussions about infrastructures, we instead seek to draw up a (macro) structural backdrop that can ground more in-depth investigations of how control is enacted within – and perhaps despite – these overarching conditions.

Towards digital communication systems

In this chapter, we argue for reconsidering the epistemic approaches to studying and comparing the structural arrangements that shape mediated communication across contexts. Our goal when developing a framework for analysing digital communication systems is to provide empirical research tools for measuring and comparing how digitalised communication environments evolve and diverge across societal and geopolitical contexts. Inspired by the capability approach, we move beyond the historical institutions who guarded mediated communication technologies in the past and place individuals as the primary units of normative judgement. That is, by mapping out and investigating the structural arrangements as they appear from the perspective of individuals engaging in digital communication activities, we ask the following questions: What technologies and infrastructures support these activities? What companies and institutions own, supply, and control the vital communication resources? And under what rules and conditions are they supplied?

In answering these questions, we touch upon longstanding theoretical discussions about the interplay between (new) technologies and (old) institutions – and, perhaps more importantly, we engage in questions of how infrastructures,

markets, and states mutually enable and constrain human capabilities. While we address this empirically in the analytical chapters (Chapters 3–6), the existing literature also aids us in establishing a theoretical backdrop for discussing our findings. That is, we define infrastructures as the material resources and networks that support mundane (communication) activities, regardless of the symbolic content of these activities. Markets, in turn, constitute the arenas where these resources are traded and commodified and where market actors gatekeep individuals' access to the infrastructures. Finally, states are defined as institutional bodies that establish the formal rules and conditions that market actors as well as individuals must comply with, while also contributing to the basic organisation and development of the infrastructures.

As articulated by Hughes (1987) in the beginning of this chapter, large technological systems are developed under the influence of strategic, economic, or ideological interests, but they also have the potential to disrupt the social structures that pushed them forward to begin with. As seen in numerous and recurrent examples of political conflicts, regulatory dilemmas, and market disruption, the Internet is by now well beyond the early stages of transfer and adaptation, leaving us amid a technological momentum that urges considerations of how infrastructures change the playing field for industry actors and policymakers alike. By not empirically analysing actual individuals or institutions, but instead looking at the common (structurally enabled and constrained) conditions for communicating across Denmark, Finland, Norway, and Sweden, we push ongoing discussions about the current and future organisation of digital societies.

In doing so, we run the risk of producing somewhat reductionist and static images of how digital communication activities play out in real life. In order "not to lapse into unwarranted structural determinism", it is important to keep in mind "that individuals also influence the way institutions are formed and run" (Chang, 2002: 556). Individuals' capabilities are not (pre) determined by the macro-structures that surround them but are also highly dependent on subjective abilities and sociocultural circumstances. Nor are markets or political arrangements pure outcomes of material conditions and economic power structures but are also influenced by individual stakeholders and cultural norms and traditions. While forces other than infrastructures, markets, and states surely impact digital communication, they do not figure as explicit dimensions, indicators, and measures in our analyses. They are instead important aspects that should be considered when interpreting and explaining the differences and similarities that can be identified through comparative studies based on the proposed analytical framework.

Our analyses should not be mistaken for applying universally to all situations and questions regarding Nordic infrastructures, markets, and states. Rather, the findings of this book will benefit tremendously from being nuanced in more detailed studies focusing on, for instance, ongoing and future

infrastructure projects, digitalisation processes in particular institutions and sectors, or governance and decision-making processes seeking to address the challenges identified here. Regardless of the inherent limitations of large-scale studies such as ours, the persistent use of the models, concepts, and empirical approaches provided by media system research testifies to the continued need for empirically grounded macro-analyses that can serve as explanatory backdrops for more focused meso- and micro-studies. Emergent typologies on Internet regimes should be tested empirically and systematically if they are to reach their full potential as frameworks for understanding, explaining, and scrutinising digital political economies and governance forms. In the next chapter, we therefore operationalise the conceptualisation of digital communication systems as a methodological framework for such empirical analyses: the Digital Communication System Matrix.

CHAPTER 2

Step-by-step: Comparing infrastructures, markets, & states

We need a more general understanding of how regulation works – one that focuses on more than the single influence of any one force such as government, norms, or the market, and instead integrates these factors into a single account.

LESSIG, 2006: 121

Digital communication systems are dynamic organisms characterised by complex modes of governance and shaped by multiple structuring forces. As argued by Lessig in the quote above and discussed extensively in the previous chapter, regulation is neither a one-way nor a top-down process through which one force dictates the rest. Rather, the effect of state policies depends on the market structures and material conditions that prevail in the context in which they are enforced. Markets are, in turn, dependent on material and political environments. And infrastructures take shape from the minds of the people who design and control them and the political decisions by which they were encouraged or supported. This is not the same, however, as saying that the various structural forces are impossible to separate. In fact, they must be treated as distinct analytical dimensions if we are to systematically assess their interdependencies on a macro scale (Flensburg & Lai, forthcoming).

On the basis of the conceptualisation of digital communication systems in the previous chapter, the following outlines a three-step methodological guide for 1) operationalising the concept of digital communication systems in a matrix that can be used for empirical mappings and comparisons; 2) establishing subdimensions that serve as continuums for measuring and analysing infrastructural conditions, market configurations, and state involvement across contexts; and 3) selecting empirical indicators and measures that can guide data collection through existing databases and other publicly available sources.

Step one: The Digital Communication System Matrix

As we have previously argued (Flensburg & Lai, 2020a), the shortcomings of news- and journalism-centric media system analyses calls for an increased awareness of the infrastructures that support and frame digital communications. As discussed in Chapter 1, we address this by changing the perspective from media institutions (the press) and specific types of content (news) to individuals and the wealth of their digital communications. However, this raises new methodological challenges: An ever-growing group of market players and governance forms transcending sectors, policy frameworks, and research fields implies a tremendous extension of the scope of analysis. Yet, we continue to argue that this is a necessary evil, since the Internet erodes these exact boundaries (Flensburg & Lai, 2020a).

Dimensions & layers

Following the theoretical discussions outlined in the previous chapter, we define a digital communication system as consisting of the underlying, material infrastructures that allow data to be transported via the Internet as well as the institutional arrangements that control and regulate them. Operationalising the concept for empirical and comparative analysis, we approach these systems from three distinct – albeit mutually shaping – analytical dimensions: infrastructures, markets, and states. The infrastructure dimension refers to the material resources (network connections, servers, software, data traffic, etc.) that support any Internet-based activity. The market dimension includes the market actors (e.g., Telenor, Alphabet, Schibsted, or Microsoft) that own, supply, and control these resources. The state dimension comprises the ways state authorities intervene in and shape the organisation and distribution of infrastructural resources (e.g., through state ownership, public funding, and government policies) (Flensburg & Lai, 2020a).

Our empirical analysis of digital communication systems begins with the infrastructure dimension, where we identify the key material resources underlying any digital communication activity. The Internet consists of various layers that enable the flow of data between networks, devices, and applications (Lessig, 1999; Tanenbaum & Wetherall, 2011). These layers are hierarchical and refer to the chain of infrastructurally enabled events that play out in any digital communication situation: To go online, a user must access some sort of Internet connection that allows data to be transported between local and global networks, connecting to the server of a communication service, which finally processes and displays the user's request (while simultaneously routing (meta) data in the opposite direction).

In applying the Digital Communication System Matrix, we specifically distinguish between 1) *access networks* that connect individual users and

their devices to the Internet; 2) *backbone* networks that link local access networks and allow them to exchange data; 3) *applications* used for digital communication purposes; and 4) *data*, understood in a broad sense as all types of information broken down to digital bits that are transmitted over the Internet – both as content materialised in user interfaces and as user information flowing in the opposite direction. Each of these four layers are essentially infrastructures that enable or constrain the transfer of data packages between senders and receivers. Though perhaps incongruous with this framing, we label the fourth layer the "data" layer to emphasise that these infrastructural arrangements support what we commonly refer to as the "data economy" (i.e., the economic structures that support the processing and handling of user data, for example, tracking web history, registering location information, targeting ads, etc.) (Flensburg & Lai, 2023).

By mapping out these infrastructural components of the Internet, we can move on to identify the market actors that own and control them as well as the various forms of state involvement that influence their institutionalisation. That is, we map out key market actors serving as Internet service providers, backbone operators, suppliers of digital services, and data processers and brokers. We also identify the various legislative frameworks that influence the control of each component and assess the role of the state by measuring the degree of public ownership and funding. This analytical procedure is illustrated in Table 2.1, which presents the Digital Communication System Matrix, consisting of the three dimensions (infrastructures, markets, and states) and the four layers covering the basic material aspects of digital communication (access networks, backbone networks, applications, and data).

TABLE 2.1 The Digital Communication System Matrix

	Infrastructures	**Markets**	**States**
Access networks	What are the existing access networks for digital communication?	Who owns and controls digital access networks?	How does the state regulate digital access networks?
Backbone networks	What are the existing backbone networks for digital communication?	Who owns and controls digital backbone networks?	How does the state regulate digital backbone networks?
Applications	What are the existing applications for digital communication?	Who owns and controls digital communication applications?	How does the state regulate digital communication applications?
Data	What are the existing types of digital communication data?	Who owns and controls digital communication data?	How does the state regulate digital communication data?

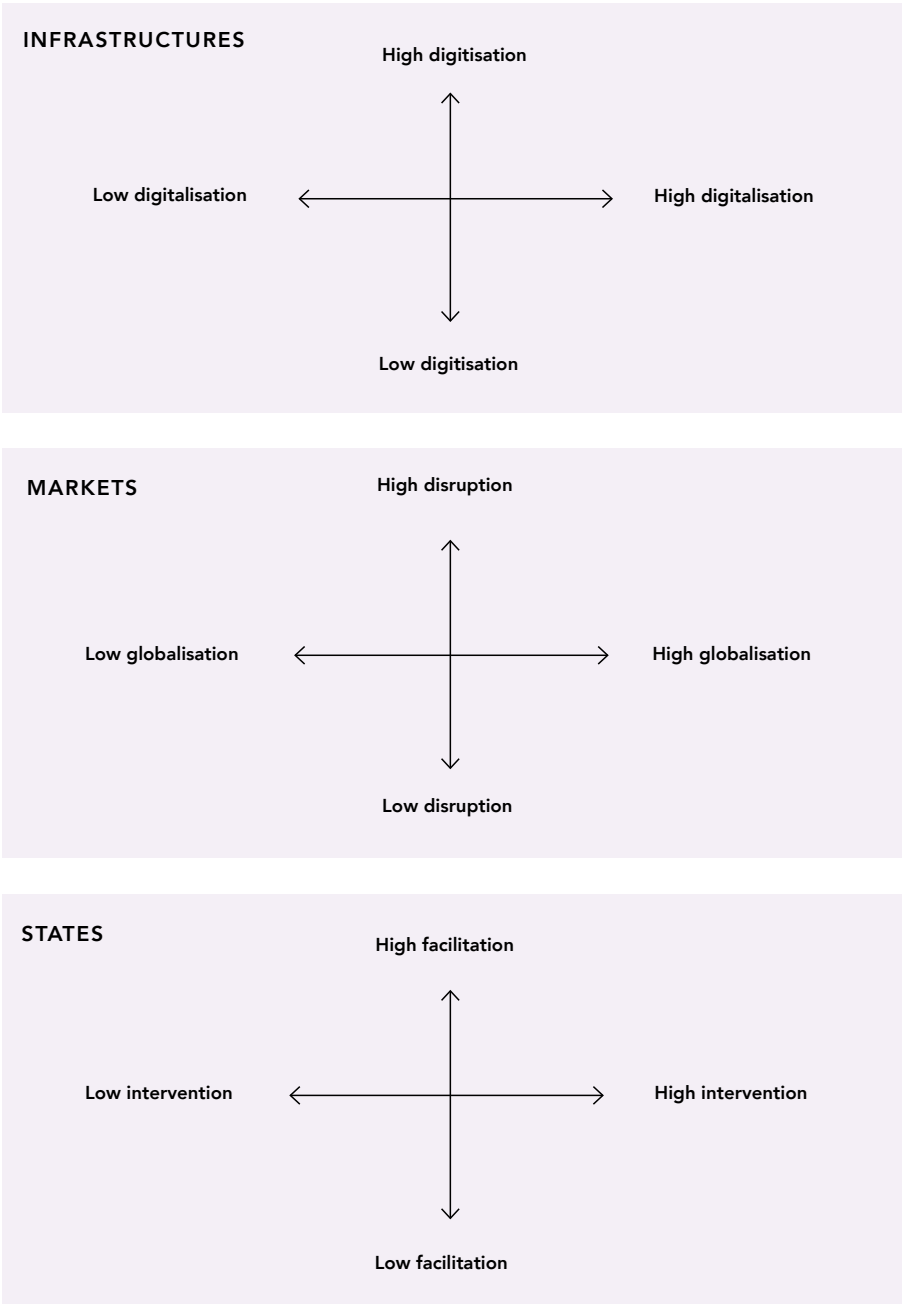
Source: adapted from Flensburg & Lai, 2019, 2020a

The four analytical layers are interdependent. For example, access networks enable or constrain the layers following them; a lost broadband connection also means loss of connection to the global backbone network of fibre-optic cables and Internet exchange points, which in turn restricts access to applications and data. Our analytical strategy is therefore to begin with the access network layer and from the infrastructural dimension. Pinpointing the availability and use of various digital access networks allows us to identify the most prominent market actors and competition structures in the telecommunication sectors, as well as legislative frameworks or government interventions regulating the organisation of these infrastructures. The matrix thus allows us to identify and map the components of digital communication systems and to further develop indicators and measures for comparing different contexts empirically (Flensburg & Lai, 2020a).

Step two: The continuums

The matrix above enables descriptive mappings of digital communication systems and serves as a necessary first step towards more encompassing analyses of digitised communication environments. To move beyond purely descriptive accounts, we break down the overarching research aim of comparing Internet infrastructures and political economies across contexts into questions of how developed and used the infrastructure is; how market powers are configured; and how the state influences infrastructure and market developments. Following the strategy of Brüggemann and colleagues (2014: 1039), who argue that for any standardised measurement of media systems, "dimensions have to vary on a continuum between two poles", we establish six subdimensions that range from low to high, as visualised by the axes of Figure 2.1: Digitisation of infrastructures and digitalisation of communication; market globalisation and disruption; and state facilitation and intervention.

FIGURE 2.1 The six subdimensions of the Digital Communication System Matrix



Source: adapted from Flensburg & Lai, 2020a

Digitisation & digitalisation

To measure and compare national infrastructural conditions, we focus on the development of Internet infrastructures and the reliance on them for communicating. The subdimensions are the *digitisation* of infrastructures, understood as the processes of converting analogue information into digital bits of 0s and 1s, and *digitalisation* of communication whereby social life is restructured through the adoption of digital technologies (Brennen & Kreiss, 2016). Digitisation and digitalisation are mutually dependent. For instance, the degree of digitisation (e.g., the availability of access networks, backbone infrastructures, accessibility of applications) impacts the potential digitalisation of social life and societal functions. Similarly, the degree of digitalisation and the extent to which various digital technologies are used is not only dependent on the existing Internet infrastructures but also stimulates further infrastructural developments.

Disruption & globalisation

The market conditions are similarly measured and compared by assessing the power balances between the different types of market actors that control key components of the Internet infrastructure (e.g., fibre broadband, submarine cables, websites, and cookies). For the purpose of answering our central research question, we focus specifically on the interplay between historically anchored, national institutions and global Big Tech corporations. We therefore divide the market dimension into the subdimensions of *disruption* and *globalisation*. Disruption measures and compares the market shares of so-called "brownfield" actors such as telephone companies, news media, and so forth, pre-existing the Internet, and "greenfield" actors in the form of new digital entrants such as Google and Facebook that were "born" with the Internet (Hjarvard & Helles, 2015). Globalisation measures and compares the market shares of nationally and internationally owned companies. Both subdimensions address the restructuring of historical power structures and control mechanisms represented by national market actors and legacy business models, and they remain buzzwords in current market discourse.

Facilitation & intervention

Lastly, the state dimension is measured by evaluating the state's involvement in the development of digital communication infrastructures and markets. Specifically, we distinguish between the degree of *facilitation* of infrastructures and of *intervention*. Though not covering the entirety of ways the state is involved in digital communication activities, facilitation and intervention represent two significant types of (welfare) state involvement.

While media system analyses and political economy have a longstanding tradition for measuring and assessing the effect of state ownership (Doyle, 2002; Noam, 2009; Winseck, 2008), media and communication policy studies often focus on formalised state interventions in the form of regulation and legislative arrangements (d'Haenens et al., 2018; Puppis & Just, 2012). When applying the subdimension of facilitation, we follow the same procedure as for the market subdimensions and measure the state's ownership and market shares across the four layers of Internet infrastructure (the degree of public ownership of wired broadband, submarine cables, apps, etc.). To measure the degree of intervention, we look at the ways the state regulates the material conditions in the digital communication system through establishing or mandating official agencies and formalised policies that relate to the four infrastructural layers (digitalisation strategies, funding for broadband build-out, agencies responsible for monitoring web and app markets, cookie policies, etc.).

The six subdimensions serve as analytical guideposts when developing the twelve indicative questions outlined in the Digital Communication System Matrix (illustrated in Table 2.1) into empirical measurements. In other words, the four analytical layers (access networks, backbone networks, applications, and data) form the outset for selecting empirical points of reference that allow us to compare Denmark, Finland, Norway, and Sweden in terms of their degrees of digitisation and digitalisation, market disruption and globalisation, and state facilitation and intervention. In the following section, we describe the operationalisation of the analytical dimensions in detail by outlining the empirical indicators and measurements used in the analyses, describing the data sources, and discussing the methodological challenges, concerns, and potentials.

Step three: The indicators

The third step entails identifying and selecting between possible empirical indicators for measurement that enable us to compare the four countries as they relate to the continuums described in step two. These indicators allow us to address the twelve questions at the intersection of the dimensions and layers of the Digital Communication System Matrix. Each indicator is chosen based on a (principal) assessment of its relevance and a (pragmatic) consideration of the availability and quality of existing databases and sources. All indicators and measures can be investigated using publicly available data (listed in Table 2.2), and they differ in terms of their methods, populations, and samples, with some relying on surveys and panels and others on web traffic measurements, registry data, or industry reports. They are all up to date and can be compared across the Nordic region, and even the European Union, though additional sources must be added for global comparisons. Depending on the data source in question, we have conducted various types of data processing

and (re)coding, following a coding manual, which is elaborated on shortly. In other words, our methods span qualitative and quantitative approaches for collecting and analysing both found and made data (Jensen, 2012).

TABLE 2.2 Data sources

Data Source	Time period	Collection method	Population	Sample
Similarweb	2021	Panels & traffic	National population	n.a.
Eurostat [collected by the National Statistical Institute]	1990–2022	Online survey	Individuals aged 16+; households	1500*
National legislative databases	2021	Registry of appointed funding, agencies, & strategies and policies	Legislation	Census
Regional Internet Registers Statistics – RIPE NCC Allocations	1970–2022	Registry of autonomous system number requests	Autonomous system numbers	Census
TeleGeography Internet Exchange Map	1989–2022	Industry participants survey (cable owners, carriers) augmented with publicly available information (e.g., FCC cable landing licences)	Submarine cables worldwide	Census
TeleGeography Submarine Cable Map	1989–2022	Industry participants survey (Internet exchange point owners) augmented with publicly available information	Internet exchange points worldwide	Census
webXray	2021	Loading of first-party (web page) & possible third-party domains (trackers)	–	Census
Exodus Privacy	2021	Unpacking of App APKs [manifest file]	–	Census
Host.io	2021	Who-is look-up	–	Census
National tele-communication statistics	2000–2022	Industry participants survey	Broadband connections countrywide	Census

* Standard sample size for the national statistical agencies.

Infrastructures

The indicators used for approaching the infrastructure dimension, and its subdimensions of digitisation and digitalisation, are directly derived from the four infrastructural layers of the Digital Communication System Matrix.

For the access networks layer, we look at Internet penetration across fixed and mobile broadband and the coverage of highspeed and fibre-based connections as measures for determining the degree of digitisation. To assess the degree of digitalisation, we look at the amount of data that is transferred over mobile networks. For this part of the analysis, we rely on national telecommunication statistics collected and calculated by the national telecommunication authorities and Eurostat.

For the backbone networks layer, we focus on three main measures that adhere to existing research on key components of the Internet backbone (Winseck, 2017, 2019): the number and length of submarine cables going in and out of the countries, the number of Internet exchange points, and the number of autonomous system numbers as well as their associated IP addresses. The submarine cables represent the global part of the backbone (connecting the Nordic region to, e.g., the US), and information about them can be accessed through TeleGeography's Submarine Cable Map. Representing regional hubs where networks peer, Internet Exchange Points (IXPs) are registered in a free online resource, also published by TeleGeography. The autonomous system numbers represent the local networks, and each network provider must be allocated a number and registered at the non-profit organisation Regional Internet Registry for Europe, the Middle East and parts of Central Asia (RIPE NCC), which provides publicly available lists of all national autonomous system numbers. As these measures do not convey information on uses and communications explicitly, they all speak to the subdimension of digitisation. Unlike the data on access networks, which can be applied without further processing, the backbone networks layer requires more *making* in the form of harvesting data from TeleGeography's GitHub repository on submarine cables and Internet exchange points as well as from RIPE NCC's registry of allocated autonomous system numbers.

For the applications layer, we approach the digitalisation of communication by gauging the usage of Internet-based services (video-on-demand, online news, social media, etc.) as published in the Eurostat database. For assessing the degree of digitisation, we focus on the types of apps and websites in the top-50 for each country in the Similarweb database, providing an indication of the availability of digital services able to substitute former (analogue) communication media. This entails coding the categories of the most-visited apps and websites according to those of Eurostat.

Lastly, for the data layer, we focus on data harvesting when measuring the degree of digitalisation – or perhaps more accurately, the closely related phenomenon of datafication (van Dijck, 2014; Mayer-Schönberger & Cukier,

2013). That is, rather than looking at what types of content users *receive* through Internet-based services, we focus on the content that is *produced* by users and monetised by third-party services. This monetisation happens through data harvesting, processing, and distribution for various purposes, including, but not limited to, advertising, hosting, and analytics. We investigate the degree to which users' everyday lives are continuously being datafied through the distribution of metadata comprising information on their digital activities, preferences, locations, and so forth. Specifically, for each country, we extract the existing unique third-party cookies (Helles et al., 2020) placed on the top-50 websites with the webXray extension (Libert, 2015), as well as existing third-party software development kits in the top-50 apps as they appear in the Exodus Privacy database (Lai & Flensburg, 2020).

TABLE 2.3 Infrastructure dimension – digitisation & digitalisation subdimensions

Indicator	Measure	Variable	Scale	Source
Access networks	Internet penetration	Digitisation of infrastructures	% of households	Eurostat
	Fixed broadband connections	Digitisation of infrastructures	% of households	Eurostat
	Mobile broadband connections	Digitisation of infrastructures	% of households	Eurostat
	Mobile broadband traffic	Digitalisation of communication	Gigabytes per capita/ month	National telecommunication statistics
Backbone networks	Fibre-optic submarine cables	Digitisation of infrastructures	Number of cables per 10 m. inhabitants	TeleGeography
	Length of submarine cables landing in country	Digitisation of infrastructures	Kilometres of cable per 10 m. inhabitants	TeleGeography
	Internet exchange points	Digitisation of infrastructures	Number of Internet exchange points per 10 m. inhabitants	TeleGeography
	Assigned autonomous system numbers	Digitisation of infrastructures	Number of autonomous system numbers per 10 m. inhabitants	RIPE NCC

Applications	Website categories in top-50	Digitisation of infrastructures	% of news; music, videos, games; video-on-demand; video calls; social networks; banking; shopping; interaction with public authorities	Similarweb
	App categories in top-50	Digitisation of infrastructures	% of news; music, videos, games; video-on-demand; video calls; social networks; banking; shopping; interaction with public authorities	Similarweb
	Usage of digital services	Digitalisation of communication	% of news; music, videos, games; video-on-demand; video calls; social networks; banking; shopping; interaction with public authorities	Eurostat
Data	Third-party services in top-50 apps (software development kits)	Digitalisation of communication & digitisation of infrastructures	Number of software development kits	Exodus Privacy
	Third-party services in top-50 websites (cookies)	Digitalisation of communication & digitisation of infrastructures	Number of web cookies	webXray

Markets

The indicators in the market dimension are also derived from the four infrastructural layers of the Digital Communication System Matrix, distinguishing between access network operators, backbone providers, application suppliers, and third-party data service. For each indicator, we first categorise the market actors according to a coding manual that differentiates between whether they are: 1) international or national; 2) greenfield or brownfield; and 3) private or state owned. These codes reflect the two subdimensions used to assess and compare the degrees of disruption and globalisation in specific markets – as well as the subdimension of facilitation, used to assess the role of the state (as overviewed in Figure 2.1). On the basis of the coding, we therefore calculate the prevalence of the different types of market actors. If a market,

for instance, is dominated by internationally owned companies, we can conclude that it is more globalised than if the majority of actors are of national origin. Also, if most infrastructure operators are legacy actors originating in the analogue age, then the market is less disrupted than in contexts where brownfield actors have been pushed to the peripheries by new greenfield actors. And finally, in contexts where private enterprises dominate the Internet infrastructure market, the state tends to be less facilitating than in contexts with high degrees of state ownership. The extensive data transformation undertaken as part of this coding process emphasises the lack of monitoring of and data on the digital economy at large.

As shown in Table 2.4, the access network market indicator is measured by calculating the market shares of, respectively, fixed-line and mobile broadband providers, as they figure in national telecommunication statistics. These measures allow for charting the ratio and interdependence between national, telecommunications operators and global, digital-native broadband providers.

The backbone network market indicator is measured by calculating marked shares for Internet exchange points, fibre-optic submarine cables, and autonomous system numbers. We collect the owners of the national Internet exchange points and submarine cables landing in Denmark, Finland, Norway, and Sweden through the TeleGeography repositories. The holders of autonomous system numbers are accessed through the RIPE NCC database and provides information on local network operators. Yet, as many services store content outside of their national context, we supplement the data with information on web hosting. This is done by looking up the autonomous system numbers of the top-50 websites in each country using the Host.io database that comprises domain information from 456,126,930 and counting websites and is updated on a regular basis. Like the previous indicator, the three backbone network market measures apply to the disruption subdimension, but also, importantly, to globalisation, by distinguishing between different degrees of national ownership of an essentially global infrastructure. Specifically for the submarine cables, we look at both the number and the length of the cables for a specific market actor.

The application market indicator is measured by calculating the ownership shares of the top-50 most-visited websites and mobile apps, and we coded the actors according to the same principles as for the remaining market indicators. From an economic as well as a cultural perspective, the distribution between national and international – and brownfield and greenfield – players is indicative of how the national digital communication environment is structured. The prominence of social networking sites (e.g., Facebook) and streaming services (e.g., Netflix) testify to the extent to which "over-the-top" services (or those which bypass traditional platforms to offer services directly on the Internet) replace previous, dedicated communication technologies and national market actors. Likewise, the positions of, for instance, public service institutions or online newspapers in the top-50 testify to the perseverance of

power structures and institutional logics associated with the analogue media systems of the twentieth century.

TABLE 2.4 Market dimension – disruption & globalisation (& state facilitation) subdimensions

Indicator	Measure	Variable*	Scale	Source
Access network market	Fixed broadband market shares	Disruption, globalisation, & state facilitation	%	ITU (National telecommunication statistics)
	Mobile broadband market shares	Disruption, globalisation, & state facilitation	%	National telecommunication statistics
Backbone network market	Submarine cable market shares	Disruption, globalisation, & state facilitation	%	TeleGeography
	Internet exchange point market shares	Disruption, globalisation, & state facilitation	%	TeleGeography
	National autonomous system number market shares	Disruption, globalisation, & state facilitation	%	RIR (RIPE NCC)
	Hosting autonomous system number market shares	Disruption, globalisation, & state facilitation	%	Host.io
Application market	Top-50 website market shares	Disruption, globalisation, & state facilitation	%	Similarweb
	Top-50 app market shares	Disruption, globalisation, & state facilitation	%	Similarweb
Data market	Third-party cookies in top-50 market shares	Disruption, globalisation, & state facilitation	%	Similarweb + webXray
	Third-party software development kits in top-50 market shares	Disruption, globalisation, & state facilitation	%	Similarweb + Exodus Privacy

* The last variable speaks to the state facilitation subdimension of the state dimension, but the coding according to the variables of, respectively, public and private, as well as publicly and privately funded, market actors is carried out concurrently with the remaining coding of market actors in the market dimension.

The data market indicator is derived from the applications indicator insofar as it zooms in on the third-party service providers that support the most popular websites and mobile apps. Though a cliché, "data is indeed the new oil" (Yonego, 2014) of the digital economy, and it is thus essential in any comparison of digital communication systems to consider the distribution, and exertion, of power at this final and often hidden layer of the Internet infrastructure. Just as backbone investments are essential to large digital corporations, so is the capacity to profit from data harvesting. Based on the infrastructure analyses of web cookies and software development kits for apps, we therefore code the market shares of third-party service providers according to the coding manual.

States

Like for the market dimension, the indicators for assessing the role of the state are selected and developed based on the initial mapping of the four layers of the Internet infrastructure, as laid out in the Digital Communication System Matrix (e.g., we investigate state ownership of backbone networks, state regulation of content, etc.). Data for assessing state facilitation is derived from the categorisation of market actors as either private or state-owned, as described in the previous section. Across the four indicators, measures relating to the subdimension of state intervention were selected by reviewing several databases that include aspects of political regulation of the Internet (e.g., The Economist Intelligence Unit, 2021). The next analytical step entails assessing relevant funding schemes, agencies, and policies in the national settings. The chosen measures are in line with contemporary constructed baselines for evaluating political regulation of the Internet, such as the "principles for governments" in the Contract for the Web (World Wide Web Foundation, n.d.).

Apart from national funding schemes, agencies, and policies, several international bodies (e.g., the Internet Assigned Numbers Authority, part of the Internet Corporation for Assigned Names and Numbers (ICANN), and Regional Internet Registers like RIPE NCC in Europe) are significantly involved in regulating the Internet as a worldwide infrastructure. Also, policies at the European Union level lay the groundwork for national legislation. Thus, in the analysis of the state dimension, some differences are regional rather than national because of, for example, European Union governance, while other similarities hinge on global governance bodies (see Flensburg & Lai, 2020a).

Table 2.5 provides an overview of the indicators and measures used in our empirical analyses of the role of the state in digital communication systems. It shows that the indicator for state involvement in access networks covers state facilitation of and intervention into mobile and fixed broadband infrastructures. Based on the categorisation of market actors as either private or state-owned, we first determine the percentage of state ownership of Internet service providers and evaluate whether fixed and mobile broadband projects

are publicly funded, monitored by an official agency or state body, and if the interventions are formalised in government policies by reviewing national legislative databases. These measures emphasise the degree of state involvement in the development and supply of Internet connections through, for instance, competition regulation.

The indicator for state involvement in backbone networks reflects the infrastructure and market dimensions by measuring the degrees of ownership and facilitation as well as intervention into submarine cables, Internet exchange points, and autonomous system numbers. Like for the access networks, we first outline the degree of state ownership for the three backbone components and then enquire into public funding, officially appointed agencies and bodies, and formalised policies. These measures are critical, because the backbone is the least monitored layer of Internet infrastructure (Nuechterlein & Weiser, 2013).

For the indicator for state involvement in applications, we gauge the degree of state ownership of apps and websites as well as the interventions into how they are built, owned, and used. Using the categorisation of market actors as either private or state-owned, we determine the overall governance dynamics of the top-50 and assess the impact of public funding schemes, regulatory intervention, and so forth. These measures speak to the degree of disruption and globalisation of markets insofar as the efficacy of (nation-state) regulation is related to the existence and prominence of national, legacy, and public institutions.

Finally, the indicator for state involvement in the data layer comprises measures of state ownership and facilitation of infrastructures for data harvesting and processing. In line with the analysis of the other indicators, this includes public ownership of third-party services as well as funding, agencies, and policies aimed at regulating data collection and distribution (i.e., we assess whether data-protection and cookie policies are included in legislation and whether rights to privacy and data-protection are established). In the European Union, the General Data Protection Regulation is a critical obstacle for market actors that have earlier operated businesses "under the radar" of state governance (Flensburg & Lai, 2020a).

TABLE 2.5 State dimension – state facilitation & intervention subdimensions

Indicator	Measure	Variable	Scale	Source
State involvement in access networks	State ownership of mobile broadband	State facilitation	%	National telecommunication statistics
	Funding, official agency, & strategy/ policy for mobile broadband	State intervention	Binary Y/N	National legislative databases
	State ownership of fixed broadband	State facilitation	%	National telecommunication statistics
	Funding, official agency, & strategy/ policy for fixed broadband	State intervention	Binary Y/N	National legislative databases
State involvement in backbone networks	State ownership of submarine cables	State facilitation	%	TeleGeography
	Funding, official agency, & strategy/ policy for submarine cables	State intervention	Binary Y/N	National legislative databases
	State ownership of Internet exchange points	State facilitation	%	TeleGeography
	Funding, official agency, & strategy/ policy for Internet exchange points	State intervention	Binary Y/N	National legislative databases
	State ownership of autonomous system numbers	State facilitation	%	RIPE NCC
	Funding, official agency, & strategy/ policy for autonomous system numbers	State intervention	Binary Y/N	National legislative databases

State involvement in applications	State ownership of websites	State facilitation	%	Similarweb
	Funding, official agency, & strategy/ policy for websites	State intervention	Binary Y/N	National legislative databases
	State ownership of apps	State facilitation	%	Similarweb
	Funding, official agency, & strategy/ policy for apps	State intervention	Binary Y/N	National legislative databases
State involvement in data	State ownership of third-party cookies	State facilitation	%	webXray
	Funding, official agency, & strategy/ policy for third-party cookies	State intervention	Binary Y/N	National legislative databases
	State ownership of third-party software development kits	State facilitation	%	Exodus Privacy
	Funding, official agency, & strategy/ policy for third-party software development kits	State intervention	Binary Y/N	National legislative databases

Found, made, & remade

As evident in the sections above, many of our analyses rely less on what has traditionally been associated with methods for *making* data – like interviews or experiments – and more on data that can be *found* in databases, registers, repositories, or embedded in the very infrastructures that we study (Jensen, 2012: 435). The data found can be divided into two overarching types: existing datasets and statistics and data that can be "scraped" from digital repositories (as also overviewed in Table 2.2). The first type requires quite some making on the part of the responsible institution or stakeholder (be it the European Union statistics body Eurostat or the commercially funded TeleGeography) for it to lend itself in a somewhat ready-made format to comparative purposes such as ours.

The second type relies on the massive volumes of information that are available through various online sources and which can be harvested using

different types of data-scraping tools that identify specific information containers or tools developed for digital environments like app stores. In short, these tools are foundational for various reverse engineering practices aimed at studying data infrastructures with and through the technical features of the infrastructure (Libert, 2015). Such practices can also be collected under the interdisciplinary field of digital methods, which is concerned with repurposing digital services for studying the social through growing availability of (large-scale) digital data (Rogers, 2013).

Both types of data come with challenges and prospects for research, which can also be traced back to the simple fact that most found data have been made for someone else to do something that is most likely different from the aims of the researchers who find it. For example, while the Baltic telecommunication statistics constitute a reliable and valid source for comparing especially Nordic broadband coverage, capacity, and so forth, they do not relay information on market shares for specific Internet service providers or mobile operators. This information must therefore be obtained from the national telecommunication statistics agency in each country, which in turn proves to be challenging to compare. Another example is that Denmark and Finland provide actual datasets on market shares for individual Internet service providers and mobile operators on a half-year basis going back more than ten years, while for Sweden and Norway, we have had to rely on reports where the data has already been processed and is visualised in tables and figures focusing on full calendar years. The data on especially the Danish context is much more granular and includes a wider range of small operators.

In a similar vein, the webXray extension used to scrape web cookie scripts from the most-used websites in the Nordic countries shed light on otherwise invisible infrastructures and markets. Yet, neither the tool nor the data it amasses are adopted or systematically monitored by official institutions. As such, due to the unauthorised nature of the data collection, the analysis building on it is necessarily more explorative. Tools developed for interventions into data infrastructures are also notoriously volatile insofar as they rely on technological configurations that are often altered to suit the fluctuations of the market (think of the closing down of major data hoses like the Facebook API [Helmond, 2015] or Google abandoning third-party cookies in the Chrome browser [Perry, 2020]).

A glance down the list of data sources in Table 2.2 shows that most of them are run by commercial enterprises that profit from them in various ways. The Similarweb platform used to assess the most-used websites and apps, for instance, provides digital intelligence to small and mid-size businesses seeking to analyse their (and competitors') traffic and performance. To give another example, TeleGeography, a leading telecommunication market analysis and consultancy firm, provides business-to-business information on routing and

network performance, which can in turn be leveraged for comparisons between countries and regions. This dependence on commercial sources gives rise to a discussion about the often-proprietary nature of digital data and the lack of official data sources (Flensburg & Lai, 2020a), which we touch upon throughout the book (see e.g., Chapter 7). Yet, these epistemic problems call for much deeper discussions than what can be fully comprised within the scope of this book.

For now, we emphasise three challenges of working with commercial data, which have also been particularly covered in the loosely connected field of critical data studies (Dalton & Thatcher, 2014; Iliadis & Russo, 2016): First, commercially funded data is loaded with different and sometimes contradictory ideologies concerning the *role* of the data, what it can be used for, what kinds of knowledge it generates, and why. Second, the underlying methods and systems used for generating and collecting commercial data are often black-boxed insofar as they constitute either trade secrets or ways of leveraging competitors. And third, commercial data often do not come cheaply, which means that access to these data generates a wealth of divides between what has been referred to as the data rich and data poor (Andrejevic, 2014; boyd & Crawford, 2011): researchers who have funding to purchase data from commercial brokers and the resources to process it, and those who have neither.

We have approached these challenges through several methodological decisions, with implications at the level of analyses and findings. A common denominator for most of the sources grounding our analyses is that the data required a lot of *re*making on our part to be able make the analyses in the first place. The data in the book have thereby undergone extensive cleaning and coding processes to become applicable to our research questions. The coding of market actors produces entirely new data with which to approach market structures but also provides a backdrop for future monitoring of otherwise unmonitored markets. As a result of working with the data, we probe at the underlying motivations for making the data in the first place as well as question the often-hidden methodological foundations for them. Also, for ideological as well as practical reasons, all data are publicly available and free of charge to enhance reliability and enable any researcher to mirror the methods and data sources in other contexts.

Future steps: A dynamic framework

The Digital Communication System Matrix allows the measurement and comparison of digital communication systems across national and regional contexts, thus providing the opportunity to develop typologies for understanding structural differences and similarities between, in the case of this book, Denmark, Finland, Norway, and Sweden. Through the step-by-step construction of a methodological approach to empirical analyses and

comparisons, we have operationalised the theoretical questions about how infrastructures, markets, and states mutually shape each other and structure the communication environment that enables and constrains people's capabilities. It is important to stress that digital communication systems are inherently dynamic and in flux, as are the available data sources, resources, and tools for analysing them. Frameworks like ours must therefore necessarily be flexible and open to adjustment as the objects of analysis evolve or data become available (or disappear). In other words, researchers applying the suggested methods and analytical approaches should take a step or two back and re-evaluate the indicators, measures, and continuums selected here before proceeding.

In doing so, future analyses will hopefully compensate for the limitations of the present analyses: Several additional measures could have benefitted our study, but these are mostly unobtainable to researchers, and as such, not part of the framework. None of the Nordic telecommunication authorities were able to provide us with information on the amount of data traffic in *fixed* broadband networks that would surely have supplemented the information on the use of mobile data and provided a more precise picture of Internet use. The backbone analyses would have benefitted tremendously from information on data centres and content delivery networks that are largely unmonitored. The application layer suffered from the absence of official databases and the reliance on commercial services, which are developed for entirely different purposes, lack relevant information on use and download numbers, and reveal little about their measurement systems. And finally, the analyses of the data layer also necessarily relied on somewhat explorative tools and methods in the absence of established and accessible approaches to studying (hidden) third-party ecologies (Pybus & Coté, 2021).

These limitations aside, the Digital Communication System Matrix offers an unprecedented possibility for testing the things we think we already know about the state of digital communication systems in the Nordic welfare states. Also, we trust that the matrix is valuable for later comparisons beyond this book and welcome future developments of the indicators and measures presented here.

PART II

MAPS

CHAPTER 3

Accessing the Nordic Internets

The ongoing transformation of communication technology in the digital age extends the reach of communication media to all domains of social life in a network that is at the same time global and local, generic and customised in an ever-changing pattern.

CASTELLS, 2007: 239

The Wi-Fi connections, modems, and mobile networks that allow devices to send and receive data constitute most people's direct encounters with the material infrastructures of the Internet and are therefore natural starting points for our investigation of the Nordic digital communication system environments. If the reply to John F. Kennedy's 1950s love letter were to be transmitted digitally today, Gunilla von Post would have a range of options to choose from: She could either turn on a stationary computer or a laptop, which would link to a Wi-Fi connection and the underlying copper wire, coaxial cable, or fibre-optic network. Alternatively, she could unlock her smartphone and launch a message app, using her mobile subscription and a 3G, 4G, or 5G network.

Each of these scenarios have different material, economic, and political implications and entail distinctive chains of events in terms of the underlying infrastructures, the market actors involved, and the policies and regulations that govern them. DSL connections, for instance, utilise the copper wire networks originally developed for landline telephony, and which are typically supplied by legacy telecommunication operators. Fibre-optic networks, in contrast, have been established within the last decades and are often owned and supplied by utility companies, municipalities, and local companies. And mobile broadband depends on the public allocation – and auctioning – of spectrum and radio frequencies that are divided between competing operators.

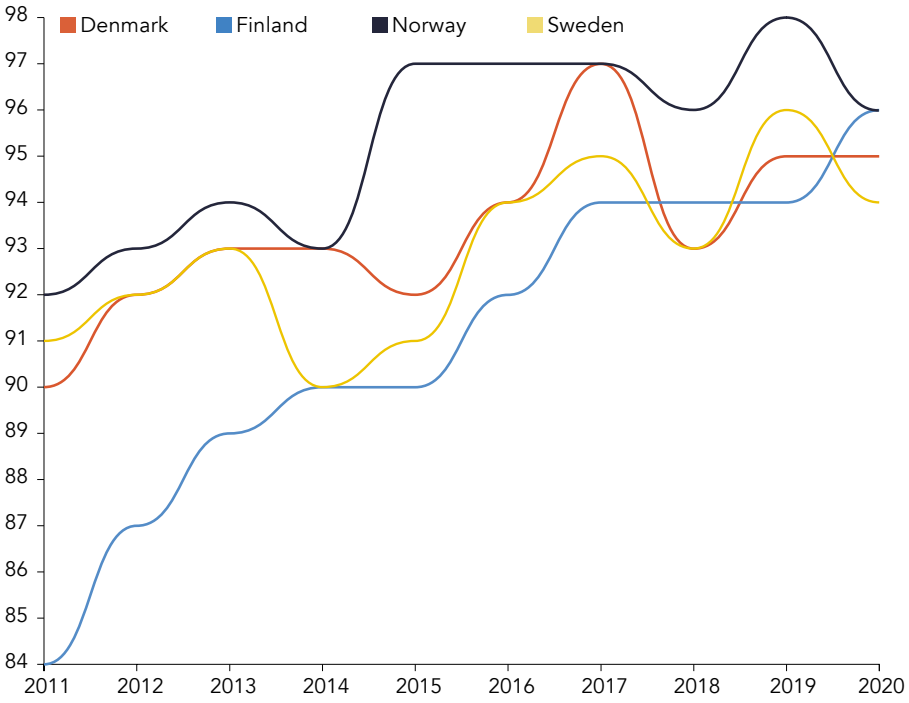
To understand the structural forces that influence how the "last mile" of the Internet materialises in Denmark, Finland, Norway, and Sweden, this chapter analyses the mutual dependencies between material access networks, markets for Internet service provision, and broadband policies. Building on a comprehensive mapping of the infrastructural arrangements across Denmark, Finland, Norway, and Sweden, we scrutinise the commercial dynamics of various types of Internet service providers and discuss the impact of political strategies and regulatory interventions. In the end, this enables us to draw a comprehensive picture of the structural conditions that allow Nordic users to *access* the Internet in the first place, and to discuss the tensions and dilemmas that follow.

Waves & wires

Known for its comprehensive digital infrastructures, the Nordic region continuously stands out in global comparisons of Internet coverage and penetration. Across this geographically diverse region, high-speed Internet connections spread early and rapidly, allowing for the digitalisation of the Nordic societies and the everyday lives of the people who live there. The capital regions of Denmark, Finland, and Sweden hold the highest shares of daily Internet users in the EU (more than 95% of adults) (Eurostat, 2021), and even the sparsely populated Northern areas of Finland, Norway, and Sweden are, by all comparisons, well-connected as a result of significant and ongoing state-initiated broadband strategies and projects (European Commission, n.d.-a).

Illustrating the development since 2011, Figure 3.1 shows that in 2020, well beyond 90 per cent of Nordic households had an Internet connection. Internet penetration in Finland has historically lagged behind Denmark, Norway, and Sweden but has by now caught up entirely to the standards of the region. This reflects a comprehensive coverage that allows users to go online almost regardless of where they live, either through a fixed or mobile broadband connection that is generally of a high quality, speed, and capacity.

FIGURE 3.1 Internet penetration in Denmark, Finland, Norway, & Sweden, 2011–2020 (per cent)



COMMENTS: Based on the percentage of households having access to the Internet.
SOURCE: Eurostat

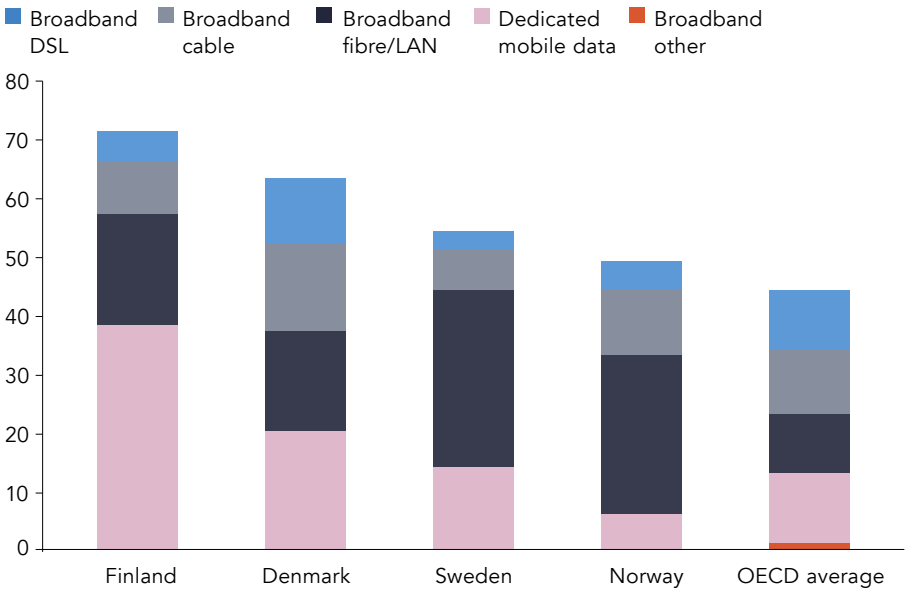
At first glance, the countries seem highly similar when it comes to the development, coverage, and use of broadband services. By looking closer at the infrastructural arrangements, however, we see that the underlying infrastructures for accessing the Internet are quite different. Looking at the distribution between fixed and mobile broadband, we find that Norway and Finland are each other's opposite: In Norway, 90 per cent of all households have a fixed broadband connection, while only 30 per cent use mobile broadband to access the Internet; in contrast, 91 per cent of Finnish households have a mobile broadband connection, while just 57 per cent connect via fixed networks (Eurostat, 2021).

Infrastructural heritages

Diving deeper into the materiality of the broadband infrastructures, we identify important differences in the technologies underlying the access networks. Figure 3.2 illustrates the total number of broadband subscriptions as reported by the national Internet service providers to the national telecommunication

authorities. It shows that all four countries are above the OECD average when measured on the number of broadband subscriptions per 100 inhabitants, with Finland having the highest number of subscriptions (72) and Norway having the least (48). This might correspond to the differences between the two countries in terms of fixed and mobile subscriptions discussed earlier: While mobile subscriptions are usually tied to an individual (device), fixed broadband is most often shared by users in a household, a firm, and so forth.

FIGURE 3.2 Number of broadband subscriptions in Denmark, Finland, Norway, & Sweden by technology, 2021 (per 100 inhabitants)



SOURCE: OECD

While there is an equal distribution between the technologies used to connect to the Internet across the combined OECD countries, the four Nordic cases are significantly dissimilar. Internet connections in Denmark to a wide extent rely on historical telecommunication infrastructures, while Norway and Sweden have invested heavily in establishing new high-speed fibre-optic networks. That is, 17 per cent of all Danish broadband subscriptions come in the form of DSL connections reutilising the copper wire networks originally used for landline telephony, and 24 per cent are supplied through the coaxial cables that continue to also serve television distribution. Compared with the other countries, Denmark has a smaller proportion of fibre-optic broadband connections (40% of subscriptions), whereas Sweden, which consistently ranks in the global top-five when it comes to fibre-optic broadband, has 75 per cent fibre and only 6 per cent DSL and 12 per cent cable connections.

These differences testify to both the infrastructural conditions that prevailed prior to the Internet and to different market interests. By digitising existing infrastructures, legacy telecommunication companies, such as the Danish incumbent TDC, have managed to repurpose their existing assets and to position themselves as leading Internet service providers. In Sweden, the prevalence of fibre-optic connections is a result of significant and often public investments in building and running high-speed networks that are owned by the municipalities (Zager, 2019).

Another central difference relates to the already mentioned highly mobile context of Finland, where 53 per cent of all broadband connections come in the form of dedicated mobile data subscriptions (excluding subscriptions that combine voice, text message, and data services). In comparison, the corresponding share in Norway is only 12 per cent. The prevalence of mobile broadband in Finland and its marginal position in Norway becomes even more significant when we look at the mobile data traffic numbers: Finnish users on average consumed 48.2 gigabytes of mobile data per month in 2020, while Norwegians used a seventh of that (6.7 gigabytes), and Danes and Swedes used 17.9 and 15 gigabytes, respectively (Nordic-Baltic Tele Statistics, 2021). In fact, Finland is by far the highest ranking (OECD) country when it comes to mobile data usage. However, the mobile connections also constitute a weak spot in the country's access networks, as the speeds are usually slower for mobile connections than for fixed.

The dissimilarities in the material foundation for the digitalisation of Nordic societies suggests that market structures and political priorities and strategies are not aligned across the four countries, despite their immediate similarities in terms of coverage and usage. In the next section, we analyse the Internet service provider markets to understand the economic background for the different infrastructural developments.

The rise & fall of incumbent empires

Corresponding with the national infrastructural differences outlined above, Nordic Internet users are met with dissimilar prices when paying their monthly broadband bills (see Table 3.1). With an average price of USD 5.81 per 1 gigabyte of mobile data and USD 79.16 per month for fixed broadband, Norway stands out as the most expensive context for acquiring access to the Internet, even when we consider the country's high income levels. At the other end of the scale, Denmark constitutes the country with the lowest average prices on both mobile data and fixed broadband. In Norway, the higher prices for especially mobile data reflect the significantly lower mobile-traffic numbers, while the low prices in Finland, but also Denmark, are concurrent with these countries' higher mobile-traffic numbers.

TABLE 3.1 Comparisons of broadband prices, 2021 (USD)

	Average price of 1 gigabyte of mobile data	Average cost of fixed broadband per month
Denmark	0.79	52.02
Finland	0.97	43.57
Norway	5.81	79.16
Sweden	1.45	48.40

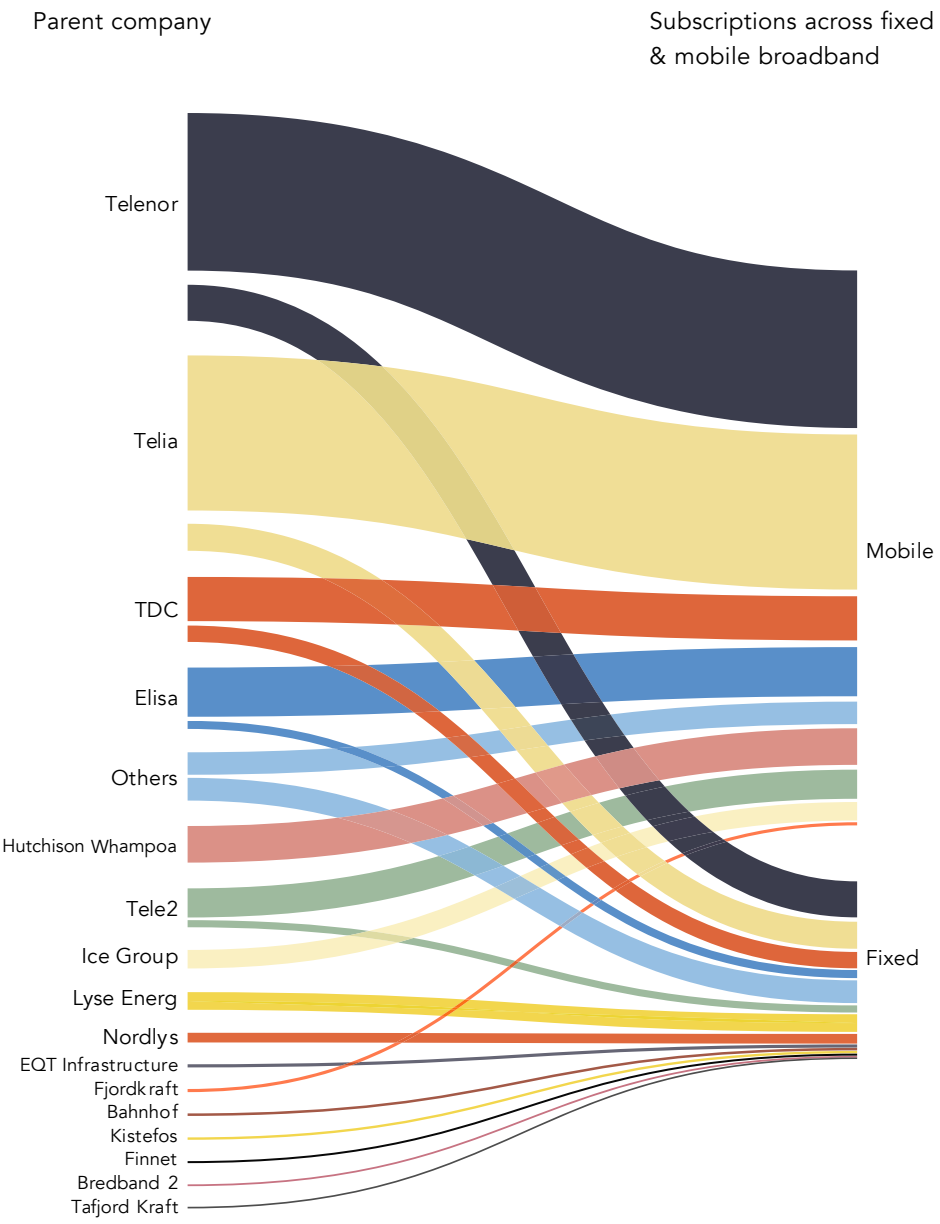
SOURCE: cable.co.uk

The economic differences are also evident when we look at the investments made in the Nordic industry: The Norwegian Internet service providers report the highest level of investments, with EUR 1,220 per capita from 2015 to 2020, compared with EUR 1,078 in Denmark, EUR 885 in Sweden, and EUR 538 in Finland over the same period. In Denmark, however, investments increased significantly from 2015 to 2020 (from EUR 158 to EUR 236 per capita), while they dropped in both Sweden and Finland. These uneven price levels and financial "muscle powers" indicate that the conditions for running an Internet service provider business vary between the four countries.

Comparing broadband ecologies

The infrastructural and economic conditions outlined above are mutually dependent on the market structures and commercial incentives of the Internet service providers who build and run the access networks. These market actors have immense interests in influencing *how* the Internet reaches Nordic individuals and households, and they also play key roles in designing the infrastructures. Figure 3.3 shows the largest Internet service providers operating in the Nordic context, ranking and sizing them according to the number of subscriptions they sell. Distinguishing between mobile and fixed subscriptions, the figure shows the prevalence of Norwegian and Swedish incumbents Telenor and Telia across the countries as well as across fixed and mobile subscriptions. However, it also testifies to the entrance of newer national and international actors such as Hutchison Whampoa (the company 3) and Ice (both providers in the mobile realm) as well as utility companies acting as fibre-optic providers (e.g., Lyse and Norlys).

FIGURE 3.3 Broadband providers in Denmark, Finland, Norway, & Sweden ranked by number of subscriptions, 2021

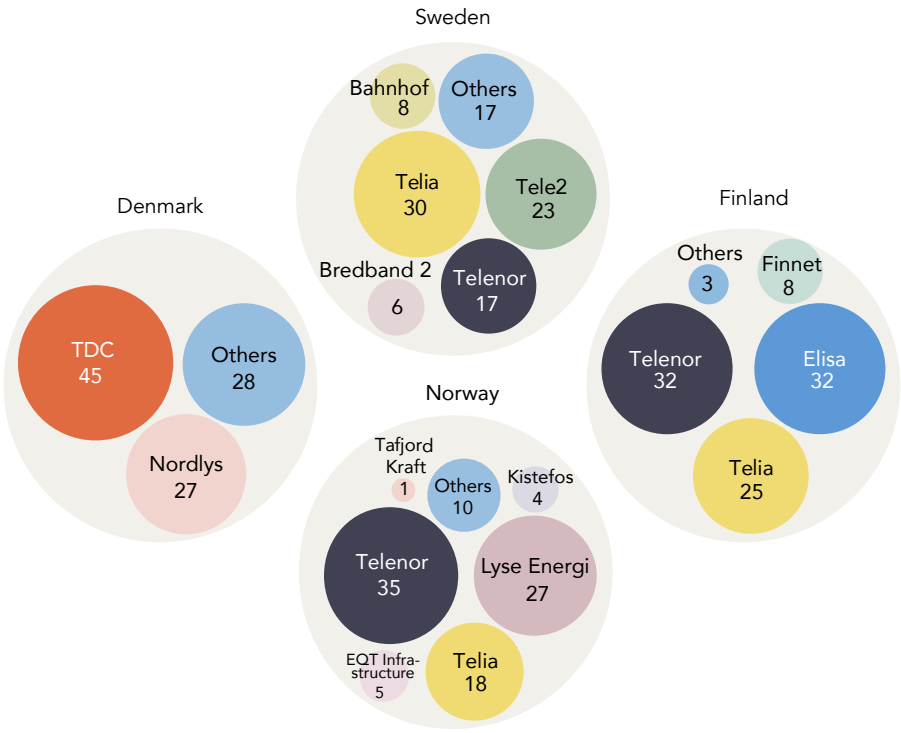


SOURCE: National Tele Statistics Denmark, National Tele Statistics Finland, National Tele Statistics Norway, National Tele Statistics Sweden

These market structures underline the successful expansion strategies of especially Telia and Telenor, who have managed to export their national businesses to the neighbouring markets. By all comparisons, the Danish and Finnish incumbents (TDC and Elisa) are less dominant in the Nordic broadband market despite their continued prevalence in the national markets. Especially in Denmark, where DSL and cable connections are still common for accessing the Internet, TDC controls nearly half (45%) of the market for fixed broadband and more than one-third (38%) of the mobile market. Compared with the other countries, Denmark therefore represents the most consolidated market for Internet service provision, where smaller companies (e.g., Hiper) have been bought by the larger actors (e.g., TDC). As mentioned, TDC has been able to translate their historically dominant position in telephony and television distribution into the realm of broadband provision, yet primarily in the national market.

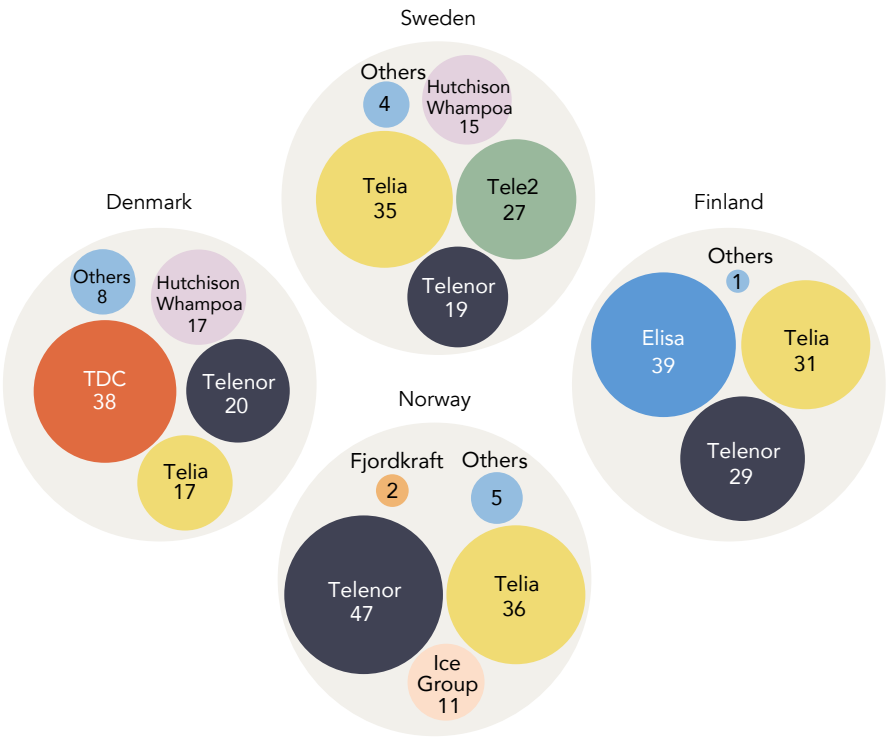
This example shows that the while the Nordic Internet service provider market is made up of a relatively limited selection of operators and is somewhat concentrated around legacy companies acting as gatekeepers in the analogue communication system, there are also significant national variations between the internal markets. Illustrating these differences, Figures 3.4a and 3.4b break down the market shares for leading operators of fixed broadband and mobile broadband in Denmark, Finland, Norway, and Sweden. The figures compare both the countries and the different Internet service provider markets based on fixed and mobile infrastructures, respectively.

FIGURE 3.4a Market shares of fixed broadband subscriptions in Denmark, Finland, Norway, & Sweden, 2020 (per cent)



SOURCE: National Tele Statistics Denmark, National Tele Statistics Finland, National Tele Statistics Norway, National Tele Statistics Sweden.

FIGURE 3.4b Market shares of mobile broadband subscriptions in Denmark, Finland, Norway, & Sweden, 2020 (per cent)



SOURCE: National Tele Statistics Denmark, National Tele Statistics Finland, National Tele Statistics Norway, National Tele Statistics Sweden.

Zooming in on the fixed broadband ecology in Figure 3.4a, the prevalence of especially Telenor and Telia is again clear: They are both dominant in their home markets and hold strong positions in their neighbouring countries (except Denmark). In Finland, Telenor has acquired the same market share as that of the Finnish incumbent Elisa (32%). Since 2015, the incumbents have generally lost national market shares across Denmark (from 56% to 45%), Norway (from 41% to 35%), and Sweden (from 38% to 30%), which in part can be traced back to the surge in fibre-optic connections across the Nordic region. This is evident in TDC's only competitors being predominantly fibre companies (e.g., Norlys) as well as in the presence of smaller fibre companies in both Sweden and Norway that are typically developed and run locally (e.g., Kistefos and Tafjord Kraft).

By comparison, the incumbents' shares in the market for mobile broadband (see Figure 3.4b) are more constant over time and more evenly distributed between competing operators: Since 2015, the four incumbents have supplied between 35 per cent (Sweden) and 47 per cent (Norway) of mobile subscriptions in the national markets. The incumbents of Norway and Sweden also constitute significant mobile network operators across the region: Telenor has a market share of 20 and 19 per cent in Denmark and Sweden, and 29 per cent in Finland. Telenor's dominance in the mobile market as well as the higher prices for mobile data suggest that the legacy business model of the company is more resilient in Norway compared with the other countries, where the higher degree of competition has pushed prices down and made mobile broadband an attractive alternative.

The traffic numbers for mobile data in Norway again show a population that still predominantly accesses the Internet through the fixed lines of Telenor. If they do turn to their mobile data subscription, the fees generate excess income for the same company. The high mobile data prices also hold back the transition to over-the-top services that can offer alternatives to traditional voice and message services and thereby serve as a threat to the legacy mobile services and income avenues (BEREC, 2016). In comparison, the presence of successful new entrants such as the company 3 (owned by Hutchison Whampoa) in the Danish and Swedish markets speaks to the mobile operators' dependencies on the electromagnetic spectrum allocated by state authorities to multiple operators, which creates a "natural" competition between the market actors who obtain the licences to build and run mobile networks.

The companies populating Figures 3.4a and 3.4b differ when it comes to both geographical origin and the legacy of their businesses. Some date back to the domestic establishment of energy and telephone grids, while others have been born with the Internet, often in international contexts. In Norway and Sweden, most actors involved in both fixed and mobile broadband provision are nationally owned (60% or more), while the situation is reversed in Finland and Denmark. Whereas the high share of non-national companies operating

in the Finnish context (57% for fixed and 60% for mobile) can for large parts be explained by the strong positions of Telenor and Telia, the large share of international companies in Denmark (45% for fixed and 91% for mobile) is specifically related to the Danish state selling the incumbent TDC to international shareholders as well as the presence of the strong mobile operator 3.

If we look at the ratio between brownfield and greenfield companies, Norway and Sweden again pool together by having the largest portions of newcomers in both markets (e.g., greenfield companies hold a share of 42% in the Swedish mobile broadband market, and a share of 36% in the Norwegian fixed broadband market), whereas Denmark () and Finland are still largely dominated by legacy companies such as TDC, Telia, Elisa, and Telenor (more than 70% for Denmark and 97% for Finland). The strong position of brownfield actors in Denmark traces back to the infrastructural foundations for the Danish Internet, where older infrastructures (DSL and cable television) – and thereby older market actors – are still highly relevant. In Finland, it is rather a question of the Finnish, Norwegian, and Swedish incumbents providing nearly all broadband connections – fixed *and* mobile.

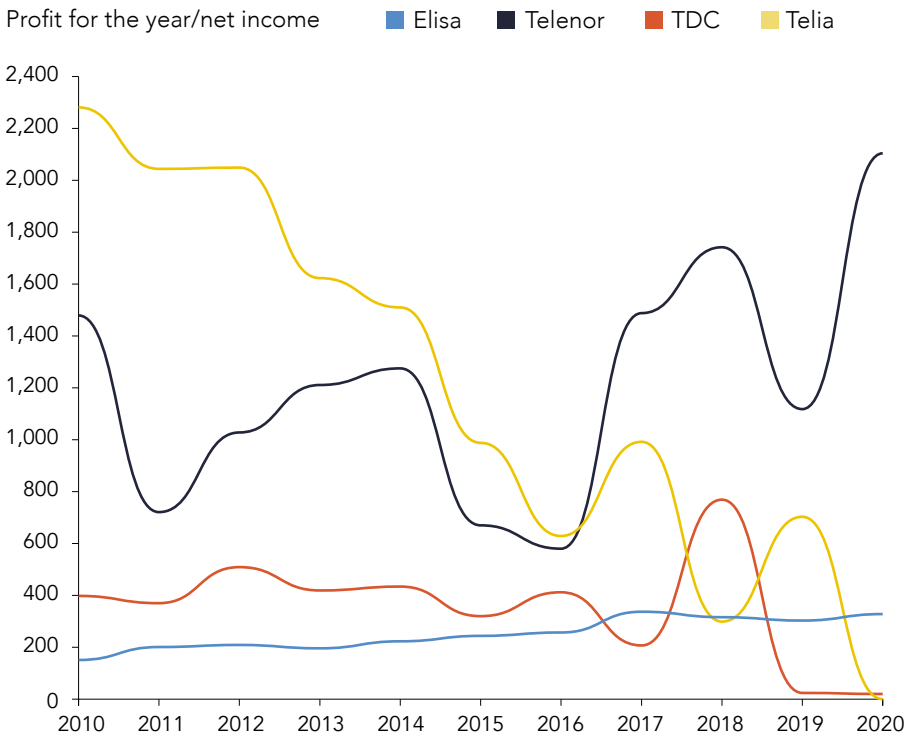
The disruptive force of over-the-top services

The dominant positions of legacy institutions testify to the Nordic incumbents' success in expanding their traditional businesses of telecommunications and television distribution to also include broadband provision. However, unlike their successors in mobile and fibre that built their businesses on the premises of the Internet, these companies have experienced a hollowing out of their traditional business models: From approximately 2010 and onwards, there is a steady decline in the use of landline and mobile calls, SMS, prepaid phone cards, and bundled cable television channels, making the business of selling these services less lucrative. This decline should be considered in the context of the breakthrough of various over-the-top services for communicating (WhatsApp, Facebook Messenger, Viber, FaceTime, iMessage, etc.) and for accessing television content (Netflix, Disney+, Amazon Prime, HBO Max, etc.). We focus explicitly on these in Chapter 5.

Paradoxically, the business models that funded early broadband build-out would, in later stages of the Internet's evolution, be diminished by the success of this new infrastructure. The formerly profitable ventures of phone calls and television distribution along with the highly developed existing infrastructures paved the way for the fast and extensive digitalisation of the Nordics, but they also laid the groundwork for the success of various high-capacity over-the-top services. While one would expect this hollowing out of the incumbents' traditional business models to show in declining revenues – and perhaps especially in the bottom lines – this is not the case for all four companies. Figure 3.5 shows the net income for each of the incumbent actors – TDC, Elisa, Telenor, and Telia – from 2010 to 2020. While Elisa in

Finland has managed to keep its income in a slight but steady incline, Telia has seen a steady decline, leading to a negative income in 2020. TDC also suffers from economic losses throughout the period, going from approximately EUR 400 million in 2010 to just EUR 20 million in 2020. For Telenor, we see a quite different development, with the company experiencing losses over the past ten years but also regaining much of what was lost towards the end of the period, which also needs to be attributed to their businesses outside the region (e.g., in Asia).

FIGURE 3.5 Annual net income for incumbent telecommunication companies, 2010–2020 (EUR millions)



SOURCE: Yearly reports and financial statements from TDC, Elisa, Telenor, and Telia

The same tendencies are mirrored if we follow the revenue streams across the countries. In 2020, the revenues from mobile and fixed call services and broadband services make up EUR 427 per capita in Norway and between EUR 344–352 per capita in the remaining Nordic countries (Nordic-Baltic Tele Statistics, 2020). Especially Sweden has experienced a drop in revenues over the past years, while revenues in Finland have increased.

The infrastructural and economic differences that condition how the Internet is accessed in the four countries are closely tied to political decisions and strategies made throughout the history of the Nordic Internets. In the following section, we investigate how policymakers and state authorities have contributed to the shaping of the national access networks through various types of broadband funding and spectrum administration.

Governing access

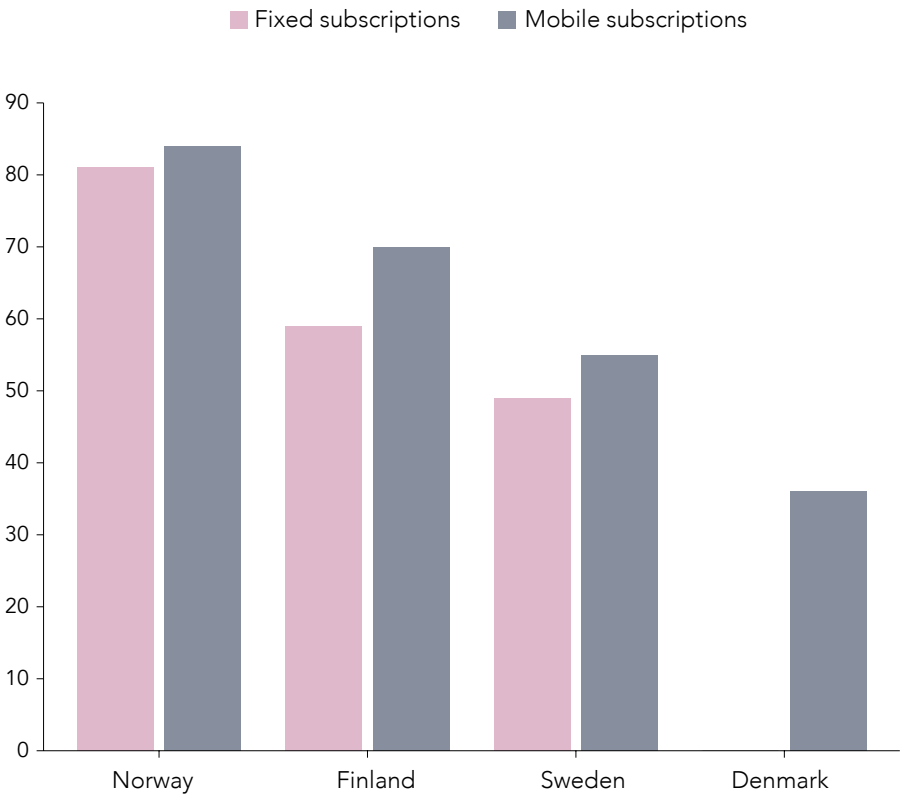
The Nordic welfare states have historically played key roles in building, running, monitoring, and regulating communication networks, as outlined in Chapter 1. Through public ownership of telecommunication companies, funding of infrastructure projects, and control of competition structures, state authorities have influenced the development and conditions of access network markets in all four countries, albeit in different ways. In the following sections, we seek political explanations for the infrastructural and market differences identified in the previous sections, while simultaneously interrogating how the material and economic conditions influence the efficacy of the welfare states.

Telephonic legacies

A quick rundown of the histories of the four incumbent network operators testifies to the high degree of state influence in the telecommunication sectors in the twentieth century: In Norway and Sweden, the market positions of Telenor and Telia can be traced back to the companies' origins as public monopoly providers of telegraph services in the nineteenth century, while in Denmark and Finland, TDC and Elisa originated in state-commissioned telephone companies. To date, the largest shareholders in Telenor, Telia, and Elisa are state institutions, while the shares of the previously state-owned TDC were gradually sold in the 1990s, so that the company is now owned by the Australian Macquarie Group. The different strategies of the Nordic governments and the historical decisions made in terms of public ownership and privatisation are clearly reflected in our analysis of Internet service provider ownership.

Figure 3.6 illustrates the total market shares of companies that are owned fully or partly by state institutions. The main explanation for the sizeable share of subscriptions supplied by state-owned companies can be found by returning to Figure 3.4a and 3.4b, where the partly state-owned Telenor and Telia appear as important providers of mobile broadband in all countries and of fixed broadband in Finland, Norway, and Sweden. The figure also testifies to the public investments in fibre-optic networks in Norway, where the municipality-owned utility companies Tafjord and Lyse Energi both figure prominently in the market for fixed broadband.

FIGURE 3.6 Market shares of access networks by state-financed companies in Denmark, Finland, Norway, & Sweden, 2021 (per cent)



COMMENTS: Companies are coded as state-owned when state institutions are the largest shareholder in the company (e.g., the government of Norway owns 53.97% of Telenor and the Swedish State controls 39.5% of the shares in Telia while no other shareholder has more than 5%).
SOURCE: National Tele Statistics Denmark, National Tele Statistics Finland, National Tele Statistics Norway, National Tele Statistics Sweden

Sweden's heavy investments in building and running municipal fibre-optic networks are not directly reflected in the figure but might be hidden in the "other" category of the ownership analysis that makes up 17 per cent of the fixed broadband subscriptions. Unlike in Norway, where publicly owned utility companies are among the largest broadband providers, the municipal fibre companies in Sweden are only allowed to operate locally and thereby own smaller and more distributed market shares. In many cases, they serve as pure infrastructure providers, leasing lines to service operators who then sell the actual subscriptions. Therefore, state influence might be larger in Sweden than what Figure 3.6 would have one think. Denmark also has a significant "other" category (28%) that might skew the accuracy of the ownership coding, as it potentially contains state-owned companies. However, the absence of state ownership in the Danish fixed broadband market is caused mainly by the market dominance of the privatised TDC and the cooperatively owned Norlys.

Broadband pools & fibre projects

The broadband infrastructures in the Nordic countries are subject to intense monitoring and political attention, encouraged by ongoing European Union strategies and benchmarks on connectivity (European Commission, n.d.-b). In all four countries, the overarching policy aim has been to foster a market-driven build-out of broadband infrastructures reflecting the general liberalisation of the telecommunication sectors of the 1990s. However, given the limited market potential in rural and sparsely populated areas, public funding has, to varying degrees and in different formats, also been an integral part of broadband development in the region. Apart from the tendency to sustain public ownership of telecommunication companies, millions of euros have been invested by the states in non-commercially profitable broadband projects across the Nordics.

Of the four countries, Sweden has been the most proactive in terms of public investments in Internet infrastructure. In 2000, the Swedish government allocated EUR 280 million to the establishment of a national, operator-neutral backbone, gave the municipalities tax breaks worth EUR 310 million to develop local access networks, and provided EUR 252 million to regional network planning (Forzati & Mattsson, 2014). Over the last decades, funding has slowed down, but broadband expansions in rural areas are continuously prioritised (Government Offices of Sweden, 2020). As a result of the early initiatives in terms of establishing and running local networks, the Swedish municipalities have, as mentioned, been a driving force in the build-out of a comprehensive, and near nation-wide, fibre-optic network. Being obliged to make their network capacity available to external service providers (Hansteen, 2005), the municipal companies avoid local monopolisation by enabling a multitude of local companies to supply consumers with broadband (Zager, 2019).

In contrast, the broadband policies of Denmark and Norway have traditionally focused on stimulating the demand for Internet connections rather than supplying infrastructures (Hansteen, 2005; Henten & Falch, 2014). Aiming to create market incentives to build and supply network access, comprehensive digitalisation strategies have, since the 1990s, encouraged people to use online services and funded public application development. However, through the so-called Høykom programme, the Norwegian government has also contributed to the establishment of broadband networks in areas with little or no coverage. In 2007, it spent EUR 36 million on co-funding broadband projects in areas with no existing offers (OECD, 2008), and in 2014, a support scheme was established that continues to provide funding for broadband in areas where infrastructure projects are not commercially profitable (e.g., EUR 36 million in 2021).

Following a path quite similar to that of Norway, Denmark had limited state financial support for broadband build-out in the early years, and only a few local broadband projects received public funding (Ministry of Industry, Business and Financial Affairs, 2013). Incumbent operators (i.e., TDC) have, since the mid 1990s, been subject to universal service requirements including basic Internet provision, and regulators monitor the market closely to ensure competing companies' access to TDC's infrastructures. The first direct support from the Danish state was allocated to a regional broadband project in 2011 (Henten & Falch, 2014), while in 2016, the so-called broadband pool was established, with EUR 13 million per year allocated to (fixed) broadband projects in sparsely populated areas. Despite recent efforts to abandon the Danish scheme, funding is continued at the time of writing. It is important to note that from the beginning of Internet roll-out, the conditions for building, running, and profiting from broadband have been different in Denmark compared with its neighbouring countries: Denmark is much smaller, more densely populated, and was already extensively supplied in terms of landline telephony and cable television, making the establishment of access networks easier and less expensive. The market-based model has thereby been more successful in Denmark, as broadband projects have generally been more commercially profitable.

Like in Denmark and Norway, public broadband funding came rather late in Finland, and the investments have been smaller than in the other countries (EUR 76 million from 2010 to 2020) (Traficom, 2021). However, Finland reached global headlines in 2010, when the government made broadband a guaranteed legal right for all its citizens and set an ambitious goal of providing all households and companies access to a 100 megabit broadband connection (Nieminen, 2013). This goal has mainly been pursued through broadband monitoring, price regulation, and limited funding of broadband projects in non-commercially profitable regions. Despite the political ambitions, Finland's broadband policies and public investments have not led to a significant build-out of fibre-optic networks (like in Sweden and Norway). However, Finnish

governments have encouraged and supported the development of access networks and broadband services by other means: spectrum policies.

Allocating for mobile

While fixed broadband is dependent on terrestrial cable-laying and can, in principle, be established by any actor with sufficient means and expertise, mobile networks depend on electromagnetic spectrum, a scarce resource allocated by state authorities. The prioritisation and allocation of spectrum for mobile networks therefore constitutes a cornerstone in contemporary communication policy, as it directly influences the development of the networks and the competition structures of the mobile economy (Ala-Fossi & Bonet, 2018). By reallocating spectrum from broadcasting to mobile communication, governments can push a transition from traditionally distributed radio and television to Internet-based streaming. Decisions to not release spectrum for mobile networks or charging high prices for it can, on the contrary, potentially hold back a move from fixed to mobile Internet usage, while also protecting the legacy business models of the broadcasting sector. Due to its political and economic implications, spectrum policy has been subject to intense negotiations and conflicts between key actors in the (digital) media and communication market but is left surprisingly out of the public debate.

In the Nordic context, Finland stands out as a leading advocate for mobile technologies, while the three other countries have tended to promote and support fixed Internet connections. Reflecting the interests of the former mobile manufacturer Nokia, Finland has led an active spectrum policy, assigning frequencies to mobile operators at low costs and reserving large amounts of spectrum for mobile communication (rather than broadcasting) (Ala-Fossi, 2020). The prominent position of mobile broadband in Finland is, as such, directly related to the political decisions made regarding the allocation of spectrum to build 3G networks in the early 2000s. While Denmark, Norway, and Sweden followed the UK's example and auctioned off licences to the highest bidder, Finland continued to assign the frequencies for a nominal fee.

Finland is exceptional not just in the Nordic context but also on a global scale. The Finnish frequency policies can be seen as an "indirect public support for telecom operators' mobile businesses […] making it easier for the operators to invest in mobile networks [and] investments in fixed networks less attractive" (Ala-Fossi, 2020: 137). In markets where mobile frequencies have been auctioned off for millions of euros, while fixed broadband projects have been subsidised, the high reliance on fixed broadband connections comes as no surprise. And vice versa: The high usage of mobile broadband and low prices for data in Finland reflects the fact that operators have been able to develop mobile networks at significantly lower costs than in the other Nordic countries.

In recent years, Finland has adopted the auction-based frequency allocation practices of other European countries when allocating spectrum for 4G, and most recently 5G, networks. In the latest auction, the three large mobile network operators Elisa, Telia, and DNA each bought 800 megahertz of the 26 gigahertz band for EUR 7 million (that is EUR 21 million for 2400 megahertz in total) as an addition to the 390 megahertz that were sold in the 3.4–3.8 gigahertz band for a total of EUR 77.6 million in 2018. To compare, in 2020 Norway sold a total of 590 megahertz in the 2.6–3.6 gigahertz band for the total price of EUR 387 million, while Sweden sold of 400 megahertz in the same bands for EUR 224 million. In 2021, Denmark sold a larger amount of megahertz (3,490 in total, much of which is in the 25 gigahertz band) for the price of EUR 279 million. As such, the Finnish pricing on mobile frequencies continue to be lower than in the other Nordic countries, and Finland is also a global first mover when it comes to releasing spectrum for 5G.

To sum up, the political decisions regarding the roll-out of Internet connections have been highly influential for the development of broadband infrastructures and markets. The Nordic welfare states have put strategies in place for ensuring universal access and have provided funding to make up for market failure and cater to rural areas. In doing so, policymakers have also contributed to the shaping of the Internet service provider markets by creating incentives to invest in some technologies over others. The significance of fibre-optic connections in the Swedish context can be directly related to the public investments made in the early 2000s, while the dependence on mobile broadband in Finland is linked to the governments' approach to frequency allocation. In Denmark, the reluctance and lack of need to support broadband projects might explain the lower presence of fibre-optic broadband, while the low usage and high prices of mobile data in Norway relate to the business strategies of leading market actors, weaker competition, and spectrum policies.

The last mile & the last bastion

We started the chapter by asking how the "last mile" of the Internet materialises in the largest countries of the Nordic region and how historical as well as newer infrastructural arrangements, market structures, and broadband strategies have shaped the structural conditions for accessing the Internet. We have used a wide range of data sources, each shaping the conclusions we (can) make when answering this question. When measuring and comparing Internet penetration, we can look at the number of households reporting that they own a broadband connection or that they use the Internet on a regular basis. We can also look at the number of subscriptions reported by Internet service providers and the type of network access they depend on. These methodological choices are critical, as the first tends to lead us to identify similarities in the comprehensive Internet penetration and coverage across

the Nordics. The latter, in turn, sensitises us to underlying differences such as the variations in the types of access networks. Also, the availability of some data sources (e.g., on mobile data traffic) and the absence of others (e.g., on data traffic in fixed networks) creates biases and gaps in our analyses. While we can conclude that mobile data use varies significantly across the Nordic region, the limited insight into the potential variations in the usage of fixed broadband make it difficult to draw definite conclusions on the potential differences and similarities in terms of Internet traffic as a whole.

These methodological issues are, on the one hand, essential to take into consideration when interpreting the empirical analyses presented here. On the other hand, the discussions on data sources and methodological entry points constitute important, and often neglected, research contributions in their own right, encouraging us to think about how knowledge is created in the first place. Future investigations of access network infrastructures, markets, and policies might ask why some variables and indicators are pursued and highlighted while others are left out – and to what effect. The measures applied by the European Union, the OECD, or nation-states when establishing benchmarks and setting up goals for broadband penetration influence policy decisions and initiatives – in turn shaping market and scholarly research relying on the same data (Lokot & Wijermars, 2023). While the findings presented here provide important insights into the state and nature of Nordic access networks, they are also highly dependent on, and a result of, the political and economic context that we study.

Leaving the methodological considerations aside for now, we end the chapter by summing up three main conclusions: First, we identify both similarities between the countries and historical continuities that link back to the Nordic welfare state models of the twentieth century. Since the 1990s, it has been a key political concern to ensure universal access to the Internet, and the Nordic countries consistently rank in the top of global statistics measuring Internet penetration and broadband coverage. To reach this goal, public funding schemes have ensured high coverage and high-capacity broadband in remote and sparsely populated areas with limited commercial potential. Legacy telecommunication companies with strong ties to the welfare state have established themselves as dominating Internet service providers, utilising their existing market positions, economic muscle power, and technological expertise to roll out extensive broadband networks across the region. While global Big Tech corporations dominate vast parts of the remaining digital ecology (especially markets for app and website provision and data collection and processing, as outlined later in the book), the legacy providers thus continue to gatekeep "the last mile".

Second, despite the evident resemblance between the Nordic countries, the distinctive infrastructural arrangements, market differences, and variations in political broadband strategies contradict the persistent belief in Nordic coherence. Denmark stands out as the most "market-friendly" of the four

countries, with commercial Internet service providers dominating both mobile and fixed broadband and less public funding. As we discuss further in Chapter 4, Denmark's strategic position in the heart of Northern Europe has made international companies eager to invest in data centres and other types of backbone infrastructures, pushing for tech-friendly policies and limited state intervention. In contrast to the privatised Danish network infrastructure, the Swedish public sector has invested heavily in building and running fibre-optic networks across the country, with the municipalities serving as key infrastructure providers. Norwegian and Swedish incumbents are still largely state-owned, and especially Telenor in Norway has managed to sustain its profitable business model, despite recent market transformations. Finally, Finland stands out, mainly due to its mobile broadband infrastructures and policies, as a context that reveals a very different route to digitalisation.

Finally, while national legacy providers continue to stand strong in the market for broadband, their business models suffer the same fate as other legacy actors in the digital ecosystem. The material foundation for their historical positions has gradually eroded, and they are becoming increasingly marginalised by global competitors in the Big Tech industry. The former market leaders – accustomed to earning money from supplying a variety of services and owning entire value chains – increasingly need to accept a more humble position as last-mile providers. This weakens their investment power and could open the field up for other types of Internet service providers with the resources to build and improve the infrastructure.

On a global scale, we see signs that Big Tech corporations are moving into this part of the digital market. For example, in Myanmar, Telenor and Facebook collaborated to build and provide mobile Internet (Facebook's FreeBasics) to rural and poor areas, and the coffee chain Starbucks has abandoned their former collaboration with the American telco AT&T to offer in-store Wi-Fi to instead partner with Google, which promises up to ten times faster speeds. Promoting yet another – and possibly competing – type of access network technology, Elon Musk and Amazon are in the process of launching extensive fleets of low-Earth orbit satellites capable of supplying broadband in previously unconnected areas (Lohmeyer et al., 2023). In a Nordic context, Netflix is already collaborating with operators of fixed and mobile broadband networks to improve content distribution by installing content delivery systems in the local networks, and thereby store content at the edges rather than transporting it from centrally placed hosting facilities (Böttger et al., 2018; Helles & Flyverbom, 2019).

Wrapping up the first of the analytical chapters, we are now one step closer to answering the question of how Nordic digital communication systems are organised and controlled. By investigating the last mile of the Internet, we have learned that national infrastructures, legacy companies, and state authorities have played important roles in the societal digitalisation processes. We have

also come to know, however, that the rise of digital communication systems challenges the institutional order of the Nordic welfare states in important ways. Following these processes one step further, in the next chapter we investigate what happens when our communications leave the house modems or the local cell towers to travel around the globe and beneath ground and sea.

CHAPTER 4

The backbone of communication

The Internet has a complex technical architecture beneath the layer of applications and content and generally out of public view. This architecture includes a considerable ecosystem of Internet governance technologies, meaning the digital systems and processes inherently designed to keep the Internet operational.

DENARDIS, 2012: 721

In this chapter we turn to the Internet's backbone – one of the most obscure but essential layers of the Internet infrastructure. Often described in vague and obfuscating terms such as "the cloud", the extensive networks, exchange hubs, and data centres located beyond the last mile of access networks are what makes the Internet what it essentially is: a network of networks. Tracing the route taken by the hypothetical, and massively delayed, response to John F. Kennedy's love letter, the message would now move beyond the local broadband infrastructures of Sweden and orbit into the global web of submarine cables, Internet exchange points, and terrestrial wires. While access networks have been systematically registered since the first copper wire connections, backbone networks remain highly unmonitored, kept largely out of the public eye, and are instead subject to intense speculation. As recent whistle-blower revelations have shown, the cables that connect the Nordic countries to the US, Russia, and China are important means of intelligence activities and state espionage (Nilsen, 2022; Reuters, 2021). These cables, along with other key components of the Internet backbone, constitute sites of economic and geopolitical power struggles. They are fundamental infrastructural resources, essential market assets, and critical societal goods that, following the historical logics of the Nordic welfare states, are obvious contenders for public scrutiny and democratic deliberation.

Informing these debates and qualifying potential monitoring efforts, in this chapter we map and discuss three important components of the Nordic

backbone infrastructure: submarine cables, Internet exchange points, and autonomous systems. While these indicators surely do not comprise the entire backbone architecture (e.g., the lack of systematic information on data centres is an obvious challenge to this analysis), they cover a lot of ground: from local networks linking IP addresses and domains, over regional data exchanges between different network providers, to the global highways that transport data between the Nordics and the rest of the world. Adhering to the overall framework of the book and mirroring the structure of Chapter 3, we start out by mapping the infrastructural backbone conditions of Denmark, Finland, Norway, and Sweden and then move on to map the ownership structures of each of the infrastructural components, focusing on the degree of market disruption and globalisation. Finally, we assess the influence of the Nordic welfare states in terms of backbone ownership, and facilitation and intervention, and discuss the consequences of the current mode of (commercial) governance.

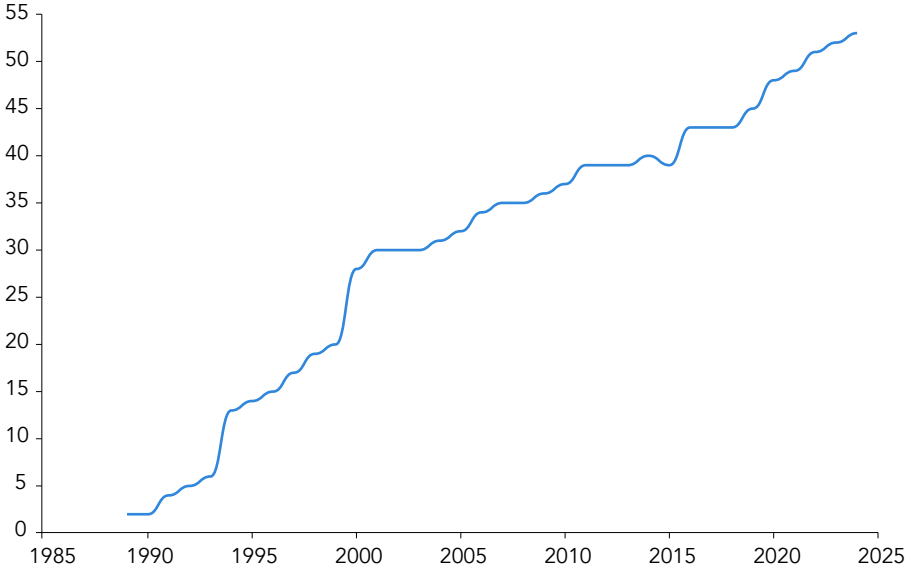
Mermaids & sea serpents

Like for the access networks layer, the geographic differences are important factors for understanding the development of backbone networks. Especially the locations of the countries, either in the centre or the periphery of Northern Europe, but also their varying terrains, sizes, and population densities, serve as backdrops for explaining each country's role in the global Internet infrastructure.

Gateways to the North

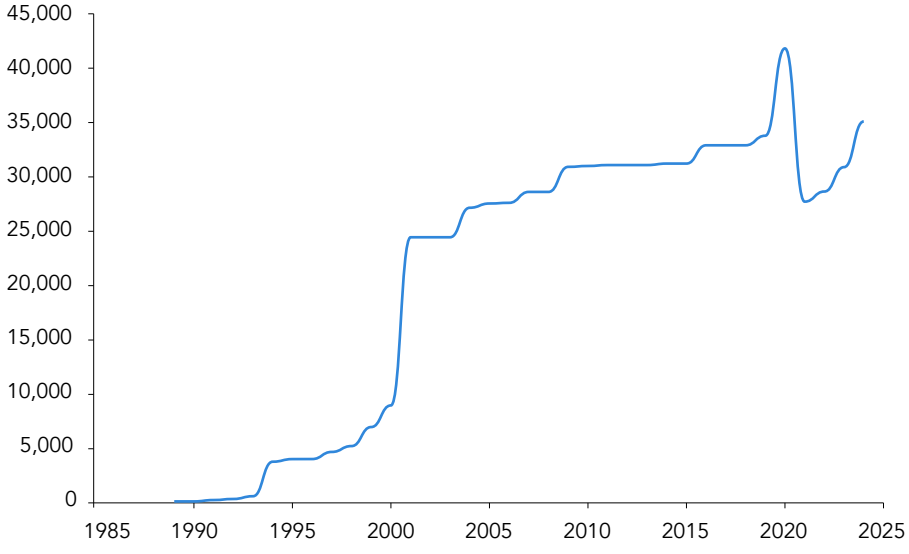
The laying of extensive submarine cable routes connecting the Nordic coastlines to the US constitutes a critical foundation for the initial spread of Internet connections, and thereby for the later digitalisation of the Nordic societies. A submarine cable is typically no more than 25 millimetres in diameter, yet the optical fibre strings at its core can transmit up to 250 terabytes of data per second. As such, the web of submarine cables branching out across the seabed serve as super-highways for global communication. As illustrated in Figure 4.1a, 55 cables have been (or are in the process of being) established in the four countries since 1989. Figure 4.1b presents the accumulated length of the cables.

FIGURE 4.1A Number of active submarine cables established or planned in Denmark, Finland, Norway, & Sweden, 1989–2024



SOURCE: TeleGeography

FIGURE 4.1B Length of active submarine cables established or planned in Denmark, Finland, Norway, & Sweden, 1989–2024

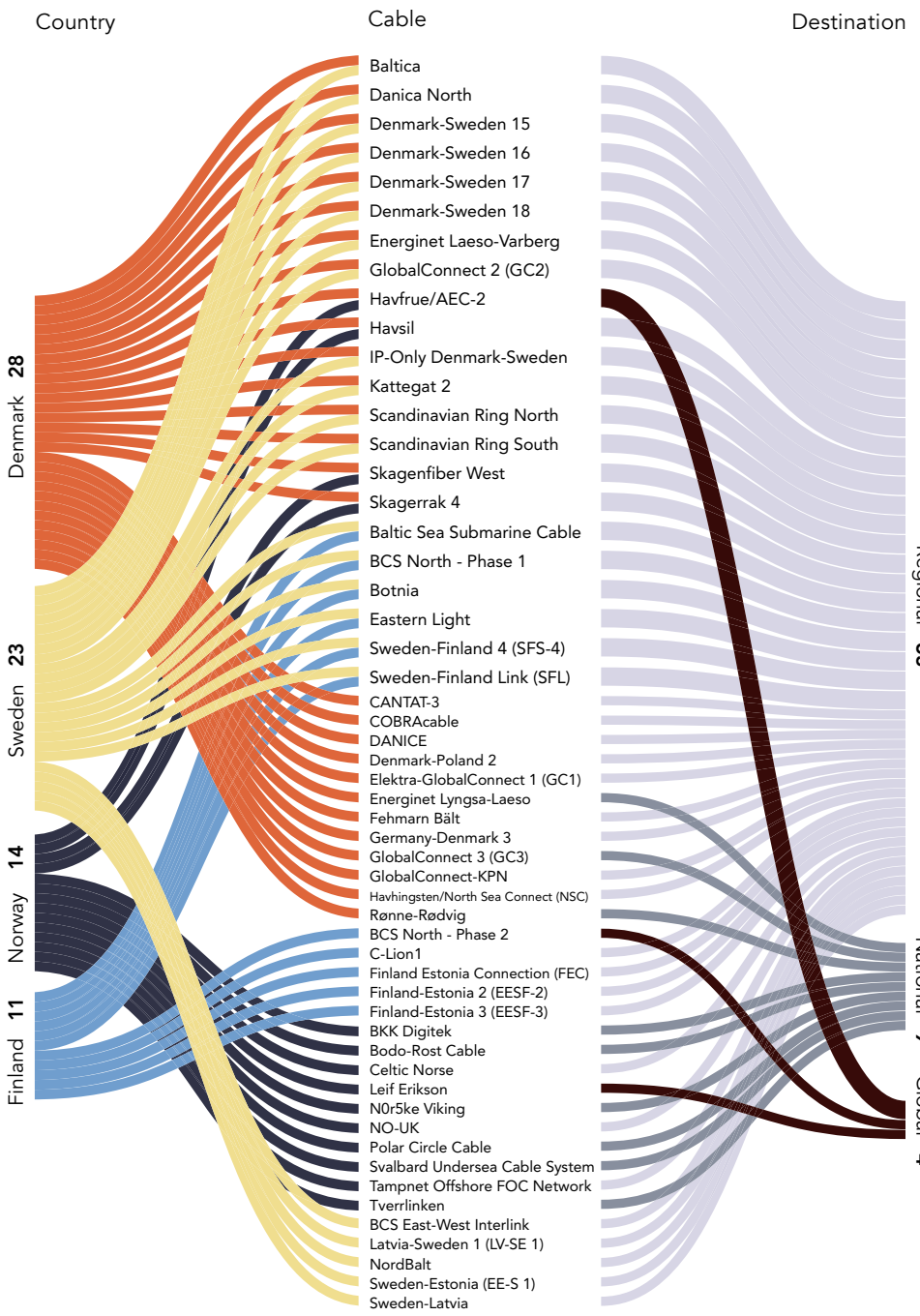


SOURCE: TeleGeography

As illustrated in Figures 4.1a and 4.1b, Nordic submarine cable history can be roughly divided into three periods: an early growth phase from the late 1980s to the early 2000s; a stagnation phase lasting from the dot-com bubble burst in the early 2000s and until around 2018; and the ongoing growth phase taking off from 2019, when new and extensive cables are being planned and laid and older ones are being taken out of operation (Flensburg & Lai, 2020b; Routley, 2019). In the first growth phase, a wide range of cable routes were established connecting the Nordic region to the increasingly global Internet. In the second phase of stagnation, the investments were placed elsewhere, such as the roll-out of various access networks as described in the previous chapter, while only a few, and relatively short, submarine cable routes were being put into place. The recent growth in both the number and the length of cables going in and out of the Nordics is, in part, a result of the massive digitisation that has created a need for strengthened network connections to transport high-capacity streaming content to the end-user or ever-growing amounts of metadata in the opposite direction. The current investments also, however, testify to expectations regarding future high-capacity ventures such as the Internet of Things, blockchain technology, virtual reality, artificial intelligence, and so forth. And lastly, since these cables have an estimated lifespan of approximately 20–25 years, several recent investments also come in anticipation of the older cables approaching their expiration date – if not because they are worn out, then because they can no longer handle the amounts of traffic required of them (Chesnoy, 2016).

The submarine cables coming in and out of Denmark, Finland, Norway, and Sweden are of varying length and terminate at different destinations – the shortest being only five kilometres long, connecting Denmark and Sweden across Oresund, and the lengthiest being the 7,650 kilometres long, connecting the west coast of Denmark and the southern tip of Norway with New Jersey in the US. A wide range of cables create connections across the Baltic Sea, while others make the journey through the North Sea, and sometimes move on to cross the Atlantic Ocean. Several differences between the four countries emerge, as illustrated in Figure 4.2, which compares the total number of cables landing in each country and divides them into national, regional (European), and global connections depending on the countries linked by the cable in question.

FIGURE 4.2 Number of submarine cables landing in Denmark, Finland, Norway, & Sweden by geographic destination, 2022



SOURCE: TeleGeography

The highest number of submarine cables land in Denmark. In addition to the global Havfrue [Mermaid] cable that in 2020 replaced the former cross-Atlantic TAT-14, Denmark is regionally connected to other European Union countries through 24 connections and has three national cables connecting the Danish islands. The lowest number of submarine cables reaches Finland, which has ten regional connections (mainly through the Baltic Sea) and one global (connecting to Russia through the Gulf of Finland). Like Denmark, Norway has a strategic position, on the coast of the North Sea, making it an obvious stop en route to North America, ranking Norway at the top both when it comes to the number of global cable connections (the Mermaid cable and the planned Leif Eriksson connection to Canada planned for 2024). Norway also has a comparatively high number of national cables (six in total, all on the west coast), but only six regional cables. Three of these connect to Denmark while the remaining three connect to the UK, making Norway reliant on Denmark as a digital passage to continental Europe. Finally, Sweden stands out with 23 cables that are all connected regionally – either across the Baltic Sea, the Gulf of Bothnia, or the Kattegat Strait – and a complete lack of global and national cables.

Critical junctures

Once the submarine cables land on Nordic shores, they connect to terrestrial networks that exchange data at local hubs, the so-called Internet exchange points (IXPs). IXPs serve as junctures where Internet traffic is exchanged between the thousands of networks that make up the global Internet system (Winseck, 2017). That is, when an end-user sends a message (broken down to data packages) to a recipient who connects through another access network, an Internet service provider must pass the data on to the recipient's network operator. IXPs make this process safer, faster, and more cost-efficient by allowing network operators to peer with each other, or exchange data, at central locations. IXPs also constitute gateways for Big Tech corporations such as Facebook, Google, and Netflix to connect with local and regional Internet service providers such as Telenor and Telia, and thereby travel that last mile to their customers. The large data exchanges are therefore another key component of the Internet backbone, although they seldom surface in public debate and scientific enquiry.

The general lack of official sources and databases complicates the mapping of the IXP developments and national differences. According to the European Internet Exchange Association's report (2020), the number of (known) IXPs in the European Union has increased by 87.5 per cent over the past ten years, with the DE-CIX in Frankfurt being the largest exchange hub in Europe, both in terms of connecting networks (autonomous systems) and traffic rates. Among the Nordic IXPs, only Sweden reaches the European Internet Exchange Association's top-10, coming in seventh in terms of traffic, while no

Nordic IXPs reach the top-10 in terms of the number of connecting networks. There are (at least) 83 IXPs in the four countries: Most are found in Sweden (40), followed by Finland (18), Norway (12), then Denmark (13). Many are placed in or near major cities and are often part of a larger group of exchange points owned and managed by the same authority or corporation. The earliest IXPs were established in Espoo, Finland and Oslo, Norway in 1993, while Denmark and Sweden followed in 1994 and 1996.

Autonomous systems

The final step in our mapping of the Nordic backbone infrastructures is the thousands of networks that meet in the IXPs to exchange data. To be able to route data back and forth, network operators must acquire an autonomous system number (ASN) from a regional registry (in the case of European network operators, the Regional Internet Registry for Europe, the Middle East, and parts of Central Asia, or RIPE NCC). ASNs can be compared to postal codes: As unique identifiers, they enable network operators to locate each other and send and receive data that is then directed to the individual end user's (IP) address. Most ASNs are controlled by Internet service providers, various types of IT companies (e.g., data centres and cloud services, IT consultancy companies, hardware or software manufactures, etc.), or large companies or institutions with a need for in-house network services (hospitals, big commercial corporations, banks, etc.). Each ASN operator is responsible for a bulk of IP addresses (between 32 and 6.9 million in our dataset) with the Internet service providers having the highest number of associated IP addresses.

Thanks to the ASN registries, we have more precise and comprehensive data on this part of the backbone infrastructure compared with the submarine cables and IXPs. Throughout the four countries, there are, at the time of writing, a total of 2,021 ASNs, among which the earliest were registered in 1990, though the majority were registered from 2010 onwards. The four countries are strikingly similar, both in terms of the amount of ASNs per capita and the timeline of ASN assignment. However, since many of the most-used online services either reside outside the Nordic region or store their data with international cloud services, the national ASN lists do not provide a comprehensive overview of the network services that support digital communication in Denmark, Finland, Norway, and Sweden. To make up for this, we also look at the hosting services used by the top-50 most-used websites in each country (analysed further in Chapter 5) by using a who.is database. As with the other commercial databases, we do not have full insight into *how* the data are collected and processed, but for the purpose of enriching and nuancing the national ASN lists, we consider it as a reasonably reliable source of information. The vast majority of websites are hosted on international servers and are thus associated with international ASNs – most frequently residing in the US. This is partly explained by the relatively high shares of international websites

used in the Nordic region (Facebook, Google Search, etc.; see Chapter 5), but a wide range of nationally owned websites are also hosted internationally due to the extensive use of global cloud services, which we discuss further on.

Across the three types of backbone infrastructure – submarine cables, IXPs, and ASNs – the data presented here tell the story of Nordic digitisation: The early laying of cables, establishment of IXPs, and registering of ASNs all served as critical foundations for the introduction and growing use of digital services by making it possible to route data between different networks. The later and more extensive waves of backbone build-out are a result of the successful digitalisation of Nordic societies that created an increased (and increasing) need for high-capacity connections and networks to transport ever-growing amounts of data traffic. The recent investments in backbone projects follow this historical trajectory by establishing a foundation for future business ventures that will take digitisation to the next level. In other words, by owning and building key components of the backbone infrastructure, powerful market actors are shaping future digital societies.

Expanding territories

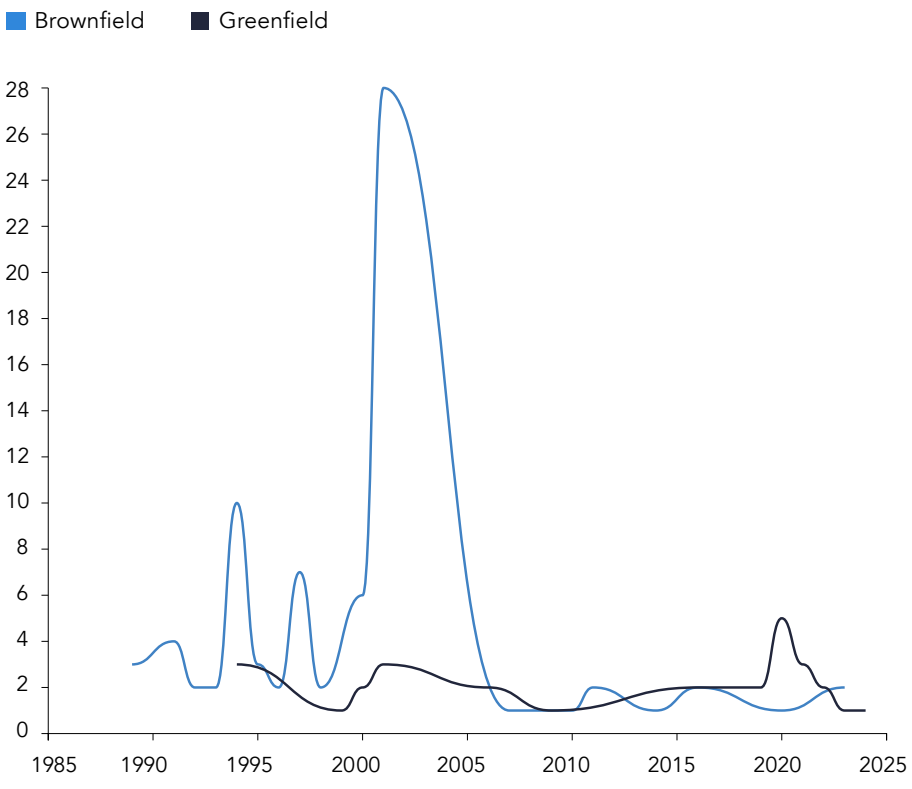
A range of market actors – from legacy telcos and public institutions to private enterprises – control the three types of backbone infrastructure just outlined. While the first backbone build-outs were largely initiated and funded by national institutions, rooted in the historical welfare systems, the more recent waves involve global market actors that built a business entirely on providing digital services.

The old incumbents & the digital newcomers

The cross-Atlantic submarine cable connections are particularly illustrative of how the infrastructural power structures have evolved since the early days of the Internet. In 2020, the TAT-14 cable, established in 2001 by a consortium of legacy telecommunication operators including the Nordic incumbents, Telia, Telenor, TDC, and Elisa, was replaced by the Mermaid cable, owned by Google and Facebook's mother companies, Alphabet and Meta, the Norwegian industry investor, Bulk Infrastructure, and the Irish subsea fibre operator, Aqua Comms. That is, while the legacy telecommunication industry until recently controlled the transporting of data between Northern Europe and the US, they now depend on external providers that also supply some of the most popular over-the-top services, and thereby threaten the very business models of the same telcos (see Chapter 3). In turn, while platform companies such as Facebook and Google originally depended on the legacy telecommunication operators that built and ran the underlying networks, they are increasingly taking over the entire value chain by moving into a wide range of backbone activities (Plantin et al., 2018; Plantin & Punathambekar, 2019).

While the Mermaid cable is a unique example of the shift from telco to platform power (at least in the Nordic region), the general development in the ownership of submarine cables also indicates that legacy actors are becoming less active in cable projects, while digital newcomers are gaining more ground. Figure 4.3 gauges the distribution of legacy (brownfield) and digital (greenfield) companies involved in Nordic submarine cable projects since 1989. It shows that in the first phase (approx. 1989–2000), brownfield companies (mainly national telcos) initiated and financed the cable projects, while the later growth phase (approx. 2018 and onwards) represents a rise in the numbers of greenfield actors (both national and Nordic actors such as NOR5KE Fibre, GlobalConnect, and Bulk Infrastructure as well as global companies such as Aqua Comms, Meta, and Alphabet). The drastic drop in the number of brownfield actors in 2021 is caused by the termination of the TAT-14 cable, involving a total of 31 (telco) actors.

FIGURE 4.3 Type of companies involved in submarine cable laying in Denmark, Finland, Norway, & Sweden, 1989–2024 (*N*)

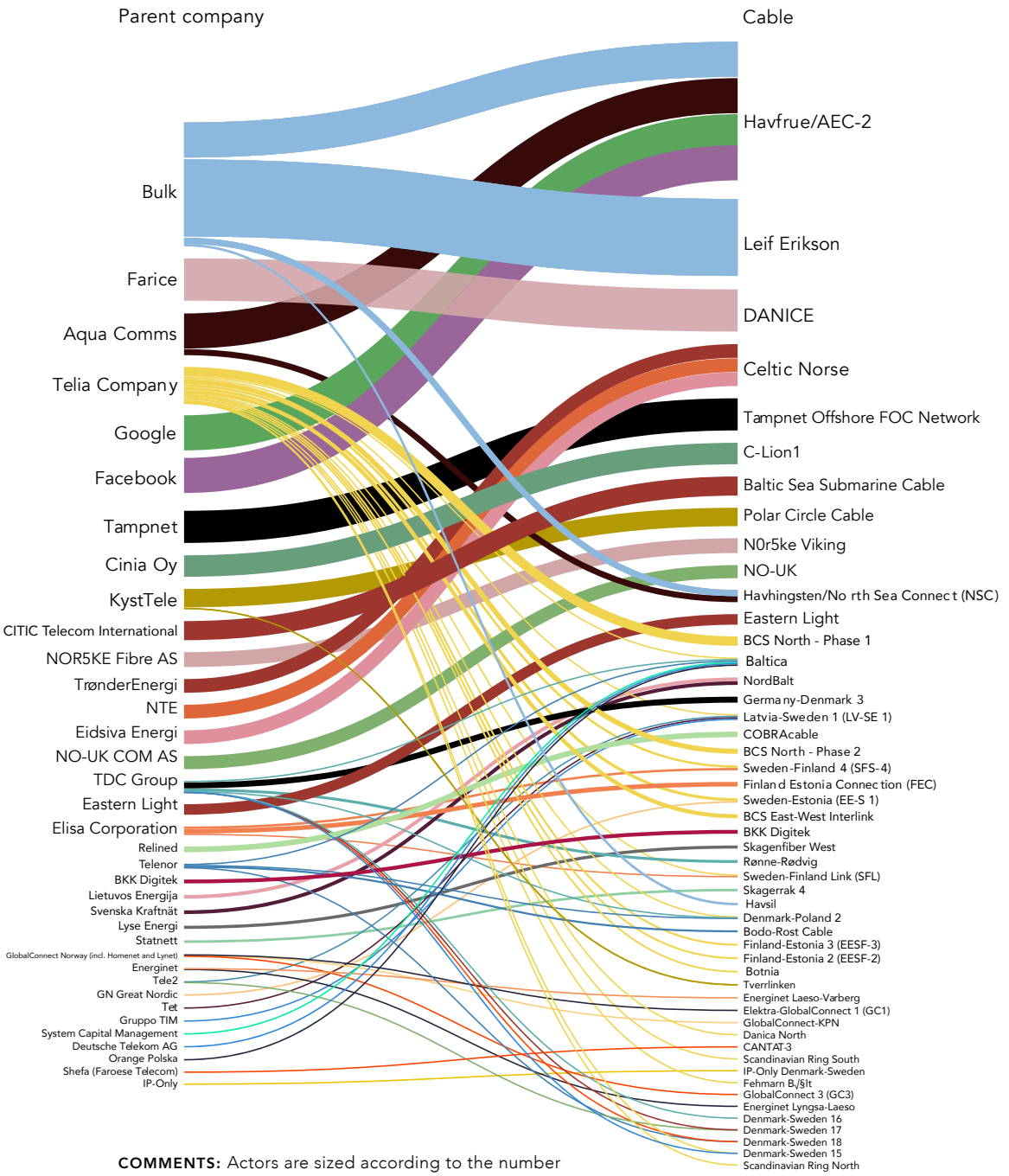


COMMENTS: Market actors coded according to owners' original business model in either the digital realm (greenfield) or as part of a legacy, pre-digital sector (brownfield).
SOURCE: TeleGeography

The calculations illustrated in Figure 4.3 do not take into account the shares of each company nor the length and significance of the cables they have invested in. As such, the graph only provides an indication of whether the market actors that make up the Nordic submarine cable sector are incumbent brownfield actors or greenfield newcomers, and it is not an accurate account of market power or competition structures. Continuing with the example of the Mermaid cable, Meta and Aqua Comms both own double the shares of Alphabet and Bulk Infrastructure, making the global ownership share larger, even if Figure 4.3 does not account for this. Nonetheless, the graph provides insight into the historical development and sensitises us to the economic implications of the geopolitical and infrastructural conditions discussed earlier in this chapter. The number of different companies also tells a story about market concentration – from submarine cables being laid by large multinational consortiums to cables being financed by a single or a few companies.

Across Denmark, Finland, Norway, and Sweden, legacy telecommunication operators (most prominently Telia, TDC, Elisa, and Telenor) continue to control a large number of cables in collaboration with other, predominantly European, telcos and fibre and utility companies. If we look solely at the sum of cables in the Nordic context, ownership is to a large extent divided between national and regional brownfield companies. However, digging deeper into the Nordic submarine cable market structures, Figure 4.4 sizes the different companies involved in the submarine cables currently in use according to the extent of those cables. To the right-side of the figure, it lists the different cables according to length, and to the left-side, it shows the cable owners and their relationship to one or more cables in the Nordic context. Of the four incumbent telecommunications operators, Telia stands out by being fourth on the list of owners and operating of a multitude of different (albeit smaller) cables, while the remaining incumbents are found further down. Just above and below Telia are companies like the Norwegian infrastructure provider Bulk, the Icelandic telco Farice, as well as Alphabet and Meta, all of which come out in the top due to their ownership of extensive trans-Atlantic cables.

FIGURE 4.4 Market ownership of Nordic submarine cables, 2022

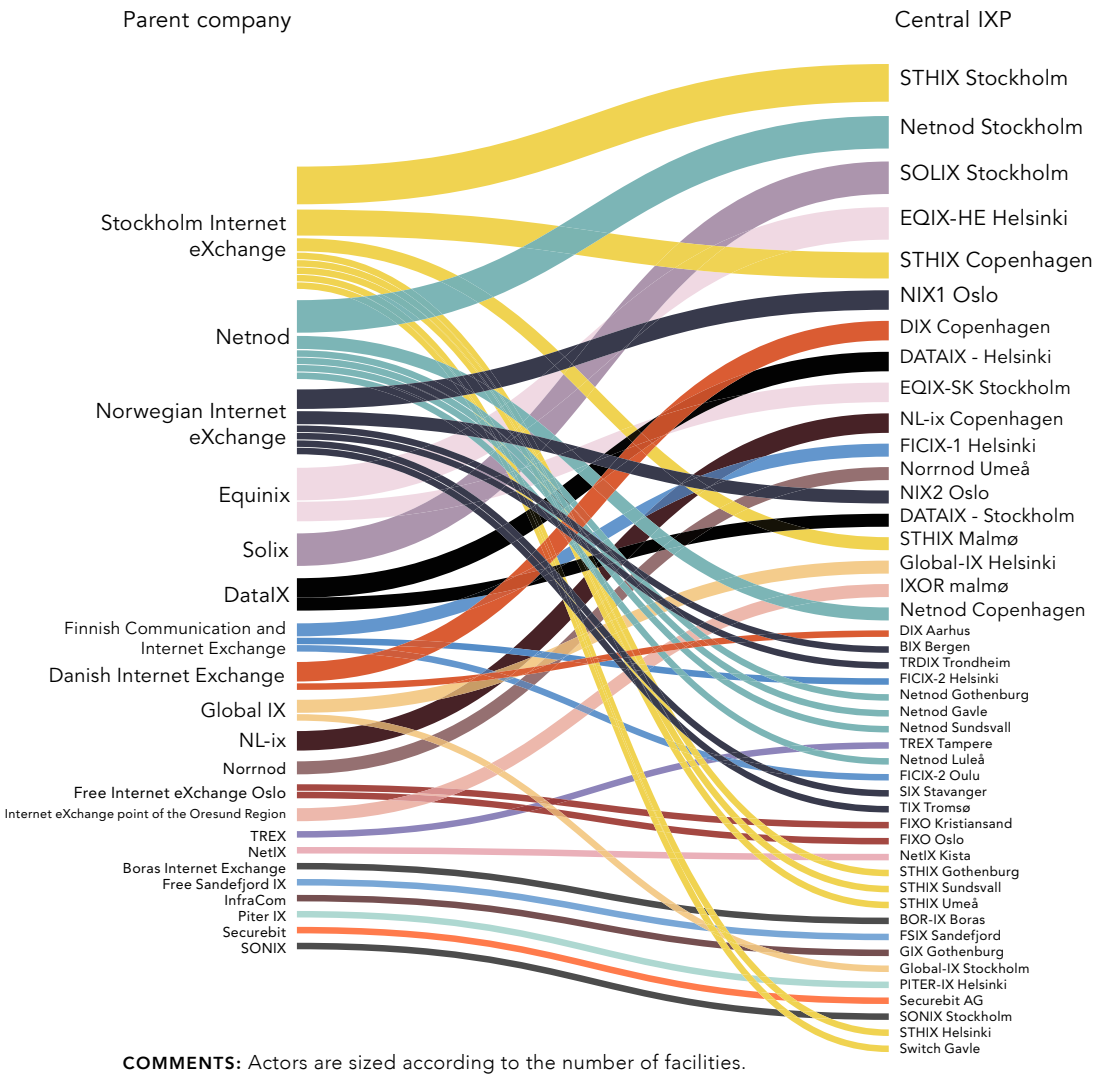


COMMENTS: Actors are sized according to the number of cables they are sole owners of or own parts of as well as the length of those cables.
SOURCE: TeleGeography

Digital matchmakers

Similar to the market for submarine cables, the markets for IXPs in the largest Nordic countries are a mixture of national stakeholders and international market actors operating from Russia and the US. Illustrating the ownership of the 83 IXPs found in Denmark, Finland, Norway, and Sweden, Figure 4.5 comprises the largest market actors according to the number of facilities they own. The most prevalent companies are Stockholm Internet eXchange and Netnod, each owning sixteen and eleven exchange points, respectively, across the region.

FIGURE 4.5 Market ownership of Nordic IXPs, 2021



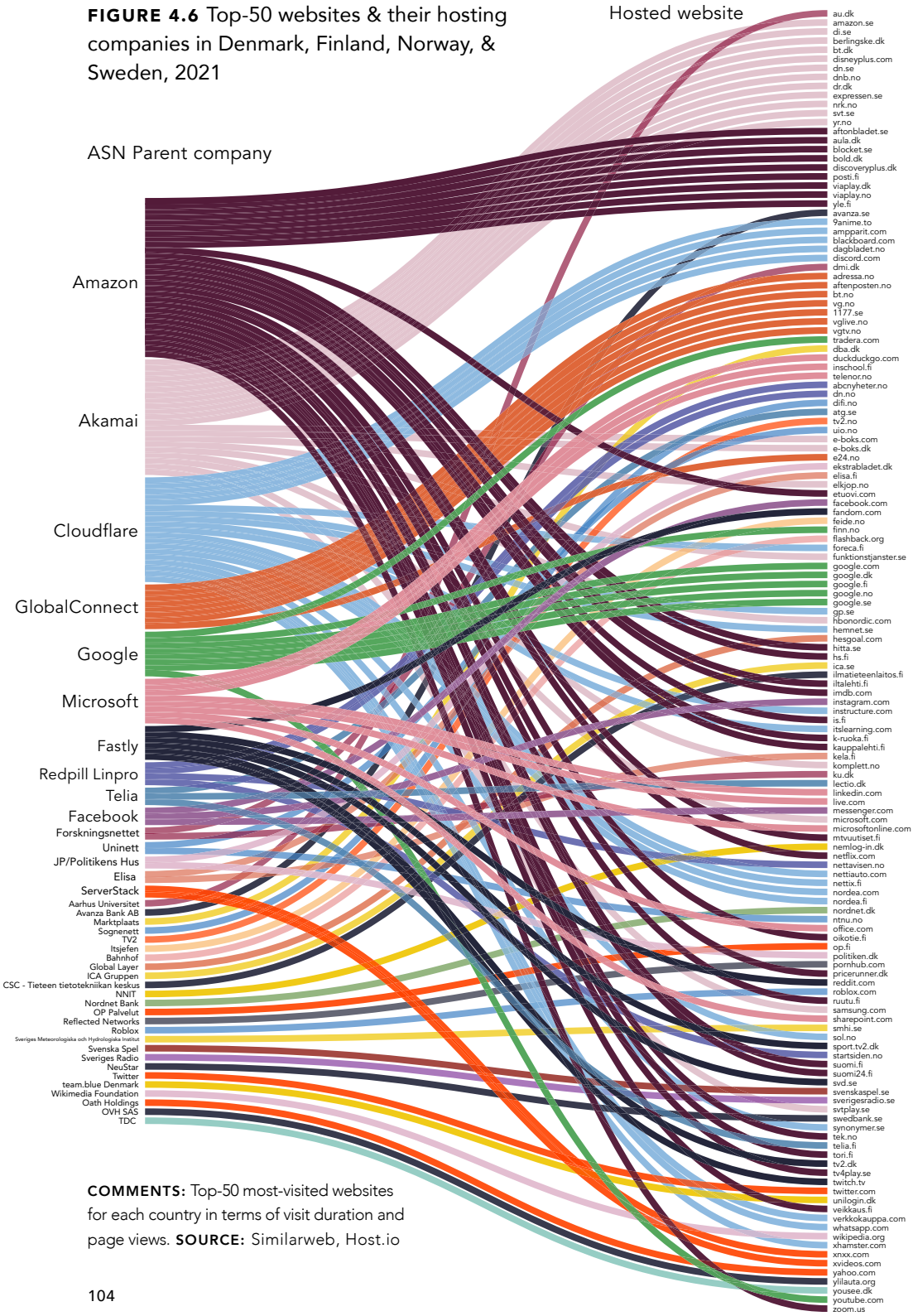
COMMENTS: Actors are sized according to the number of facilities.
SOURCE: TeleGeography

Like the early cable projects, the first IXPs were established by public organisations with close ties to the Nordic welfare states. The Norwegian Internet Exchange, the Danish Internet Exchange Point, and the Swedish Norrnod (established in 1993, 1994, and 1996, respectively) were all hosted by universities as part of larger national efforts to develop data and computing technologies. The Finnish Communication and Internet Exchange was founded by Helsinki's telephone company and the Post and Telecommunications authority in 1993, and to date, it is run as a non-profit organisation. In contrast, the later IXP projects are remarkably more commercial and global: The US-based data centre company Equinix has, from 2018 and onwards, built several exchange points in Finland and Sweden, while the Dutch company NL-ix has established exchange points across Denmark, and the Russian Global IX and Piter dominate the Finnish IXP market.

Highway patrols

In contrast to the multiple differences between the four countries when it comes to submarine cables and IXPs, the ownership structures of terrestrial inland networks are strikingly similar – both in terms of the number of ASNs and their historical development and when measuring the degrees of market disruption and globalisation. National market actors dominate across all four countries, with national ownership of between 85 and 90 per cent of the ASNs, with a slight dominance of greenfield companies (60–64%). The prevalence of greenfield companies can be traced back to the type of business behind the majority of the obtained ASNs that are largely controlled by cloud service providers, data centre owners, software developers, IT consultancy firms, IXP owners, and so forth. Among the brownfield actors, telcos, large private businesses (like Maersk and Coop), and public institutions and authorities (e.g., universities, agencies and ministries, municipalities, hospitals, utility companies, etc.) make up the largest groups. The significant shares of nationally owned companies in the national ASN markets are contrasted by the predominantly global ownership of the ASNs that host the top-50 websites in each country, as illustrated in Figure 4.6, which lists the hosted websites to the right and the hosting companies to the left.

FIGURE 4.6 Top-50 websites & their hosting companies in Denmark, Finland, Norway, & Sweden, 2021



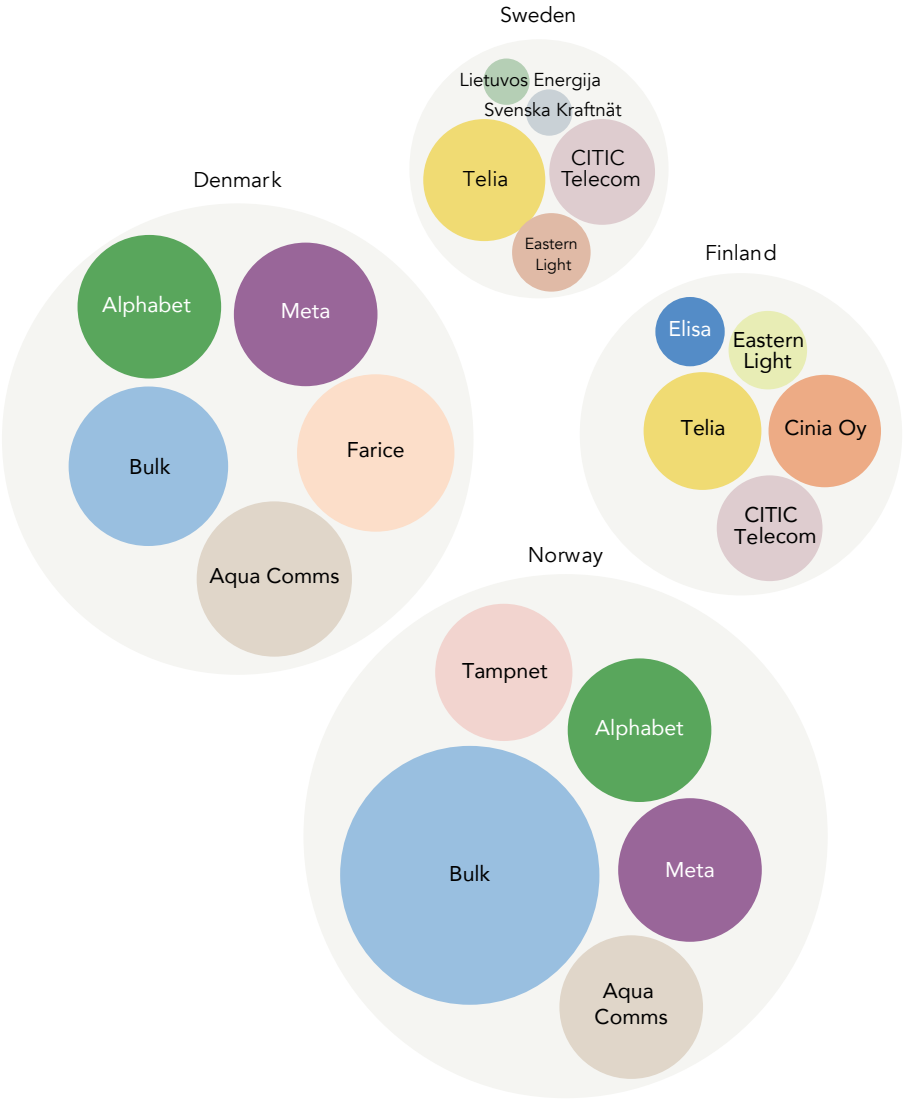
COMMENTS: Top-50 most-visited websites for each country in terms of visit duration and page views. **SOURCE:** Similarweb, Host.io

Unsurprisingly, Amazon comes out as the number-one hosting company, supplying the tremendously popular Amazon Web Services used by a multitude of public and private actors throughout the Nordics. Amazon hosts 34 of the 200 websites, including the Nordic streaming platform Viaplay, the Swedish news site *Aftonbladet*, the Danish public platform for daycare institutions and schools Aula, and the Finnish postal service company Posti. Next after Amazon comes the American-owned hosting and distribution company Akamai, which serves 24 of the top websites, including the Danish, Swedish, and Norwegian public broadcasters, DR, SVT, and NRK (Finnish Yle is served by Amazon), as well as the Swedish newspapers *Dagens Industri*, *Dagens Nyheter*, and *Expressen*, and the Norwegian weather service yr.no. Other central actors include Cloudflare, Google, and Microsoft, where the latter two are also prominent providers of software and other services. Of the 200 websites, 146 are hosted by US-based companies, while only 44 are based in the one of the four Nordic countries, among which the largest is with the infrastructure company GlobalConnect.

Comparing backbone ecologies

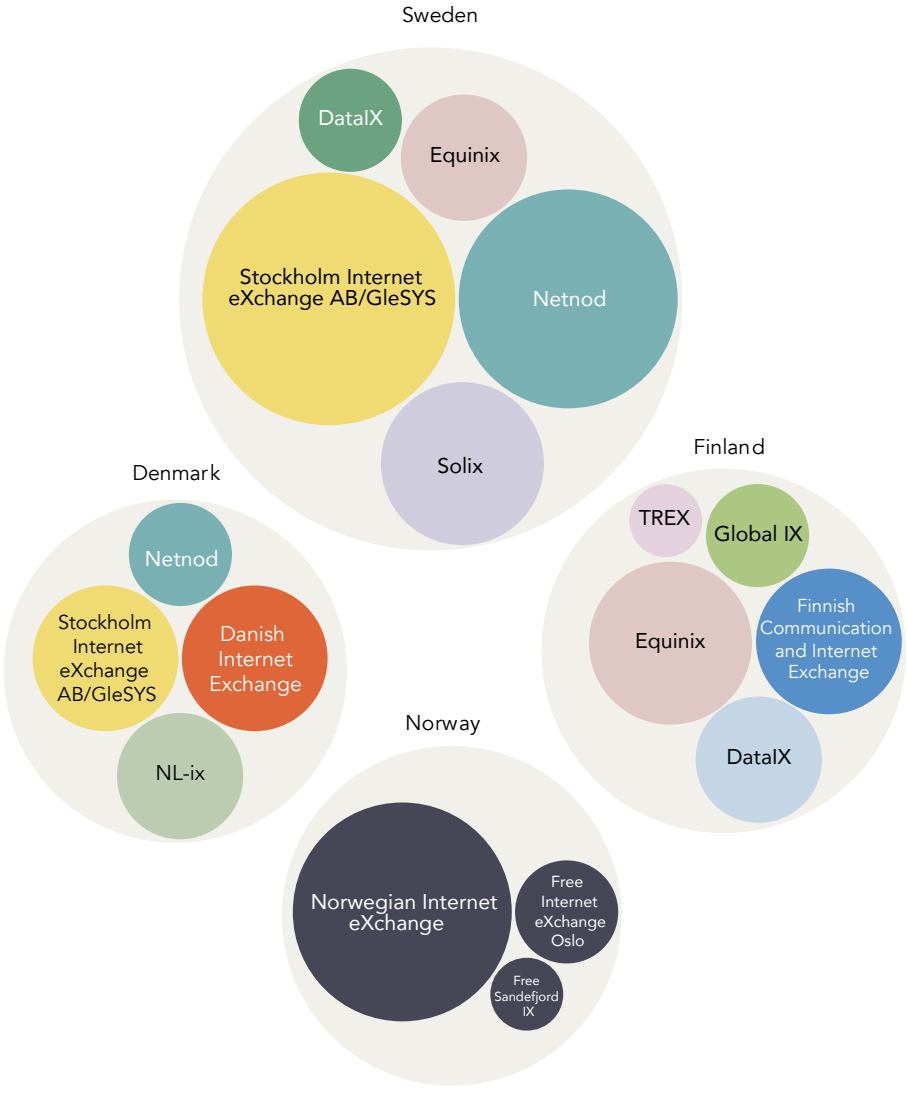
Taken together, the ownership of the three types of backbone network infrastructures – submarine cables, IXPs, and ASNs – speaks to geopolitical factors and processes of globalisation that have played out differently across the four countries. To dive into these variations, Figures 4.7a and 4.7b compare the largest owners of submarine cables and IXPs in each country, sized according to the number and length of the cables they operate and the number of IXP facilities they manage.

FIGURE 4.7a Largest market actors involved in Nordic submarine cables in Denmark, Finland, Norway, & Sweden, 2022



COMMENTS: Actors are measured according to the number of cables they are sole owners of or own parts of, as well as the length of those cables.
SOURCE: TeleGeography

FIGURE 4.7b Largest market actors involved in Nordic IXPs Denmark, Finland, Norway, & Sweden, 2022



COMMENTS: Actors are measured according to the number of IXP facilities the manage.
SOURCE: TeleGeography

In Figure 4.7a, we see that while some companies (e.g., Telia and Bulk) operate cables across the Nordic region, there are important variations at the national levels. As a result of their western coastlines, Denmark and Norway both connect to the US through extensive cable routes, which is contrasted by the shorter and more regional routes of Sweden and Finland. Both Sweden and Finland have a higher proportion of national legacy actors (e.g., Telia and Elisa), reflecting the historical evolution in submarine cables outlined ealier: In the growth phase, when legacy telcos dominated, Sweden had the highest number of cables, while the more recent build-out of the Danish and Norwegian submarine cables has been led by mainly greenfield actors such as GlobalConnect, Bulk Infrastructure, and later Aqua Comms, Alphabet, and Meta. Despite the apparent similarities between the Danish and Norwegian submarine cable markets (related to the two countries sharing a significant amount of cable connections, including the cross-Atlantic Mermaid cable), Norway stands out due to the position of national market actors, most prominently Bulk Infrastructure. The company is, as of this writing, establishing yet another trans-Atlantic cable connection – the Leif Eriksson cable planned for 2024 – which it is the sole owner of. In contrast, all companies in the Danish top-5 are internationally owned, and Denmark generally has the highest share of regional or global companies, reflecting the variety of commercial interests in the Danish context.

Turning to the ownership of IXPs, Figure 4.7b illustrates that the Norwegian IXP market also contrasts with the Danish one by being entirely in the hands of national market actors, while the Danish context is again highly internationalised, with only one national market actor out of four. Also, Finland hosts several international actors, including five American-owned ones (e.g., Equinix) and six Russian-owned ones (e.g., DataIX) that coexist with a total of five nationally-owned IXPs. Similarly, Sweden has an even distribution of American and Russian IXPs (3 each) yet also has 33 nationally owned facilities, making it more similar to Norway than any of the other countries.

Comparing the ownership of national ASNs and the ASN hosting companies for the top-50 websites in each context, Figures 4.8a and 4.8b show two vastly dissimilar ecosystems. Figure 4.8a shows the largest owners of national ASNs include, without exceptions, the nation-states and municipalities within each country, followed by a number of impactful national or Nordic companies like large telcos (e.g., Telia in Sweden, Norway, and Finland), large infrastructure operators (e.g., GlobalConnect in Norway), and large IT companies (e.g., Nokia in Finland). Sweden stands out at first glance by displaying an ecosystem that is larger compared with the remaining countries, yet this is merely a result of the country having a population that is approximately double the size, with an equivalent proportion of ASNs. Rather, the figure confirms the already-mentioned consistency across the four contexts when it comes to the distribution and ownership of local, inland networks: They are predominantly run by IT companies as well as public authorities. And the top-5 is, importantly, deprived of any international and global actors.

FIGURE 4.8a Largest ASN owners in Denmark, Finland, Norway, & Sweden, 2021

COMMENTS: The figure is based on a coding of all the autonomous system numbers in Denmark, Finland, Norway, and Sweden (*N* = 2,021).
SOURCE: RIPE NCC

FIGURE 4.8b Largest ASN hosting companies in Denmark, Finland, Norway, & Sweden, 2021

COMMENTS: Measured on the basis of the top-50 websites in each country.
SOURCE: SimilarWeb, Host.io

The ASN hosting ecosystem looks entirely different: It shows that apart from GlobalConnect making it into the top-5 over hosting companies in Sweden, all actors are global corporations that have extended their original online business (of selling books online like Amazon or ordering the World Wide Web in a search engine like Alphabet) to also offer hosting services for websites (and other applications). Although the same companies – Amazon, Alphabet, Akamai, Microsoft, and Cloudflare – reoccur across the countries, there are also slight differences: With seventeen of the top-50 websites hosted by national companies, Norway has the least globalised ASN infrastructure, while only five of the Finnish sites are hosted nationally and forty are in the US. Especially Norwegian newspapers such as *Aftenposten.no*, *abcnyheter.no*, and *Dagens Næringsliv* are all hosted nationally, by GlobalConnect (owned by the Swedish private equity fund, EQ) and the Scandinavian cloud company Redpill Linpro. In contrast, the Finnish market is more concentrated around global actors, with Amazon hosting sixteen of the top-50 websites, as opposed to between four and seven sites in Denmark, Norway, and Sweden. The comparison between the two ecosystems shows that one is dominated by national and local actors and the other by global Big Tech corporations. Whereas the local networks have been (and continue to be) a highly national infrastructure, the critical issue of how and where to host the ever-increasing amounts of online data generated by existing and new applications is solved by other infrastructure providers with a different kind of server capacity.

In general, the Nordic backbone market illustrates the commercial tensions and shifting power balance in the digital environment: As mediated communication has been increasingly globalised, the market structures characterising the classic Nordic welfare systems of the twentieth century have come under pressure. National legacy actors increasingly *compete* with but also *depend* on global Big Tech corporations, whose economic scope is entirely different. To add to the identified market tendencies, recent investments in data centres in the Nordic region testify to the interest and influence of these US-based companies (Christensen et al., 2018: 7). This asymmetrical power balance, and its many consequences (e.g., missing tax payments, opaque governance forms, and weakened dialogue between state and market stakeholders), has recently evoked political debates and calls for intervention and regulation. In the next section, we look into the roles and strategies of the Nordic welfare states in terms of influencing the backbone development and economy.

The black-boxed backbone

The backbone networks constitute the least-regulated infrastructural layer of digital communication systems, and formalised state power within this particular sphere is limited. Since "no regulator prescribes the terms of […] peering and transit agreements, or require[s] any Internet-based network

to interconnect with any other" (Nuechterlein & Weiser, 2013: 6), these arrangements are deeply black-boxed and largely unmonitored. Government policies and legislation are generally inconclusive in terms of describing the conditions and requirements that submarine cable projects, IXP providers, and ASN operators and hosting facilities are subject to. Questions about the degree of direct state involvement in backbone developments and market structures are therefore, in one sense, relatively straightforward to answer: It is more or less absent. Yet in another sense, the governance of this vital infrastructural layer and the political and legislative conditions surrounding it constitute some of the most important and pertinent issues faced by Internet researchers and regulators (ten Oever, 2019).

Recent debates on intelligence activities and wiretapping call for thorough and in-depth investigations of backbone governance that dig deeper than what can be comprised within the scope of large-scale, macro analyses such as ours. We acknowledge that backbone regulation cannot be reduced to questions of nation-state legislation and national government policy. International bodies as well as global Big Tech corporations also govern the Internet's backbone, in both formalised and less formalised manners: The Internet Corporation for Assigned Names and Numbers has established policies for coordinating the Internet's naming system, and the regional Internet registries maintain official registries for monitoring the development of autonomous systems. Backbone operators develop elaborate terms of service agreements and codes of conduct, yet their governing power also surfaces under more or less unusual circumstances: Think of the capitol riots of 2021, where Amazon, and not the state apparatus, had the capability of shutting down critical servers hosting communication and coordination efforts on the part of the insurgents.

While official accounts about these processes are rare, and decision-making is difficult to trace, a first step is to map out the various types of formal state involvement that directly or indirectly shape the national Internet backbones. Following the indicators of the Digital Communication System Matrix, in the next sections we therefore chart public ownership of backbone network infrastructures, state strategies, and funding schemes. These indicators do not provide insight into the day-to-day governance by global institutions, nor the potential conflicts between state policies and commercial interests, yet they do provide a basis for assessing the role of the state and how it might affect or be affected by infrastructural and economic conditions.

Public goods & private money

Mirroring the legacy ownership of central parts of the Internet backbone in the early phases of digitalisation, public institutions were important gatekeepers of digital communication in the 1990s. Across all three types of backbone network infrastructures – submarine cables, IXPs, and ASNs – public institutions outweigh the private actors until the 2000s. Over the last two decades,

however, the entry of new private actors has challenged the former positions of state-owned institutions, rendering the state less involved in the technical and economic aspects of digital communication.

The development in public ownership of submarine cables reflects the three build-out periods discussed earlier: In the first period (approx. 1989–2001), state-owned institutions dominated the submarine sector in continuation of their historical activities and business models. In the second period (approx. 2002–2018), public actors sustained their position due to comprehensive cable investments made by public fibre and energy companies, such as Energinet, Statnett, and Svenska Kraftnät. In the third period (from 2019 onwards), we see a growth in the share of private actors and the entry of a number of global platform corporations.

Moving on to the IXPs, the vast majority (68 of 83) are at the time of writing owned by private companies (some of them are non-profit), and only 15 are owned directly or indirectly by the state (mainly universities). It is difficult to outline the exact history of the Nordic IXPs, since many do not disclose information on their year of establishment, yet the development in ownership structures point in the same direction as for the submarine cables: towards increased privatisation. Since 2009, no state-owned IXPs have been established, while the number of privately owned IXPs has increased significantly (from 20 to a total of 68).

For the ASNs, we also observe a shift from public to private ownership from around 2000 and onwards. While public ASNs outnumbered the private networks until 1997, private companies have rapidly outgrown the public operators, multiplying their number of networks from 105 in 2000 to 1,608 in 2021. In comparison, the increase in public networks for the same period is from just 76 to 388. Mirroring the ASN ownership analysis of companies hosting the top-50 websites in the four countries, we find only eight state-owned ASNs (three each in Denmark and Sweden and one each in Norway and Finland). That is, public websites also generally rely on external hosting services, cloud solutions, and distribution systems provided by private companies.

Illustrating national variations between the four countries, Table 4.1 lists percentages of public ownership across the three types of backbone network infrastructures. It shows that Finland has the highest share of public submarine cable owners (13 of 15, or 87%), while Denmark has the lowest (16 of 42, or 38%). When it comes to IXPs, Finland is placed at the other end of the scale, with no publicly owned facilities, while nine out of twelve Norwegian IXPs are state owned (primarily through the universities). Looking at the share of state-owned ASNs, the differences between the four countries are insignificant: Denmark has the lowest share (14%), and Sweden has the highest (21%).

TABLE 4.1 Public ownership shares of submarine cables, IXPs, & national ASNs in Denmark, Finland, Norway, & Sweden (per cent)

	Public ownership of cables	Public ownership of IXPs	Public ownership of ASNs
Denmark	38	31	14
Finland	87	0	19
Norway	53	75	20
Sweden	56	5	21

SOURCE: TeleGeography, RIPE NCC

To sum up, while "U.S. Internet companies are important but subordinate players within consortia that are dominated by a mix of private- and state-owned national carriers as well as some relatively new competitors" (Winseck, 2019: 112) on a global scale, we see signs of a tilting power balance in the largest Nordic countries. Especially strategically positioned countries such as Denmark and Finland currently experience a heightened interest from global Big Tech, while the degree of welfare state involvement is generally higher in contexts where brownfield actors (i.e., national incumbent telcos) have a strong position in the national (and international) market, like in Norway and Sweden.

Governing the on/off switch

Moving from state facilitation in the form of public ownership to state intervention in the backbone infrastructure and market, the policies and regulatory frameworks that impact submarine cable laying, Internet exchange, and network routing are highly complex. Government policies on submarine cables landing in the region follow a total of eight European Union directives and conventions, all of which relate to environmental issues, including protection of the seabed and wildlife and reduction of waste (Raha & Raju, 2021). No regulations target submarine cable markets, concentration, ownership structures, and so forth, making submarine cables an "orphan" in international law (Matley, 2019). While national competition laws officially apply to all market actors that operate in a given context, such regulatory interventions rely both on the actual identification of the market in question and on systematic monitoring of it. In the absence of both, this regulation is, to the best of our knowledge, not enforced. Recent suggestions as to how states can enhance regulatory efforts point to the

need for national submarine cable agencies and state registries to monitor submarine cable developments (Raha & Raju, 2021). However, no such steps have been taken in the Nordics.

In a similar vein, IXP registries are, as mentioned, hard to come by, and we have used a combination of databases for our analyses. Similarly, there is no agency or established policies targeting IXPs specifically outside the realm of cybersecurity. While cybersecurity constitutes a fundamental pillar of contemporary Internet policies, it concerns specific incidents and notification practices rather than the (infra)structural conditions, and it does not target economic arrangements. Bodies like the Internet Corporation for Assigned Names and Numbers and RIPE NCC govern the assignment of ASNs and the overall operation of the Domain Name System; yet, mirroring the former two indicators, state involvement in the form of government policies is difficult to come by.

In terms of public funding for backbone build-out, we have found limited evidence of state subsidies for establishing submarine cables, IXPs, and autonomous systems. However, the Swedish government allocated EUR 280 million in the early 2000s to build a national operator-neutral backbone (Forzati & Mattsson, 2014). Similar support schemes for building international routes have been discussed in Norway. Moreover, both the Norwegian and the Swedish states have taken extensive measures to make the countries as attractive as possible for large international data centre projects through, for instance, tax reductions (Ministry of Trade, Industry and Fisheries, 2017; Cision PR Newswire, 2021). This way, the Nordic governments exhibit extensive interest in emphasising the region's "competitive advantages" when it comes to building international infrastructure hubs (Christensen et al., 2018). Most recently, the Nordic university and research networks have suggested extending the global submarine cable routes to Asia across the Arctic region, possibly by means of state subsidies to make up for the economic uncertainties involved in such investments (Copenhagen Economics, 2022).

Overall, our investigation of the role of the state points to limited public involvement in the backbone infrastructure and market. Along with the gradual privatisation of the Internet backbone, the impact of state-owned facilities has been reduced and regulatory gaps have emerged. Efforts have been made to translate existing frameworks to also include the Internet in the remaining three infrastructural layers analysed in this book: for example, telecommunication policies extended to also include broadband, cultural policies applied to Internet-based content distribution, and existing data protection developed to capture digital security and privacy issues. While this translation has been relatively straightforward (despite the strategy's many weaknesses that we address in the other chapters),

there has been no obvious contenders for adapting existing policies for this particular layer of the backbone. However, recent eye-opening revelations of wiretapping and cyber-attacks encourage decision-makers and regulators to put backbone network infrastructures at the top of the political agenda. In approaching these issues, it has been suggested to look beyond the last decades' political solutions and seek inspiration in similar historical infrastructure developments as they played out in the late nineteenth and early twentieth centuries around the processes of electrification or the evolution of global telegraph networks (Winseck, 2012; Winseck & Pike, 2007).

Horizons & vertigos

In this chapter, we have shown that mapping the backbone network infrastructures of the Internet in this northern corner of Europe is a difficult task. The difficulty can be traced back to not least the methodological and empirical foundations for such mappings. To begin with, the available data sources are – unlike the official registries of access networks used in the previous chapter – informal, unstable, and built for purposes other than the research endeavours of this book. The databases are run by private enterprises, which happen to overlap with the very companies and stakeholders that we are studying. The data sources are often financed by data reselling business models, for the purpose of securing business-to-business ventures, or for other commercial gains. As such, critical analyses of the political economy of data infrastructures largely depend on the goodwill of industry stakeholders for departing data – and black-boxed systems or company secrets might overturn the wish to impart such data publicly. Moreover, the data sources restrict our ability to ask further questions – for instance, regarding market shares in joint-venture submarine cables, international interests in building out the Nordic IXP infrastructure, or hosting agreements across the Atlantic.

Nonetheless, the analyses of the chapter leave us with three critical findings that resonate with and have repercussions for our understandings of the remaining parts of the digital communication systems in Denmark, Finland, Norway, and Sweden. First, and similar to the access network analyses in the previous chapter, the mappings and comparisons of backbone network infrastructures emphasise that material conditions effect the shaping of digital political economies. Geopolitical contexts constitute important backdrops for understanding the underlying conditions for building and running digital services, Big Tech corporations' commercial incentives for expanding into specific national markets, and the political decisions and prioritisations that influence the institutionalisation of the Internet.

In the case of Denmark, the country's location, geographical features, and demographic characteristics provide important insights into the high degrees of globalisation as well as the liberal and tech-friendly policies. As another, and perhaps more troubling example, Finland's position as a critical peering juncture between the East and the West draws attention to the intertwining of material infrastructures and global politics, expressed in Russia's increasing control of data and communication flows and recent activities in terms of cyber warfare. In making sense of these emergent forms of Internet control, the backbone is a fundamental pillar that other infrastructural arrangements should be seen in the light of.

Second, in making sense of the backbone's historical evolution, the analysis finds three overall coherent periods of backbone development: an initial phase (ending by the early 2000s) of extensive build-out led by welfare institutions and encouraged by public funding (if not through actual subsidies, then by virtue of public ownership); an intermediary phase of relative standstill, where other parts of the infrastructure were developed (access networks, applications and platforms, data harvesting models, etc.); and lastly, a recent growth phase, where global newcomers are increasingly building, replacing, and running the backbone networks and are drawing the contours of future digital services and business models that we do not yet know the full extent and nature of. Just as the submarine cable laying projects in the 1990s paved the way for later digitisation processes across both public (digitised social security systems, digital public communication systems, etc.) and private (streaming services, ad tech, etc.) domains, the submarine cable and data centre projects initiated within recent years serve as foundations for an anticipated exponential growth in new high-capacity technologies (Internet of Things, self-driving cars, metaverses, virtual reality, etc.).

Third, and related to the characteristics of this last phase, this chapter tells a story about data and platform stakeholders investing in fundamental infrastructure to control larger parts of the value chain underlying digital communication in the region – often by invitation from the local governments. In other words, instead of being dependent on national institutions that laid the foundation for the platforms' entry into the Nordic markets, the global Big Tech corporations now increasingly take ownership of the Internet's on/off switch – a process which has been referred to as the "platformisation of infrastructures" (Plantin et al., 2018). Say, if Alphabet and Meta decide to cut off the Mermaid cable, cross-Atlantic data transport will be slowed down drastically. If Amazon turns off its servers, key welfare state functions will break down. And if NL-ix's IXPs shut down, networks that exchange data at its locations will have to seek new routes. As the power of these companies

is increasingly built into the very architecture of our digitalised and datafied societies, regulation will continue to face challenges, despite current changes in the political discourses around Big Tech. In the next chapter, we scrutinise the increasing power of platforms that enable the continued transition from legacy communication media to Internet-based over-the-top services transcending historical infrastructures, legacy gatekeepers and business models, and classic welfare state policies.

CHAPTER 5

Over-the-top applications

I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. You are not welcome among us. You have no sovereignty where we gather. […] I declare the global social space we are building to be naturally independent of the tyrannies you seek to impose on us. You have no moral right to rule us nor do you possess any methods of enforcement we have true reason to fear.

BARLOW, 1996: PARA. 1–2

At the World Economic Forum in Switzerland in 1996, the co-founder of The Electronic Frontier Foundation, John Perry Barlow, drafted "A Declaration of the Independence of Cyberspace", quoted above. Addressing the governments of the industrial world as "weary giants of flesh and steel", Barlow encapsulated the early imaginary of cyberspace as a place where old power structures, control mechanisms, and bureaucratic modes of government would be broken down and individuals set free. The World Wide Web, introduced just a few years earlier, served as the material foundation for the rise of new forms of communication, publishing outlets, and business ventures. By launching a website, individuals, organisations, and companies could circumvent former gatekeepers and push back on existing rules and regulations. Decades later, the declaration still makes for an interesting, albeit controversial, read: Barlow predicted the clashes between the old world and the new, reminding us of recurring dilemmas concerning freedom and community online. In other words, the declaration sets the scene for mapping and analysing the most hyped and exposed infrastructural layer of digital communication systems – the applications layer.

Until now, we have focused on the Internet's backend: last-mile networks, geopolitical junctures, and submarine cable routes. We have followed the continuous flows of data that travel to and from the end-user's device through underlying and hidden distribution systems and have hardly touched upon the use of Internet-based services and software. For a moment, we now venture to the frontend of the Internet: the interfaces that meet the user when they pick up their smartphone to write a cross-Atlantic love message (or engage in any other

digital activity). These interfaces could be the heavily discussed and contested platforms of Google, Instagram, TikTok, PornHub, and Reddit, as well as the national news sites, e-government services, and public service media's streaming platforms – that is, what most people think of when asked about the Internet.

The emergence and growing use of over-the-top services – such as e-mail, instant messaging, video calls, and streaming – is the most obvious sign of the Internet's evolution into a general-purpose technology (Bresnahan, 2010; Naughton, 2016) and, in effect, a critical societal infrastructure. The societal consequences of the growing reliance on digital applications and services have been thoroughly debated in academic discussions as well as news coverage on social media revolutions (Hanson, 2016; Marr, 2020), metaverses (Ravenscraft, 2022), algorithmic power (Bucher, 2018), platformisation (van Dijck, 2020), and so forth. Yet, despite the public, political, and scholarly preoccupation with the applications layer and the fact that most Big Tech corporations gained their position in the digital ecosystem by supplying web services such as search engines, social media, streaming services, web stores, and so forth, the applications layer remains largely unmonitored. Measurements of web traffic are notoriously ambiguous and unreliable (Taneja, 2016) – mobile app measures even more so (Dieter et al., 2019). In the absence of official monitoring, researchers rely on commercial and methodologically questionable data sources that pop up, shut down, and change in unpredictable ways (Venturini & Rogers, 2019).

In this chapter, we confront the methodological challenges by charting and comparing the application infrastructures and markets in the studied region. Mirroring the previous chapters and the structuring principles of the Digital Communication System Matrix outlined in Chapter 2, we start by examining the technical and material aspects of the application infrastructure, focusing on the functionalities of top web and app services in Denmark, Finland, Norway, and Sweden, and their dependence on the broader Internet infrastructure. We then move on to uncover the ownership and competition structures of the same websites and apps, emphasising the power balance between national, legacy brownfield actors and international, digital greenfield players. And finally, we discuss how Nordic welfare states influence the development and structural conditions of this infrastructural layer of digital communication systems.

Nordic application environments

The gradual move from analogue to digital distribution constitutes a shift from what used to be different and separate technologies (for watching television, sending mail, making phone calls, and reading the news) to Internet-based services going over-the-top of the original technologies and celebrating an Internet-based independence from old value chains. This historical transformation of the basic conditions for sending and receiving mediated content relies on a multitude of technological innovations and comprehensive digitalisation processes. The emergence and growing use of websites in the

1990s depended on the development of basic programming languages (HTML), the introduction of hyperlink protocols (HTTP) that allowed for easy linking between sites and servers, and the continuing penetration and improvement of Internet connections and backbone networks. The uptake of increasingly advanced and high-capacity communication services, such as streaming, went hand in hand with technological advances and infrastructural improvement like new content delivery networks, technologies for controlling in- and outgoing data packages, and high-capacity broadband (Sandvig, 2015).

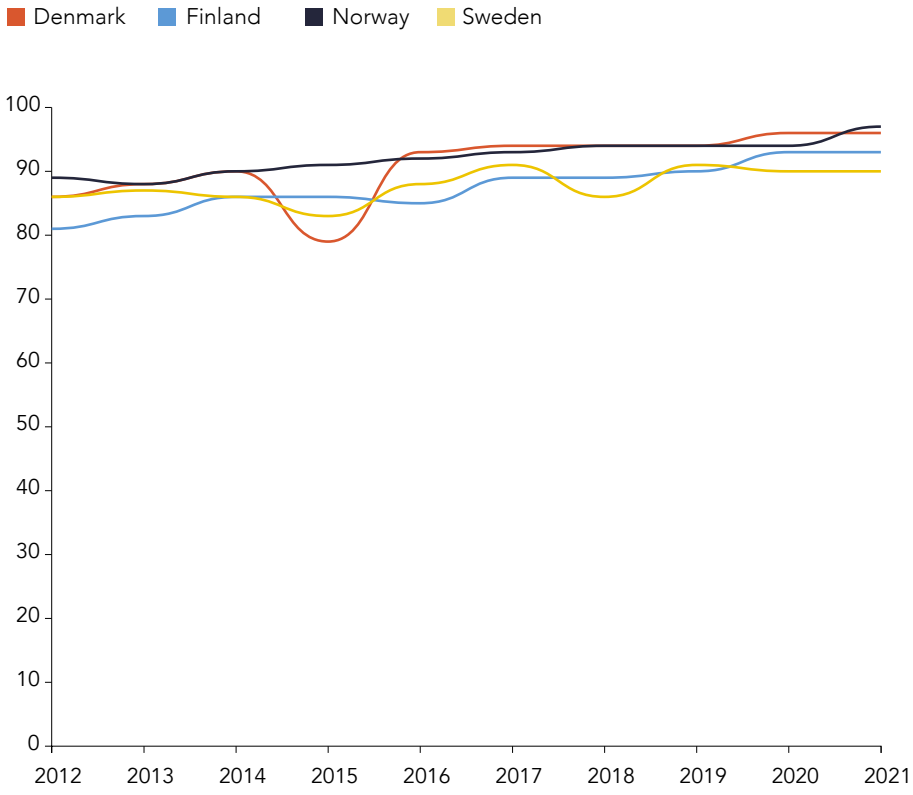
As another cornerstone moment in the history of over-the-top services, the development of smartphones, apps, and mobile networks released digital services from their previous reliance on (stationary) computers and fixed network connections, allowing digital communication services to enter all parts of everyday life. They also evoked an infrastructural rearrangement of the basic conditions for supplying digital services, since mobile apps make up a different structural communication environment than websites. Most importantly for our analyses, websites and apps differ in the ways they are supplied to and reach the end user. While website developers buy a domain name and make their site available regardless of the users' browsers, apps are installed on individual users' devices and must be custom-made for the different operating systems and app stores. As such, apps are developed and published in more closed-off environments than what was initially imagined with the development of the open web (Berners-Lee et al., 1992).

The evolution of various types of Internet-based applications are key to understanding both the development in Internet usage and the commercial power structures that have emerged over the last decades. To assess how these developments have played out in a Nordic context, we first summarise the timelines for various types of over-the-top services and then investigate the top-50 websites and apps within each country.

The over-the-top timeline

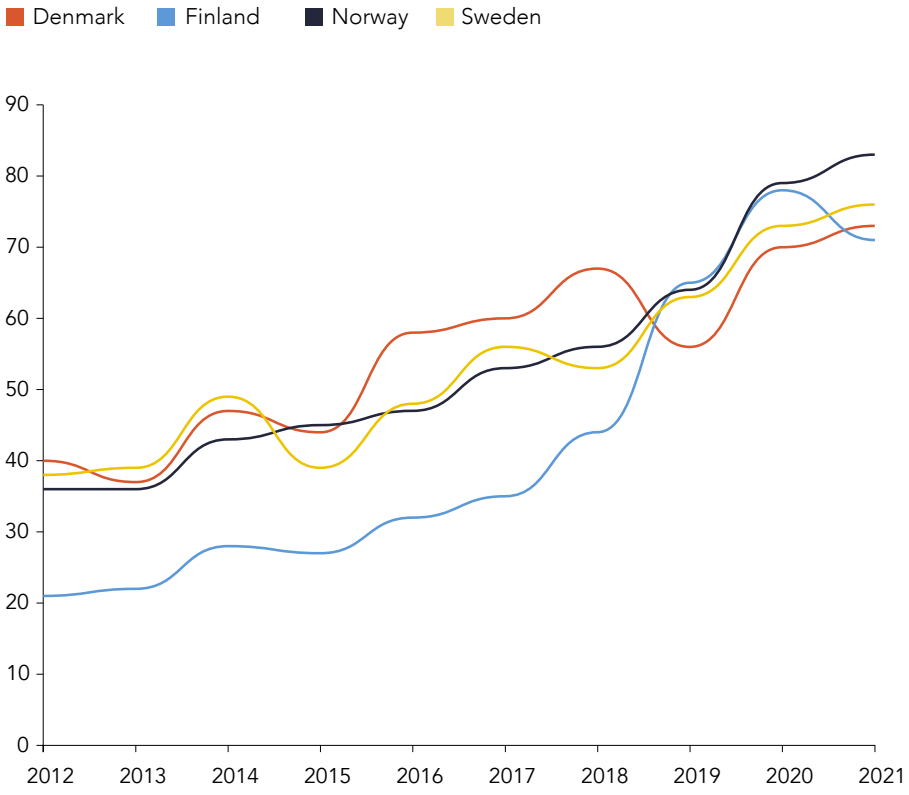
To get an overview of what Nordic citizens do with the Internet, we employ the Eurostat (2021) survey. This shows us that the Danes, Finns, Norwegians, and Swedes are remarkably similar when it comes to how they spend their time online: Aside from Sweden showing marginally smaller numbers across most uses (we specifically look at ten use categories: e-mails, online calls, social networks, news, banking, health, streaming-TV, gaming, streaming/downloading music, and instant messaging), there are no significant differences between the four countries. Rather, the interesting findings about uses of the Internet to be gleaned from the Eurostat data have to do with their gradual integration into Nordic societies and the resulting deterioration of other dedicated technologies. Illustrating this, Figures 5.1a and 5.1b show two particular uses of the Internet that are both common now (though one became so more recently than the other): electronic mail systems and online voice and video calls.

FIGURE 5.1a Individuals using the Internet for e-mail in Denmark, Finland, Norway, & Sweden, 2021 (per cent)



SOURCE: Eurostat

FIGURE 5.1b Individuals using the Internet for online telephone and video calls in Denmark, Finland, Norway, & Sweden, 2021 (per cent)

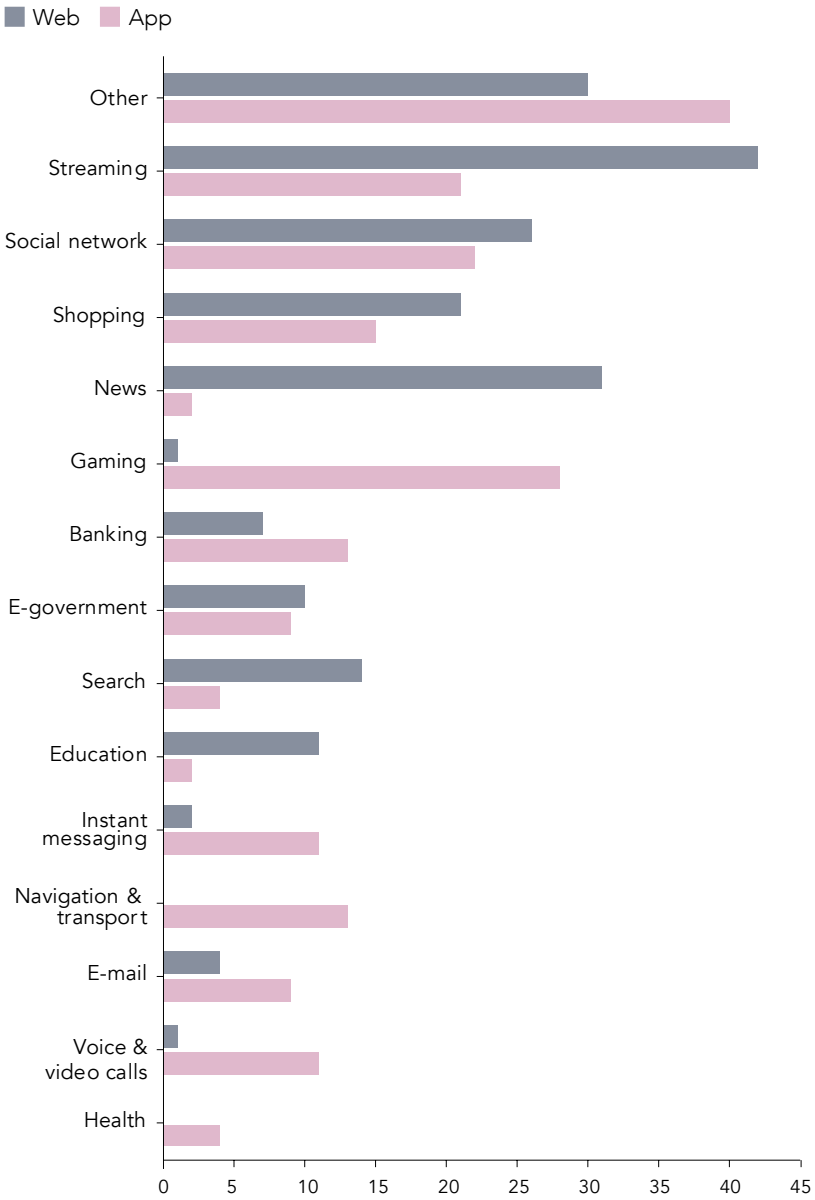


SOURCE: Eurostat

2012–2022 represents a decade where the "killer" application of the e-mail (Naughton, 2016) had already acquired its momentum across work and personal life, making the curve flatline. Phone calls (including those accompanied by video) over the Internet were still in a growth phase in the early 2010s (approx. 40% of the Danes, Norwegians, and Swedes, and 20% of Finns made calls online). Yet, online telephony gained momentum over the decade only to peak in 2021, with a 70–80 per cent user level across the region (evidently also accelerated by the Covid-19 pandemic, where particularly video calls could mimic the in-person interaction made difficult by the virus). While e-mail is a low-capacity technology (especially if all you are sending is typed letters on a screen), online (video) calls demand more bandwidth and a more mature infrastructure. The growing use of online voice calls and instant messaging as alternatives to classic telephone calls and text messaging should also be considered in the context of the rise of smartphones. As such, the history of over-the-top services is also one of gradually more advanced services venturing online: e-mails replacing what used to be the responsibility of the postal services, and now calls and streaming over the Internet infringing on the once lucrative business of the telcos.

Whereas early Internet activities relied on stationary computers, browsers, and websites, the development of smartphones into most people's number-one device plays a major part in the wide-ranging and ubiquitous use of digital services across all spheres of everyday life. To explore the differences between web and mobile services, Figure 5.2 visualises the four countries' most-popular websites and apps coded based on the use categories from Eurostat mentioned earlier. The figure illustrates the prevalence of various types of over-the-top services in the Nordics, while also providing insight into the different uses of websites and apps.

FIGURE 5.2 Total number of applications in each use category by infrastructure, 2021



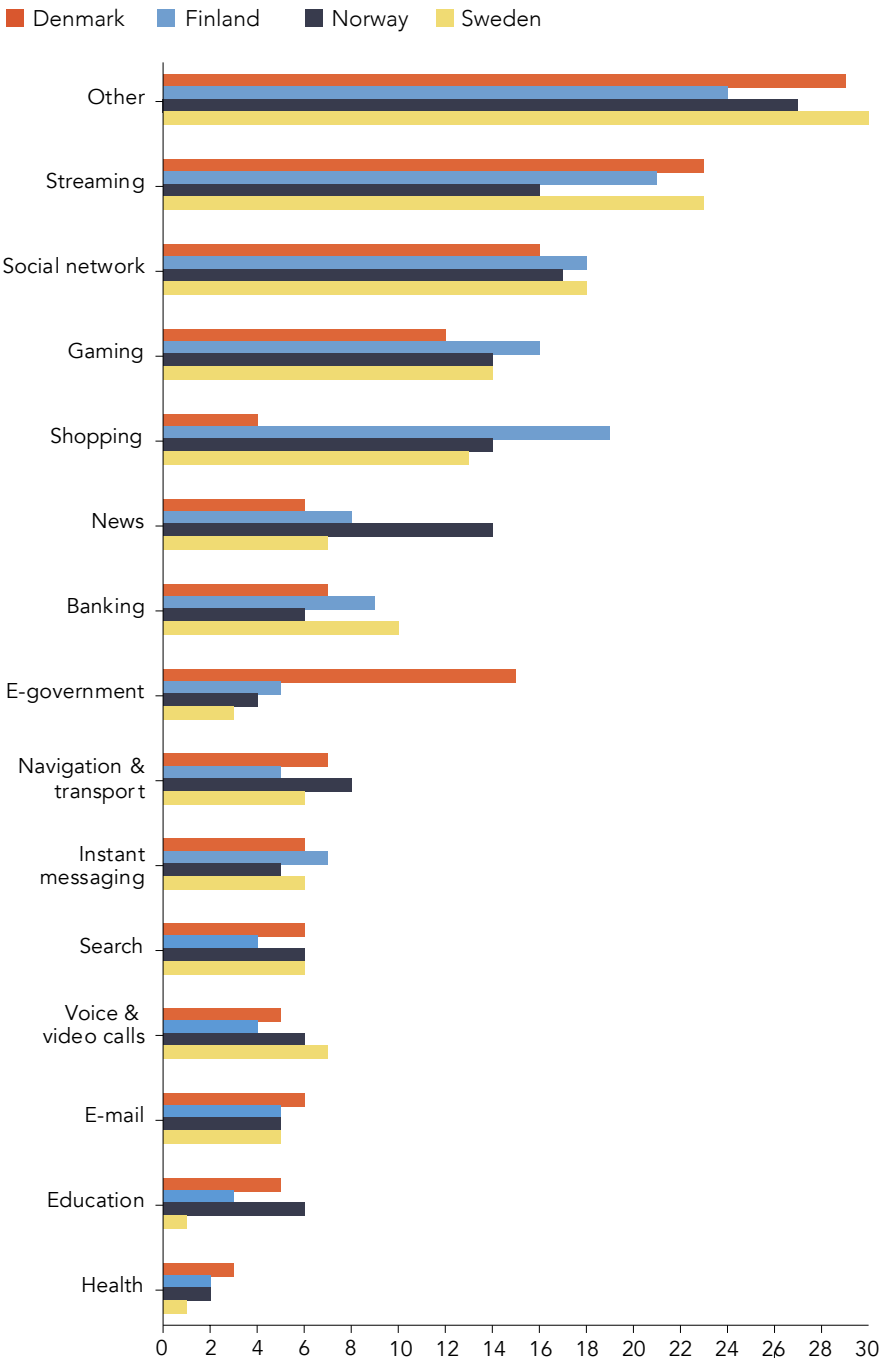
COMMENTS: iOS and Android apps have been combined for the purpose of comparing the basic mobile infrastructure with that of the web.
SOURCE: Similarweb

There are differences across nearly all use categories, with some standing out more than others: the web top-lists exhibit double the number of streaming applications compared with the app top-lists, suggesting that many people access their streaming services through a web browser (e.g., on a laptop), even if there are also many who use dedicated mobile apps. News applications are also far more common on the web than the apps, as are the search and education categories. In comparison, the app top-lists are awash with mobile games, instant message and call services, and tools for navigation and transportation. Perhaps not surprisingly, there are obvious advantages in such applications being mobile and allowing for on-the-go activities like coordinating everyday tasks, finding one's way around a city, or killing time.

What people do with (most of) their time

Even if the four Nordic countries come across as quite similar in the Eurostat data, a glance down the top-lists in each context reveals several differences when it comes to the most-used websites and apps. Figure 5.3 again builds on a coding of each of the countries' top-50 websites and apps using the categories from Eurostat. It includes duplicates (i.e., if both the web and app version of Netflix is on the Norwegian top list, then it will figure twice in the use categories), thereby underlining the popularity of the category as it traverses the different infrastructures. Other categories are, in contrast, predominantly web- or app-centric.

FIGURE 5.3 Number of applications in each use category by country, 2021



COMMENTS: Including duplicates across app operating systems and websites.
SOURCE: Similarweb

Unlike applications for e-mails, search, and social networks that are equally popular across the four countries, streaming applications are less common on the Norwegian top-list compared with the remaining countries, whereas shopping applications are in high demand on the Finnish top-list (19 apps). Norway also stands out by exhibiting double the number of news applications (14) compared with the other countries (7 or less), and Denmark tops the charts in terms of e-government services with more than three-times the number of applications (15) compared with the other countries (5 or less). These differences supplement the Eurostat survey data by providing insights into where people spend most of their time, yet it is important to note that the data do not account for the longtail of applications *also* used by Danes, Finns, Norwegians, and Swedes beyond the top-50.

To sum up, we find clear evidence of the highly digitalised Nordic societies that have become world famous for their uptake of over-the-top services for a wide range of purposes, reflecting the highly developed infrastructures and comprehensive coverage discussed in the previous chapters. We find differences between the use of web- and app-based services pointing back to the different affordances of stationary devices and fixed connections, on the one hand, and mobile technologies and networks on the other. In the following, we elaborate on how these differences relate to digital market structures in the region.

Platform power

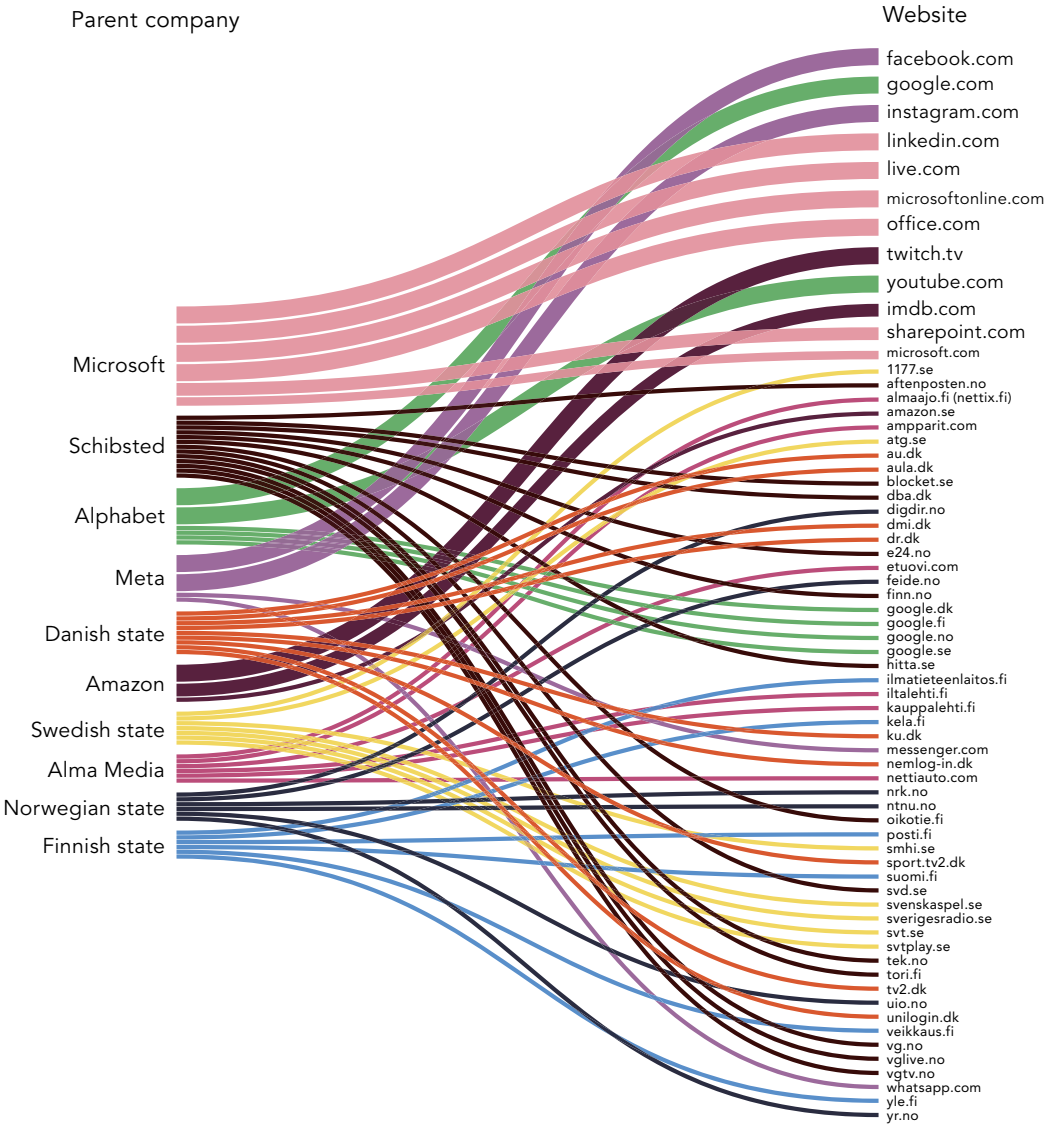
The application infrastructures described above are controlled by a wide range of market actors, including the feared and hyped "tech giants" as well national, legacy actors originating in the welfare systems of the twentieth century. Web and app markets are typically studied using nationally bounded measurement systems based on actors enlisting their outlets to official statistics bodies like Gallup or Nielsen. As a consequence, such lists only include national application owners willing to offer (parts of) their data, leaving gaping holes in the web traffic measurements where popular international outlets like Facebook and Netflix ought to be. As an alternative, the following explorative mapping of the application markets relies on the top-50 lists supplied by Similarweb and sustained by a mix between user panels and traffic data.

Caught in the web

Looking first at the Nordic website market, Figure 5.4 visualises the parent companies of the top-50 websites in the four countries. It shows that Microsoft, as a result of its array of popular software packages and online resources, is the largest web actor, owning 21 of the 200 websites. Coming in (at a not-so-close) second, the Norwegian media mastodont Schibsted owns 13 sites, followed by Alphabet with 12. To be clear, some of these are duplicates, since, for instance, Google.com and YouTube.com (both owned by Alphabet) figure

on all four top-lists along with the country-specific versions of Google Search. The same is the case for Microsoft, where office.com, live.com, and LinkedIn are in the top-50 in all four countries and thereby appear four times each in the dataset. However, we do not limit the analysis to the deduplicated list of websites, since the recurrence of these sites also testifies to the prominence of the companies offering them in the Nordic context.

FIGURE 5.4 Top-10 parent companies of the top-50 websites, 2021



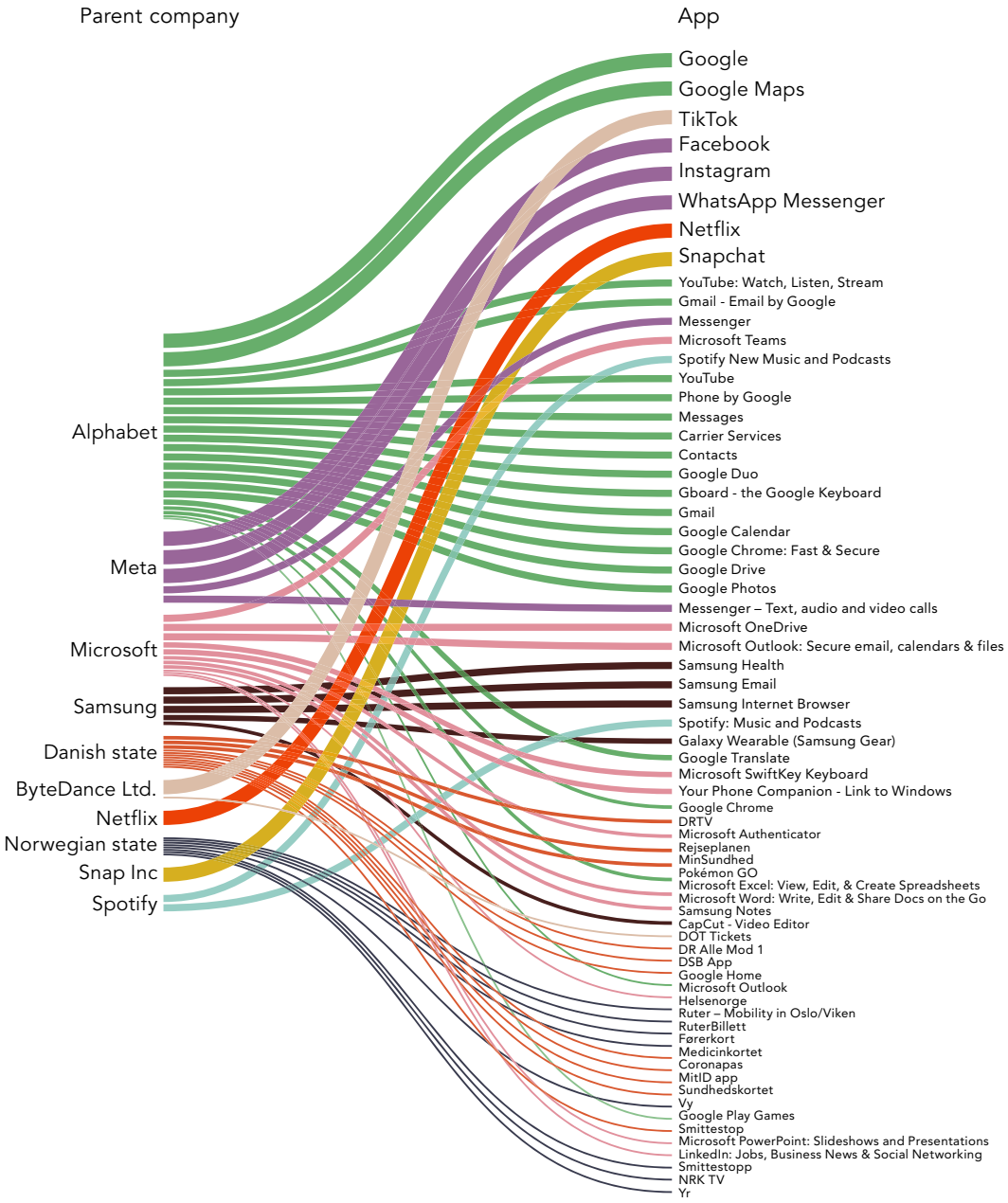
COMMENTS: *N* = 200 or the top-50 websites in Denmark, Finland, Norway, and Sweden; sized according to the number of times they occur on the top-lists.
SOURCE: Similarweb

More than half of the websites (112 of 200) are owned by international companies, of which most built their business entirely on supplying digital services. 88 of the 112 internationally owned websites belong to greenfield actors (e.g., Microsoft, Amazon, and Meta), while only 24 sites are supplied by brownfield companies and institutions originating outside the digital realm (e.g., news media, broadcasters, and telcos). Of the remaining nationally owned websites, the situation is the reverse: 74 websites are owned by brownfield actors, while just 13 are owned by greenfield companies. In other words, nationally developed and owned apps tend to be supplied by legacy companies and institutions basing their ventures into the digital realm on already established business models and historical market positions, whereas online-first applications are generally supplied by global tech companies, often originating in Silicon Valley.

There's an app for that

The tendencies observed in the web market (overweight of international companies that are simultaneously predominantly native to the digital environment, and a smaller portion of national brownfield companies) are generally amplified in the mobile market. Mirroring the visualisation of website market actors, Figure 5.5 illustrates the prevalence of parent companies owning the top-50 apps in Apple's AppStore and Alphabet's Google Play store across the four countries (400 apps in total). It shows that although the desktop giant Microsoft also plays a central role in the app ecology, Alphabet is the number-one market leader, owning 81 out of the 400 apps. Again, it is important to point out that many of these are duplicates – Gmail, Google Search, Google Maps, and YouTube figure on all four countries top-lists across both the iOS (Apple) and Android (Alphabet) systems.

FIGURE 5.5 Top-10 parent companies of the top-50 apps, 2021



COMMENTS: *N* = 400, or the top-50 Google Play and AppStore apps in Denmark, Finland, Norway, and Sweden; sized according to the number of times they occur on the top-lists.
SOURCE: Similarweb

When looking at the figure, the striking dominance of one of the operating system owners (Alphabet) is contrasted by the apparent absence of the other (Apple). There is a simple infrastructural explanation for this seeming market asymmetry: Whereas Apple's general-purpose apps (e.g., Contacts and Messages) come preinstalled on all iPhones running iOS, Android users must download such apps. In other words, since devices from the most common manufacturers using the Android system (Samsung, LG, HTC, Motorola) come with the Google Play store preinstalled, users seeking to download general-purpose apps will find Alphabet's own products. In effect, Alphabet's apps figure more prominently on the top-lists than Apple's, since the analysis is based on apps that are *downloaded*.

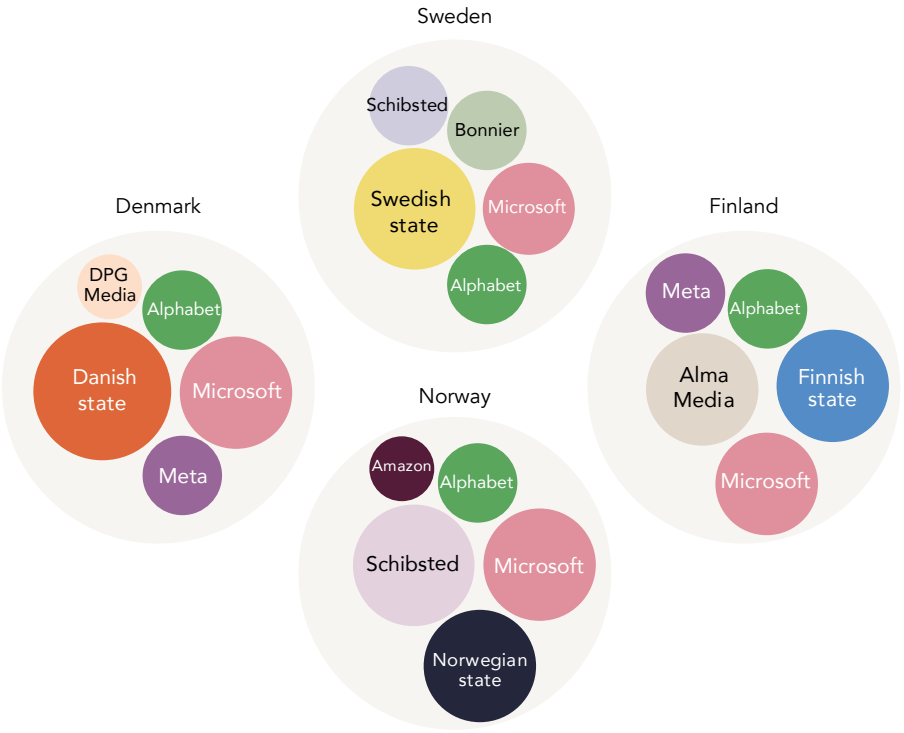
Aside from Alphabet, other large actors of the Nordic app ecology include Meta, with a total of 32 apps across the four countries and the two operating systems, as well as Microsoft (27) and Samsung (17). The global Big Tech corporations are followed by the respective national states owning between four (Sweden and Finland) and fourteen (Denmark) apps on the top-lists as well as several successful national and international companies, including ByteDance (most famous for TikTok), Spotify, and Netflix.

Of the 400 apps on the four countries' top-lists, one-fourth (94 apps) are owned by national companies or institutions, of which two-thirds (65) are brownfield actors. These include state bodies (health authorities, transportation authorities, etc.) owning a total of 32 out of the 94 apps, followed by banks (19), shopping groups (13), and legacy news media (4). The remaining 306 apps are owned by international corporations like large game studios (with 54 apps), Big Tech corporations (offering 43 apps for social networking), and streaming outlets (29 apps). The majority are greenfield actors (accounting for 270 out of the 306 privately owned apps), with brownfield companies offering a small selection of apps for streaming (e.g., Disney) or food (e.g., McDonald's).

Comparing application ecologies

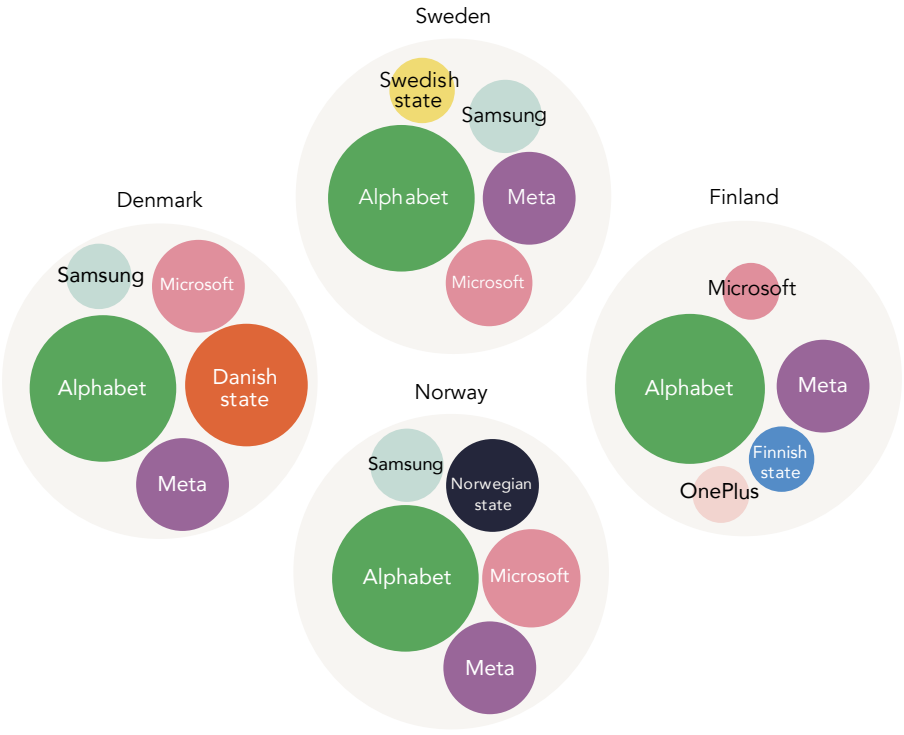
When comparing the Nordic application ecologies, the most interesting differences are not so much between national contexts as they are between different infrastructural ecosystems. To illustrate this, Figures 5.6a and 5.6b map the largest companies sized according to the number of services they own in the national top web and app spheres. Figure 5.6a charts the top-5 website providers, while Figure 5.6b charts the top-5 app providers.

FIGURE 5.6a Largest top-50 website owners in Denmark, Finland, Norway, & Sweden, 2021



SOURCE: Similarweb

FIGURE 5.6b Largest top-50 mobile app owners in Denmark, Finland, Norway, & Sweden, 2021



SOURCE: Similarweb

Looking at the parent companies that own the most websites on each country's top-50 list, we see that the Nordic states, alongside Microsoft and Alphabet, consistently figure in the top-five (e.g., Microsoft owns between four and six websites on each country's top list, while the individual states control between six and nine). Legacy news media also appear in the top-five in all countries, with the most prevalent being Schibsted owning seven sites in Norway and Alma Media owning six in Finland. The data generally suggest that national, legacy news media have a much stronger online presence in Norway, where thirteen of the top-50 websites are owned by legacy media corporations, while this is only the case for six sites in Sweden and five each in Denmark and Finland. In terms of the web companies' original business models, Norway exhibits the highest number of brownfield actors (27) and Sweden the lowest (21).

The data do not suggest any clear-cut market tendencies that set one country apart from the others – if anything, they underline previous findings about the strong position of brownfield actors in Norway and the high globalisation of the Danish market. While we identify minor national differences in the web market, they become nearly washed away once we look at the mobile market. As digital activities increasingly move from web to app infrastructures, the formerly heterogenous digital markets turn more homogeneous. In all four countries, Alphabet, Meta, and Microsoft are among the largest app providers, thereby pushing national actors, including Bonnier, Alma Media, and Schibsted, out of the top-five. To elaborate, while the share of nationally owned websites on the top-lists is pushed upwards by the strong presence of national, legacy news outlets (especially in Norway), news apps are almost non-existent on the countries' lists of top *apps* (none in Denmark, one in both Norway and Sweden, and two in Finland). Similarly, while at first glance streaming is a prevalent category across both ecologies, the underlying ownership structures tell a different story: One in four streaming websites are nationally owned (often by legacy media companies like the public service broadcasters or beforementioned Schibsted), yet only one of eight streaming apps is offered by national actors (the field is dominated by companies that have obtained a regional or global presence, including Nordic Entertainment Group with Viaplay, and Spotify). The Nordic app markets are thus significantly more concentrated than the web markets, and the gradual transition from web to mobile embodies a shift from Nordic companies having a larger presence in their national and regional contexts to a more globalised market, where international corporations are increasing their dominance and significantly outnumber classic welfare institutions such as legacy news and public service media.

Yet, one interesting exception to the apparent homogeneity stands out when we look at the ownership of nationally supplied mobile apps. While brownfield actors dominate the nationally developed mobile apps on the top-50 in Denmark, Finland, and Norway, more than half (13 of 25) of the national app providers in Sweden are greenfield actors. This resonates very well with a popular understanding of Sweden as "the Silicon Valley of Europe" that has been home to multiple internationally successful applications such as Spotify and Skype (Fulton & Mukherjee, 2021; Hastings, 2021; Kjølberg, 2021). In other words, the (slight) national differences in the application ecologies can be seen as different strategic efforts to compete with global Big Tech: While legacy institutions push back on international disruption and competition in Norway, homegrown IT start-ups seem to lead the battle in Sweden.

As a final point, across infrastructural ecosystems and national contexts, corporations originating in other European countries are by far outnumbered by both national and global actors, suggesting a poor internal market in the European Union (at least from a Nordic perspective). Non-Nordic European market actors account for just 0.5 per cent of both the top websites and apps, while global actors account for 45 per cent of the websites and 65 per cent of the apps. Several high-profile European Union cases and initiatives along with national lawsuits have, in recent years, targeted market concentrations and emerging monopolies in the digital economy, and more recently, pushes have been made towards strengthening internal supply chains in Europe (through encouraging chip production, European algorithms, etc.). Yet, both the horizontal and vertical market structures continue to be dominated by the same "usual suspects": There are no real alternatives to platforms such as Facebook, YouTube, and Google, and Alphabet and Apple are effectively a duopoly in the mobile market through their ownership of Android and iOS, their corresponding app stores, and a wealth of general-purpose apps. Website and app developers in the European Union generally depend on infrastructures supplied by predominantly American companies and thereby continuously strengthen the business models of their own largest competitors. In the following, we explore how Nordic governments are responding to these challenges and how the ever-growing power of Big Tech is influencing established welfare state logics.

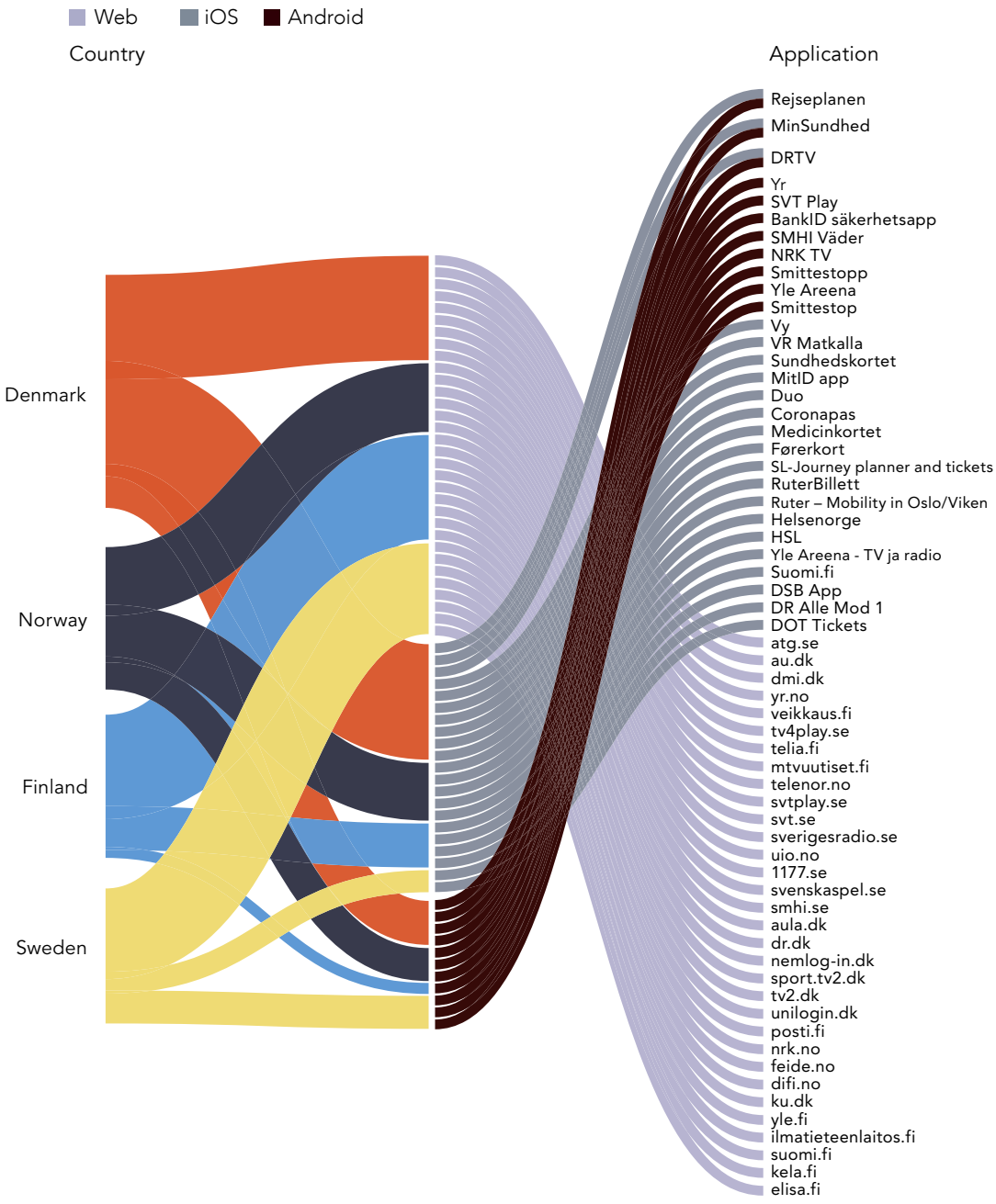
Gatekeeping the gatekeepers

The global and commercial governance of key communication services and infrastructures outlined above presents an alternative to the persistent view of the Nordic countries as prime examples of democratic corporatist media systems (Brüggemann et al., 2014; Hallin & Mancini, 2004; Humprecht et al., 2022; Mattoni & Ceccobelli, 2018) or media welfare states (Enli et al., 2018; Enli & Syvertsen, 2020; Syvertsen et al., 2014). Emphasising the perseverance of strong journalistic institutions, editorial independence, structural state regulation, and corporatist decision-making processes, media system analyses tend to focus on path-dependent political discourses and institutional practices. In this section, we argue that the rise of over-the-top applications in many ways constitutes a significant *change* of path when it comes to the role and modes of (welfare) state involvement in mediated communication.

Public services & private platforms

The ownership analyses presented earlier clearly shows that national, legacy media institutions hold relatively weak and declining positions, especially in the mobile (app) ecosystem. However, the Nordic welfare states do continue to have a significant presence in the applications sphere, just not in the sense of a *media* welfare state. The power of welfare states instead lives on in the many public digitalisation strategies, bringing with them an array of digital public services such as communication with authorities, healthcare, transportation, and digitalised identification systems. Of the top-200 websites analysed, 32 belong to public institutions, such as the Nordic universities, public service broadcasters, public transportation companies, and various other state authorities. In contrast to the limited position of legacy media in the app sphere, e-government services are, as mentioned, a significant category across both operating systems, with 21 of the 200 iOS apps and 11 of the 200 Android apps being state commissioned or funded. Figure 5.7 charts these applications according to the country they appear in and their infrastructure.

FIGURE 5.7 Publicly owned applications in Denmark, Finland, Norway, & Sweden by infrastructure, 2021



SOURCE: Similarweb

As illustrated by the figure, state applications are particularity prevalent in Denmark, where nine of the top-50 websites are publicly owned, and 18 apps across both operating systems are either owned or commissioned by the state for various e-government purposes. In contrast, only 6 out of the 100 apps on the Finnish top-lists are owned or commissioned by the state. An interesting point in this regard is that the Finnish digitalisation of citizenship has been led by the banks that have developed the country's digital identification systems and subsequently led the Finnish state to pay to use their systems for all other public authentication issues (think of Covid-19 passes, communication platforms, etc.) (Nets, n.d.). In comparison, the Danish state has paid a private company to build a digital key system for the same purposes, which the banks in Denmark then use (NemID, n.d.).

Responsibility gaps

All four countries have invested extensively in public digital media and by now provide highly used streaming, podcast, and news services. As a result, existing regulatory frameworks have been updated to also include digital content outlets: Following the European Union's Audiovisual Media Services Directive (European Commission, 2018), national broadcasting policies have been extended to streaming services, and media ethics and accountability systems have been amended for digital media (Eberwein et al., 2018). Since legacy newspapers were among the first to establish websites and venture into digital content distribution (Brügger & Milligan, 2019), the Nordic press subsidy systems have gradually been modified to also include digital news (Rat, 2020). Established media policies have been digitalised, sustaining a view on media as sociocultural institutions that are to be protected against the economic threats of the platform economy (Knudsen et al., 2017; Sirkkunen et al., 2021).

The strategy of implementing Internet-based services into existing legislation was relatively efficient in the early phases of digitalisation, where legacy institutions such as newspapers, broadcasters, and telcos dominated the application ecology. In the later phases, however, the rise of digital communication services that cannot be comprised within the scope of traditional "media", yet hold increasingly powerful positions as key gatekeepers for digital communication, has challenged existing political and regulatory approaches. While legacy media policies regulate an increasingly minor part of the application ecology, a range of responsibility gaps have emerged between sector-specific government bodies and applications that do not fit neatly into any of them. Examples of this include the prevalence of social media platforms such as Facebook that, since the 2000s, have evolved into important sites of public information dissemination and debate; the position of YouTube as a key distributor of audiovisual content; and the dominance of Google as an advertisement giant and disrupter of the commercial media industry. These "new King Kongs of the online world" (Cunningham & Silver, 2013) influence the conditions for legacy media actors

(thereby impacting legacy media regulation) and disrupt the institutional order of the analogue communication system (outlined in Chapter 1). That is, many over-the-top services fall between and break down the boundaries of one-to-one and one-to-many communication and combine synchronous and asynchronous modes of distribution (Bar & Sandvig, 2008).

The rise of over-the-top services thus constitutes a still largely unsolved regulatory crisis, where existing polices and regulatory frameworks – developed in and for the analogue media system – have lost their former effect. While the high media penetration and stable media markets functioned as proxies for democratic cultures and processes in the golden age of news media and traditional broadcasting, the disruption and globalisation of the last decades have altered the material foundation for public (and private) communication and challenged the underlying political logics and dynamics. One consequence of the shifting power structures in the applications market is that US-based platforms increasingly curate the Nordic public spheres by censoring national content and services. Recent examples of this include Alphabet banning the Danish public service broadcaster's children's app because it contained a television show where the host handed out candy in the shape of tobacco pipes to kids (Hilstrøm, 2020), and Facebook censoring the Norwegian *Aftenposten* for its republication of the iconic image from the Vietnam War of a nude child fleeing from a napalm attack (Larsen, 2016).

As a result of these cases, a growing demand for regulation of otherwise highly unregulated aspects of communication in everyday life has appeared, and disparate initiatives have been taken to encourage Big Tech corporations to take on local responsibilities in terms of content production and curation (Meyer, 2020), union rights (Heikkilä, 2020), and so forth – but thus far, without much effect. Instead, national application providers grow increasingly dependent on the infrastructures of global actors to function – be it commercially or technically. Aside from the multitude of highly used websites and apps supplied by global Big Tech corporations, national and even public outlets largely depend on the very same companies to make their services available and operational, distribute content, collect user statistics, serve ads, and so forth (see Chapter 6 for a more thorough discussion of this). Whereas legacy media regulation in the forms of licensing, public subsidies, or rules on ownership concentration can be described as governance *of* infrastructure, the examples of global companies curating the Nordic public spheres can be defined as governance *by* infrastructure. Governance by infrastructure is made possible when "points of infrastructural control can serve as proxies to regain (or gain) control or manipulate the flow of money, information, and the marketplace of ideas in the digital sphere" (Musiani et al., 2016: 4). While governance by infrastructure is nothing new (think of the editorial power held by publishers, broadcasters, and other analogue gatekeepers), the leverage that infrastructure ownership grants the individual public or private actor has increased – in scope and in reach.

By their control of sector-specific infrastructures like printing presses and electromagnetic frequencies, national, legacy media institutions would serve as gatekeepers for particular *types* of public information dissemination and debate (news, public programming) under the rule of different societal contracts regarding social responsibilities and accountabilities. In comparison, by their control of digital information flows and content distribution (through social media applications, app stores, and cloud services) global companies have taken over this gatekeeping role, while also expanding the types of communication that come under their control: essentially public – and private – communication of any kind. In effect, welfare state systems like those of the Nordic countries experience a slide towards commercial governance by infrastructure and an unmatched potential for cultural clashes. This is, above all, a consequence of the global platforms coming out of specific cultural contexts – like Silicon Valley in the US – that are nothing like those of this small region in Northern Europe. A clash of cultures is, one might say, inevitable, yet the increase in scope and reach of governance by infrastructure leaves the once-powerful Nordic welfare institutions with little to negotiate with and a lot to lose (even as much has been lost already: readership, viewership, ad revenues, editorial freedom, etc.).

Regulating Big Tech

It is beyond the scope of this book to provide an in-depth analysis of how the developments described above have been addressed in each of the four countries and to systematically compare potential similarities and differences in terms of application policies. Instead, we conclude this part of the analysis with a few examples of how the infrastructural power of Big Tech might be challenged in the coming years. First and most importantly, the European Union is currently passing several legislative proposals, including the much anticipated Digital Services Act aimed at enhancing regulation of digital platforms through increasing their responsibilities in terms of algorithmic content curation, enforcing anti-trust regulation, and thereby fighting back against market concentration (European Commission, 2022). These interventions follow recent years' so-called techlash, where global companies such as Alphabet, Amazon, Meta, Microsoft, and Apple have been fined for violating the General Data Protection Regulation, avoiding tax payment, and abusing their market positions (Investopedia, 2018).

On a national level, the Nordic welfare states are known for facilitating and funding digital start-ups and thereby allocating funds for the national IT sectors (NS Business, 2018). The success of especially the Swedish IT sector is often considered a direct result of early government policies seeking to promote uptake of IT technologies and high-capacity broadband (European Schoolnet and University of Liège, 2012). The applications sector, and the IT industry more broadly, has thus traditionally been seen as an engine for

economic growth rather than a sociocultural concern. In recent years, the undeniable dominance of Big Tech has, however, evoked a more critical debate, especially in Denmark, where the foreign ministry in 2021 published a strategy for "tech diplomacy", which emphasised that "there is no question that the tech sector must be regulated – the question is how to regulate it" (Ministry of Foreign Affairs of Denmark, 2021: 3). As part of the media funding agreement, Denmark has also taken steps towards requiring foreign streaming companies to pay a so-called culture fee to Danish film production (The Ministry of Culture, 2022). As an example of attempted enforcement of competition regulation in the digital realm, the Swedish competition authorities have conducted a market analysis of the competition in five sectors that have been affected by digital platforms. The report concludes that "it is possible in a number of cases to address competition concerns on digital markets with the current competition law framework", but that these frameworks are insufficient when it comes to effective enforcement, and that "some types of concerns may also fall outside of the scope of the current competition rules" (Swedish Competition Authority, 2021: 4; for similar examples, see Halvorsen et al., 2021; Sirkkunen et al., 2021; Svensson, 2022). In sum, there has not, to the best of our knowledge, been any real initiatives taken to regulate the app and web markets.

Summing up how Nordic welfare states influence the applications layer of digital communication systems, various efforts have been made to continue and revise existing media and communication policies to fit the digital environment. In emphasising the discursive and ideological path dependencies, media system analyses tend to conclude that the active role of the state and close collaborations between the political system and the media market have been sustained. However, our analyses show that the effect of these regulatory interventions are declining as more and more communication moves to platforms that do not fit into – nor are *willing* to fit into – the existing definitions of "media". As a result, established welfare policies aimed at ensuring a thriving and democratic public sphere, in practice, regulate a shrinking part of the ecosystem of public information spread and debate. The relative success of public applications could, however, be seen as a sign of Nordic welfare states continuing their active facilitation in the everyday lives of citizens, only in a very different way than what is typically understood when referring to *media* welfare states (Syvertsen et al., 2014).

Ruptures & tectonic plates

We opened this chapter by stating that the applications layer is the most exposed and debated layer of digital communication systems. Yet, as we have shown, when it comes to empirical analyses of patterns across web and mobile interfaces, this domain also proves difficult to grasp. Despite the obvious cracks in the business models underlying legacy market actors and

the growing awareness and debate of the role played by Big Tech corporations, web and app markets are still remarkably unmonitored, and reliable measurement systems are hard to come by. This chapter has pinpointed one way forward in terms of empirical monitoring that challenges the inherent biases and blind spots that continue to limit research on the structural conditions for digital communication in the Nordics and beyond. However, the methodological difficulties that emerged circumscribe the potential takeaways from our analyses and must, as such, be addressed directly.

The most significant challenge is related to the use of Similarweb for assessing web and app traffic. Like former state-of-the-art web measurement tools (most prominently Amazon's Alexa rankings that closed down in 2022), Similarweb's database is provided by a commercial company for entirely different purposes than ours. The data collection procedures are opaque, and the data provides a limited view of the longtail of most-used websites and apps. Since we do not have access to the raw data used to generate the top-lists, we are left with the final rankings, unable to make calculations on the prominence of various companies (we can only account for their prevalence since, e.g., websites number 1 and 50 hold equal status in our datasets). We have limited insight into the top-lists' capacity to represent the actual websites and apps used in the four countries, and the results presented above should be read as indications of the Nordic markets rather than exact accounts. Above all, they are testament to the need for methodological development, academic and political initiatives, and funding of systems that can improve digital measurements and market analyses.

Despite the methodological limitations, the analyses clearly display how Big Tech corporations control vast parts of the application market as well as the underlying infrastructure (operating systems, browsers, app stores). When launching a website or app, national companies, in other words, depend on and strengthen the position of global companies that are simultaneously their largest competitors for users and ad revenues. Following up on this overarching finding, three main takeaways can be drawn from the analyses of the applications layer.

First, by shifting our gaze away from the services being supplied, and towards the underlying conditions for supplying them in the first place, we observe a change in the basic conditions for using and supplying communication services. When launching a website or an app, developers become embedded in a broader ecology with more fierce competition than what was the case in analogue communication systems. Users, in turn, benefit from a much broader selection of services and competing offers – often provided without direct monetary exchange – but must accept the often opaque and incomprehensible terms and conditions that national governments and welfare institutions have less control over than in the analogue communication systems. This way, the gradual transition from dedicated and specialised

communication technologies to over-the-top Internet-based services triggers a fundamental reconfiguration of the infrastructural, market, and regulatory logics that materialise in different ways across the Nordic welfare states.

Relatedly, the web ecosystem, more than that of apps, mirrors the differences between the "old" media systems of the Nordic countries, where national news and public service media share the top-lists with online shopping outlets, e-government services, porn sites, social media platforms, and various types of e-mail and work-related services. In the app ecosystem, however, digital newcomers and the occasional e-government service dominate, and the tendencies of market disruptions and globalisation are more evident. These differences reflect in part the distinctive standards and conditions for launching a website or an app. As mentioned earlier, the World Wide Web was designed as an open environment where individuals could publish content, launch a business, or participate in different forms of communication irrespective of former monopolies and gatekeepers. Mobile apps, on the other hand, reside inside walled gardens, where a duopoly consisting of Alphabet and Apple currently dominate all parts of the mobile value chain – from operating systems to app stores and app provision and to the third-party services that we focus on in Chapter 6. These mobile-market giants have not only gained their position through the massive success of their services, but also by making other market actors dependent on them. This means that there are important structural differences between apps and websites when it comes to the material, economic, and regulatory conditions for supplying a given service.

Finally, the last takeaway has to do with the particular types of market actors that dominate the applications layer: namely, platform corporations that benefit from multisided business models and network effects, continuously accumulating their market positions and power in the digital communication systems (van Dijck et al., 2018; Parker et al., 2016). While classic welfare policies and regulatory mechanisms were built on a material foundation where national and specialised institutions controlled the basic channels of communication, the towers of control have been relocated with the rise of global companies falling between established sectors and policy frameworks. Platform companies continuously extend their activities and assets both horizontally and vertically, making other actors dependent on them while at the same time using this position to improve their own services. The ruptures seen at the surface layer of applications are thus signs of a more fundamental reordering of the tectonic plates of communication systems, with important repercussions for the organisation of societies. In the next chapter, we explore one of the most important sites of contemporary digital control: data harvesting and distribution.

CHAPTER 6

Bits of data, bits of power

The phrase – bits of power – is a reminder of the significance of power relations in the changing technological and institutional environment in which information is produced, circulated and applied.

MANSELL, 2017A: 3

Following the infinite flows of data that travel through the pathways, junctures, and super-highways of the Internet, we have now reached the last layer of the Digital Communication System Matrix: the data infrastructures that underly contemporary digital communication where bits of data serve as "bits of power" (Mansell, 2017a) for the stakeholders involved in the massive and ongoing datafication of society and everyday life. At this point, we return to the end user who turned on her Wi-Fi network or activated her mobile broadband in the beginning of Chapter 3 to send of a declaration of love across the Atlantic. We have followed the sending of her message through a multitude of local and global networks and routers to the servers of the websites or apps that might distribute the (datafied) content to its end-destination.

On the surface, this digitised, communicative exchange resembles legacy content distribution, where information is transported from a sender to a receiver by means of a mediating technology enabling either one-to-one or one-to-many communication (Jensen & Helles, 2011). Digital communication systems are, however, characterised by an additional layer of complexity: While the content exchange seems relatively straightforward on the surface, a wide range of underlying data connections are simultaneously being made as the exchange takes place. The user does not only communicate with the official content provider or mediator of communication but also with a multitude of other stakeholders (known as third-parties) that collect, distribute, and process (meta)data for a variety of purposes in what has been dubbed a

web of many-to-one communication (Jensen & Helles, 2017). Much like the submarine cable routes, Internet exchange points, and autonomous systems that enable data to travel between continents, this ubiquitous collection and distribution of metadata is generally out of public view, as are the opaque infrastructures and ecosystems it depends on. While data harvesting, processing, and distribution are fundamental to all Internet-enabled services, the data market is essentially unmonitored, and only recently have democratic deliberations on the so-called surveillance capitalist systems (Zuboff, 2019) reached the public agenda.

In effect, we now move from the frontend of the applications that can be found on the screens of our digital devices and return to the backend of the same systems to investigate the transactions and power structures that are built into the architectures of the Internet in its current form. Mirroring Chapter 3–5, the first section outlines and maps the data infrastructures in Denmark, Finland, Norway, and Sweden, where we focus on the development and current state of web- and app-based data harvesting and distribution. Building on this, we shed light on the third-party market actors who supply website and app developers with data tools (for analysing their users, serving ads, etc.). And finally, we discuss the implications of the emergence of the data economy for the Nordic welfare states and how this has been addressed politically.

Surveillance architectures

In a way, data harvesting and registration have always been inherent architectural features of Internet-based communication: To access content stored on another computer, it is necessary to send a request containing information such as one's IP address. Yet, the extensive collection and processing of metadata characteristic of contemporary digital communication systems is by no means technologically determined or unavoidable. In fact, the early web architecture catered to anonymity by allowing people to stay unknown and nameless behind screens (Turkle, 1995). As the commercial potentials of the Internet began to show in the early 1990s, however, the anonymous user became an obstacle – the web needed a memory, and the HTTP cookie technology gave it just that.

Cookies enabled the identification of users as they followed links between websites or traversed the many sub-pages of a given site, which, in turn, paved the way for several highly useful functions, like placing items in a shopping cart only to continue browsing for more. Over time, many companies went into the business of providing various third-party services to websites, including performing analytics, hosting content, delivering specialised fonts, and so forth. But most significantly, the technology became fundamental to the online advertising industry, as it allowed for third-party data vendors and

advertisers to tap into user data, build user databases and panels, and deliver targeted ads. The web cookie, as a crucial innovation, thereby shaped the digital market by allowing for user tracking, profiling, targeted advertisement, and much more (Helles et al., 2022).

The introduction of the smartphone and other mobile devices accelerated and fuelled the already booming data economy by enhancing the possibilities for collecting and distributing information on users' activities and locations across time and space. As mentioned in Chapter 2, mobile apps are built with software development kits (SDKs) that serve different (technical and commercial) purposes. That is, cookies and other third-party services are embedded in websites and can be dis-embedded upon request from the webmaster if considered (un)fit. For instance, many Russian-owned third-party domains were recently blocked from a horde of European news sites as a consequence of Russia's invasion of Ukraine (Bech-Nielsen & Magnussen, 2022). In contrast, apps are constructed in a modular fashion consisting of several often externally provided kits and packages, which means that an app is essentially an assemblage of building bricks (Dieter et al., 2019; Gerlitz et al., 2019). This, in turn, makes the reversing of having used a particular SDK for one's app a much more difficult task – if you remove one brick, then the structure might collapse altogether, requiring you to build a new one from scratch.

Web crumbles

To detect and analyse cookies and other third-party domains linked to websites, we use the open source tool webXray (n.d.), which reverse-engineers third-party web technologies by scanning the requested sites for embedded third-party domains (Libert, 2015). webXray holds up the found third-party domains against a custom library of domain ownership to chart the flow of data from a third-party domain to a potential parent company. Although this library is extensive, there are many unknown domains, which required us to extensively recode (see Chapter 2 for a more detailed walk-through of this). webXray identified a total of 447 different third-party domains appearing 1,759 times across the top websites ($N = 200$) in the four countries (as described in Chapter 5, several websites are on the top-lists of more than one country). The third-party domains in the dataset serve a wide range of different purposes, including site analytics, hosting, advertising, profiling, identification, and content delivery. Among the most prevalent is the content delivery service gstatic.com (present on 31% of the top-200 sites), the ad-trackers google.com (26%) and adnxs.com (18%), and hosting service provider cloudfront.net (10%).

To help understand the relationships between websites and third-party services, Table 6.1 ranks the different categories of websites in the top-200 according to the average number of embedded third-party services per website. If we look at the types of sites with the most and the least third-party

services, we see that the top is dominated by Nordic news sites, with a quarter (25.9%) of third-party domains, while the bottom consists of sites that can be collected under the headings of banking, search, gaming, and messaging.

TABLE 6.1 Third-party domains found on the top-50 websites by category, 2022

Category	Websites	Third parties	Average no. of third parties per website	Min. no. of third parties	Max. no. of third parties
News	31	803	25.9	0	100
Shopping	21	197	9.4	0	24
Voice and video calls	1	7	7.0	7	7
Streaming	42	282	6.7	0	31
Other	40	241	6.0	0	27
Social network	26	153	5.9	0	20
E-government	11	33	3.0	0	10
E-mail	4	12	3.0	3	3
Banking	7	13	1.9	0	4
Search	14	15	1.1	0	2
Gaming	1	1	1.0	1	1
Instant messaging	2	2	1.0	0	2
All websites	200	1759	8.8	0	100

SOURCE: webXray

Looking closer at the individual websites, we see that some, like the Norwegian newspaper *Dagbladet* (dagbladet.no) or the Finnish social media site Suomi24 (suomi24.fi), use more than 50 third-party services, while others, like the Swedish bank Swedbank (swedbank.se) or the Danish Meteorological Institute (dmi.dk), use just one service from a third party, according to webXray. The implementation of third-party services is, as mentioned, a question of needing specific services on one's site (analytics, fonts, etc.), but it is also related to the fundamental business model underlying large parts of the "free" web, namely targeted advertising customised according to user profiles. Businesses that also originally depended on advertising as a way of

financing their activities – like news and shopping – are also at the top when it comes to embedding third parties on their sites, whereas e-government sites employ less third-party services, since they do not have the same need for commodifying user data and serving ads. As such, tracing back to the original business models of the (now) online services, some digital activities are more tracked than others.

App bricks

Third-party SDKs serve a range of different functions for mobile apps. Theoretically, app developers could design apps from scratch, but this would take up much more time, resources, and technological skills than simply using one or several of the already developed kits out there. Therefore, apps integrate – by design – a wealth of third-party SDKs fit for nearly any purpose an app developer might have. In order to detect and analyse third-party SDKs in Android apps, we use the non-profit Open Access database Exodus Privacy (Exodus n.d.), which unpacks the apps' so-called Android Application Package and looks for known SDKs. Just like with tools for detecting third-party technologies on the web, Exodus is only as good as its underlying library: Specifically, Exodus compares the SDKs that it finds in a given app against its library of known third-party SDKs in order to provide the list of SDKs pertaining to the app. In effect, if Exodus does not know a certain SDK, it will not detect it in the app, meaning that, if anything, Exodus *under*estimates the number of third-party SDKs in the analysed apps.

Exodus identifies a total of 67 different third-party SDKs that appear 573 times across the 200 most-used Android apps on the countries' top-lists (again, multiple apps are found on all four top-50 lists). Like for the web domains, the SDKs in the dataset serve a multitude of purposes such as analytics, crash reporting, advertisement, and identification, and they include both well-known and lesser-known third-party services such as Google Firebase Analytics (present on 60% of the 200 apps), the ad-tracker Google AdMob (20%), and Facebook Login (11%). Linking the app categories and the use of third-party SDKs, Table 6.2 ranks all the categories of apps according to the average number of SDKs they embed. Some apps (like Truecaller, Viber, and PokemonGo) use more than ten different third-party SDKs, while others (like Google Maps, Google Photos, NemID, and BankID säkerhetsapp) use just one.

TABLE 6.2 Third-party SDKs found on the top-50 apps by category, 2022

Category	Apps	Third parties	Average no. of third parties per app	Min. no. of third parties	Max. no. of third parties
News	4	37	9.3	1	11
Gaming	4	34	8.5	1	10
Shopping	4	27	6.8	7	9
Streaming	18	82	4.6	6	8
Health	6	23	3.8	3	4
Social network	24	88	3.7	1	8
Voice and video calls	18	56	3.1	8	6
Search	4	12	3.0	1	3
Instant messaging	14	40	2.9	3	12
E-mail	12	28	2.3	5	7
Banking	14	29	2.1	3	6
Other	73	110	1.5	1	15
E-government	5	7	1.4	2	2
All apps	200	573	2.9	1	15

SOURCE: Exodus Privacy

While employing third-party SDKs is a way of easing the development process, it also, just like with third parties in websites, emphasises the fundamental business model underlying most free-to-download apps: namely, in the first instance, user data harvesting and profiling, and in the second, targeted advertising. As such, we find several news apps, free gaming apps, and shopping apps at the top when it comes to the implementation of third-party SDKs. At the bottom, we find an entirely different sample of apps consisting of several of Alphabet's own apps available through the Google Play store as well as a range of apps developed by different public authorities or banks, mainly for authentication and identification purposes. Although they bulk together when we look at the implementation of third-party SDKs alone, these apps, like for the websites, are at the bottom for quite different reasons. On the one hand, apps developed for authentication are not financed through data reselling or advertising and therefore have no need for SDKs delivering these functions. On the other hand, as one of the most dominant third-party actors in the mobile (and the web) sphere, Alphabet has more than 400 developer

tools in its own suite (Google for Developers, n.d.) and therefore no need for external third-party SDKs.

Third parties in orbit

Comparing the most-used websites and apps in each of the four Nordic contexts in terms of how they mobilise third-party infrastructures, Table 6.3 accounts for a number of differences relating to the use of third-party domains in websites and SDKs in apps. The table is based on the top-50 website and app lists and therefore only provides a rudimentary indication of the national variations in the quantities of third-party services. When it comes to third-party SDKs, we see that Denmark has the least, with 115 SDKs embedded in the country's top-50 apps, whereas Norway has the most, with 161. If we instead look at the embedding of third-party domains in websites, we see a similar pattern – Denmark with the least and Norway with the most. Yet, the differences are exacerbated so that the 50 most-used sites in Norway load a total of 704 third-party domains, whereas the corresponding number for Denmark is 259.

TABLE 6.3 Third-party domains & SDKs found on the top-50 websites & apps in Denmark, Finland, Norway, & Sweden, 2022

	Third-party domains	Third-party SDKs
Denmark	259	115
Finland	406	145
Norway	704	161
Sweden	390	152
Total	1,759	573

SOURCE: webXray, Exodus Privacy

The main explanation for these differences is found in the types of apps on the countries' top-lists: While the Norwegian top-lists feature an overweight of news outlets, the Danish top-lists are heavy with international and specifically American outlets for social networking, messaging, and so forth. The latter category tends to use less third-party services as a consequence of being themselves some of the largest third-party service provides in the ecosystem (think of Alphabet, Meta, Microsoft, etc.). To explore this further, we zoom in on Nordic data markets to explore how the infrastructural resources of third-party services in websites and apps function as central assets in the digital economy.

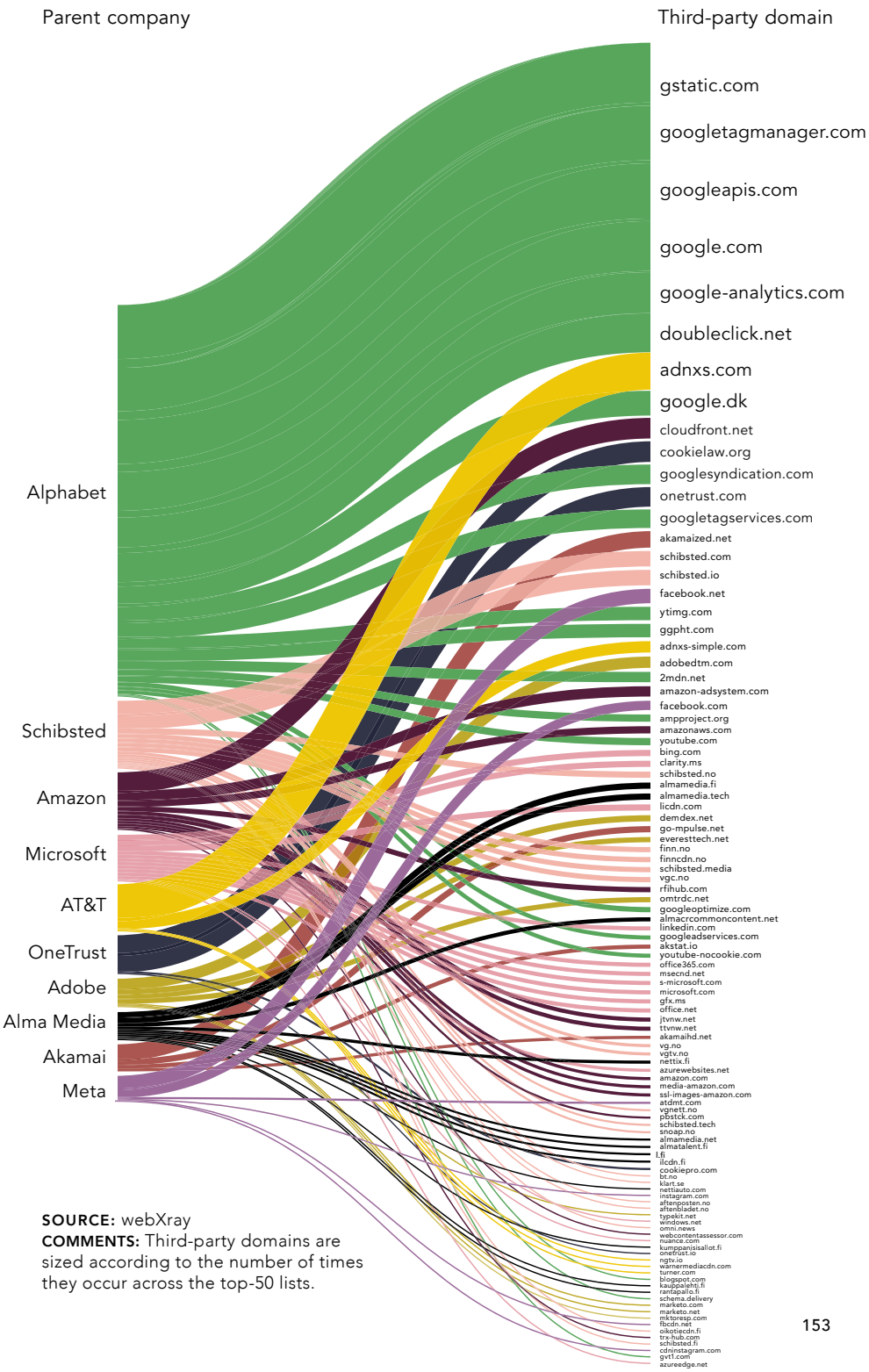
The data asset

The markets for providing digital third-party services and for trading in user data have only expanded since the first commercial attempts at "monetising eyeballs" online (Smythe, 1981). User data has received much tribute as the "new oil" (Yonego, 2014) of the economy while also being critiqued from various fronts as the foundation for surveillance capitalism (Zuboff, 2019; see also Couldry & Mejias, 2019; Sadowski, 2019). In a Nordic context, the evident datafication of a wide range of sectors and welfare services are increasingly addressed and critically discussed (see, e.g., Andreassen et al., 2021; Lammi & Pantzar, 2019; Rantanen & Koskinen, 2020; Tupasela et al., 2020), but empirical analyses of Nordic third-party data markets are few and far apart (for exceptions, see Knudsen et al., 2017; Norwegian Consumer Council, 2020). In this section, we therefore map and compare the ownership structures of the third-party services identified earlier, to give an account of the commercial power structures that shape how websites and apps operate.

Valleys of the North

Looking first at the companies that supply the vast swarms of web cookies and other third-party domains identified above, the power of Silicon Valley (i.e., US-based Big Tech corporations) is hard to miss. Figure 6.1 illustrates, (to the left) the top-10 companies that supply the highest number of identified third-party domains across the four countries and (to the right) their presence on the top websites.

FIGURE 6.1 Top-10 parent companies & their third-party domains, 2022



SOURCE: webXray
COMMENTS: Third-party domains are sized according to the number of times they occur across the top-50 lists.

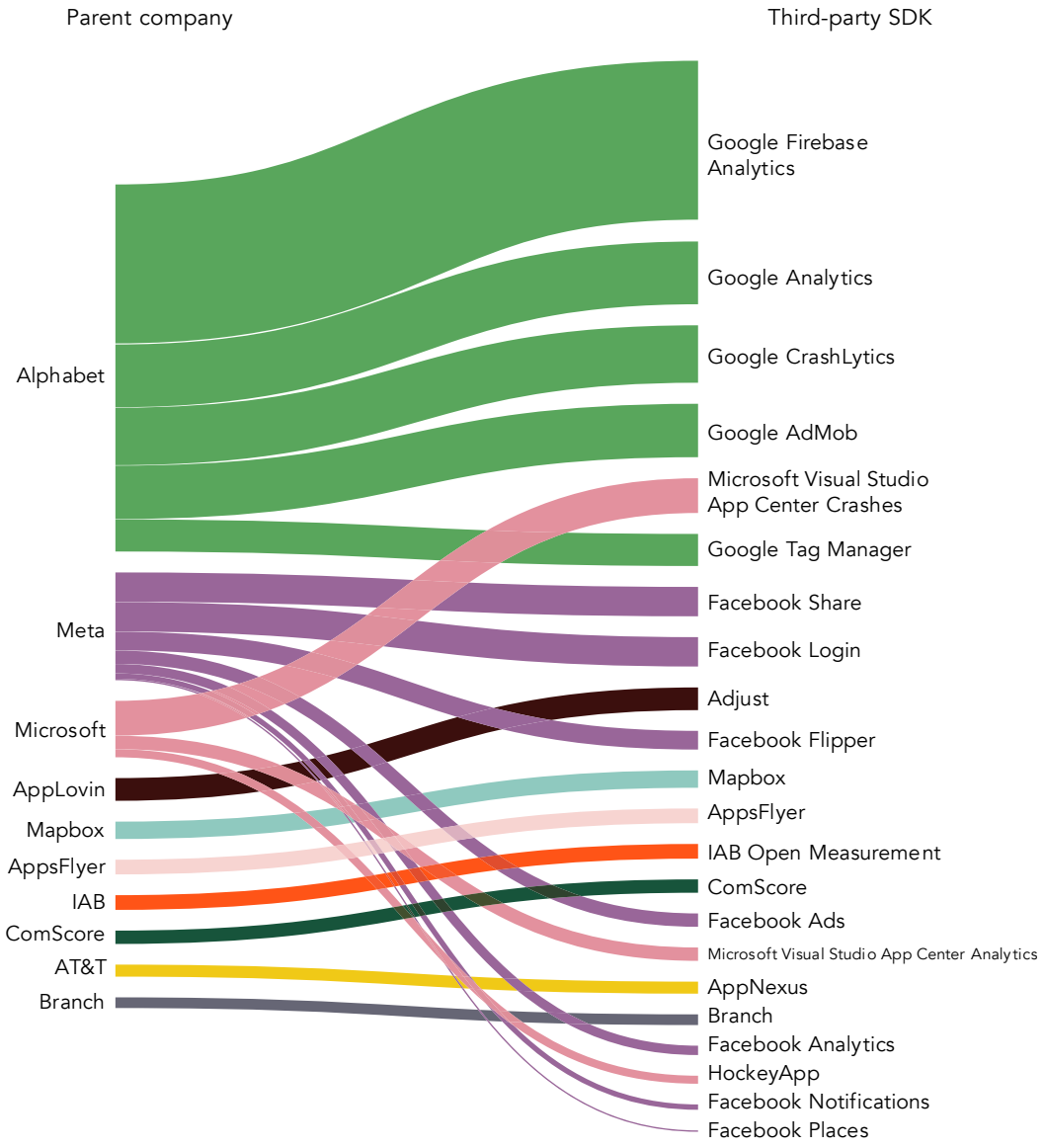
The top-10 companies own 838 (48%) of the 1,759 third-party domains across the countries' top-lists (again, sites that appear in more than one country, and thereby also their third parties, are duplicated). Among them, Google's mother company, Alphabet, stands out as the most dominant. Alphabet controls more than half (437) of the third-party domains supplied by the top-10 companies, which also amounts to a quarter of the total third-party domains. Of the 447 *unique* third-party domains, 20 can be traced back to Alphabet, and the company is present on 139 of the top-200 websites. The (far behind) second runner-up on the top-10 list of the most prevalent third-party companies is a Nordic legacy giant, namely Schibsted, that supplies 75 (4%) of the third-party domains and is present on 15 of the top websites (mainly due to its presence on various news sites).

The top-10 hints at a general tendency of a highly concentrated and globalised Nordic data market, where 82 per cent of the third-party domains linked to the top websites are owned by international companies, and 69 per cent reside outside Europe (almost exclusively in the US). The share of international actors is, however, not equally distributed between the four countries: Denmark has a higher share of both non-national actors (93%) and of non-European actors (84%), while the share of international companies is a little lower in Norway (75%). These differences most likely reflect the different web ecologies described in Chapter 5, where the Danish top-list contains a lower number of nationally owned websites, which are less likely to embed national third-party domains. Related to this, the share of legacy brownfield actors (e.g., telcos and newspapers) acting as third-party companies for websites other than their own is also limited (15%), especially for the Danish top-list (8%), compared to the share of digitally born greenfield actors (84% on the Nordic top-lists as a whole and 92% on the Danish top-list). It is important to note that these national variations are *not* representative of the broader web ecology but simply a reflection of the websites that made it into the top-50 – if a top-500 list had been available to us, the picture could be very different.

A concentrated realm

The power structures described above are even more clearly manifested when turning to the data market underlying the supply, functionalities, and business models of mobile apps. Mirroring the previous flowchart, Figure 6.2 illustrates the top-10 third-party companies (on the left) that deliver services (listed on the right) to the most-used Android apps in the Nordics. Importantly, we do not have access to similar data for iOS, but previous studies suggest a comparable bulk of top companies in iOS (Binns et al., 2018a) or even, as a result of Apple's newest privacy updates, a more condensed market than that of the Android system (Kollnig et al., 2022a).

FIGURE 6.2 Top-10 parent companies & the third-party SDKs they operate, 2022



SOURCE: Exodus Privacy
COMMENTS: Third-party SDKs are sized according to the number of times they occur across the top-50 lists.

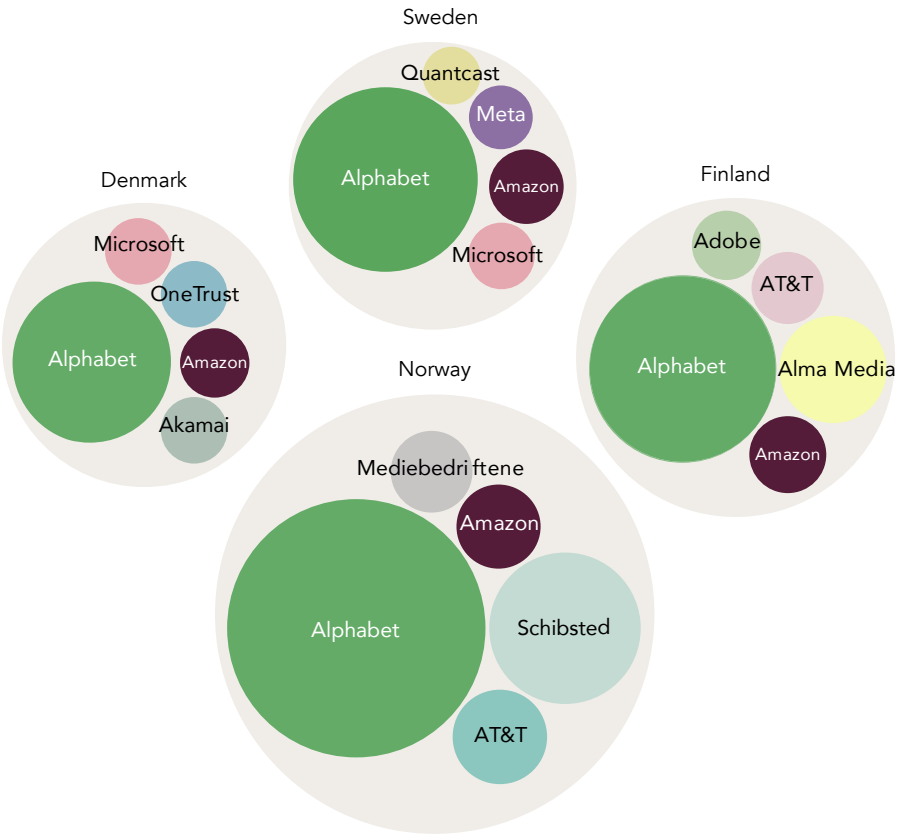
The top-10 third-party companies account for 83 per cent of the total number of embedded SDKs (N = 573) in the top apps, making for an even more concentrated third-party market than that of the web. Again, Alphabet stands out as *the* dominating market actor, controlling 48 per cent of the third-party services in the dataset and appearing as a third-party provider for 144 of the 200 apps. Unlike for the web market, where Facebook's parent company Meta holds a surprisingly limited position, the company is a strong player in the Nordic SDK market, where the Facebook Share (for sharing content directly from your app onto Facebook's platform) and Facebook Ads (for serving ads) SDKs are among the most-widely used. Another difference is that all the SDKs in top-10 are supplied by US-based companies, reflecting the striking fact that only 2 of the 573 identified third-party services (i.e., less than 0.5%) are nationally owned, and only 13 are supplied by brownfield companies (AT&T and Schibsted).

Looking at the four countries individually, the differences are minor (due to the homogeneity of the app market discussed in Chapter 5). Like for the websites, the apps appearing on the Danish top-lists have slightly fewer third-party services, and only one is owned by a brownfield actor (AT&T), while five of the SDKs in Norway and Sweden are owned by Schibsted. A few of the third-party services embedded on the Norwegian (3) and Swedish (4) top-lists are owned by companies based in the Nordics or other European countries, while the top apps in Denmark and Finland only use global (mainly American) third-party services.

Comparing data ecosystems

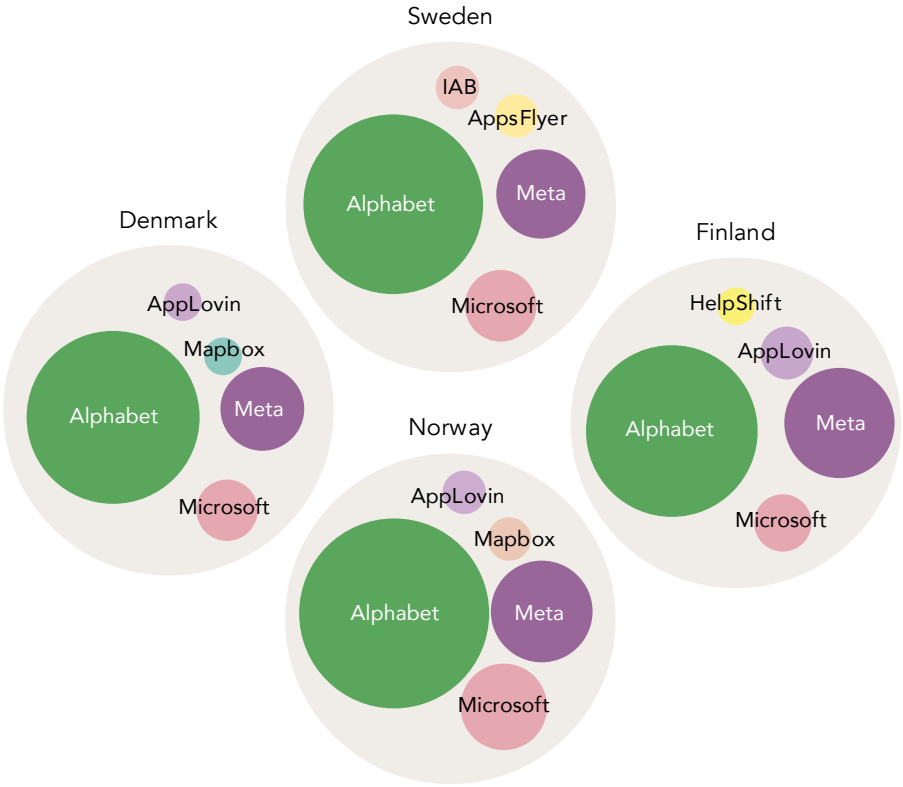
Taken together, the two analytical indicators (third-party web domains and app SDKs) tell a story of a highly datafied and globalised market for website and app development and provision. The power of Big Tech, born in the early days of the digital goldrush, is indisputable when looking at the control of the data infrastructures that support mundane communication activities across platforms and devices. Figures 6.3a and 6.3b compare the four countries by looking at the five largest third-party companies providing data infrastructures for websites and mobile apps. Sizing the companies according to their number of third-party web domains and SDKs, the figures show that Norway and Finland have a higher representation of national legacy companies (Schibsted and Alma Media) acting as powerful third-party providers on the web. The rise of the mobile data market, however, seems to erode these national differences, creating a more homogeneous and globalised third-party ecosystem in the region, where national legacy actors are pushed to the peripheries (Binns et al., 2018b).

FIGURE 6.3a Top-5 third-party service providers for top-50 websites in Denmark, Finland, Norway, & Sweden, 2021



COMMENTS: Sized according to their number of third-party domains in the dataset.
SOURCE: webXray

FIGURE 6.3b Top-5 third-party service providers for top-50 apps in Denmark, Finland, Norway, & Sweden, 2021



COMMENTS: Sized according to their number of third-party SDKs in the dataset.
SOURCE: Exodus Privacy

Linking the prevalence of third-party domains and SDKs to the ownership of the websites and apps embedding them, Table 6.4 shows that nationally owned websites and apps tend to embed a much larger number of third-party trackers (on average, 11.7 third-party domains for websites and 4.3 third-party SDKs for apps) than their internationally owned counterparts (on average, 6.5 third-party domains and 2.5 third-party SDKs). Also, websites operated by brownfield companies tend to embed more third-party services (on average, 12.9) compared with websites owned by greenfield companies (on average 4.9).

TABLE 6.4 Average number of third-party services by type of ownership, 2022

	National application ownership	International application ownership	Brownfield application ownership	Greenfield application ownership	Total
Average third-party domains on websites	11.7	6.5	12.9	4.9	8.8
Average third-party SDKs on apps	4.3	2.5	2.9	2.9	2.9

SOURCE: webXray, Exodus Privacy

This points to the skewed power balance between Nordic and global (primarily American) companies, where the former depends on the latter for carrying out a multitude of different technical and commercial services. It confirms that whereas smaller Nordic companies hinge on the use of third-party services provided by Big Tech, platforms such as YouTube and Facebook have these tools in-house. It also speaks to the finding above suggesting that the multitude of global and American sites and apps on the Danish top-lists correlates with a relatively smaller portion of embedded third-party services. It does not, however, mean that Danes are less tracked than other Nordic citizens, but rather that tracking happens through other technologies (fingerprinting, etc.), with fewer companies controlling the information.

Datafication of welfare

Extensive data collection and registration are not new to the Nordic welfare states, where a wide range of public services are based on rigorous recording of citizens' lives – from the earliest movements in the womb to the assignment of social security numbers, testing of children in kindergartens and schools, calculations of social benefits, tax reports, medical journals, and much more.

The region is famous (and infamous) for its social welfare systems and for the high degrees of trust that citizens generally hold in the authorities assigning the benefits and keeping track of their personal information (Delhey & Newton, 2005). However, the public digitalisation project described in the previous chapters has fundamentally altered the conditions for these long-lasting processes of datafication – both by introducing new modes of data collection and processing and by replacing the very infrastructures that support key welfare functions with digital technologies that are, as discussed previously, tightly knit into the global data ecosystem and its economy. As such,

> [the] datafied welfare state raises questions not just about the ways in which decisions and practices in public administration are organized, but about their contingency on a particular process that threatens to displace the very public infrastructure upon which the welfare state is built. (Dencik, 2021: 160)

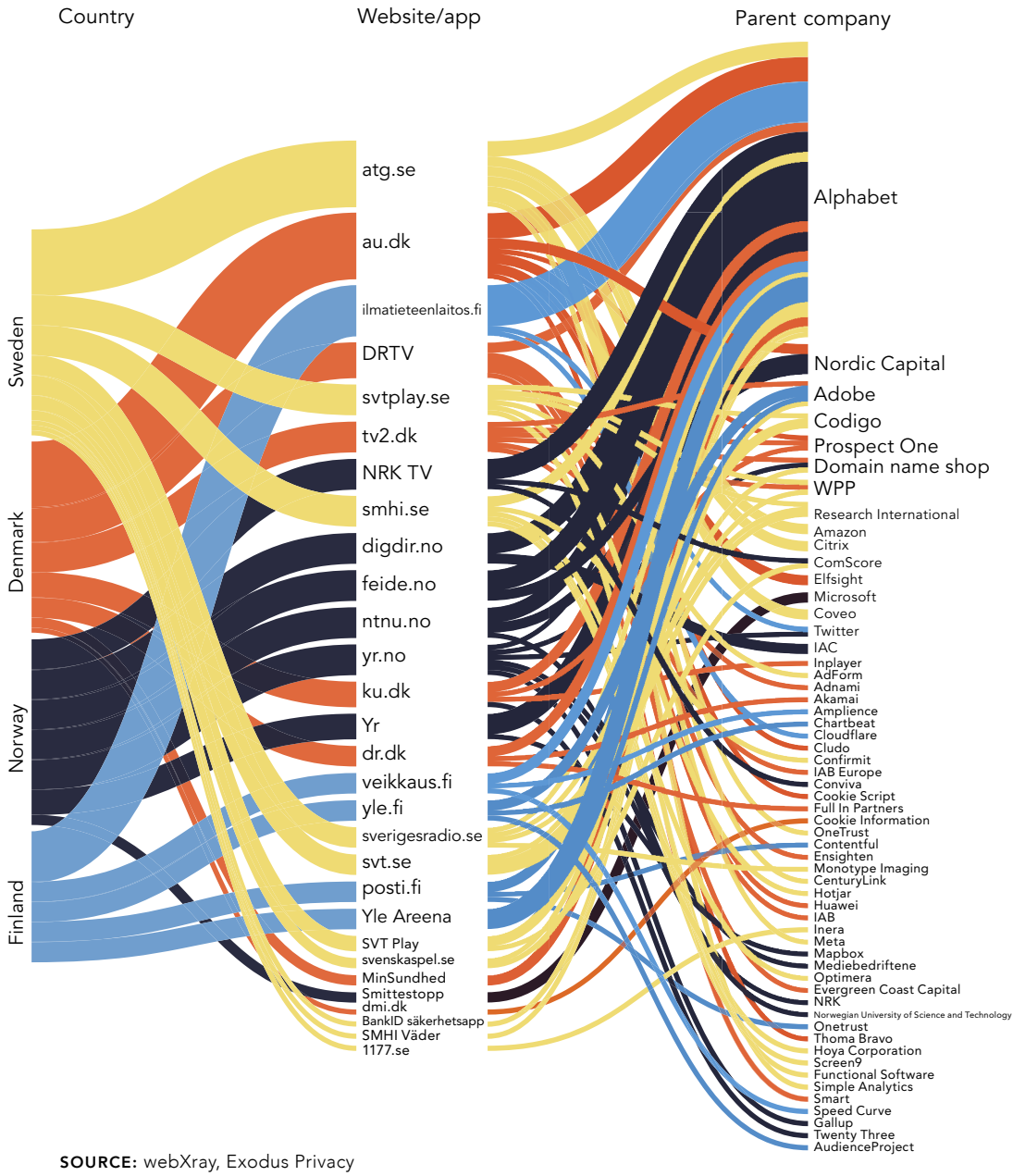
The datafication of the Nordic welfare states is thus not only a matter of governmental bodies and state authorities collecting, storing, and processing vast amounts of citizen data. It is also about an increasing reliance on commercial market actors supplying the underlying infrastructures that enable the provision of digital welfare services. Contributing to nascent critical discussions within academic communities and well as the political system, we investigate how the Danish, Finnish, Norwegian, and Swedish welfare states both depend on and respond to the datafication processes described above. Instead of measuring the (non-existent) public ownership of third-party services, we zoom in on the publicly owned applications from Chapter 5 to measure their uses of third-party services and thereby map out the infrastructures and market actors that support the digital undertakings of Nordic welfare states. In continuation, we discuss the political initiatives that have already been taken and reflect on how ongoing and future actions might – or might not – change current datafication processes in welfare states.

Servicing the public

Focusing on the state-owned applications in the larger sample of top websites and apps, Figure 6.4 illustrates their uses of third-party services. It overviews a total of 29 publicly owned websites and apps (in the centre of the figure) – ten in Sweden, seven in both Denmark and Norway, and five in Finland – that connect to 144 third-party services owned by 58 different parent companies (to the right in the figure). The four countries are sized and ranked according to the number of publicly owned websites and apps they have as well as the quantities of third-party services those sites and apps embed. Towards the top of the figure, we find the Swedish gaming authorities (atg.se), the University of Aarhus in Denmark (au.dk), the Finnish meteorological institute (ilmatieteenlaitos.fi), as well as the Danish and Norwegian public

service broadcasters' streaming outlets (DRTV and svtplay.se). Towards the bottom of the figure are applications for identification services and health systems, including Covid-19 tracing apps like the Norwegian Smittestopp.

FIGURE 6.4 State-owned websites and apps and their third-party parent companies in Denmark, Finland, Norway, & Sweden, 2022



SOURCE: webXray, Exodus Privacy

As a common denominator for both the most- and the least-tracked public applications, the parent companies that supply and operate the third-party data infrastructures are largely commercial, often American businesses like Alphabet, Adobe, and ComScore. There are, however, also Nordic and European actors among the most prevalent parent companies, including the Copenhagen-based company Nordic Capital, Krakow-based Prospect One, and London-based WPP. Compared to the full sample of the most-used sites and apps, the bulk of companies involved in supplying third-party data infrastructures for the provision of welfare state services is more diverse (even if Alphabet still comes out on top). The sample underlines the need for critical scrutiny of the ways (particularly American) Big Tech engages in the data collection practices of the welfare states relying on externally provided infrastructures.

Cookie rules & mobile vacuums

According to the Internet Privacy Index (BestVPN, n.d.), Denmark, Finland, Norway, and Sweden are all in the global top-5 when it comes to protecting users' privacy online. As a recent pushback against commercial datafication and third-party data vendors, various legislative initiatives have been taken, most notably targeting the web cookie infrastructure. Specifically, all four Nordic countries have adapted their political frameworks to comply with the European Union's ePrivacy Directive – in popular terms, the cookie directive (European Parliament & The Council, 2009) – and the General Data Protection Regulation (European Parliament & The Council, 2016). The directives stipulate that digital data collection must be formally consented to through pop-up cookie consent declarations, the collection of user data must be kept to a minimum, user data must be stored for a limited period of time and serve a legitimate purpose, and user data cannot be distributed to others. While the responsibilities for enforcing the cookie directive is managed by varying authorities in the different countries (e.g., the National Communication Authority in Norway and the Business Authorities in Denmark), the enforcement of the General Data Protection Regulation lies with the national data protection bodies (the Swedish Authority for Privacy Protection, the Finnish Data Protection Ombudsman, the Danish Data Protection Agency, and the Norwegian Data Protection Authority).

Accompanying these legislative frameworks, Nordic data protection bodies have recently launched investigations into third-party data infrastructures. These actions do not compare in scope to pushbacks against the data practices and market powers of American Big Tech corporations by other European countries

– for example, the French data regulator fining Google, Facebook, and Amazon for violating e-privacy rules as well as the General Data Protection Regulation (Braun, 2022) or the German Bundeskartellamt (2019) prosecuting Facebook and Amazon for antitrust violations and breaches of privacy rules. Yet, they are testimonies to shifting political attitudes: The Danish Government has established several bodies including the Office for Tech Giants and the Office of Denmark's Tech Ambassador (Ministry of Foreign Affairs of Denmark, 2021) to look into the power of Big Tech across Danish society; joining a European coordinated effort (European Data Protection Board, 2022), the Finnish Data Protection Ombudsman in 2022 launched an investigation of the use of cloud-based services in the public sector; and in 2020, the Swedish Authority for Privacy Protection (2020) fined Google for violations to the General Data Protection Regulation. Being particularly active in campaigns against untransparent data harvesting and distribution, the Norwegian authorities have published several reports uncovering third-party data flows (Norwegian Consumer Council, 2018, 2020), launched an investigation into particularly the use of Google Analytics by the Data Protection Agency (Datatilsynet, 2022), suggested a ban against all surveillance-based advertising (Thon et al., 2021), and most recently fined Meta NOK 1 million per day for privacy breaches in their behaviour-based marketing strategy (Datatilsynet, 2023).

Despite this increasing regulatory attention and political debate, *enforcements* of regulations for global Big Tech are limited – particularly at the level of data infrastructures. As a consequence of the current regulatory approach, and more specifically the lack of monitoring of third-party markets, the cookie consent declarations (still) stand as the last bastion between users and immense data harvesting, leaving business models that are fuelled by so-called informed consent to pass under the radar (Nissenbaum, 2011). This regulatory vacuum is particularly evident when zooming in on the market for mobile datafication. As of this writing, rules like those enforced by the cookie directive do not apply to the use of third-party services in apps (Binns et al., 2018a). While more and more communication – interpersonal, networked, public, and private – moves to mobile platforms, data harvesting moves back into to shadows, since established frameworks are designed for the web.

The current waves of political initiatives and critical discourses addressing the state of the global data economy makes forecasts about the future difficult. The new Digital Services Act (also discussed in Chapter 5) sets out to increase user protection and transparency around the collection of data and

thus aims to follow up on the shortcomings of the General Data Protection Regulation. Yet we cannot at the time of writing predict the effects and concrete regulatory interventions following it. Moreover, a number of recent examples of self-regulation seem to increase the autonomy of mobile-app users when it comes to different privacy measures (e.g., Apple enabling users to opt out of third-party tracking on iPhones through the App Tracking Transparency update to iOS-14 as well the implementation of Privacy Nutrition Labels in the App Store). Yet, recent studies find that such measures do not limit tracking of users altogether but rather concentrate the tracking capacities to fewer, and bigger, companies (like Apple) (Kollnig et al., 2022a; see also Kollnig et al., 2022b).

Blocking the data hose?

Like the previous analytical chapters, the results presented here should be considered in the context of the methods used to collect and analyse the underlying datasets. The empirical material is collected through various reverse-engineering strategies developed for scrutinising data infrastructures. While we stand on the shoulders of work that eases this process by offering software (webXray) or building databases (Exodus Privacy), the scraping and analysis of third-party infrastructures and their markets are laboursome tasks. Moreover, such research interventions are constantly under siege from commercial actors threatening with lawsuits (Sandvig et al., 2016; Volz, 2016), closing down so-called data hoses in the form of application programming interfaces (Bruns, 2019; Perriam et al., 2019; Venturini & Rogers, 2019), or changing the design of their services.

When it comes to third-party services on websites, the webXray tool is just one of many options for venturing into this quite developed field of empirical studies (others would be Firefox's Lightbeam extension, Ghostory's database, or the Digital Methods Initiative's Tracker Tracker Tool, to mention a few). Despite these caveats, the cookie technology has for some time now been under pressure from various angles, leading Alphabet – the most prevalent third-party service provider – to exclaim that it will abandon the technology in Chrome altogether by 2023 (Bohn, 2021; Burgess, 2022; Chromium Blog, 2020). By all comparisons, studies of mobile tracking technologies are fewer and further apart, as are publicly available tools and databases for studying them empirically. The SDK ecology makes up a much more complex and closed off system, leaving researchers obliged to accept a wide range of methodological disadvantages. These include the lack of libraries that are not Western-centric, meaning that Russia, for instance, might play a much larger role in the mobile ecosystem than what our analyses indicate.

This calls for developing and improving existing knowledge and methods on mobile third-party services.

Leaving the methodological discussions for now, we end the chapter by summing up three important take-aways from the analysis of data infrastructures, markets, and regulation in the Nordics: First, the free access to highly used applications such Facebook, Instagram, Google Search, and so forth is entirely dependent on the collection and reselling of user data. The ever-growing data economy thus serves as a foundation for the Big Tech corporations' competitive advantages (over, e.g., legacy newspapers and other institutions). It also pushes infrastructural investments needed for transporting more heavy loads of data faster in order to serve large algorithms, keep advanced ad exchanges running, and so forth. In other words, advances in the data economy spark developments in the access network, backbone, and application layers. Alphabet's and Meta's recent ventures into the market for Internet service provision as well as massive backbone investments like the Mermaid cable and local data centres are built on the fortunes made from, primarily, commercial activities in the data layer.

Second, and relatedly, the power of Big Tech is most easily observed at this layer: There is a clear discrepancy between the more nationally oriented application market and the globalised and entirely commercial data market. As a consequence, website and app providers often compete with Big Tech corporations (for viewership, ad revenues, etc.) while also depending on them for both technical and commercial purposes. In other words, application providers feed the beasts that are simultaneously killing off their original business models. Similar to circumstances in the access network layer, the evolution of the Internet as a basic societal infrastructure constitutes an immense and almost existential dilemma for legacy actors: When positioning themselves in the digital realm, they stay relevant to the users but simultaneously hollow out their original business models by engaging in a competition that is uneven from the start.

And finally, the increasing reliance on Big Tech by various welfare institutions and sectors – from news media and broadcasters to healthcare and social services – is slowly transforming the technological, economic, and regulatory foundations of individuals' everyday communications as well as the Nordic welfare states. Our analyses show how conditions for engaging in mundane digital activities as well as for providing welfare services are to a wide extent controlled by a few US-based companies who have taken over the role as incumbent infrastructure providers without having to succumb to the requirements and responsibilities that former monopoly institutions were faced with. The absence of public ownership

of third-party services represents an important finding that illustrates the diminishing power of the welfare state as a supplier of vital communication infrastructures. The growing reliance on commercial technologies that are increasingly considered proxies for data security contributes to naturalising and legitimising the infrastructural power and societal position of Big Tech (Dencik, 2021; Mansell, 2017a).

PART III

ROUTES

CHAPTER 7

A waltz

The welfare state reconfigures social welfare into a problem that necessarily has to be optimized computationally rather than engaged with through human experience and expertise, and embeds social welfare within an ecosystem that endlessly perpetuates this reconfiguration.

DENCIK, 2021: 160

The past four analytical chapters have cut across prevailing and persistent silos, be they sectoral ones between the media and the telecommunication industries, regulatory ones between cultural and business policies, or academic ones between the fields of media studies and computer science – to mention a few. In moving between these silos, Chapters 3–6 may risk coming across as four entirely different accounts of vastly dissimilar types of infrastructures and communications. Yet at the same time, this analytical convergence reflects a reality that does not confine itself to any of the silos that were once so engrained: Whereas John F. Kennedy's 70-year-old love letter travelled largely in accordance with the boundaries of national postal systems and their regulations, the love message of today could take many different paths, crossing a much more complex and multifaceted set of infrastructures, markets, and states on its way (Share Lab, 2015). These wide-ranging value chains, dispersed market structures, and opaque governance forms constitute a cognitive enigma as well as a practical challenge for researchers seeking to understand the structural arrangements surrounding Internet-based communication. They are also an inescapable consequence of the rise of digital communication systems.

To explore the interdependencies between the infrastructural layers of access networks, backbone technologies, applications, and data, and the structuring forces of infrastructures, markets, and states, we discuss in the following how digital communication systems in Denmark, Finland, Norway, and Sweden have evolved – from early phases of institutional continuity

to later phases of extensive transformation of the material premises for organising and controlling societies. More specifically, we assess the material foundations for digital communication, the market power of Big Tech, and the institutional features of the Nordic countries that shape the datafied welfare states of 2020s (Andreassen et al., 2021; Dencik, 2021; Dencik & Kaun, 2020). In doing so, we revisit the questions raised in Chapter 1 and discuss how our study contributes to emerging understandings of political economies of Internet infrastructures across contexts. Finally, we round up the methodological discussions that have emerged throughout the book by addressing the broader implications for empirical research into the contemporary digital communication environment.

Big Tech & the welfare state

Each of the analytical chapters approach the six subdimensions developed in Chapter 2: digitisation of infrastructures and digitalisation of communication; market disruption and globalisation; and state facilitation and intervention. While these phenomena can be observed separately within each of the analytical layers that we have zoomed in on in the previous chapters, they can also form the basis for a broader discussion of the complex dynamics of digital communication systems at large.

Material & social heritages

In examining and comparing the infrastructural processes of digitisation and digitalisation, our analyses have touched upon ongoing, if not eternal, questions of whether humans shape technologies or if it is the other way around. Despite the growing interest in the mutual influence of material infrastructures and social arrangements, researchers continue to struggle with this problem of causality (Jensen, 2013; Sandvig, 2013). Applying a sociotechnical perspective that emphasises technological innovations as reflecting cultural, economic, and political circumstances, the comprehensive roll-out of broadband infrastructures and uptake of digital technologies in the early 1990s and 2000s can be interpreted as a natural outcome of the institutional legacies of the Nordics.

Historically, the region is known for its high penetration of media and communication technologies, for being financially resourceful, and for welfare policies that have framed new communication technologies as public and universal goods. Early digitalisation strategies in general (and with important exceptions such as the Swedish infrastructure investment strategies) favoured a demand-driven uptake of digital technologies, considering the sociocultural digitalisation of the Nordic societies as a prerequisite for the infrastructural digitisation – rather than the other way around. The evolution of digital communication system infrastructures in the largest Nordic countries is

thereby part of an institutional and social history, where the Internet is one in a series of technologies that have been introduced, institutionalised, and integrated into broader welfare models.

From a more technologically deterministic perspective, the same digitisation processes serve as transformative forces that alter human activities and societal structures. In this view, the emergence of digital communication systems is not just another chapter in an ongoing and path-dependent tale of social history, but rather an important turning point that reconfigures the entire material foundation for Nordic societies (and beyond). That is, focusing on the material affordances of the Internet draws attention to the fundamental differences between analogue and digital communication technologies, such as the discrepancies between national or global distribution systems, content stored at central locations or at the peripheries, and dedicated network services or convergent, general-purpose technologies. In other words, digitalisation was not only a deliberate political strategy, but also constitutes a significant reconfiguration of the material basis for policymaking, regulation, and commercial market structures.

Taking this materialist argument a step further, the successful digitalisation of the region was also rooted in already existing and highly developed infrastructures supplying electricity, telephony, television, and so forth. Rather than being a mere outcome of political decisions and ideological traditions, the swift digitisation of the Nordic communication systems thereby rested on an infrastructural foundation that shaped the development of specific broadband infrastructures (e.g., the development of Internet connections based on copper wire, coaxial cable, mobile frequencies, or optical fibre). The material features of these broadband technologies, and later the distinctions between web-based and mobile application infrastructures, further influence the ways they are and can be regulated and controlled (as exemplified in the differences between mobile frequency allocation and terrestrial broadband policies or regulation of, respectively, web- and app-based third-party data).

These institutional and materialist interpretations of our empirical findings illustrate how the analyses of the infrastructural layers of the Digital Communication System Matrix do not align with either of the two theoretical poles. Instead, they point to a mid-way perspective similar to Thomas P. Hughes's (1987, 1993, 1994) theory of momentum, briefly discussed in Chapter 1. Like Hughes, we argue that social constructivism and technological determinism are both valuable theoretical lenses for capturing the forces that shape infrastructural developments, but they are suited for understanding different periods in the lifespan of a given technology.

In the early phases of Internet evolution, sociocultural (material) conditions, economic incentives, and political decisions were important factors in introducing and adapting the Internet technology to the Nordic context. Young digital communication systems were, in other words, shaped by their

domestic and historical contexts where national and often state-owned telcos supplied the connections and underlying backbone infrastructure, while legacy media invested in and developed the earliest websites to distribute their content digitally.

In later phases, the comprehensive digitalisation of the Nordic societies has inevitably transformed the material foundations for the welfare state and fostered a critical dependence on technologies controlled by entirely different institutional logics and values than the ones associated with the Nordic welfare systems. The rise of a wide range of over-the-top services has relieved the former dedicated distribution systems (e.g., postal services, print, landline and mobile telephony, broadcasting, etc.) and thereby challenged the business models that funded the initial waves of digitisation and digitalisation. The first generations of Internet infrastructures (e.g., submarine cables, copper wire connections, websites, and cookie technologies) are currently being replaced with newer iterations, often supplied by other market actors, and based on alternative (and walled-off) business models. This reconfiguration of the material basis for digital communication, and of the underlying power structures, challenges regulative frameworks developed for analogue communication systems and thereby creates a "crisis of control" (Beniger, 1986) that is still in the process of being solved.

Move fast & break things

Investigating how digital communication is organised and controlled through the ownership of critical infrastructural resources, our analyses also contribute to ongoing debates about the power of global Big Tech corporations and processes of market disruption and globalisation. The power of Big Tech is – not surprisingly – most easily observed in the markets for applications and data, where US-based companies originating in the Silicon Valley–goldrush of the 2000s supply the most-used websites and apps, while also dominating the provision of third-party data services. Through their supply of operating systems, hosting services, and a wide range of tools for data processing and monetisation, corporations such as Alphabet, Apple, Meta, and Amazon control important links in the value chain that other actors depend on for keeping their online businesses alive.

Part of our analyses, however, also aligns with recent studies of the geopolitical economy of the Internet finding that "the United States […] does not rule the 'guts and the gears' – the hardware, the material infrastructure – of the Internet" (Winseck, 2019: 115). The access network market, for instance, continues to be largely inhabited by national telecommunication operators such as the incumbents Telenor, Telia, Elisa, and TDC. The backbone network market consists of a diverse group of telcos, utility providers, national IT companies, and platform players moving into the business of supplying, for example, submarine cables (Plantin & Punathambekar, 2019).

Yet, as we have shown throughout the book, the nationally and historically anchored telecommunication and media sectors have lost their former strength and prominence in the communication system, due to cancelled subscriptions and intense competition from digital newcomers and over-the-top services. This significantly debilitates their investment power and ability to ensure the competitiveness of their products (especially when competing with global and highly innovative market actors). As older "guts and gears" are currently being replaced by newer models – from submarine cables to Internet exchange points, content delivery networks, and future satellite connections – the power of Big Tech becomes evident. Beyond the confines of the Nordics, we see large platform owners laying new and extensive submarine cables connecting the African continent as well as parts of South America and Asia, while also offering access network services through different zero-rate initiatives, such as Meta's Discover (formerly FreeBasics) or SpaceX's StarLink.

Furthermore, as emphasised by multiple platform studies (Plantin et al., 2018; Poell et al., 2019), infrastructures like operating systems, developer tools, and tracking technologies are essential material components (guts and gears, if you will) in contemporary digital ecosystems that allow Big Tech to further cement its power across the value chain. Alphabet has, for instance, positioned itself at the very core of Nordic (and global) application and data markets by supplying a wide range of services that allow developers to "build everything with Google" (Google for Developers, n.d.). As a counter-provocation to the argument against American hegemony (Winseck, 2019), our analyses thereby indicate that in the Nordic region, a few (US-based) companies control increasingly larger shares of a digital value chain that was once in the hands of a varied collection of disparate (national and regional) actors.

This reflects an ongoing shift in the infrastructural power balance where national, legacy gatekeepers are increasingly being replaced by global corporations that are "born" digital. The first group of brownfield actors had clear advantages in the early phases of Internet evolution, where they could use their historical market positions, economic and technological resources, and existing assets (in the form of established infrastructures or content genres) to launch an additional digital presence that supplemented their main businesses (of, e.g., providing phone subscriptions, broadcasting commercial television, or selling news and ads). In contrast, the latter group of greenfield actors had to build their businesses and market positions from scratch, without existing revenue streams to support the necessary infrastructural investments. In the later phases of Internet evolution, brownfield actors, however, struggle to protect their original business models from digital alternatives, while investing heavily in keeping up with technological developments. Greenfield actors can, on the other hand, focus on their core digital business – and expand into others – while basing their ventures on a much broader (global) market than the national companies.

Our comparative analyses are also testimonies to the many directions that technological developments can and do take – also in contexts that share a long history and are as institutionally and culturally similar as the Nordics. One example can be found in the contrast between Norway and Denmark when it comes to digital market developments: Norway has followed a path where large national actors, like Schibsted and Telenor, have maintained powerful positions in the national and neighbouring markets by developing highly used digital outlets and third-party services, or by protecting and extending the original business of offering (fixed) broadband connections. In contrast, backbone infrastructures in Denmark are increasingly owned by international commercial companies, the web and app spheres are highly globalised, and the Danish data market is concentrated around a few Big Tech corporations. The seemingly similar systems of the Nordic countries thereby diverge when it comes to the resilience of traditions, values, and market dynamics that characterised the Nordic welfare states' media and telecommunications sectors of the twentieth century.

Public service 2.0?

Directing attention towards the political systems and their ability to influence the structural conditions surrounding communication, our analyses engage with fundamental discussions about the role of the (welfare) state in contemporary digital societies. Corresponding with the historical arguments made previously, we identify a paradox in the ways state policies and digitalisation processes mutually influence each other: Whereas early digitalisation strategies echoed welfare ideals of universalism and communication technologies as public goods, the success of these strategies has led to a comprehensive commercialisation of the communication system that undermines key welfare institutions and the efficacy of existing regulatory frameworks.

The fast and successful implementation of the Internet as a common and increasingly dominating societal infrastructure has created regulatory vacuums and challenges that state authorities struggle to identify and, even more so, push back against. While significant state subsidies have been allocated to make up for the declining business models of telecommunications providers, postal services, and newspapers, the underlying infrastructural arrangements and business models that ground over-the-top services continue to be black-boxed and fly under the radar of regulators (Flensburg, 2021). Reforms of existing media policies have attempted to include digital outlets, yet users continuously move to new platforms that fall outside the categories of "media" and which are provided by companies that do not reside under Nordic jurisdictions.

Assessing the role of Nordic welfare states in the digital age thus depends on one's analytical perspective. If we focus solely on the sustainment of welfare discourses and attempts to reform existing (media) policies, we might confirm existing notions of the Nordics as prime examples of democratic

corporatist systems or media welfare states (Enli et al., 2018; Humprecht et al., 2022; Kammer, 2016; Syvertsen et al., 2014). If we instead consider the efficacy of the political frameworks and the reliance on data infrastructures for (the provision of) basic welfare services, our assessment of the adaptability of the welfare regime will be the opposite. We might then ask the devotees of the media system and media welfare state typologies how the increasingly globalised and privatised infrastructures supporting digital communication align with the notion of communication technologies as a public good; how effectful institutionalised editorial freedom and cultural policies are in a communication environment where public debates and information dissemination largely take place on platforms that are unaffected by content quotas and established ethical control schemes; and how resilient the traditions for consensual and corporatist negotiations between stakeholders are in a world where global Big Tech can pull the plug on national communication infrastructures (as already seen elsewhere in the world).

By looking beyond official statements, discourses, and goals and investigating the structural and material conditions for the Nordic welfare states, we become aware of the foundations that the societal developments of the twentieth century rested on. That is, the institutional characteristics associated with Nordic media and communication systems were intrinsically linked to a historical period of economic growth, political stability, and nation-state supremacy that enabled a comprehensive redistribution of goods, the development of a strong public sector, and the introduction of a wide range of social benefits (Hilson, 2020). While larger economies chose a more capitalist path, the Nordic countries found a middle-way between libertarian and socialist ideals, where the state compensates for potential market concentrations and provides non-commercial alternatives.

Looking at the current debate on digitalisation, there is a clear ideological continuity, emphasising a continued – if not increased – need for the state to ensure a well-functioning public sphere through, for instance, subsidising news media and supporting public service broadcasting. Yet, the disruption of national economies and the weakening of legacy institutions significantly challenge the foundation for the continued build-out of welfare services and the institutions' independence and self-governance. The recurrent economic aid packages for legacy sectors raise important questions about media independence and unfair competition, but they also stall (public) investments in establishing alternative digital (public) infrastructures. These processes are self-reinforcing, insofar as the reliance on international and commercially supplied services feeds a global industry that continues to challenge existing revenue streams and national tax systems, thereby hollowing out the economic underpinnings of the welfare state.

Importantly, the welfare systems have also benefitted tremendously from the Internet, insofar as it has revolutionised key welfare processes – from social casework over tax systems to payments of public benefits and beyond: "the

ideology of dataism has become increasingly entangled with welfare provision" (Andreassen et al., 2021: 207). While welfare systems long before the Internet depended on various datafication technologies to orchestrate the distribution of goods in society, many attempts are now being made to harness the advantages of digital systems for further quantification, qualification, and optimisation (Fourcade & Gordon, 2020). Digital technologies are in many ways a perfect fit for Nordic welfare states, as they allow public authorities to document and systematise their existing case and data work. The digital refinements of established datafication practices have, however, also embedded key welfare state services in commercially governed surveillance infrastructures.

When Covid-19 developed into a global pandemic in 2020, and nation-states around the world were faced with immense challenges of creating sustainable architectures for collecting and storing health data, launching digital certificates, tracing infected citizens, and so forth, Big Tech corporations lined up with answers to critical questions about data and cyber security. These included the unusual collaboration between Apple and Alphabet to develop contact tracing technologies, or Amazon's assistance to nation-states scrambling to come up with solutions for hosting the large quantities of data that follow from initiatives like the Covid-19 passports. In the midst of the pandemic, crisis measures and quick-fix solutions drew attention away from the commercial aspects of these technologies and the data they harness, and towards the health benefits of them, thereby further naturalising the infrastructural power of Big Tech (Lai, 2021; Taylor et al., 2020).

When making these provocations, it is important to again recall the national variations that we observe across the region, and which we summarise in the final chapter. A broader comparison of countries that includes other types of regimes might sensitise us to distinctive features of the Nordics that reflect former typologies and historical path dependencies. Furthermore, the current political momentum and growing critiques of the contemporary institutionalisation of digital power can lead to future interventions in the forms of digital public infrastructure projects (Zuckerman, 2020), break-ups of anti-competitive market actors (Taplin, 2017), or bans against surveillance-based business models (Zuboff, 2019). The Nordic welfare states have, in the past, been able to find solutions that cater to both consumer needs and commercial interests (Castells & Himanen, 2002) by providing viable non-commercial alternatives. However, we have yet to see convincing and comprehensive strategies for shifting the current infrastructural power (im)balance.

At the mercy of the objects we study

In a curious catch-22, the skewed power balance also manifests itself it the methods used for both data collection and data analyses throughout this book. Being a critical infrastructure for communication as well as research, the Internet and the applications it carries both enable and constrain empirical

interventions. Internet infrastructures are, in this sense, both the object of study and the means by which to carry out our research. As we discuss throughout the book, our findings rely on empirical data gathered through flawed and volatile methods. We have made no efforts to hide or beautify the empirical foundations of our analyses – rather, we perceive the methodological challenges as important insights and findings in their own right. These methodological challenges can be collected under three overall themes that defer and discourage researchers from embarking on comprehensive, empirical explorations of contemporary digital ecosystems.

First, as covered in the literature on digital methods (Rogers, 2013; Venturini et al., 2018), these types of research interventions often face problems related to questions of validity, reliability, and generalisability. Such problems, in turn, relate to the ephemerality of the data produced, the methods' reliance on open sources and tools, and the inaccessibility of populations, samples, and sampling criteria. This is particularly evident in our analyses of backbone networks, applications, and third-party services, where we rely on open data repositories, commercial measurement systems, and tools for reverse engineering that depend on activist initiatives. As a central feature, analyses that rely on digital methods are carried out, for better or worse, on the premises of the very same platforms that researchers aim to study (Venturini & Rogers, 2019). This relates to the second theme continuously touched upon throughout our analyses, namely the commercial embedding of the objects we study.

With a few exceptions, our analyses rely on commercial services often developed for purposes other than research. Being valuable assets in the digital economy, the infrastructures we study are governed by commercial logics of opacity and obfuscation (Draper & Turow, 2019). In effect, the tools and services that are built on top of them can be shut down if they are deemed bad for business or simply not profitable (as seen with the recent examples of Amazon closing the Alexa web measurement service or Meta restricting access to the Facebook API). This creates an uneven power balance between researchers and infrastructure providers that is exacerbated by the fact that these corporations have economic and technological muscle power that far exceeds the departments of even the largest universities in the world. As a (meta) comment to the overarching conclusions of the book, we, as researchers, also contribute to the naturalisation of Big Tech's power and position as critical societal (and research) infrastructures when using these resources. Just as the Nordic welfare state institutions, we have the choice of either dismissing the empirical and methodological opportunities provided by the rise of digital environments or taking advantage of them. For the purposes of this book, we chose the latter.

The final theme relates to the problems of studying digital ecosystems from a comprehensive and top-level perspective that does not allow for detailed analyses of the individual analytical dimensions and layers. Had we focused

on the individual space between the state dimension and the backbone layer of the Digital Communication System Matrix (see Chapter 2), we could, for instance, have ventured into in-depth studies of submarine cable regulations. This way, the book would have provided a much more detailed account of the global network of submarine cables, while also being able to dive into the build-out of single cables, the composition of specific consortia, and legislative dilemmas relating to cyber security, as well as the environmental and economic repercussions of cable laying.

To give another example, we could have focused on the space between the markets dimension and the applications layer in order to explore the longtail market of websites and apps (e.g., all national domains in each country). In-depth case studies would provide much more nuanced accounts of the national web and app ecologies and their complexities, but they would also reproduce persistent understandings of national markets as made up by national actors alone. Moreover, particular analyses of anything from submarine cable regulation to web and app markets reveal little about how the different layers of Internet infrastructure interact and co-depend in ways that explain economic incentives, growth phases, and technological breakthroughs. By not cutting across the infrastructural components and value chains, we reinforce persistent biases in media and communication research discussed in the Introduction. In effect, we miss out on the interconnectedness of digital communication systems at best and, at worst, adhere and contribute to Big Tech's efforts to downplay business models that go way beyond the provision of a single service such as a search engine, a social media site, or a web shop.

Our findings illustrate the value and prospects of comparative analyses in general, and of the Digital Communication System Matrix in particular. By comparing different – but in this case highly interconnected – contexts, we gain insight into how historical circumstances, geopolitical conditions, economic power structures, and political prioritisations shape Internet evolution. As such, our analyses demonstrate that empirical research interventions – and official monitoring activities – are possible and have great potential (even when we consider present methodological constraints).

The methodological limitations mean that the empirical analyses of this book are indicative rather than exact accounts. We do not present a concise mapping of everything that could be documented about infrastructures, markets, and states in Denmark, Finland, Norway, and Sweden, and we invite future studies to refine the methods and empirical approaches presented here. Yet, it is also important to note that methodological challenges are an integral part of all empirical inquiries – just think of various limitations related to doing a survey, carrying out qualitative interviews, conducting an experiment, and so forth. If we dwell too long on the problems, we risk having to give up on asking the urgent and societally critical questions simply because they are difficult to answer.

CHAPTER 8

Road to nowhere

Well, we know where we're going, but we don't know where we've been, and we know, what we're knowing, but we can't say, what we've seen [...] and the future is certain, give us time to work it out.

TALKING HEADS, 1985

In the very first lines of the book, we invited the reader to embark on a time travel back to the 1950s and imagine the sending of a love letter across the Atlantic Ocean. We described how, in a literal sense, the letter changed hands from American postal service operators to their European and ultimately Swedish counterparts, and how each step of the route was managed and regulated by public institutions acting on the basis of political mandates. Over the preceding chapters, we have outlined the quite different chain of events that would play out if John F. Kennedy's Swedish lover was to answer using the communication technologies available today. Not only would she have to acquire some sort of digital device and a working Internet connection, she would also need a multitude of operators to transport her (datafied) message through numerous networks, exchange hubs, and submarine cable routes. She would have to accept the terms and conditions of the application of her choice in order to use it, and thereby, most likely, agree to pay for the service with information about her identity, whereabouts, and preferences. And above all, she would have to rely on commercial enterprises rather than welfare state institutions as providers of basic communication services.

In the everyday lives of individual Danes, Finns, Norwegians, and Swedes, these structural conditions might be of little importance. If the letter makes its way to the receiver – and the transfer even takes place without direct costs – the sender may consider it a success and quickly forget about its journey. If the access network operator makes sure the connection is stable and fast

enough to support the digital service in question, the individual Internet user will most likely be indifferent to the underlying backbone operations and exchanges of data taking place behind the interface.

However, critical debates about the political economy of Internet infrastructures are slowly but surely beginning to gain strength. Policymakers, regulators, and mainstream media are increasingly questioning the power and governance of Big Tech – all the while these same corporations are joining forces in lobbying activities aimed at protecting their business models and minimising the losses that may follow from legislative initiatives such as the European Union's Digital Services Act. Amidst these complex and critical processes, research plays a crucial role in developing theoretical, methodological, and empirical approaches that can shed light on otherwise invisible structural arrangements. Democratic deliberations and regulatory interventions are critically dependent on knowledge about and tools for monitoring the constantly evolving digital societies.

Contributing to this growing research agenda, we have explored how digital communication systems in the largest Nordic countries are organised and controlled. We have made various types of comparisons: between countries as geopolitical environments that frame the capabilities of individual Internet users; between infrastructural layers representing different links in the value chains; and between infrastructures, markets, and states as structuring forces that (mutually) shape digital societies. In the following sections, we sum up our main findings from the comparative analyses and outline future paths for research as well as regulation. We thereby conclude the book with a call for studies to develop, apply, and test the methods for studying digital communication systems – within and outside the Nordic region.

Comparing digital communication systems

In comparing the four largest Nordic countries, we have found that the gradual transition from analogue to digital distribution entails a significant shift in the underlying structural arrangements that frame mediated communication. Following different infrastructural, economic, and political routes, Denmark, Finland, Norway, and Sweden have, over the last decades, developed into highly digitalised societies that face similar challenges in terms of adapting their welfare state models to an increasingly global and commercial communication environment. Synthesising the main findings from the four analytical chapters (Chapters 3–6), Table 8.1 ascribes keywords to each country, emphasising the central features of their digital communication systems. The countries are held up against the three theoretical dimensions – infrastructures, markets, and states – as well as each of the analytical layers – access networks, backbone networks, applications, and data. The table thereby highlights the ways each country stands out, while downplaying the wealth of similarities that were instead foregrounded in the discussions of the previous chapter.

TABLE 8.1 Digital communication systems of Denmark, Finland, Norway, and Sweden

		Denmark	Finland	Norway	Sweden
Infrastructures	Access networks	Heritage	Mobile	Fixed	Fibre
	Backbone	European hub	Gateway to the East	Infrastructural appendix	Terrestrial juncture
	Applications	Online citizenship	The private sphere	A web of news	Killer innovations
	Data	A concentrated realm	In between	Local alternatives	A longtail of trackers
Markets	Internet service providers	Struggling business models	Mobile triopoly	Brownfield supremacy	Local operators
	Backend territory	Greenfield	Geopolitical interests	National investments	Municipal leasing
	Platform power	State & Big Tech	Corporate entries	Legacy endurance	The Northern Valley
	Third parties	Emergent incumbents	Suspiciously average	Old actors in a new business	A diverse ecology
States	Broadband strategies	Market-based	Mobile-first	Incumbent governance	A public good
	Backbone policies	An absent agenda	Russian connection	Public concerns	Proactive funding
	Over-the-top service regulation	Under the radar	Towards all-IP	Protecting the home market	Growth & innovation
	Data governance	Reactive regulation	Following EU	Activist agencies	Liberal first-movers

Denmark – a global juncture

As a result of flat terrains, short distances, a central position as the most southern of the Nordic countries, and comprehensive infrastructural heritages, Denmark is a key European hub for Internet traffic. When mapping the use of web- and app-based services, the successful Danish digitalisation strategies have fostered an online citizenship, where e-government services of any kind – from health apps to public communication platforms, childcare services,

and so forth – figure prominently in the top-50. Both top apps and websites link to fewer third-party services compared with the three other countries, due to the high prevalence of platforms which are owned and operated by Big Tech corporations that already have these services in-house, making the data ecosystem in Denmark a concentrated realm.

The power of US-based Big Tech corporations (most prominently Alphabet) is evident across most parts of the digital value chain – from submarine cables to mobile apps, third-party services, and beyond. While legacy telcos such as TDC and various television distributors and fibre companies hold strong positions in the Internet service provider market, their struggling business models have made room for greenfield investments in backbone build-out. At the application level, the Danish state and Big Tech both figure prominently on the top-lists, while legacy media hold more peripheral market positions. Regardless of the success of e-government services, emergent incumbents in the form of global platform players act as key providers of third-party infrastructures that enable welfare services to function.

Despite Denmark being the most disrupted and globalised of the four countries, political action has been long underway, and market-based logics favouring growth and innovation have dominated political discussions and strategies. In the last few years, however, especially Big Tech's role in information and content distribution has been subject to intense debate and occasional regulatory initiatives, while the Internet backbone has largely been an absent agenda in political and public discussions. Various steps have been taken to introduce content quotas for foreign streaming services or increase the moderating responsibilities of social media, yet none have thus far been implemented or enforced, meaning that over-the-top services continue to fly under the radar. Unlike the ongoing debates concerning digital communication content, data harvesting and distribution by third-party companies tend to be addressed on a case-by-case basis, making the Danish strategy appear to be best described as reactive regulation.

Finland – the mobile valley

Dubbed the "mobile valley" by Castells and Himanen (2002), Finland stands out from the other three countries by largely relying on mobile broadband, reflecting Nokia's former position in the market for first-generation mobile phones. Another characteristic that is – and always has been – a sensitive topic is the country's proximity to Russia, which makes Finland a digital gateway to the East. Looking at the top websites and apps, Finland is largely aligned with its neighbouring countries, but has a slight preference for applications catering to the private sphere (e.g., online shopping and porn) rather than public applications (e.g., news and e-government services). The third-party infrastructure falls almost exactly mid-way between the three other countries in terms of the number of third parties that collect and process user data.

As a result of the high reliance on mobile broadband, where different operators are assigned to build and run competing networks, the Finnish Internet service provider market tends to be more evenly split between operators, creating what we refer to as a mobile triopoly. The country's strategic location between the East and West means that its backbone infrastructures are subject to heavy geopolitical interests, with the US and Russia splitting the market for Internet exchange. Turning to the applications layer, Finland is characterised by its corporate entries into otherwise public domains, with the banks being in charge of developing the authentication systems used by public authorities. In relation to this, Finland also stands out as having the fewest e-government websites and apps in top-50. While we might expect that the Russian involvement in other parts of the digital ecosystem would be mirrored in the provision of third-party services, the data market is surprisingly (and perhaps suspiciously) average, containing mainly US-based Big Tech corporations in combination with a few Nordic actors.

The high use of mobile data and the world-leading development of 5G networks are partly a result of market powers pushing this agenda decades ago, but also a consequence of a deliberate mobile-first strategy. As a result of the Finnish state's allocation of frequencies at significantly lower costs than most other European Union countries, operators have been able to build and run mobile networks more easily and supply services at low rates, thereby accelerating the use of mobile broadband even more. Reflecting the country's complicated relationship with its large eastern neighbour, broadcasting and frequency allocation policies have historically been affected by military and political interests, and the very present conflicts at the eastern outskirts of Europe continuously raise concern in a country with many Russian connections. All the while, the Finnish state is a global first-mover when it comes to the transition towards all-IP distribution by pushing for the release of all frequencies currently reserved for broadcast. Finally, like the other Nordic countries, Finland has been following the European Union's lead when it comes to data protection by implementing the General Data Protection Regulation and taking part in several larger initiatives aimed at securing citizens' privacy.

Norway – land of legacies

In 1973, Norway became among the first non-American countries to connect to the Arpanet, casting this infrastructural appendix of Europe in one of the leading roles in Internet history. Despite the country's challenging terrains and long distances, significant investments have been made in establishing extensive fixed networks of fibre-optic cables to connect even the most remote regions, while the mobile infrastructures are less developed and used compared with the other Nordic countries. When activating their broadband connections, many Norwegians enter a web of news that is saturated by classic

media content. These services are, in turn, dependent on a complex ecology of third-party tracking consisting largely of international infrastructures but also local alternatives provided by national and regional players.

Norway thus stands out as the country where the institutional path-dependency on the twentieth century welfare models are most easily observed: Sustaining what we might refer to as brownfield supremacy, the state-owned incumbent, Telenor, continues to own and run large parts of the access networks – across both fixed and mobile infrastructures – while also controlling a fair share of submarine cables and other backbone infrastructures. The company has managed to transfer its historical market position and business model into the digital age, also positioning itself as a major infrastructure player in the global Internet economy. The same goes for other backbone companies, such as Bulk, that are currently making significant national investments in establishing global connections and placing Norway as a hub for (American) data traffic. Another example of legacy endurance can be found in the media conglomerate Schibsted that, as an old actor in a new business, has translated its historical market position to the digital realm and ventured into competition with global application providers and third-party data vendors.

Due to the relatively strong presence of legacy actors, the impact of the Norwegian welfare state seems more preserved than in other contexts. Telenor continues to be partly state-owned and to uphold incumbent governance of basic communication goods. While the overall broadband strategy has been focused on stimulating the demand side, various support schemes have, within the last decades, ensured funding for broadband projects in non-commercially profitable areas. Public concerns have also been raised about the state of the Norwegian backbone infrastructure, leading to the allocation of state-funding. Norwegian stakeholders generally seem to be more proactive towards protecting the home market for applications, as illustrated in a recent example where the Norwegian public service broadcaster, NRK, terminated the Facebook presence of its news outlet (MacGregor, 2022). And finally, the scepticism towards global platforms is also evident in the Norwegian Consumer Council and Data Protection body acting as an activist agency in speaking out against "surveillance-based advertising".

Sweden – the early start-up

While Sweden's position in the middle of the Nordic region means that it does not have the same physical global connections as its neighbouring countries, its extensive coverage of fibre-optic cables makes it a key terrestrial juncture for Internet traffic. Both access networks and backbone infrastructures were laid early on, meaning that Sweden's transition into the digital age was relatively smooth. The early coverage of high-speed broadband created a prospering environment for developing killer innovations in the realm of applications,

while also paving the way for a longtail of trackers making a business from collecting and processing user data from these innovations and beyond.

Across the four infrastructural layers, a broad range of market actors compete for Swedish customers, with a wide range of local operators providing Internet through municipal leasing arrangements on the basis of the state-funded backbone infrastructure. Referred to as the Northern (Silicon) Valley, Sweden is home to several globally successful digital services – like Spotify, Skype, Pirate Bay, and Klarna – that are able to compete with the many international actors that also inhabit the Swedish market. At the level of data, we also find a more diverse ecology of third-party services compared with the three other countries.

Through its early broadband and digitisation strategies, the Swedish state has promoted a view on digital communication as a public good. To ensure comprehensive coverage and high-capacity networks, proactive funding has been allocated in the form of both direct and indirect support for broadband and backbone build-out. While the funding has decreased over the last decades, expansions into rural areas are continuously prioritised, and the municipalities continue to hold key positions as backbone providers. On the level of applications and data, the Swedish authorities have favoured a growth and innovation discourse, emphasising the economic potentials rather than the challenges of digitalisation. However, Sweden also has a tradition of being a liberal first-mover, as the earliest country to implement data protection legislation, which has in turn proved to be a challenge for the implementation of the more generic General Data Protection Regulation.

Datafied welfare?

Behind the empirical findings outlined above, the question that remains is: So what? So what if the transparency of communication environments does not increase – but quite the opposite – alongside increasing datafication? So what if global digital actors take over critical infrastructures and societal functions? And so what if the welfare states of the twentieth century are losing their grips? To approach these questions, we return to the capability approach introduced in the first chapters of the book and assess the implications for welfare at a societal and an individual level.

As discussed earlier in the book, the capability approach broadens concerns about well-being and (in)equality from questions about access to digital technologies or consumption of digital content to the ways the same technologies and their institutional arrangements frame human agency. The high degrees of connectivity and comprehensive coverage across the Nordic region make digital services and content available day and night. We can communicate across continents free of charge, check our health information, do our taxes, and express our opinions publicly from the comfort of our homes

(or anywhere else). On the surface, the Internet gives us the freedom to choose between a multitude of suppliers and products and to opt out if the terms and conditions do not sit right with us or if we find a better offer. Yet, as we have shown, the apparent freedom comes at significant costs that are carved into the physical and structural arrangements surrounding digital communication.

When we, throughout this book, discuss welfare (states) and the ways certain ideals and principles of what used to be considered welfare have been reconfigured, much can be traced back to the gradual and increasing merging with commercial interests of corporate infrastructure suppliers. Early promises of a cyberspace that would break down power structures have in recent years been replaced by a maturing Internet that shows the contours of unequal power concentrations that far exceed the monopolies of legacy actors. While the rise of new incumbent infrastructure providers is often discussed with reference to the suffering legacy sectors and institutions, it also interacts with social inequalities at a much more fundamental level. That is, universal access to the Internet and equal conditions for using it do not go hand in hand: Following from the capacities of (in particular) commercial actors to track people's online activities and target products accordingly, individuals are met with personalised prices and offers and filtered feeds with potential for discrimination and bias in terms of race, gender, social class, capital, and much more (Andrejevic, 2020; Crawford, 2021; Noble, 2018). These unequal conditions and opportunities are infrastructurally, economically, and politically embedded, since modes and degrees of datafication vary between devices, operating systems, and applications.

While people's choices of how to use digital technologies will surely reflect – and perhaps exacerbate – inequalities, advocates of the capability approach argue that societies should, at the least, work towards levelling out the space of opportunities that individuals choose from in the first place (Nussbaum 2011: 18). Historically, the Nordic welfare states have promoted this logic through significant redistribution of economic goods and the establishment of high-quality alternatives, without requiring people to choose a particular option – that is, not forcing people to watch public service content, enrol their children in the public school system, or use state-funded health services, but to form a set of viable options to choose from. The network effects that support the business models of web searching, social media, and online shopping are themselves limiting this freedom of choice for individuals. Since these systems (and often particular brands like Facebook or Google) are firmly engrained in people's everyday lives as well as across societal sectors, opting out is challenging at best, and impossible at worst (Portwood-Stacer, 2013). Often, when it comes to the variety of digital services that play prominent roles in people's everyday lives, there are no (public) alternatives (and if there ever were, they were bought up, competed out of business, etc.). The rise of digital communication systems – along with other important societal transformations

including climate changes and economic recessions – thereby has important implications for what citizens in the region can expect from the state.

For the present, the limited power of state authorities in the digital realm might not be an urgent concern – and will perhaps only occasionally surface if we unsuccessfully claim our consumer rights when making online purchases, experience that sensitive data is distributed without our consent, or have our social media profiles hacked. The datafication architectures underlying mundane digital activities might not seem as controversial in this part of the world, where we are used to excessive registration as a necessary tool for welfare bureaucracy, and where we generally have a high level of trust in authorities. In that sense, one might argue that the price of "free" services has always been a trade-off between citizens agreeing to supply parts of their autonomy and privacy in return for universal benefits. However, as our analyses point to, the supply of digital services – including classic welfare services such as healthcare, education, news and information dissemination, and so forth – relies on a complex web of infrastructural arrangements supplied and controlled by a variety of non-state actors. When placing citizen datafication in the hands of commercial actors operating outside the jurisdictions of Nordic welfare states, the democratic control over these practices is diminished.

Looking at the digital communication systems of the Nordic welfare states with the capability approach does thus not only foster a deeper investigation of the current conditions for communicating and living in digital and datafied societies, but it also encourages us to approach questions of how we envision these societies to be a hundred years from now. What will the long-term consequences be of the institutional arrangements that are currently being established and naturalised? What will the monumental depositories of fine-grained data on human behaviour be used for? And "what kind of world will be borne through the midwifery of our new and more powerful communications tools?" (Mansell, 2017a: 4; Smythe, 1950).

Evolving Internet regimes

To conclude, we return to our initial characterisation of this book as an exploration of what we think we know. Through mapping, measuring, and analysing the impact of classic welfare institutions and (US-based) corporations in Denmark, Finland, Norway, and Sweden, we have identified an unequal power balance that does not seem likely to stabilise any time soon. Through controlling critical infrastructural resources that ground the increasingly digitalised and datafied Nordic societies, Big Tech has taken over key gatekeeping functions while simultaneously weakening the structural conditions and institutions of the welfare states. Even in contexts such as Norway, where legacy actors and homegrown start-ups stand strong, the power of global market actors like Alphabet is unquestionable.

In identifying similarities and differences between the four countries, we have found explanations that trace back to material (historically rooted and geographically conditioned) infrastructures, economic incentives and business models (of both legacy institutions and global disruptors), and political strategies and regulatory enforcements (or the lack thereof). Taken together, these explanations tell a story of Nordic Internet development – and the mutual ways technologies and political economies shape each other. Recalling Hughes's (1987) evolutionary history of large technological systems, we have discussed how the institutional features of analogue media systems played a determining role in shaping the early Internet. In the more mature phases of Internet evolution, however, the material characteristics of the network infrastructure altered the fundamental conditions for communicating, running a business, and governing basic societal goods.

In moving forward from the final pages of this book, several routes appear for research to follow: One option is to use the present study as a baseline for longitudinal investigations of the region as one of the most digitalised in the world and one that is likely to serve as a first mover into future "metaverses" and beyond. Such efforts will be a critical next step towards strengthening and developing official monitoring schemes and ultimately qualifying regulatory innovations. Another route goes beyond the Nordics and towards large-scale global comparisons, since the analyses of this book leave us with several new questions: Do the Nordics make up a particular cluster of digital communication systems, if we compare them to a larger sample of countries? What is the scope of variation in terms of data infrastructures, markets, and states in a broader, international perspective? And how are digital communication systems developing within other regimes (e.g., authoritarian or more libertarian ones)?

Answering these questions will enable researchers to understand how basic digital capabilities are shaped across less similar contexts; what the emancipatory as well as the supressing potentials of emerging Internet regimes are; where the ideological battles can and should be fought; what the digital future will look like if we continue down the paths we are currently on; and where the critical junctures and possible (emergency) exits are located. In other words, this book begs for a sequel (and perhaps also a prequal) asking how we got here and identifying alternative futures that were lost along the way.

References

Access Now. (2022). *The return of digital authoritarianism: Internet shutdowns in 2021*. https://www.accessnow.org/cms/assets/uploads/2022/05/2021-KIO-Report-May-24-2022.pdf

Ala-Fossi, M. (2020). Finland: Media welfare state in the digital era? *Journal of Digital Media & Policy*, *11*(2), 133–150. https://doi.org/10.1386/jdmp_00020_1

Ala-Fossi, M., & Bonet, M. (2018). Who's afraid of a pan-European spectrum policy? The EU and the battles over the UHF broadcast band. *International Journal of Communication*, *12*, 337–358. https://ijoc.org/index.php/ijoc/article/view/6713/2238

Alizadeh, T., & Farid, R. (2017). Political economy of telecommunication infrastructure: An investigation of the National Broadband Network early rollout and pork barrel politics in Australia. *Telecommunications Policy*, *41*(4), 242–252. https://doi.org/10.1016/j.telpol.2017.02.002

Andreassen, R., Kaun, A., & Nikunen, K. (2021). Fostering the data welfare state: A Nordic perspective on datafication. *Nordicom Review*, *42*(2), 207–223. https://doi.org/10.2478/nor-2021-0051

Andrejevic, M. (2011). Surveillance and alienation in the online economy. *Surveillance & Society*, *8*(3), 278–287. https://doi.org/10.24908/ss.v8i3.4164

Andrejevic, M. (2014). The big data divide. *International Journal of Communication*, *8*, 1673–1689. https://ijoc.org/index.php/ijoc/article/view/2161/1163

Andrejevic, M. (2020). *Automated media*. Routledge. https://doi.org/10.4324/9780429242595

Babe, R. E. (1995). *Communication and the transformation of economics: Essays in information, public policy, and political economy*. Routledge. https://doi.org/10.4324/9780429501524

Bar, F., & Sandvig, C. (2008). US communication policy after convergence. *Media, Culture & Society*, *30*(4), 531–550. https://doi.org/10.1177/0163443708091181

Barlow, J. P. (1996). *A declaration of the independence of cyberspace*. Electronic Frontier Foundation. https://www.eff.org/cyberspace-independence

Bech-Nielsen, P. C., & Magnussen, M. (2022, March 12). *Dagblade sender danskeres brugerdata til russiske virksomheder* [*Dagblade sends Danes' user data to Russian companies*]. Techmediet Radar. https://radarmedia.dk/dagblade-sender-danskeres-brugerdata-til-russiske-virksomheder/

Beniger, J. R. (1986). *The control revolution: Technological and economic origins of the Information Society*. Harvard University Press.

Benjamin, G. (2022, June 23). *Internet shutdowns hide atrocities: People in Myanmar need global action*. Access Now. https://www.accessnow.org/myanmar-shutdowns-hide-atrocities/

Benkler, Y. (2019). A political economy of utopia? *Duke Law & Technology Review*, *18*(1), 78–88.

Bennett, W. L. (2015). Changing societies, changing media systems: Challenges for communication theory, research and education. In S. Coleman, G. Moss, & K. Parry (Eds.), *Can the media serve democracy?* (pp. 151–163). Palgrave Macmillan. https://doi.org/10.1057/9781137467928_14

Benson, R., Blach-Ørsten, M., Powers, M., Willig, I., & Zambrano, S. V. (2012). Media systems online and off: Comparing the form of news in the United States, Denmark, and France. *Journal of Communication*, *62*(1), 21–38. https://doi.org/10.1111/j.1460-2466.2011.01625.x

BEREC (Body of European Regulators for Electronic Communications). (2016). *Report on harmonised definitions for indicators regarding OTT services, relevant to electronic communications markets*. https://tinyurl.com/bdd5hh73

Berners-Lee, T., Cailliau, R., Groff, J., & Pollermann, B. (1992). World-wide web: The information universe. *Internet Research*, *2*(1), 52–58. https://doi.org/10.1108/eb047254

BestVPN. (n.d.). *Internet privacy index (2022)*. Retrieved May 15, 2022, from https://bestvpn.org/privacy-index/

Binns, R., Lyngs, U., Van Kleek, M., Zhao, J., Libert, T., & Shadbolt, N. (2018a, May). Third party tracking in the mobile ecosystem. *Proceedings of the 10th ACM Conference on Web Science*, 23–31. https://doi.org/10.1145/3201064.3201089

Binns, R., Zhao, J., Kleek, M. V., & Shadbolt, N. (2018b). Measuring third-party tracker power across web and mobile. *ACM Transactions on Internet Technology*, *18*(4), 1–22. https://doi.org/10.1145/3176246

Björksten, G. (2022). *A-taxonomy-of-internet-shutdowns-the-technologies-behind-network-interference.pdf*. Access Now. https://tinyurl.com/2p9yb664

Blanke, T., & Pybus, J. (2020). The material conditions of platforms: Monopolization through decentralization. *Social Media + Society*, *6*(4). https://doi.org/10.1177/2056305120971632

Bogost, I., & Montfort, N. (2009, December 12). Platform studies: Frequently questioned answers. *Proceedings of the Digital Arts and Culture Conference, UC Irvine*. https://escholarship.org/uc/item/01r0k9br

Bohn, D. (2021, June 24). *Google delays blocking third-party cookies in Chrome until 2023*. The Verge. https://www.theverge.com/2021/6/24/22547339/google-chrome-cookiepocalypse-delayed-2023

Bowker, G. C., Baker, K., Millerand, F., & Ribes, D. (2009). Toward information infrastructure studies: Ways of knowing in a networked environment. In J. Hunsinger, L. Klastrup, & M. Allen (Eds.), *International handbook of internet research* (pp. 97–117). Springer. https://doi.org/10.1007/978-1-4020-9789-8_5

boyd, d., & Crawford, K. (2011, September 21). *Six provocations for big data* [Conference presentation]. A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society, Oxford Internet Institute. http://dx.doi.org/10.2139/ssrn.1926431

Braman, S. (2004). Where has media policy gone? Defining the field in the twenty-first century. *Communication Law and Policy*, *9*(2), 153–182. https://doi.org/10.1207/s15326926clp0902_1

Braun, E. (2022, January 5). *Google, Facebook face big privacy fines in France*. Politico. https://www.politico.eu/article/google-facebook-face-big-privacy-fines-in-france/

Brennen, J. S., & Kreiss, D. (2016). Digitalization. In *The International Encyclopedia of Communication Theory and Philosophy* (pp. 1–11). American Cancer Society. https://doi.org/10.1002/9781118766804.wbiect111

Bresnahan, T. (2010). General purpose technologies. In B. H. Hall, & N. Rosenberg (Eds.), *Handbook of the economics of innovation* (Vol. 2) (pp. 761–791). North-Holland. https://doi.org/10.1016/S0169-7218(10)02002-2

Bruns, A. (2019). After the 'APIcalypse': Social media platforms and their fight against critical scholarly research. *Information, Communication & Society*, *22*(11), 1544–1566. https://doi.org/10.1080/1369118X.2019.1637447

Bruun, H. (2019). *Re-scheduling television in the digital era*. Routledge. https://doi.org/10.4324/9780429276309

Brüggemann, M., Engesser, S., Büchel, F., Humprecht, E., & Castro, L. (2014). Hallin and Mancini revisited: Four empirical types of western media systems. *Journal of Communication*, *64*(6), 1037–1065. https://doi.org/10.1111/jcom.12127

Brügger, N., & Milligan, I. (Eds.). (2019). *The Sage handbook of web history*. Sage. https://doi.org/10.4135/9781526470546

Bucher, T. (2017). The algorithmic imaginary: Exploring the ordinary affects of Facebook algorithms. *Information, Communication & Society*, *20*(1), 30–44. https://doi.org/10.1080/1369118X.2016.1154086

Bucher, T. (2018). *If...then: Algorithmic power and politics*. Oxford University Press. https://doi.org/10.1093/oso/9780190493028.001.0001

Bundeskartellamt [Federal Cartel Office of Germany]. (2019, February 7). *Bundeskartellamt prohibits Facebook from combining user data from different sourcesBackground information on the Bundeskartellamt's Facebook proceeding*. https://tinyurl.com/4bnckemp

Burgess, M. (2022, January 27). Google has a new plan to kill cookies: People are still mad. *Wired*. https://www.wired.com/story/google-floc-cookies-chrome-topics/

Böttger, T., Cuadrado, F., Tyson, G., Castro, I., & Uhlig, S. (2018). Open connect everywhere: A glimpse at the internet ecosystem through the lens of the Netflix CDN. *Computer Communications Review*, *48*(1). https://doi.org/10.48550/arXiv.1606.05519

Castells, M. (2007). Communication, power and counter-power in the network society. *International Journal of Communication*, *1*, 238–266. https://ijoc.org/index.php/ijoc/article/view/46/35

Castells, M. (2011). *The rise of the network society*. John Wiley & Sons. https://doi.org/10.1002/9781444319514

Castells, M., & Himanen, P. (2002). *The information society and the welfare state: The Finnish model*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199256990.001.0001

Chadwick, A. (2017). *The hybrid media system: Politics and power* (2nd ed.). Oxford University Press. https://doi.org/10.1093/oso/9780190696726.001.0001

Chang, H.-J. (2002). Breaking the mould: An institutionalist political economy alternative to the neo-liberal theory of the market and the state. *Cambridge Journal of Economics*, *26*(5), 539–559. https://www.jstor.org/stable/23600312

Chesnoy, J. (2016). *Undersea fiber communication systems* (2nd ed.). Academic Press.

Christensen, J. D., Therkelsen, J., Georgiev, I., & Sand, H. (2018). *Data centre opportunities in the Nordics*. Nordic Council of Ministers. https://doi.org/10.6027/TN2018-553

Chromium Blog. (2020, January 14). *Building a more private web: A path towards making third party cookies obsolete*. https://blog.chromium.org/2020/01/building-more-private-web-path-towards.html

Cision PR Newswire. (2021, July 14). *Sweden data center investment & opportunities analysis report 2021–2026: Over $7 Billion will be invested in core & shell development of data centers*. https://tinyurl.com/y5n4hnu4

Claffy, K. C., Clark, D. D., Bauer, S., & Dhamdhere, A. D. (2016). *Policy challenges in mapping internet interdomain congestion* [Conference presentation]. TPRC 44: The 44th Research Conference on Communication, Information and Internet Policy 2016. https://papers.ssrn.com/abstract=2756868

Copenhagen Economics. (2022). *The economic value of submarine cables in the Arctic: An analysis of the societal value of digital infrastructure investments in the Nordic countries, and R&E networks' potential role in these projects*. https://tinyurl.com/4ddu4u5w

Couldry, N. (2019). Capabilities for what? Developing Sen's moral theory for communications research. *Journal of Information Policy*, *9*, 43–55. https://doi.org/10.5325/jinfopoli.9.2019.0043

Couldry, N., & Mejias, U. A. (2019). *The costs of connection: How data is colonizing human life and appropriating it for capitalism*. Stanford University Press.

Crawford, K. (2021). *Atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press.

Cunningham, S., & Silver, J. (2013). *Screen distribution and the new King Kongs of the online world*. Palgrave Macmillan. https://doi.org/10.1057/9781137326454

Curran, J., Iyengar, S., Lund, A. B., & Salovaara-Moring, I. (2011). Media system, public knowledge and democracy: A comparative study. In J. Curran (Ed.), *Media and Democracy* (pp. 5–26). Routledge. https://doi.org/10.4324/9780203406878

Daccak, M. (2021). *The future of public service television in Sweden: A study on challenges and opportunities for SVT Play in a shifting television landscape* [Master's thesis, KTH Royal Institute of Technology, School of Electrical Engineering and Computer Science (EECS), Sweden]. http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-292841

Dalton, C., & Thatcher, J. (2014, May 12). What does a critical data studies look like, and why do we care? *Society+Space*. https://www.societyandspace.org/articles/what-does-a-critical-data-studies-look-like-and-why-do-we-care

Datatilsynet. (2022). *Google Analytics kan være ulovlig* [*Google Analytics may be illegal*]. https://www.datatilsynet.no/aktuelt/aktuelle-nyheter-2022/google-analytics-kan-vare-ulovlig/

Datatilsynet. (2023, July 17). *Midlertidig forbud mot adferdsbasert markedsføring på Facebook og Instagram* [*Temporary ban on behavioural marketing on Facebook and Instagram*]. Datatilsynet. https://tinyurl.com/33x2z982

De Filippi, P., & Bourcier, D. (2016). "Three-strikes" response to copyright infringement: The case of HADOPI. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 125–152). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_7

DeFleur, M. L. (1971). Mass media as social systems. In W. Schramm (Ed.), *The process and effects of mass communication* (pp. 63–83). University of Illinois Press.

Delhey, J., & Newton, K. (2005). Predicting cross-national levels of social trust: Global pattern or Nordic exceptionalism? *European Sociological Review*, *21*(4), 311–327. https://doi.org/10.1093/esr/jci022

DeNardis, L. (2012). Hidden levers of internet control. *Information, Communication & Society*, *15*(5), 720–738. https://doi.org/10.1080/1369118X.2012.659199

DeNardis, L., & Musiani, F. (2016). Governance by infrastructure. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 3–21). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_1

Dencik, L. (2021). The datafied welfare state: A perspective from the UK. In A. Hepp, J. Jarke, & L. Kramp (Eds.), *The ambivalences of data power: New perspectives in critical data studies* (p. 145–165). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-96180-0_7

Dencik, L., & Kaun, A. (2020). Datafication and the welfare state. *Global Perspectives*, *1*(1), 12912. https://doi.org/10.1525/gp.2020.12912

d'Haenens, L., Sousa, H., & Trappel, J. (Eds.). (2018). *Comparative media policy, regulation and governance in Europe: Unpacking the policy cycle*. Intellect.

Dieter, M., Gerlitz, C., Helmond, A., Tkacz, N., van der Vlist, F. N., & Weltevrede, E. (2019). Multi-situated app studies: Methods and propositions. *Social Media + Society*, *5*(2), 205630511984648. https://doi.org/10.1177/2056305119846486

Donders, K., Van den Bulck, H., & Raats, T. (2019). The politics of pleasing: A critical analysis of multistakeholderism in public service media policies in Flanders. *Media, Culture & Society*, *41*(3), 347–366. https://doi.org/10.1177/0163443718782004

Donges, P. (2007). The new institutionalism as a theoretical foundation of media governance. *Communications: European Journal of Communication Research*, *32*(3), 325–330.

Doyle, G. (2002). *Media ownership: The economics and politics of convergence and concentration in the UK and European media*. Sage.

Draper, N. A., & Turow, J. (2019). The corporate cultivation of digital resignation. *New Media & Society*, *21*(8), 1824–1839. https://doi.org/10.1177/1461444819833331

Eberwein, T., Fengler, S., & Karmasin, M. (Eds.). (2018). *The European handbook of media accountability*. Routledge. https://doi.org/10.4324/9781315616353

Edwards, P. N. (2002). Infrastructure and modernity: Force, time, and social organization in the history of sociotechnical systems. In T. J. Misa, P. Brey, & A. Feenberg (Eds.), *Modernity and technology* (pp. 185–226). MIT Press. https://doi.org/10.7551/mitpress/4729.001.0001

Enli, G., Raats, T., Syvertsen, T., & Donders, K. (2019). Media policy for private media in the age of digital platforms. *European Journal of Communication*, *34*(4), 395–409. https://doi.org/10.1177/0267323119861512

Enli, G., & Syvertsen, T. (2020). The media welfare state: Why such a concept, what is it used for, does it have a future? *Nordic Journal of Media Studies*, *2*(1), 37–45. https://doi.org/10.2478/njms-2020-0004

Enli, G., Syvertsen, T., & Mjøs, O. J. (2018). The welfare state and the media system. *Scandinavian Journal of History*, *43*(5), 601–623. https://doi.org/10.1080/03468755.2018.1474023

Ensafi, R., Winter, P., Mueen, A., & Crandall, J. R. (2015). Analyzing the great firewall of China over space and time. *Proceedings on Privacy Enhancing Technologies*, *2015*(1), 61–76. https://doi.org/10.1515/popets-2015-0005

Esping-Andersen, G. (1990). *The three worlds of welfare capitalism*. Princeton University Press.

Esq, N. K. (2022, August 18). *Updates: Digital rights in the Russia-Ukraine conflict*. Access Now. https://www.accessnow.org/digital-rights-ukraine-russia-conflict/

Ettema, J. S., & Whitney, D. C. (1994). The money arrow: An introduction to audiencemaking. In J. S. Ettema, & D. C. Whitney (Eds.), *Audiencemaking: How the media create the audience* (pp. 1–18). Sage.

European Commission. (n.d.-a). *Broadband in EU countries | Shaping Europe's digital future*. Retrieved January 19, 2022, from https://digital-strategy.ec.europa.eu/en/policies/broadband-eu-countries

European Commission. (n.d.-b). *Connectivity | Shaping Europe's digital future*. Retrieved January 21, 2022, from https://digital-strategy.ec.europa.eu/en/policies/connectivity

European Commission. (2017). *Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service*. https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784

European Commission. (2018, June 18). *Antitrust: Commission fines Google €4.34 billion for abuse of dominance regarding Android devices* [Press release]. https://ec.europa.eu/commission/presscorner/detail/en/IP_18_4581

European Commission. (2021). *Directive (EU) 2018/1808 of the European Parliament and of the Council of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in member states concerning the provision of audiovisual media services (Audiovisual Media Services Directive) in view of changing market realities*. https://eur-lex.europa.eu/eli/dir/2018/1808/oj

European Commission. (2022, April 23). *The digital services act package | Shaping Europe's digital future*. https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package

European Data Protection Board. (2022). *Launch of coordinated enforcement on use of cloud by public sector | European Data Protection Board*. https://tinyurl.com/43cp2cj4

Euro-IX. (2020). *Internet exchange points 2020 report*. https://tinyurl.com/2p8cdn4f

European Parliament & The Council. (2009). *Directive 2009/136/EC of the European Parliament and of the Council of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws*. 26.

European Parliament & The Council. (2016). *Regulation (EU) 2016/679 of the European Parliament and of the council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)*. https://eur-lex.europa.eu/eli/reg/2016/679/oj

European Schoolnet and University of Liège. (2012). *Survey of schools: ICT in education. Country profile: Sweden*. European Commission. https://tinyurl.com/5eut7mr6

Eurostat. (2021). *Eurostat regional yearbook 2021*. Publications Office of the European Union. https://tinyurl.com/4yvvr442

Exodus. (n.d.). Exodus: The privacy audit platform for Android applications [Database]. Retrieved April 1, 2020, from https://reports.exodus-privacy.eu.org/en/

Farooq, M., & Raju, V. (2019). Impact of over-the-top (OTT) services on the telecom companies in the era of transformative marketing. *Global Journal of Flexible Systems Management*, *20*(2), 177–188. https://doi.org/10.1007/s40171-019-00209-6

Finnemann, N. O. (2005). *Internettet i mediehistorisk perspektiv* [*The internet in a media historical perspective*]. Samfundslitteratur.

Flensburg, S. (2020). *Det digitale systemskifte: En historisk analyse af digitaliseringen af det danske kommunikationssystem* [*The digital system change: A historical analysis of the digitisation of the Danish communication system*] [Doctoral thesis, University of Copenhagen, Denmark]. https://static-curis.ku.dk/portal/files/233784455/Ph.d._afhandling_2020_Flensburg.pdf

Flensburg, S. (2021). Over-the-top and under the radar. *Nordicom Review*, *42*(1), 93–108. https://doi.org/10.2478/nor-2021-0022

Flensburg, S., & Lai, S. S. (forthcoming). Scaling up: Directions for critical studies of data infrastructure. In T. Venturini, A. Acker, J.-C. Plantin, & A. Walford (Eds.), *Sage handbook of data & society*. Sage.

Flensburg, S., & Lai, S. S. (2019). Mapping digital communication systems: Infrastructures, markets, and policies as regulatory forces. *Media, Culture & Society*, 016344371987653. https://doi.org/10.1177/0163443719876533
Flensburg, S., & Lai, S. S. (2020a). Comparing digital communication systems: An empirical framework for analysing the political economy of digital infrastructures. *Nordicom Review*, *41*(2), 127–145. https://doi.org/10.2478/nor-2020-0019
Flensburg, S., & Lai, S. S. (2020b). Networks of power: Analysing the evolution of the Danish internet infrastructure. *Internet Histories*, *5*(2), 79–100. https://doi.org/10.1080/24701475.2020.1759010
Flensburg, S., & Lai, S. S. (2022). Datafied mobile markets: Measuring control over apps, data accesses, and third-party services. *Mobile Media & Communication*, *10*(1), 136–155. https://doi.org/10.1177/20501579211039066
Flensburg, S., & Lai, S. S. (2023). Follow the data! A strategy for tracing infrastructural power. *Media and Communication*, *11*(2), 319–329. https://doi.org/10.17645/mac.v11i2.6464
Flensburg, S., & Lomborg, S. (2021). Datafication research: Mapping the field for a future agenda. *New Media & Society*, 14614448211046616. https://doi.org/10.1177/14614448211046616
Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219–245. https://doi.org/10.1177/1077800405284363
Forzati, M., & Mattsson, C. (2014). Sweden. In W. Lemstra, & W. H. Melody (Eds.), *The dynamics of broadband markets in Europe* (pp. 136–162). Cambridge University Press. https://doi.org/10.1017/CBO9781139683555.011
Fourcade, M., & Gordon, J. (2020). Learning like a state: Statecraft in the digital age. *Journal of Law and Political Economy*, *1*(1), 78–108. https://doi.org/10.5070/LP61150258
Freedman, D. (2008). *The politics of media policy*. Polity.
Fuchs, C. (2011). A contribution to the critique of the political economy of Google. *Fast Capitalism*, *8*(1), 31–50. https://doi.org/10.32855/fcapital.201101.006
Fulton, C., & Mukherjee, S. (2021). *How Sweden became the Silicon Valley of Europe*. Reuters. https://www.reuters.com/business/finance/how-sweden-became-silicon-valley-europe-2021-08-11/
Garnham, N. (1979). Contribution to a political economy of mass-communication. *Media, Culture & Society*, *1*(2), 123–146. https://doi.org/10.1177/016344377900100202
Garnham, N. (2011). The political economy of communication revisited. In J. Wasko, G. Murdock, & H. Sousa (Eds.), *The handbook of political economy of communications* (pp. 41–61). John Wiley & Sons. https://doi.org/10.1002/9781444395402.ch2
Gerlitz, C., Helmond, A., Nieborg, D. B., & van der Vlist, F. N. (2019, October 21). Apps and infrastructures – a research agenda. *Computational Culture*, *7*. http://computationalculture.net/apps-and-infrastructures-a-research-agenda/
Gibson, W. (1984). *Neuromancer* (Reprint). Ace.
Gillwald, A., & Simon, J.-P. (2012). The ICT landscape in BRICS countries: 4. South Africa. *Digiworld Economic Journal*, (86), 195–208.
Google for Developers. (n.d.). *Popular products*. Retrieved November 16, 2020, from https://developers.google.com/products
Government Offices of Sweden. (2020, May 20). *Government decides on SEK 200 million for continued broadband expansion in rural areas* [Press release].
Griffiths, J. (2021). *The great firewall of China: How to build and control an alternative version of the internet*. Bloomsbury.
Hallin, D. C., & Mancini, P. (2004). *Comparing media systems: Three models of media and politics*. Cambridge University Press. https://doi.org/10.1017/CBO9780511790867
Hallin, D. C., & Mancini, P. (2012). *Comparing media systems beyond the western world*. Cambridge University Press. https://doi.org/10.1017/CBO9781139005098
Hallin, D. C., & Mancini, P. (2017). Ten years after comparing media systems: What have we learned? *Political Communication*, *34*(2), 155–171. https://doi.org/10.1080/10584609.2016.1233158
Halvorsen, T., Lutz, C., & Barstad, J. (2021). The sharing economy in Norway: Emerging trends and debates. In A. Klimczuk, V. Česnuitytė, & G. Avram (Eds.), *The collaborative economy in action: European perspectives* (pp. 225–236). University of Limerick. https://tinyurl.com/yc3dwmbd

Hanson, J. (2016). *The social media revolution: An economic encyclopedia of friending, texting, and connecting*. Greenwood.
Hansteen, K. (2005). *Norwegian and Swedish broadband initiatives (1999–2005)*. Ministry of Modernisation. https://www.forskningsradet.no/siteassets/publikasjoner/1127199375708.pdf
Hardy, J. (2010). *Western media systems*. Routledge. https://doi.org/10.4324/9780203869048
Hardy, J. (2014). *Critical political economy of the media: An introduction*. Routledge. https://doi.org/10.4324/9780203136225
Hardy, J. (2019). Political economy of news. In *The international encyclopedia of journalism studies* (pp. 1–8). John Wiley & Sons. https://doi.org/10.1002/9781118841570.iejs0028
Harris, S. (2015). Service providers as digital media infrastructure: Turkey's cybercafe operators. In L. Parks, & N. Starosielski (Eds.), *Signal traffic: Critical studies of media infrastructures* (pp. 205–224). University of Illinois Press.
Hasebrink, U., & Domeyer, H. (2012). Media repertoires as patterns of behaviour and as meaningful practices: A multimethod approach to media use in converging media environments. *Participations: Journal of Audience and Reception Studies*, *9*(2), 757–779.
Heikkilä, M. (2020, August 5). *Amazon's ruthless business model meets Sweden's labor unions*. Politico. https://www.politico.eu/article/amazons-cut-price-culture-meets-swedens-unions/
Helles, R., & Flyverbom, M. (2019). Meshes of surveillance, prediction, and infrastructure: On the cultural and commercial consequences of digital platforms. *Surveillance & Society*, *17*(1/2), 34–39. https://doi.org/10.24908/ss.v17i1/2.13120
Helles, R., Lomborg, S., & Lai, S. S. (2020). Infrastructures of tracking: Mapping the ecology of third-party services across top sites in the EU. *New Media & Society*, *22*(11), 1957–1975. https://doi.org/10.1177/1461444820932868
Helmond, A. (2015). The platformization of the web: Making web data platform ready. *Social Media + Society*, *1*(2), 2056305115603080. https://doi.org/10.1177/2056305115603080
Henten, A., & Falch, M. (2014). Denmark. In W. Lemstra, & W. H. Melody (Eds.), *The dynamics of broadband markets in Europe* (pp. 110–135). Cambridge University Press. https://doi.org/10.1017/CBO9781139683555.010
Hastings, S. (2021, August 23). *Tech start-ups secure Sweden's title as the European Silicon Valley*. European Company Formation | Company Registration Europe. https://www.eurocompanyformations.com/blog/sweden-becomes-european-silicon-valley/
Hepp, A., Jarke, J., & Kramp, L. (Eds.). (2022). *New perspectives in critical data studies: The ambivalences of data power*. Springer. https://doi.org/10.1007/978-3-030-96180-0
Hesmondhalgh, D. (2017). Capitalism and the media: Moral economy, well-being and capabilities. *Media, Culture & Society*, *39*(2), 202–218. https://doi.org/10.1177/0163443716643153
Hesmondhalgh, D. (2021). The infrastructural turn in media and internet research. In P. McDonald (Ed.), *The Routledge companion to media industries* (p. 132–142). Routledge. https://doi.org/10.4324/9780429275340-13
Hetland, P. (1999). The internet in Norway: Dissemination and use. *Nordicom Review*, *20*(2), 33–44. https://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-9716
Hilson, M. (2020). The Nordic welfare model. In A. Lindskog, & J. Stougaard-Nielsen (Eds.), *Introduction to Nordic cultures* (pp. 70–84). UCL Press. https://doi.org/10.2307/j.ctv13xprms.11
Hilstrøm, C. (2020, August 5). Google fjerner DRs Ramasjang-app, fordi der optræder lakridspiber [Google removes DR's Ramasjang app because licorice pipes appear]. *Berlingske*. https://www.berlingske.dk/content/item/1494296
Hjarvard, S., & Helles, R. (2015). Going digital: Changing the game of Danish publishing. *Northern Lights: Film & Media Studies Yearbook*, *13*(1), 49–64. https://doi.org/10.1386/nl.13.1.49_1
Horsti, K., & Hultén, G. (2011). Directing diversity: Managing cultural diversity media policies in Finnish and Swedish public service broadcasting. *International Journal of Cultural Studies*, *14*(2), 209–227. https://doi.org/10.1177/1367877910382180
Hughes, T. P. (1987). The evolution of large technological systems. In W. E. Bijker, T. P. Hughes, & T. Pinch (Eds.), *The social construction of technological systems: New directions in the sociology and history of technology* (pp. 45–76). MIT Press. https://www.jstor.org/stable/j.ctt5vjrsq.9

Hughes, T. P. (1993). *Networks of power: Electrification in western society, 1880–1930*. JHU Press.
Hughes, T. P. (1994). Technological momentum. In M. R. Smith, & L. Marx (Eds.), *Does technology drive history? The dilemma of technological determinism* (pp. 101–113). MIT Press.
Humphreys, P. J. (1996). *Mass media and media policy in western Europe*. Manchester University Press.
Humprecht, E., Castro Herrero, L., Blassnig, S., Brüggemann, M., & Engesser, S. (2022). Media systems in the digital age: An empirical comparison of 30 countries. *Journal of Communication*, *72*(2), 145–164. https://doi.org/10.1093/joc/jqab054
Humprecht, E., Esser, F., & Van Aelst, P. (2020). Resilience to online disinformation: A framework for cross-national comparative research. *The International Journal of Press/Politics*, *25*(3), 493–516. https://doi.org/10.1177/1940161219900126
Hunt, R. R. (2014). *Moving beyond regulatory mechanisms: A typology of internet control regimes* [Master's thesis, Portland State University, USA]. https://tinyurl.com/5fuyt372
Hutchby, I. (2001). The communicative affordances of technological artefacts. In I. Hutchby, *Conversation and technology: From the telephone to the internet* (pp. 13–33). Polity.
Iliadis, A., & Russo, F. (2016). Critical data studies: An introduction. *Big Data & Society*, *3*(2), 2053951716674238. https://doi.org/10.1177/2053951716674238
Innis, H. A. (2007). *Empire and communications*. Rowman & Littlefield.
Investopedia. (2018). *EU's biggest penalties on global tech companies*. https://www.investopedia.com/tech/eus-biggest-penalties-global-tech-companies/
Jakobsson, P., Lindell, J., & Stiernstedt, F. (2021). A neoliberal media welfare state? The Swedish media system in transformation. *Javnost - The Public*, *28*(4), 375–390. https://doi.org/10.1080/13183222.2021.1969506
Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. NYU Press. https://www.jstor.org/stable/j.ctt9qffwr
Jensen, K. B. (2008). Intermediality. In W. Donsbach (Ed.), *International encyclopedia of communication*. John Wiley & Sons. https://doi.org/10.1002/9781405186407
Jensen, K. B. (2012). Lost, found, and made: Qualitative data in the study of three-step flows of communication. In I. Volkmer (Ed.), *The handbook of global media research* (pp. 433–450). John Wiley & Sons. https://doi.org/10.1002/9781118255278.ch25
Jensen, K. B. (2013). Definitive and sensitizing conceptualizations of mediatization. *Communication Theory*, *23*(3), 203–222. https://doi.org/10.1111/comt.12014
Jensen, K. B. (2021). *A theory of communication and justice*. Routledge. https://doi.org/10.4324/9781315751207
Jensen, K. B., & Helles, R. (2011). The internet as a cultural forum: Implications for research. *New Media & Society*, *13*(4), 517–533. https://doi.org/10.1177/1461444810373531
Jensen, K. B., & Helles, R. (2017). Speaking into the system: Social media and many-to-one communication. *European Journal of Communication*, *32*(1), 16–25. https://doi.org/10.1177/0267323116682805
Jensen, K. B., & Helles, R. (Eds.). (2022). *Comparing communication systems – The internets of China, Europe, and the United States*. Routledge. https://doi.org/10.4324/9781003057055
Jungherr, A., Rivero, G., & Gayo-Avello, D. (2020). *Retooling politics: How digital media are shaping democracy*. Cambridge University Press. https://doi.org/10.1017/9781108297820
Kammer, A. (2016). A welfare perspective on Nordic media subsidies. *Journal of Media Business Studies*, *13*(3), 140–152. https://doi.org/10.1080/16522354.2016.1238272
Katzenbach, C., Puppis, M., & Just, N. (2012). Technologies as institutions: Rethinking the role of technology in media governance constellations. In M. Puppis, & N. Just (Eds.), *Trends in communication policy research: New theories, methods and subjects, intellect* (pp. 117–138). Intellect.
Kitchin, R., & Lauriault, T. (2014). *Towards critical data studies: Charting and unpacking data assemblages and their work* (Preprint). https://papers.ssrn.com/abstract=2474112
Kitchin, R., & Lauriault, T. P. (2018). Toward critical data studies: Charting and unpacking data assemblages and their work. In J. Thatcher, J. Eckert, & A. Shears (Eds.), *Thinking big data in geography* (pp. 3–20). University of Nebraska Press.

Kjølberg, T. (2021, October 5). *Has Sweden become the Silicon Valley of Europe?* Daily Scandinavian. https://www.dailyscandinavian.com/has-sweden-become-the-silicon-valley-of-europe/

Kleine, D. (2013). *Technologies of choice? ICTs, development, and the capabilities approach*. MIT Press. http://www.jstor.org/stable/10.2307/j.ctt5hhkdz

Kleis Nielsen, R., & Ganter, S. A. (2018). Dealing with digital intermediaries: A case study of the relations between publishers and platforms. *New Media & Society*, *20*(4), 1600–1617. https://doi.org/10.1177/1461444817701318

Knudsen, L., Schultz Jørgensen, S., & Lindskow, K. (2017). *Globaliseringen af den danske mediebranche* [*The globalisation of the Danish media industry*]. Danish Ministry of Culture and Palaces. https://tinyurl.com/48425jcv

Kollnig, K., Shuba, A., Binns, R., Kleek, M. V., & Shadbolt, N. (2022a). Are iPhones really better for privacy? A comparative study of iOS and Android apps. *Proceedings on Privacy Enhancing Technologies*, *2022*(2), 6–24. https://doi.org/10.2478/popets-2022-0033

Kollnig, K., Shuba, A., Van Kleek, M., Binns, R., & Shadbolt, N. (2022b). Goodbye tracking? Impact of iOS app tracking transparency and privacy labels. In *2022 ACM Conference on Fairness, Accountability, and Transparency (FAccT '22), June 21–24, 2022, Seoul, Republic of Korea. ACM, New York, NY, USA*. https://doi.org/10.48550/arXiv.2204.03556

Kushida, K. E. (2015). The politics of commoditization in global ICT industries: A political economy explanation of the rise of Apple, Google, and industry disruptors. *Journal of Industry, Competition and Trade*, *15*(1), 49–67. https://doi.org/10.1007/s10842-014-0191-3

Lai, S. S. (2021). *Human capabilities in a datafied society: Empirical approaches to studying the interplay between digital communication and internet infrastructures* [Doctoral dissertation, University of Copenhagen, Denmark]. https://static-curis.ku.dk/portal/files/255351216/Lai_dissertation_print.pdf

Lai, S. S., & Flensburg, S. (2020). A proxy for privacy uncovering the surveillance ecology of mobile apps. *Big Data & Society*, *7*(2), 1–20. https://doi.org/10.1177/2053951720942543

Lai, S. S., & Flensburg, S. (2021). Invasive species of the app ecosystem: Exploring the political economy of mobile communication. *International Journal of Communication*, *15*, 2301–2318. https://ijoc.org/index.php/ijoc/article/view/16906

Lammi, M., & Pantzar, M. (2019). The data economy: How technological change has altered the role of the citizen-consumer. *Technology in Society*, *59*, 101157. https://doi.org/10.1016/j.techsoc.2019.101157

Laprise, J. (2016). Exploring PRISM's spectrum: Privacy in the information age. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 203–216). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_11

Larsen, L. K. (2016, September 9). *Flere kritiserer Facebook for at fjerne billede fra Vietnam-krigen* [*Several criticise Facebook for removing images from the Vietnam War*]. DR. https://www.dr.dk/ligetil/flere-kritiserer-facebook-fjerne-billede-fra-vietnam-krigen

Lassen, J. M., & Sørensen, J. K. (2021). Curation of a personalized video on demand service: A longitudinal study of the Danish public service broadcaster DR. *Iluminace*, *33*(1), 5–33. https://iluminace.cz/pdfs/ilu/2021/01/01.pdf

Lee, C. P., & Schmidt, K. (2018). A bridge too far? Critical remarks on the concept of "infrastructure" in computer-supported cooperative work and information systems. In V. Wulf, V Pipek, D. Randall, M. Rohde, K. Schmidt, & G. Stevens (Eds.), *Socio-Informatics* (pp. 177–218). Oxford University Press. https://doi.org/10.1093/oso/9780198733249.003.0006

Lessig, L. (1999). *Code and other laws of cyberspace*. Basic Books.

Lessig, L. (2006). *Code: Version 2.0*. Basic Books.

Libert, T. (2015). Exposing the invisible web: An analysis of third-party http requests on 1 million websites. *International Journal of Communication*, *9*, 3544–3561. https://ijoc.org/index.php/ijoc/article/view/3646

Libert, T. (2018). An automated approach to auditing disclosure of third-party data collection in website privacy policies. *Proceedings of the 2018 World Wide Web Conference*, 207–216. https://doi.org/10.1145/3178876.3186087

Lindskow, K. (2016). *Exploring digital news publishing business models: A production network approach* [Doctoral dissertation, Copenhagen Business School, Denmark]. https://tinyurl.com/4kv9c5mp

Lohmeyer, W. Q., Post, P., Fleming, K., Lisy, C., Kriezis, A., & Omer, A. (2023, February 10). A review of the current broadband satellite communications market. *Microwave Journal*, *66*(2). https://tinyurl.com/49caw3ft

Lokot, T., & Wijermars, M. (2023). The politics of internet freedom rankings. *Internet Policy Review*, *12*(2), 1–35. https://policyreview.info/articles/analysis/politics-of-internet-freedom-rankings

Lomas, N. (2022). *Report reveals how big tech lobbied to weaken EU rules*. TechCrunch. https://social.techcrunch.com/2022/04/22/google-facebook-apple-eu-lobbying-report/

Lum, C. M. K. (2006). *Perspectives on culture, technology and communication: The media ecology tradition*. Hampton Press.

Lund, A. B., Nord, L., & Roppen, J. (2009). *Nye udfordringer for gamle medier: Skandinavisk public service i det 21. århundrede* [*New challenges for old media: Scandinavian public service in the twenty-first century*]. Nordicom, University of Gothenburg. https://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-10032

MacGregor, L. (2022, May 30). *NRK forlater ikke Facebook (med det første)* [*NRK is not leaving Facebook (any time soon)*]. NRK. https://www.nrk.no/oppdrag/nrk-forlater-ikke-facebook-_med-det-forste_-1.15984791

Majone, G. (1994). The rise of the regulatory state in Europe. *West European Politics*, *17*(3), 77–101. https://doi.org/10.1080/01402389408425031

Majone, G. (1997). From the positive to the regulatory state: Causes and consequences of changes in the mode of governance. *Journal of Public Policy*, *17*(2), 139–167. https://doi.org/10.1017/S0143814X00003524

Mancini, P. (2020). Comparative media studies in the digital age | Comparing media systems and the digital age. *International Journal of Communication*, *14*, 5761–5774. https://ijoc.org/index.php/ijoc/article/view/14553

Mann, M. (1984). The autonomous power of the state: Its origins, mechanisms and results. *European Journal of Sociology*, *25*(2), 185–213. https://doi.org/10.1017/S0003975600004239

Mansell, R. (2002). From digital divides to digital entitlements in knowledge societies. *Current Sociology*, *50*(3), 407–426. https://doi.org/10.1177/0011392102050003007

Mansell, R. (2004). Political economy, power and new media. *New Media & Society*, *6*(1), 96–105. https://doi.org/10.1177/1461444804039910

Mansell, R. (2017a). Bits of power: Struggling for control of information and communication networks. *The Political Economy of Communication*, *5*(1), 2–29. https://www.polecom.org/index.php/polecom/article/view/75

Mansell, R. (2017b). Inequality and digitally mediated communication: Divides, contradictions and consequences. *Javnost – The Public*, *24*(2), 146–161. https://doi.org/10.1080/13183222.2017.1287966

Marr, B. (2020, October 8). *What is the artificial intelligence revolution and why does it matter to your business?* Forbes. https://tinyurl.com/3pkxsdyv

Matley, H. E. (2019). Closing the gaps in the regulation of submarine cables: Lessons from the Australian experience. *Australian Journal of Maritime & Ocean Affairs*, *11*(3), 165–184. https://doi.org/10.1080/18366503.2019.1653740

Mattoni, A., & Ceccobelli, D. (2018). Comparing hybrid media systems in the digital age: A theoretical framework for analysis. *European Journal of Communication*, *33*(5), 540–557. https://doi.org/10.1177/0267323118784831

Mayer-Schönberger, V., & Cukier, K. (2013). *Big data: A revolution that will transform how we live, work, and think*. Houghton Mifflin Harcourt.

Mazepa, P., & Mosco, V. (2016). A political economy approach to the internet. In J. Bauer, & M. Latzer (Eds.), *Handbook on the economics of the internet* (pp. 163–180). Edward Elgar.

McChesney, R. W., Waterman, R., & Schiller, D. (2003). *The political economy of international communications: Foundations for the emerging global debate about media ownership and regulation*. United Nations Digital Library. https://digitallibrary.un.org/record/508995

McIntyre, L. (2018). *Post-truth*. MIT Press.
McLuhan, M. (1964). The medium is the message. In M. McLuhan, *Understanding media: The extensions of man* (Chapter 1). https://web.mit.edu/allanmc/www/mcluhan.mediummessage.pdf
McLuhan, M., & Fiore, Q. (2001). *The medium is the massage: An inventory of effects*. Gingko Press.
Merrill, K. (2016). Domains of control: Governance of and by the domain name system. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 89–106). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_5
Meyer, K. S. (2020, August). *Forpligtelse for streamingtjenester: Forslag til udmøntning af en forpligtelse for streamingtjenester til at bidrage til dansk indholdsproduktion* [*Obligation for streaming services: Proposal for implementing an obligation for streaming services to contribute to Danish content production*]. Danish Ministry of Culture.
Meyrowitz, J. (2019). Medium theory. In *The international encyclopedia of media literacy* (pp. 1–7). John Wiley & Sons. https://doi.org/10.1002/9781118978238.ieml0136
Mihelj, S., Leguina, A., & Downey, J. (2019). Culture is digital: Cultural participation, diversity and the digital divide. *New Media & Society*, *21*(7), 1465–1485. https://doi.org/10.1177/1461444818822816
Miller, D., Costa, E., Haynes, N., Mcdonald, T., Nicolescu, R., Sinanan, J., Spyer, J., Venkatraman, S., & Wang, X. (2016). *How the world changed social media*. UCL Press. https://www.uclpress.co.uk/products/83038#
Ministry of Foreign Affairs of Denmark. (2021). *Strategy for Denmark's tech diplomacy 2021–2023*. https://techamb.um.dk/strategy
Ministry of Industry, Business and Financial Affairs. (2013, October 24). *Bedre bredbånd til bornholmerne* [*Better broadband for the people of Bornholm*]. https://em.dk/nyhedsarkiv/2013/oktober/bedre-bredbaand-til-bornholmerne/
Ministry of Trade, Industry and Fisheries. (2017). *Powered by nature: Norway as a data centre nation*. https://tinyurl.com/56rbzctm
Mosco, V. (2009). Overview of the political economy of communication. In V. Mosco, *The political economy of communication* (2nd ed.) (pp. 1–20). Sage. https://doi.org/10.4135/9781446279946
Mosco, V. (2014). Political economic theory and research: Conceptual foundations and current trends. In R. S. Fortner, P. M. Fackler (Eds.), *The handbook of media and mass communication theory* (pp. 37–55). John Wiley & Sons. https://doi.org/10.1002/9781118591178.ch3
Munn, L. (2020). Red territory: Forging infrastructural power. *Territory, Politics, Governance*, *11*(1), 80–99. https://doi.org/10.1080/21622671.2020.1805353
Musiani, F. (2016). Alternative technologies as alternative institutions: The case of the domain name system. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 73–86). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_4
Musiani, F., Cogburn, D. L., DeNardis, L., & Levinson, N. S. (2016). *The turn to infrastructure in internet governance*. Palgrave Macmillan. https://doi.org/10.1057/9781137483591
Møller Hartley, J., Bengtsson, M., Schjøtt Hansen, A., & Sivertsen, M. F. (2021). Researching publics in datafied societies: Insights from four approaches to the concept of 'publics' and a (hybrid) research agenda. *New Media & Society*, 14614448211021044. https://doi.org/10.1177/14614448211021045
Naughton, J. (2016). The evolution of the internet: From military experiment to general purpose technology. *Journal of Cyber Policy*, *1*(1), 5–28. https://doi.org/10.1080/23738871.2016.1157619
NemID. (n.d.). *Historien om NemID* [*The history of NemID*]. Retrieved April 26, 2022, from https://www.nemid.nu/dk-da/om-nemid/historien_om_nemid
Nets. (n.d.). *Finnish bank ID*. Retrieved April 26, 2022, from https://www.nets.eu/developer/e-ident/eids/Pages/BankIDFI.aspx
Nieborg, D. B., & Helmond, A. (2018). The political economy of Facebook's platformization in the mobile ecosystem: Facebook Messenger as a platform instance. *Media, Culture & Society*, *41*(2), 196–218. https://doi.org/10.1177/0163443718818384

Nieborg, D. B., Young, C. J., & Joseph, D. (2020). App imperialism: The political economy of the Canadian app store. *Social Media + Society*, *6*(2), 2056305120933293. https://doi.org/10.1177/2056305120933293
Nielsen, R. K., & Ganter, S. A. (2018). Dealing with digital intermediaries: A case study of the relations between publishers and platforms. *New Media & Society*, *20*(4), 1600–1617. https://doi.org/10.1177/1461444817701318
Nieminen, H. (2013). European broadband regulation: The "broadband for all 2015" strategy in Finland. In M. Löblich, & S. Pfaff-Rüdiger (Eds.), *Communication and media policy in the era of the internet: Theories and processes* (pp. 119–133). Nomos. https://doi.org/10.5771/9783845243214
Nikunen, K., & Hokka, J. (2020). Welfare state values and public service media in the era of datafication. *Global Perspectives*, *1*(1), 12906. https://doi.org/10.1525/gp.2020.12906
Nilsen, T. (2022, January). Disruption at one of two undersea cables to Svalbard. *The Independent Barents Observer*. https://tinyurl.com/5dz78ey7
Nissenbaum, H. (2011). A contextual approach to privacy online. *Daedalus*, *140*(4), 32–48. https://doi.org/10.1162/DAED_a_00113
Noam, E. (2009). *Media ownership and concentration in America*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195188523.001.0001
Noam, E. (Ed.). (2016). *Who owns the world's media? Media concentration and ownership around the world*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199987238.001.0001
Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism*. New York University Press.
Nord, L. (2008). Comparing Nordic media systems: North between west and east? *Central European Journal of Communication*, *1*, 95–110. https://tinyurl.com/4ku43rn4
Nordic-Baltic Tele Statistics. (2021, September 13). *Telecommunications markets in the Nordic and Baltic countries 2020* (1–46). https://tinyurl.com/3ebm2c8p
Norris, P. (2001). *Digital divide: Civic engagement, information poverty, and the internet worldwide*. Cambridge University Press. https://doi.org/10.1017/CBO9781139164887
Norris, P. (2009). Comparative political communications: Common frameworks or babelian confusion? *Government and Opposition*, *44*(3), 321–340. https://doi.org/10.1111/j.1477-7053.2009.01290.x
Norwegian Consumer Council. (2018, June 27). *Decieved by design: How tech companies use dark patterns to discourage us from exercising our rights to privacy*. https://tinyurl.com/34rbppku
Norwegian Consumer Council. (2020). *Out of control: How consumers are exploited by the online advertising industry*. https://www.forbrukerradet.no/undersokelse/no-undersokelsekategori/report-out-of-control/
Nothias, T. (2020). Access granted: Facebook's free basics in Africa. *Media, Culture & Society*, *42*(3), 329–348. https://doi.org/10.1177/0163443719890530
NS Business. (2018, July 11). *Nordic tech: How Scandinavia has innovated its way to the top*. https://www.ns-businesshub.com/technology/nordic-tech-scene/
Nuechterlein, J. E., & Weiser, P. J. (2013). *Digital crossroads: Telecommunications law and policy in the internet age* (2nd ed.). MIT Press.
Nussbaum, M. C. (2000). *Women and human development: The capabilities approach*. Cambridge University Press. https://doi.org/10.1017/CBO9780511841286
Nussbaum, M. C. (2011). *Creating capabilities: The human development approach*. Harvard University Press. https://doi.org/10.2307/j.ctt2jbt31
OECD. (2008). *Broadband growth and policies in OECD countries*. https://www.oecd.org/sti/broadband/40629067.pdf
O'Hara, K., Hall, W., & Cerf, V. (2021). *Four internets: Data, geopolitics, and the governance of cyberspace*. Oxford University Press. https://doi.org/10.1093/oso/9780197523681.001.0001
Ohlsson, J. (2015). *The Nordic media market 2015: Denmark, Finland, Iceland, Norway, Sweden*. Nordicom, University of Gothenburg. https://urn.kb.se/resolve?urn=urn:nbn:se:norden:org:diva-9834

Parker, G. G., Alstyne, M. W. V., & Choudary, S. P. (2016). *Platform revolution: How networked markets are transforming the economy and how to make them work for you*. W. W. Norton & Company.

Parks, L. (2015). Water, energy, access: Materializing the internet in rural Zambia. In L. Parks, & N. Starosielski (Eds.), *Signal traffic: Critical studies of media infrastructures* (pp. 115–136). University of Illinois Press. https://www.jstor.org/stable/10.5406/j.ctt155jmd9.9

Parks, L., Sterne, J., Starosielski, N., Acland, C. R., Dourish, P., Harris, S., Holt, J., Mattern, S., Miller, T., & Sandvig, C. (2015). *Signal traffic: Critical studies of media infrastructures*. University of Illinois Press. https://www.jstor.org/stable/10.5406/j.ctt155jmd9

Perriam, J., Birkbak, A., & Freeman, A. (2019). Digital methods in a post-API environment. *International Journal of Social Research Methodology*, *23*(3), 277–290. https://doi.org/10.1080/13645579.2019.1682840

Perry, E. (2020, February 7). *And that's how the Google cookie crumbles*. Social Media Week. https://socialmediaweek.org/blog/2020/02/and-thats-how-the-google-cookie-crumbles/

Peters, J. D. (2016). *The marvelous clouds: Toward a philosophy of elemental media*. University of Chicago Press.

Picard, R. G. (2020). *Media and communications policy making: Processes, dynamics and international variations*. Springer. https://doi.org/10.1007/978-3-030-35173-1

Plantin, J.-C., Lagoze, C., Edwards, P. N., & Sandvig, C. (2018). Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media & Society*, *20*(1), 293–310. https://doi.org/10.1177/1461444816661553

Plantin, J.-C., & Punathambekar, A. (2019). Digital media infrastructures: Pipes, platforms, and politics. *Media, Culture & Society*, *41*(2), 163–174. https://doi.org/10.1177/0163443718818376

Poell, T., Nieborg, D., & van Dijck, J. (2019). Platformisation. *Internet Policy Review*, *8*(4). https://doi.org/10.14763/2019.4.1425

Portwood-Stacer, L. (2013). Media refusal and conspicuous non-consumption: The performative and political dimensions of Facebook abstention. *New Media & Society*, *15*(7), 1041–1057. https://doi.org/10.1177/1461444812465139

Postman, N. (1974). Media ecology: General semantics in the third millenium. *General Semantics Bulletin*, 74–78. https://nysgs.org/resources/Documents/PostmanGSB.pdf

Psychogiopoulou, E. (Ed.). (2012). *Understanding media policies*. Palgrave Macmillan. https://doi.org/10.1057/9781137035288

Psychogiopoulou, E. (Ed.). (2014). *Media policies revisited*. Palgrave Macmillan. https://doi.org/10.1057/9781137337849

Puppis, M. (2010). Media governance: A new concept for the analysis of media policy and regulation. *Communication, Culture & Critique*, *3*(2), 134–149. https://doi.org/10.1111/j.1753-9137.2010.01063.x

Puppis, M., & Just, N. (2012). *Trends in communication policy research: New theories, methods and subjects*. Intellect.

Pybus, J., & Coté, M. (2021). Did you give permission? Datafication in the mobile ecosystem. *Information, Communication & Society*, *25*(11), 1650–1668. https://doi.org/10.1080/1369118X.2021.1877771

Raha, U. K., & Raju, K. D. (2021). *Submarine cables protection and regulations: A comparative analysis and model framework*. Springer. https://doi.org/10.1007/978-981-16-3436-9

Randall, L., & Berlina, A. (2019). *Governing the digital transition in Nordic regions: The human element*. Nordregio. https://doi.org/10.6027/R2019:4.1403-2503

Rantanen, M. M., & Koskinen, J. (2020). Respecting the individuals of data economy ecosystems. In M. Cacace, R. Halonen, H. Li, T. P. Orrensalo, C. Li, G. Widén, & R. Suomi (Eds.), *Well-being in the information society: Fruits of respect* (pp. 185–196). Springer. https://doi.org/10.1007/978-3-030-57847-3_13

Rat, R. (2020). *Media freedom made in Scandinavia – Six examples of best practice*. European Centre for Press & Media Freedom. https://www.ecpmf.eu/media-freedom-made-in-scandinavia-examples-of-best-practice/

Ravenscraft, E. (2022, April 25). What is the metaverse, exactly? *Wired*. https://www.wired.com/story/what-is-the-metaverse/

Reuters. (2021, May 31). *U.S. spied on Merkel and other Europeans through Danish cables – Broadcaster DR*. Reuters. https://tinyurl.com/yc7jtf9u
Robeyns, I. (2003). Sen's capability approach and gender inequality: Selecting relevant capabilities. *Feminist Economics*, *9*(2–3), 61–92. https://doi.org/10.1080/1354570022000078024
Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development*, *6*(1), 93–117. https://doi.org/10.1080/146498805200034266
Robeyns, I. (2016). The capability approach. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Winter 2016). Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/win2016/entries/capability-approach/
Robins, K., & Webster, F. (1999). The long history of the information revolution. In K. Robins, & F. Webster, *Times of the technoculture: From the information society to the virtual life*. Routledge. https://doi.org/10.4324/9780203169544
Rogers, R. (2013). *Digital methods*. MIT Press.
Routley, N. (2019, December 2). *Wired world: 35 years of submarine cables in one map*. Visual Capitalist. https://www.visualcapitalist.com/wired-world-35-years-of-submarine-cables-in-one-map/
Ruiz, J. B., & Barnett, G. A. (2015). Who owns the international internet networks? *The Journal of International Communication*, *21*(1), 38–57. https://doi.org/10.1080/13216597.2014.976583
Sadowski, J. (2019). When data is capital: Datafication, accumulation, and extraction. *Big Data & Society*, *6*(1). https://doi.org/10.1177/2053951718820549
Sadowski, J. (2020). The internet of landlords: Digital platforms and new mechanisms of rentier capitalism. *Antipode*, *52*(2), 562–580. https://doi.org/10.1111/anti.12595
Sandvig, C. (2013). The internet as infrastructure. In W. H. Dutton (Ed.), *The Oxford handbook of internet studies* (Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199589074.013.0005
Sandvig, C. (2015). The internet as the anti-television: Distribution infrastructure as culture and power. In L. Parks, & N. Starosielski (Eds.), *Signal traffic: Critical studies of media infrastructures* (pp. 225–245). University of Illinois Press. https://www.jstor.org/stable/10.5406/j.ctt155jmd9.14
Sandvig, C., Hamilton, K., Karahalios, K., & Langbort, C. (2016). Automation, algorithms, and politics | When the algorithm itself is a racist: Diagnosing ethical harm in the basic components of software. *International Journal of Communication*, *10*, 4972–4990. https://ijoc.org/index.php/ijoc/article/view/6182
Sargsyan, T. (2016). The turn to infrastructure in privacy governance. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 189–201). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_10
Schruers, M. (2016). Copyright, information intermediaries, and internet architecture. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in internet governance* (pp. 107–124). Palgrave Macmillan. https://doi.org/10.1057/9781137483591_6
Scolari, C. A. (2012). Media ecology: Exploring the metaphor to expand the theory. *Communication Theory*, *22*(2), 204–225. https://doi.org/10.1111/j.1468-2885.2012.01404.x
Sen, A. (1980). Equality of what? In E. Ashby, & S. M. McMurrin (Eds.), *The Tanner lectures on human values* (pp. 195–220). Cambridge University Press. https://www.ophi.org.uk/wp-content/uploads/Sen-1979_Equality-of-What.pdf
Sen, A. (1995). *Inequality reexamined*. Oxford University Press. https://doi.org/10.1093/0198289286.001.0001
Share Lab. (2015, February 5). Invisible infrastructures: The exciting life of internet packet. https://labs.rs/en/packets/
Siebert, F. S., Peterson, T., & Schramm, W. (1963). *Four theories of the press: The authoritarian, libertarian, social responsibility, and Soviet communist concepts of what the press should be and do*. University of Illinois Press. https://doi.org/10.5406/j.ctv1nhr0v
Simon, J.-P. (2012). The ICT landscape in BRICS countries: 3. China. *Digiworld Economic Journal*, *1*(85), 191. https://publications.jrc.ec.europa.eu/repository/handle/JRC71011

Sirkkunen, E. E., Horowitz, M., Nieminen, H., & Grigor, I. (Eds.). (2021). *Media platformisation and Finland: How platforms have impacted on the Finnish mediasphere and public life*. Research consortium Communication Rights in the Age of Digital Disruption (CORDI).
Sivetc, L. (2021). Controlling free expression "by infrastructure" in the Russian internet: The consequences of RuNet sovereignization. *First Monday*, *26*(5). https://doi.org/10.5210/fm.v26i5.11698
Sjøvaag, H., Pedersen, T. A., & Owren, T. (2019). Is public service broadcasting a threat to commercial media? *Media, Culture & Society*, *41*(6), 808–827. https://doi.org/10.1177/0163443718818354
Sjøvaag, H., Stavelin, E., & Moe, H. (2016). Continuity and change in public service news online. *Journalism Studies*, *17*(8), 952–970. https://doi.org/10.1080/1461670X.2015.1022204
Smythe, D. W. (1950). Television and its educational implications. *Elementary English*, *27*, 41–52.
Smythe, D. W. (1981). On the audience commodity and its work. In D. W. Smythe (Ed.), *Dependency road: Communications, capitalism, consciousness, and Canada* (pp. 22–51). Ablex.
Star, S. L. (1999). The ethnography of infrastructure. *American Behavioral Scientist*, *43*(3), 377–391. https://doi.org/10.1177/00027649921955326
Star, S. L., & Ruhleder, K. (1996). Steps toward an ecology of infrastructure: Design and access for large information spaces. *Information Systems Research*, *7*(1), 111–134. https://doi.org/10.1287/isre.7.1.111
Starosielski, N. (2015). Fixed flow: Undersea cables as media infrastructure. In L. Parks, & N. Starosielski (Eds.), *Signal traffic: Critical studies of media infrastructures* (pp. 53–70). University of Illinois Press. https://www.jstor.org/stable/10.5406/j.ctt155jmd9.6
Street, J. (2010). *Mass media, politics and democracy* (2nd ed.). Bloomsbury.
Svensson, A. F. (2022). *The legal 500 country comparative guides: Sweden TMT*. The Legal 500. https://www.legal500.com/guides/chapter/sweden-technology/?export-pdf
Swedish Authority for Privacy Protection. (2020, November 3). *Swedish authority for privacy protection imposes administrative fine on Google*. https://tinyurl.com/mcwhd9vr
Swedish Competition Authority. (2021). *The competition on digital platform markets in Sweden*. https://tinyurl.com/5n8n6pfe
Syvertsen, T. (2004). *Mediemangfold: Styring av mediene i et globalisert marked* [*Media diversity: Managing the media in a globalised market*]. IJ-forlaget.
Syvertsen, T., Enli, G., Mjøs, O. J., & Moe, H. (2014). *The media welfare state: Nordic media in the digital era*. University of Michigan Press. https://doi.org/10.3998/nmw.12367206.0001.001
Sørensen, J. K., & Van den Bulck, H. (2020). Public service media online, advertising and the third-party user data business: A trade versus trust dilemma? *Convergence*, *26*(2), 421–447. https://doi.org/10.1177/1354856518790203
Taneja, H. (2016). Using commercial audience measurement data in academic research. *Communication Methods and Measures*, *10*(2–3), 176–178. https://doi.org/10.1080/19312458.2016.1150971
Tanenbaum, A. S., & Wetherall, D. (2011). *Computer networks* (5th ed.). Pearson Prentice Hall.
Tang, M. (2020). Huawei versus the United States? The geopolitics of exterritorial internet infrastructure. *International Journal of Communication*, *14*, 4556–4577. https://ijoc.org/index.php/ijoc/article/view/12624/3204
Taplin, J. (2017, April 22). Is it time to break up Google) *The New York Times*. https://www.nytimes.com/2017/04/22/opinion/sunday/is-it-time-to-break-up-google.html
Taylor, L., Sharma, G., Martin, A., & Jamenson, S. (Eds.). (2020). *Data justice and Covid-19: Global perspectives*. Meatspace Press. https://issuu.com/meatspacepress/docs/msp_data_justice_covid-19_digital_issuu
ten Oever, N. (2019). Productive contestation, civil society, and global governance: Human Rights as a boundary object in ICANN. *Policy & Internet*, *11*(1), 37–60. https://doi.org/10.1002/poi3.172
Tenove, C. (2020). Protecting democracy from disinformation: Normative threats and policy responses. *The International Journal of Press/Politics*, *25*(3), 517–537. https://doi.org/10.1177/1940161220918740

The Economist Intelligence Unit. (2021). *The inclusive internet index* [Dataset]. https://impact.economist.com/projects/inclusive-internet-index/
The Ministry of Culture. (2022, February). *Udspil til ny medieaftale 2022* [*Plan for new media agreement 2022*]. https://kum.dk/fileadmin/_kum/1_Nyheder_og_presse/2022/Medieudspil_0302_.pdf
Thon, B. E., Blyverket, I. L., & Egenæs, J. P. (2021, November 10). *Enough is enough! Rein in the giants*. Euractiv. https://www.euractiv.com/section/digital/opinion/enough-is-enough-rein-in-the-giants/
Thylstrup, N. B. (2019). Data out of place: Toxic traces and the politics of recycling. *Big Data & Society*, *6*(2), 2053951719875479. https://doi.org/10.1177/2053951719875479
Traficom. (2021). *The new broadband aid project to support the construction of high-speed broadband from 2021*. https://www.traficom.fi/en/nopea-laajakaista
Tupasela, A., Snell, K., & Tarkkala, H. (2020). The Nordic data imaginary. *Big Data & Society*, *7*(1), 2053951720907107. https://doi.org/10.1177/2053951720907107
Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*. Touchstone.
Van Aelst, P., Strömbäck, J., Aalberg, T., Esser, F., de Vreese, C., Matthes, J., Hopmann, D., Salgado, S., Hubé, N., Stępińska, A., Papathanassopoulos, S., Berganza, R., Legnante, G., Reinemann, C., Sheafer, T., & Stanyer, J. (2017). Political communication in a high-choice media environment: A challenge for democracy? *Annals of the International Communication Association*, *41*(1), 3–27. https://doi.org/10.1080/23808985.2017.1288551
van Cuilenburg, J., & McQuail, D. (2003). Media policy paradigm shifts: Towards a new communications policy paradigm. *European Journal of Communication*, *18*(2), 181–207. https://doi.org/10.1177/0267323103018002002
Van den Bulck, H., & Donders, K. (2014). Analyzing European media policy: Stakeholders and advocacy coalitions. In K. Donders, C. Pauwels, & J. Loisen (Eds.), *The Palgrave handbook of European media policy* (pp. 19–35). Palgrave Macmillan. https://doi.org/10.1057/9781137032195_2
van Dijck, J. (2014). Datafication, dataism and dataveillance: Big data between scientific paradigm and ideology. *Surveillance & Society*, *12*(2), 197–208. https://doi.org/10.24908/ss.v12i2.4776
van Dijck, J. (2020). Seeing the forest for the trees: Visualizing platformization and its governance. *New Media & Society*, *23*(9), 2801–2819. https://doi.org/10.1177/1461444820940293
van Dijck, J., Poell, T., & de Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford University Press. https://doi.org/10.1093/oso/9780190889760.001.0001
Velkova, J. (2016). Data that warms: Waste heat, infrastructural convergence and the computation traffic commodity. *Big Data & Society*, *3*(2), 2053951716684144. https://doi.org/10.1177/2053951716684144
Velkova, J. (2020). The art of guarding the Russian cloud: Infrastructural labour in a Yandex data centre in Finland. *Digital Icons – Studies in Russian, Eurasian and Central European New Media*, *20*, 47–63. https://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-169003
Vendil Pallin, C. (2017). Internet control through ownership: The case of Russia. *Post-Soviet Affairs*, *33*(1), 16–33. https://doi.org/10.1080/1060586X.2015.1121712
Venturini, T., Bounegru, L., Gray, J., & Rogers, R. (2018). A reality check(list) for digital methods. *New Media & Society*, *20*(11), 4195–4217. https://doi.org/10.1177/1461444818769236
Venturini, T., & Rogers, R. (2019). "API-Based research" or how can digital sociology and journalism studies learn from the Facebook and Cambridge Analytica data breach. *Digital Journalism*, *7*(4), 532–540. https://doi.org/10.1080/21670811.2019.1591927
Volz, D. (2016, June 29). *ACLU files lawsuit over U.S. anti-hacking law*. Reuters. https://www.reuters.com/article/us-cyber-lawsuit-aclu-idUSKCN0ZF1Q2
Wasko, J. (2004). The political economy of communications. In J. D. H. Downing, D. McQuail, P. Schlesinger, & E. Wartella (Eds.), *The Sage handbook of media studies* (pp. 309–330). Sage. https://doi.org/10.4135/9781412976077.n16
Wasko, J. (Ed.). (2011). *The handbook of political economy of communications*. Wiley-Blackwell.
Webster, J. G. (2014). *The marketplace of attention, how audiences take shape in a digital age*. MIT Press.
webXray. (n.d.). *webXray*. Retrieved October 5, 2022, from https://webxray.org/

Winseck, D. (2008). The state of media ownership and media markets: Competition or concentration and why should we care? *Sociology Compass*, *2*(1), 34–47. https://doi.org/10.1111/j.1751-9020.2007.00061.x
Winseck, D. (2012). Submarine telegraphs, telegraph news, and the global financial crisis of 1873. *Journal of Cultural Economy*, *5*(2), 197–212. https://doi.org/10.1080/17530350.2012.660790
Winseck, D. (2017). The geopolitical economy of the global internet infrastructure. *Journal of Information Policy*, *7*, 228–267. https://doi.org/10.5325/jinfopoli.7.2017.0228
Winseck, D. (2019). Internet infrastructure and the persistent myth of U.S. hegemony. In B. Haggart, K. Henne, & N. Tusikov (Eds.), *Information, technology and control in a changing world: Understanding power structures in the 21st century* (pp. 93–120). Springer. https://doi.org/10.1007/978-3-030-14540-8_5
Winseck, D., & Jin, D. Y. (Eds.). (2011). *The political economies of media: The transformation of the global media industries*. Bloomsbury Academic. https://doi.org/10.5040/9781849664264
Winseck, D. R., & Pike, R. M. (2007). *Communication and empire: Media, markets, and globalization, 1860–1930*. Duke University Press.
World Wide Web Foundation. (n.d.). *Contract for the web*. Retrieved December 11, 2019, from https://contractfortheweb.org/
Wu, A. X., Taneja, H., & Webster, J. G. (2020). Going with the flow: Nudging attention online. *New Media & Society*, *23*(10), 2979–2998. https://doi.org/10.1177/1461444820941183
Yin, R. K. (2009). *Case study research: Design and methods*. Sage.
Yonego, J. T. (2014, July 23). Data is the new oil of the digital economy. *Wired*. https://www.wired.com/insights/2014/07/data-new-oil-digital-economy/
Zager, M. (2019, November/December). *Municipal fiber in Sweden*. Broadband Communities. http://www.bbcmag.com/community-broadband/municipal-fiber-in-sweden
Zhang, C. (2020). Who bypasses the great firewall in China? *First Monday*, *25*(4). https://doi.org/10.5210/fm.v25i4.10256
Zuboff, S. (2019). *The age of surveillance capitalism: The fight for a human future at the new frontier of power*. PublicAffairs.
Zuckerman, E. (2020, January 17). *The case for digital public infrastructure*. Knight First Amendment Institute at Columbia University. https://knightcolumbia.org/content/the-case-for-digital-public-infrastructure

The Internet is a critical part of the societal infrastructure in the Nordic region – giving rise to increasing concerns about the growing power of global tech corporations that supply the foundation for the region's evermore digitalised welfare states. Yet, we lack empirical evidence for understanding, discussing, and ultimately regulating the changing power structures surrounding Internet-based communication. Presenting a novel framework for analysing and comparing the four largest Nordic countries – Denmark, Finland, Norway, and Sweden – this book provides nuanced insights into what we think we know about digital power and control.

Identifying the main gateways into contemporary digital societies, we follow the constant flows of data – from the individual user connecting to a network operator that then passes the data on through local, terrestrial networks, Internet exchange points, and submarine cable routes, to the servers of a given website and app that in turn send the requested data back and collect a wide range of metadata in the process. This allows us to identify the key market actors and regulatory arrangements that shape the evolution of digital communication systems.

What we find is a significant historical shift in the ways basic communication resources are organised and controlled in welfare states. Alongside the rapid digitalisation of Nordic societies, new gatekeepers have entered the stage while former ones have stepped into the background, established regulatory frameworks have lost their previous efficacy, and commercial forms of governance have taken over. Yet, we also find that the four countries – that are so often described as a homogeneous whole – have followed different institutional and infrastructural paths on their way to digitalisation, resulting in different degrees of disruption, globalisation, and state involvement.

NORDICOM

UNIVERSITY OF GOTHENBURG

Nordicom is funded with support from the Nordic Council of Ministers

ISBN 978-91-88855-83-1

Nordicom is a centre for Nordic media research at the University of Gothenburg.