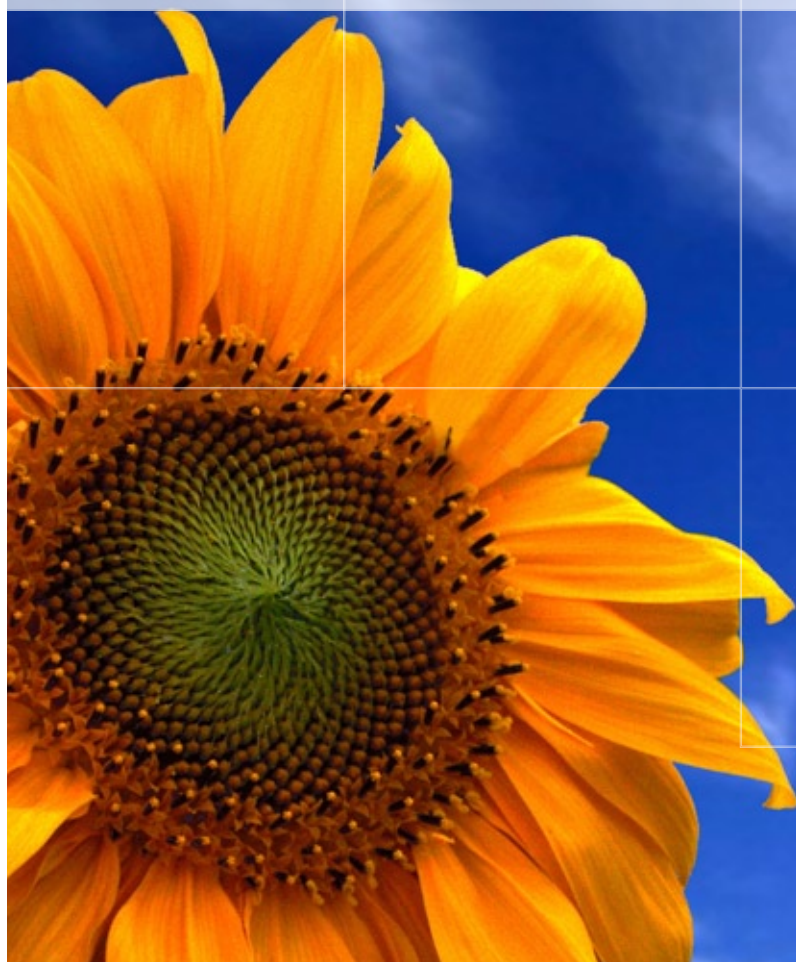


January 2008

Clean Nordic and Baltic sky

Feasibility Study

- Air transport stakeholders' future requirements for environmental friendly operations
- Needs for cooperation and information networks technologies
- A simplified concept for collaborative information shearing



Participants:

Denmark

Integra Consult

Michael Thorsen

Hans Nyhøy

Nina B. Rasmussen

Louse Andrsson

Norway

Edda Systems

Lars Aalvik

Park Air Systems

Thor Breien

SINTEF ICT

Hans Erik Swendgaard

Sweden

Saab Security Systems

Joakim Ekström

Roy Bolwede

Per Ahl

Title: Clean Nordic and Baltic Sky - Feasibility Study		
Nordic Innovation Centre project number: 07126		
Author(s): Nina B. Rasmussen, Lars Aalvik, Thor Breien, Per Ahl and Hans Erik Swendgaard		
Institution(s): Integra Consult, Edda Systems, Park Air Systems, SINTEF ICT and Saab Security Systems		
Abstract: This feasibility study is based on information collected from various ATM Stakeholders. The results show that there is cooperation among ATM stakeholders. Many of them are satisfied with the existing network and cooperation, while others see the need for improvements. It seems to be the case that international cooperation is limited to cooperation with similar organizations, i.e. the Nordic ANSPs have a forum, the Nordic airports have a forum, etc. A more detailed lay out of this observation is that: • Airline and ATM industry cooperation is close to non-existent • Airline and ANSP/airport cooperation is fragmented and faces desires for improvement • ANSP/airport and ATM Industry cooperation is fragmented, but it is in good development. Indistinct views on “who is whom’s customer” and lack of quantified network enabled profits and values, might be a reason for the modest Nordic ATM cooperation. Availability on network based information is not enough, the way of working must be changed before possible profits can be quantified. It seems to be essential that such groups are professionally managed and with a scope that gives benefit to all participants. It seems technology wise to be beneficial with more extensive collaboration regarding tests for introduction of data link (ADS-B and CPDLC). Use of data link will improve the information exchange and therefore provide for a more efficient traffic flow. CDA can significantly contribute for fuel saving and reduced noise. The use of CDA depends on collaboration between the ANSP and the airline companies. Tools for collaborative information sharing and decision support for 4D arrival management are needed to obtain these benefits. By introducing a simplified collaborative information sharing concept, which might be looked upon as a first step towards a more complete CDM/SWIM solution, the practical operation of the airport can be carried out with improved precision, at less cost, less delay, and less environmental impact.		
Topic/NICE Focus Area:		
ISSN:	Language: English	Pages: 40
Key words:		
Distributed by: Nordic Innovation Centre Stensberggata 25 NO-0170 Oslo Norway	Contact person: Hans Erik Swendgaard, Senior Advisor SINTEF ICT NO-7465 Trondheim, Norway Phone +47 93 45 91 03, hans.e.swendgaard@sintef.no	

Executive Summary

Aims

Demand for air travel is growing rapidly. Shortfalls in capacity and other constraints on the efficiency of airports and aircraft operations have negatively impacted the environment. The need to enhance efficiency without increase in emissions, within finite airspace and airport resources while still ensuring high levels of safety, has grown considerably.

SESAR has identified environmental sustainability as one of its top Key Performance Areas (KPA's). SESAR is aiming to meet the political target of 10% reduction in environmental impact per flight as an air traffic management (ATM) contribution to wider aviation sustainability aims.

One vital driving factor necessary to point out clearly is the fact that reduced fuel consumption is directly linked to reduced emissions. This means that the airline companies strive for cost efficiency and competitiveness also are a benefit for the environment. Consequently technology for ATM is in this context also environmental technology.

Different cultures, and arising demands to be met with fractioned systems based on old technologies is hampering Nordic and Baltic ATM co-operation. Several promising initiatives are in process, but the future market potential is difficult to estimate. This feasibility study is the first initiative for co-operation between air navigation service providers (ANSP), airports, airline companies and industry.

This feasibility study report aims to provide a better understanding of:

1. Established relations and network for the selected ANSPs, airports, airline companies and industry.
2. The ANSP's, airports and airline companies needs for more efficient and environmental friendly air traffic management ATM. It is expected that this also will have a barrier-breaking effect with respect to the different actors common understanding across borders and businesses.
3. Higher awareness of the feasibility study effect on Nordic and Baltic ATM technologies among key actors as the EU Commission/DG TREN, the Single European Sky ATM Research (SESAR) project and EUROCONTROL Experimental Centre.
4. Collaborative ATM decision making with related efficiency and environmental benefits. This will lead way for a clearer picture of the near future market for different ATM technologies in this area.

Working Method

The working methods have been interviews, organizing and analysis of data, work shops on specific themes and report writing.

Recommendations

Network and Cooperation

It seems to be beneficial for the Nordic and Baltic stakeholders to establish a common ground for network and cooperation. It is a necessity that all these networks are efficiently driven and that communication is professionally made partly to ensure that the networks are visual and that all employees working within ATM are aware of the groups.

Indistinct views on “who is whom’s customer” and lack of quantified network enabled profits and values is a concern. With the next generation of ATM technology coming up with the SESAR project, it appears beneficial to get a clear and precise view on these profits and values. This might constitute a knowledge base for more precise implementation of new technology and procedures. Availability on network based information is not enough, the way of working must be changed before possible profits can be quantified.

Network and Technology

Continuous decent approach (CDA) can significantly contribute to fuel saving and reduced noise. The use of CDA depends on collaboration between the ANSP, airports and the airline companies. Tools for collaborative information sharing and decision support for 4D arrival management are needed to obtain these benefits. Incentives to increase the testing of CDA seem necessary.

It seems to be beneficial with more extensively collaboration regarding tests for introduction of data link (ADS-B and CPDLC). Use of data link will improve the information exchange and therefore provide for a more efficient traffic flow. The implementation of ADS-B should increase the surveillance capability and hence make it simpler to optimise the aircraft route. Common data exchange systems for the ANSP and airline companies should be established.

By introducing a collaborative information sharing concept as defined in section 5, the practical operation of the airport can be carried out with improved precision, at less cost, less delay, and less environmental impact. As the first step ambitions should be modest in order to establish a minimum network based capability within:

- the ability to plan and sequence the traffic better due to more accurate information
- increased precision related to manning of different ground operations: gate operation, fueling, luggage handling, catering, internal airline handling, etc
- less environmental impact (ex. CDA/Green approaches)
- airports generally easier to operate and more passenger friendly due to more reliable information available.

On a longer term, still harmonized with SESAR, a more extensive collaborative decision making/system wide information management (CDM/SWIM) capability should be established in the Nordic and Baltic countries. This would also pave way for SESAR related implementations. The Nordic ATM industry network is fragmented today, but the industry could together form a well equipped and knowledgeable group that covers a broad spectrum of ATM and airport capabilities. Together with contributions from ANSP/airports and airline companies, the ATM industry contribution is considered as one of several inputs to an initial CDM/SWIM implementation in the Nordic and Baltic countries.

Table of Content

1	RELEVANT INTERNATIONAL REQUIREMENTS	1
1.1	SESAR	1
1.2	EU DIRECTIVE ON CDM	3
1.3	FINDINGS AND CONCLUSIONS	3
2	THE ANSPs, AIRPORTS AND AIRLINE COMPANIES RELATIONS AND NETWORK	5
2.1	AVINOR	5
2.2	ISAVIA	6
2.3	NAVIAIR	7
2.4	FINAVIA	8
2.5	LFV GROUP	8
2.6	KEFLAVIK AIRPORT	9
2.7	SAS GROUP	9
2.8	SAS NORGE	10
2.9	ICELANDAIR	11
2.10	FINNAIR	12
2.11	FINDINGS AND CONCLUSIONS	13
3	DESCRIPTION OF NEEDS FOR COLLABORATIVE INFORMATION SHARING AND ENVIRONMENTAL-FRIENDLY OPERATIONS	14
3.1	AVINOR	14
3.2	ISAVIA	15
3.3	NAVIAIR	17
3.4	FINAVIA	17
3.5	LFV GROUP	18
3.6	OSLO AIRPORT	20
3.7	STOCKHOLM AIRPORT	20
3.8	KEFLAVIK AIRPORT	20
3.9	SAS GROUP	21
3.10	SAS NORGE	22
3.11	ICELANDAIR	23
3.12	FINNAIR	24
3.13	FINDINGS AND CONCLUSIONS	24
4	DESCRIPTION OF THE ATM INDUSTRIES' FUTURE MARKET	26
4.1	ESSENTIAL FACTORS	26
4.2	EXPECTATIONS FOR THE FUTURE MARKET	26
4.3	FINDINGS AND CONCLUSIONS	29
5	A SIMPLIFIED CONCEPT FOR COLLABORATIVE INFORMATION SHARING	30
5.1	CONCEPTUAL SKETCH	30
5.2	TECHNICAL ASPECTS	32
5.3	BUSINESS ASPECTS	32
5.4	FINDINGS AND CONCLUSIONS	32

1 Relevant international requirements

1.1 SESAR

SESAR has identified environmental sustainability as one of its top Key Performance Areas (KPA). SESAR is aiming to meet the political target of 10% reduction in environmental impact per flight as an ATM contribution to wider aviation sustainability aims. SESAR has identified Collaborative Environmental Management (CEM) as a key driver for environmental improvement. Similarly, CDA (Continuous Decent Approach) is also considered by the SESAR concept to be an important operational improvement step. (ECIP Environment Part 1).

The SESAR Vision:

“Achieve a performance based European ATM System, built in partnership, to best support the ever increasing societal and States’, including military, expectations for air transport with respect to the growing mobility of both citizens and goods and all other aviation activities, in a safe, secure, environmentally sustainable and cost-effective manner”.

The air transport industry needs to prepare for the predicted demand for air transport, which could increase three-fold, compared to today’s traffic. Existing ATM fragmentation and current infrastructures cannot cope with such and increase. While keeping pace with the expected growth, future ATM must take into account optimisation of each and every flight. The ATM world has to shift to a performance-based operation.

The Performance Framework will be used to drive management decisions towards achieving the Vision. The SESAR Consortium has started to address the definition of the 2020 performance by setting initial targets. These will be continuously refined within the lifetime of the ATM Master Plan. ATM Performance covers a broad spectrum of aspects, which are represented through eleven Key Performance Areas (KPA). The KPA targets represent initial indicative values (working assumptions), subject to further analysis and validation. All KPAs are interdependent and will be the basis for impact assessment and consequent trade-off analysis for decision-making in the subsequent SESAR Milestone Deliverables.

1.1.1 Air Transport Framework, The Performance Target/Deliverable 2

The 11 KPAs are as follows: **Cost-Effectiveness**, **Capacity**, Efficiency, Flexibility, Predictability, **Safety**, Security, **Environmental Sustainability**, Access and Equity, Participation, Interoperability. Those how are highlighted are the KPAs that SESAR sees as directly linked to the achievement of the proposed SESAR Vision.

Capacity – Enable a triple capacity increase which will also reduce delays, on the ground and in the air (en-route and airport network), to be able to handle traffic growth well beyond 2020. The deployment of the ATM target concept should be progressive, so that only the required capacity is deployed at any time. The target for Capacity deployment is that the ATM System can accommodate by 2020 a 73% increase in traffic (from 2005 baseline) while meeting the targets for safety and quality of service KPAs (Efficiency, Flexibility, Predictability)

Cost-Effectiveness – 2020 Target: Halve the total direct ATM costs. The ATM Performance Framework provides a common basis to ensure the effectiveness of the ATM System through a dynamic relationship between European States, institutions and regulations (“Institutional and Regulatory Framework”), and all aircraft operators, air navigation service providers and airports working in partnership to match the targets (“Business management Framework”)

Environmental Sustainability - SESAR has identified environmental sustainability as one of its top Key Performance Areas (KPA's). SESAR is aiming to meet the political target of 10% reduction in environmental impact per flight as an ATM contribution to wider aviation sustainability aims. SESAR has identified Collaborative Environmental Management (CEM) as a key driver for environmental improvement. Similarly, CDA is also considered by SESAR concept to be an important operational improvement step. (ECIP Environment Part 1).

Safety – Improve the safety level by factor 3 (2020). Considering the anticipated increase in European annual traffic volume, the implication of the initial safety performance objective is that the overall safety level would gradually have to improve, to reach an improvement factor 3 in order to meet the safety objective in 2020. In the longer term safety levels would need to be able to increase by a factor 10 to meet a possible threefold increase in traffic.

1.1.2 The ATM Target Concept/Deliverable 3

The SESAR ATM Target Concept, including its Concept of Operations (ConOps), Architecture and Technologies, is the foundation of the future European ATM System. The ATM Target Concept is built on the 4D Trajectory; it is flexible and can be tailored to specific local needs including their evolution in the life of SESAR. It covers the needs of all Airspace Users operations. Key features of the 2020 ATM Target Concept are:

Business Trajectory – “Best overall outcome for a flight”

The Business Trajectory principle is central to the Concept of Operations since it interacts with all elements of the ATM system for a given flight. The Business Trajectory itself is a principle to improve design, planning and operation of the future systems and a central way to measure the future ATM System performance for an optimum execution of each flight.

Changes to the Business Trajectory are kept to a minimum, through a Collaborative Decision Making (CDM) mechanism, except in time critical situations.

Business Trajectories are expressed in all 4 dimensions (position and time) and flown with much higher precision than today.

Trajectory Management – Moving from airspace to trajectory focus while introducing a new approach to airspace design and management.

Airspace Users fly preferred routing without pre-defined routes.

Only two categories of airspace are defined and organised: Managed airspace where separation service is provided by ANSPs and unmanaged airspace where the pilot carries out the separation task.

Collaborative Planning continuously reflected in the Network Operations Plan (NOP):

All main stakeholders collaborate in a layered planning approach to establish the NOP.

It enables efficient queue management, optimizing access to constrained resources, minimises holding and ground queues. It enables priority setting by Airspace Users in the event of a capacity shortfall.

Integrated Airport operations contributing to capacity gains and reducing environmental impact:

Full integration of airport operations into the trajectory management processes.

Increase throughput and reduced environmental impact (via e.g. turnaround management, reduction of the impact of low visibility conditions, etc).

System Wide Information Management – integrating all ATM related data:

A System Wide Information Management (SWIM) environment including all ATM actors, e.g. aircraft and ground facilities, will underpin the future ATM system.

It supports CDM processes using efficient end-user applications to exploit the power of shared and up to date information.

Humans will be central in the future European ATM system as managers and decision-makers:

To accommodate the expected traffic increase, an advanced level of automation support for the humans will be required.

The nature of human roles and tasks will necessarily change. This will affect system design, staff selection, training, competence requirements and relevant regulations.

1.2 EU Directive on CDM

EUROCAE Working Group 69 is working on the definition of the different interconnected sub-systems to implement the Airport Collaborative Decision Making (A-CDM) concept.

A specification of minimum functionalities for the implementation of the A-CDM concept and specification of technical interfaces between the interconnected sub-systems are presently being developed by the working group resulting in a EUROCAE document ED-141. A draft is scheduled to be submitted for approval by the members of EUROCAE in November 2007, however it is the impression of the chairman of the working group that it will be delayed about three months.

When ED-141 has been approved by the members, the specification will be used as basis for a community specification (EU CDM directive), which is expected to be regulated by the end of 2008.

1.3 Findings and Conclusions

The EU Commission has united funding from previous fragmented ATM R&D into one massive effort by the SESAR project. The ongoing Definition Phase and the arising Development Phase have consequently a large impact on other requirements and standardization work. The objectives and the so far published reports, brings optimism towards a future holistic and interoperable understanding of ATM. It is anticipated that SESAR's short term improvements will disseminate

knowledge and technology as a basis for also short term improvements of international standards and requirements.

EUROCAE document ED-141 on A-CDM must be monitored. Any initiative in the Nordic and Baltic region should take these requirement and dissemination from SESAR Development Phase closely into consideration. Any further development of this report's simplified concept for collaborative information sharing (see section 5) should be looked upon in this perspective.

2 The ANSPs, Airports and Airline Companies Relations and Network

As a general remark to the results presented in this section about network it must be stressed that the interviews have been performed with people with different roles across the organisations. Some of the interviews have been performed with top managers and some have been performed with specialized people with regards to this study's environmental focus. This section therefore show some inconsistencies. As an example, even though North European Coordination Committee (NECC) is a committee with members from all North European ANSPs, not all of the interviewed ANSPs mentioned the committee. The reason could be that the NECC is attended by top managers and the interviewed persons may not be aware of this committee. Yet others of the interviewed persons only focused on environmental issues also when talking about the network and therefore only mentioned the network within ATM and environment.

2.1 Avinor

2.1.1 ANSPs

Avinor is a member of CANSO, a world wide organisation for Air Navigation Service providers. Avinor has bilateral agreements with the border countries' ANSP, including NATS. In addition Avinor is a founding member of the North European ANS Providers' Cooperation (NEAC). NEAC is presently consisting of seven ANSP organisations from Estonia (EANS), Finland (Finavia), Sweden (LFV), Denmark (Naviair), Iceland (ISAVIA), Ireland (IAA) and Norway (Avinor). Latvia (LGATS) has recently joined as observer.

The intention of NEAC is to collaborate and/or merge the different ANSPs services within some parts of the North European providers.

NEAC, including Avinor, is included in the LFV SESAR JU Express of Interest (EoI) in addition to Austro Control. Austro Control is not part of NEAC, but will collaborate in JU issues. Through the close collaboration with LFV, NEAC is included in the A6 group comprising the five large ANSPs in Europe and LFV.

2.1.2 Authorities

Avinor has good relations with national authorities as NCAA, SFT and the Department for protecting the Environments.

It is expected that European regulations could open for other countries' ANSP to tender for other ATC services than Towers as today.

2.1.3 EC/EUROCONTROL

Avinor is a member of EUROCONTROL's ANS Board for ANSP and airlines. Avinor participates in Single European Sky.

2.1.4 Airlines

Avinor has a close relationship with the two major national airline, SAS and Norwegian.

2.1.5 Industry

The SESAR EoI contains a Memorandum of Understanding with the North European ATM Industry Group. Avinor's strategy is to be a sparring partner with the Norwegian ATM industry.

2.2 ISAVIA

ISAVIA is a member NEAC, which is developing a master plan of which environmental issues is a part. Initiatives include green flights, more direct control of pilots, VHF and radars, and an ADS-B corridor in the North Atlantic. This corresponds with ISAVIA's own initiatives to try to utilise the flexibility they have in this region. The prime aim of the initiatives is safety and efficiency for customers, but also less fuel burn and thus less pollution. The general idea is to have more cooperation between the airline operation centres and the control centres. The next generation of ATC will rely on connectivity between the centres. Decisions will not be with the pilots in the future, but will be made elsewhere.

Another subject which should be discussed among the Nordic ANSPs in the NEAC is marketing. The question is whether they should market themselves as a whole, or whether they are individual competitors.

ISAVIA also have a fairly good cooperation with Russia.

2.2.1 Authorities

The Icelandic Civil Aviation Administration (ICAA) recently made the split into a service provider (ISAVIA) and the regulator.

2.2.2 Airlines

ISAVIA has a structured relationship with airlines at three levels: 1) domestically where a consultation meeting is held each year where they focus on operational needs (no financial issues), 2) internationally with IATA where technical and operational issues are discussed as well as new developments, changes in equipage, and 3) with regional planning office, economic and financial group are having a user consultation meeting (every second year) regarding the service provision over Reykjavik and Greenland FIRs, represented by the main airlines, looking at their operating cost estimates, the user charges, investment plans etc.

2.2.3 Airports

ISAVIA have ad hoc meetings with domestic airports to discuss development of new approaches, maintenance, terminal issues etc. Economic committees for each airport should be set up, but it is not in effect yet. This is due to some general municipality problems regarding the development of Reykjavik.

ISAVIA used to participate in very good meetings with the domestic airports of each of the Nordic countries. However two years ago the cooperation declined. There were no

representatives from Denmark and there was also difficulties with the other countries too. After some discussions two working groups were set up on small and medium sized airports. They have an annual meeting where they address various issues e.g. safety management systems, security management systems etc.

2.2.4 Industry

ISAVIA had no comments to their relationship with industry, which they have good cooperation with.

2.3 Naviair

Naviair mentioned their membership in the NEAC. Naviair is also cooperating closely with Luftfartsverket (LFV) in the NUAC project.

In addition, Naviair is involved in a cooperation between ANSPs called COOPANS. The objective of this cooperation is to share development costs in connection with systems development. Naviair is involved in this cooperation due to their new ATM system called DATMAS. Presently only Luftfartsverket and the Irish ANSP are cooperating with Naviair through this cooperation, but Naviair would consider the possibility of more ANSPs to join.

2.3.1 EC/EUROCONTROL

Naviair is satisfied with their cooperation with EUROCONTROL and other organisations. They share a lobbyist with Avinor and LFV.

Naviair plan to have better coordination with the CFMU. Their new ATM system, DATMAS, is planned to be operational from 28 December 2007. Through this system they will fulfil all issues planned by CFMU.

2.3.2 Airlines

Once a month airline meetings are held where Naviair participates. This cooperation is working to the satisfaction of Naviair.

2.3.3 Airports

It is the opinion of Naviair that the cooperation with Copenhagen Airport is well functioning. In connection to the A-SMGCS and NITOS projects they are exchanging data with Copenhagen Airport into the data server Copenhagen Flight Plan. Data retrieved from the Aeronautical Fixed Telecommunication Network (AFTN) network, which belongs to Naviair, and the SITA network, which belongs to airlines, are merged into CPH FPL.

Information sharing on environmental issues with CPH will however be needed in the future.

2.3.4 Industry

Naviair mentioned that they have a cooperation agreement with Terma.

2.4 Finavia

Finavia runs 25 airports in Finland and the largest is Helsinki-Vantaa Airport (approx. 3M passengers). At Vantaa Airport Finavia have at the moment no problem with the surrounding community. They measure Local Air Quality, up to 100 meters height, which can be seen live on www.ytv.fi. There is no Green House Gas, GHG, restrictions around the airport as in Sweden. However, for other reports reflecting Landing Take off Cycle Operation they measure up to 3000ft.

2.5 LFV Group

LFV is a member of NEAC which is regarded as the potential vehicle for future and more extensive cooperation. NEAC focus on operational procedures, training, communication, regulation etc and to establish a common or harmonized ATM concept. LFV is also cooperating closely with NAVIAR in the NUAC project and with Avinor and Naviar regarding common training under the umbrella of Entry Point North, our joint school.

Cooperation within ATM is basically good for business, but processes might be hampered by unclear views on “who is whom’s customer”. Nordic SWIM project tried to quantify network enabled profits and values, but it is difficult to identify who owes the profit, or alternatively how the profit should be split on several stakeholders. Availability on network based information is not enough, the way of working must be changed before possible profits can be quantified. Nordic SWIM conclusions were good, but an understanding on the collaboration must come first.

One of the common issues for all ANSPs is the increasing cost of infrastructure and its development. Therefore cooperation (COOPANS) between the North European states (which uses Thales systems) is established since a couple of years. LFV was one of the initiator of this cooperation.

2.5.1 Authorities

In 2006 Luftfartsverket was split into a regularity body, Luftfartsstyrelsen, and LFV responsible for ANS provision and managing the main airports.(equally important). The relation to the authority is good and the two organizations have now re-established the necessary cooperation and contacts.

2.5.2 EC/EUROCONTROL

LFV has a good cooperation with EUROCONTROL and EU. They have worked within the SESAR program since the start.

2.5.3 Airlines

LFV has a good cooperation with airlines and especially with SAS. However, they would like to see a Nordic Airline Association or similar in order to have a dialog with more users of the Nordic ATM System.

LFV would like to see a debate on fees or rather the opposite, to find a mechanism of incentives for the users to invest in new technologies in order to reduce ATM costs and environmental load.

2.5.4 Airports

LFV is running 16 of the Swedish airports and have a well established cooperation.

2.5.5 Industry

LFV sees many good effect from cooperation with the industry, and welcomes initiatives which broadens out the range of development activities.

2.6 Keflavik Airport

Keflavik International Airport is organised under the Ministry of Foreign Affairs in Iceland. Keflavik International Airport provides tower and approach services.

Keflavik Airport would like better cooperation between the US and Europe. They find the security area to be a grey area where there is much difference.

In general they like to participate in forums where they can be updated on various issues. Keflavik Airport mentioned their participation in a forum for regional airports in the Nordic countries and in AAAE (American Association of Airport Executives).

They have good cooperation with domestic ATM stakeholders such as ISAVIA and Icelandair, but they do have some problems with the municipality.

2.7 SAS Group

The interview with SAS focused on the environmental issues. The opinions about network and relations is mainly related to environmental issues.

2.7.1 Authorities

SAS meets regularly with the Danish CAA where environmental issues are discussed. They have the same regular meetings with authorities in Sweden and Norway as well.

They have very good relations with a very good dialogue with the Ministries of Transport and Environment in particular in Denmark and Norway. The relationship with similar ministries in Sweden is more on a formal level.

2.7.2 ANSPs

SAS has good cooperation with the Scandinavian ANSPs, but would like to have a better dialogue regarding environmental issues in particular with Naviar and Avinor.

SAS is not happy about differentiated environmental fees that are implemented in Sweden since the fees are not always transparent to the environmental impact. SAS believes that the proposal to sell CO₂ offset (“emission quotas or emission rights”) to passengers is in line with the position of SAS and it will give a better and clear responsibility to the society and Kyoto agreement.

Since the beginning of the EU funded program called North European ADS-B Network Update I/II/2+ (NEAN/NUPI/NUPII/NUP2+) (1994) managed by LFV SAS has been involved in the program looking at various ADS-B applications. The latest project, NUP2+, involves SAS Sweden and their operation at Arlanda Airport and will end 2007. It involves Green Approaches, Collaborative Decision Making (CDM) in the inbound flow, Departure Management (DMAN) and Surface Operation (A-SMCGS).

2.7.3 EC/EUROCONTROL

SAS has a lobbyist in Brussels with very good relations, which involves both EUROCONTROL, the European Commission and Association of European Airlines (AEA). The lobbyist also has good relationship with representatives from other airlines.

SAS is following the European Single Sky initiative very closely.

2.7.4 Airlines

Three to four times a year the airlines within Denmark meet to discuss environmental issues. In general they have a good dialogue with other airlines in Denmark where they mostly discuss traffic related issues.

2.7.5 Airports

The airport operation can be better and therefore there is room for improvement in the cooperation with the traffic department of CPH. SAS believes that there must be a great potential in savings on the environment with better airport operations. Presently SAS aircraft often wait by the runway. SAS is trying to investigate this potential as part of the initiated fuel saving-programme

At ARN there is cooperation to start CDM activities during the autumn 2007.

2.7.6 Industry

SAS have cooperation with the industry and follow very closely the different steps and new inventions in the field of new fuel systems and engines.

2.8 SAS Norge

SAS Norge is a wholly owned subsidiary of SAS. SAS Norge operates all SAS domestic flights in Norway and most of the SAS international flights from Norway.

2.8.1 Authorities

SAS Norge has no contact with CAA Norway regarding environmental issues except for discussions regarding calculations of NO_x taxies and noise certificates. Norway is the only country which has a CO₂ tax on fuel. A general tax on NO_x discharge below 3000 feet is also special for Norway.

2.8.2 ANSP

SAS Norge has a very good cooperation with Avinor, with regular meetings within several areas, including environmental issues.

SAS participates in the NHO/Avinor financed project “Bærekraftig luftfart”; the purposes are to identify operational and technical issues to obtain a more environmental friendly aviation.

SAS Norge and Avinor have insight in each other’s customer relation programme.

SAS shall measure Avinor’s Key Performance Indicators (airspace usage and capacity).

A new airspace structure is under construction, Oslo ASAP, which will include a new SID/STAR structure and AMAN.

2.8.3 EC/EUROCONTROL

SAS Norge has good relations with EUROCONTROL and participates in the IFP (Integrated Flight Plan) Software Team.

2.8.4 Airlines

Through “Bærekraftig luftfart” has SAS Norge a good dialogue with the other major domestic airlines regarding environmental issues.

Generally there is a good and cooperating relationship on the operative level, between the airlines in Norway. On the commercial level however, they are competitors.

2.8.5 Airports

OSL is SAS Norge’s hub. The communication is good with access to OSL’s operative tools as radar systems, tower and cameras.

At OSL, Terminal 2 is under planning. SAS Norge participates in the work to obtain efficient runway access for fuel cost savings.

2.8.6 Industry

Except for the participation in “Bærekraftig luftfart” steering group, SAS Norge has no contact with the industry, except through EUROCONTROL and ODSG.

2.9 Icelandair

In general Icelandair is satisfied with the relations with other ATM stakeholders in Iceland and with the Nordic countries too. The problem is in Europe and in the States.

2.9.1 Authorities

Authorities can be a problem in some countries, especially during strikes, however not particularly in the Nordic countries.

2.9.2 ANSPs

Icelandair has no cooperation problems with the service providers in the Nordic countries.

2.9.3 EC/EUROCONTROL

The cooperation with EUROCONTROL could be better.

2.9.4 Airlines

Icelandair is a member of AEA where they communicate and exchange information with other airlines. The cooperation with AEA is considered to be good.

Icelandair mentioned one common check-in system for all airlines and the fact that it would be of great benefit if all airlines could use the same system, however, this is a subject for discussion among the airlines. In general if the airlines would use the same systems and ground equipment it would save a lot of costs, however it is not realistic.

2.9.5 Airports

According to Icelandair there is a tendency to focus too much on the retailing business at airports instead of the efficiency of the operations, which tend not to have high priority. However as mentioned above, Icelandair do not see any major problems in the Nordic airports where they are satisfied with the operations and the cooperation they have with these airports. However Icelandair mentioned that the airports tend to have too few gates and too small airports. The airports cannot cope with the number of aircraft they accept into the airport, but they are aware that more slots means more fees and more earnings, which is seen as a problem and lack of quality for the individual airline.

2.10 Finnair

2.10.1 Airlines

Finnair is involved in different airline originations and associations like AEA etc.

2.10.2 Authorities/ ANSPs

Finnair has very good cooperation with local ANSP in Finland.

2.10.3 Airports

They were supposed to be part of the Nordic Swim initiative and had a leading role to manage the project. However, unfortunately this project was not launched. Finnair had big hopes for the project.

2.10.4 Industry

Not involved in R&D work.

2.11 Findings and Conclusions

The results from the interviews have generally shown that there is cooperation among ATM stakeholders. Many of them are satisfied with the existing network and cooperation both nationally and cross border to the neighbouring Nordic countries, while others see the need for improvements. It seems to be the case that international cooperation is limited to cooperation with similar organizations, i.e. the Nordic ANSPs have a forum, the Nordic airports have a forum, etc. A more detailed lay out of this observation is that:

- Airline and ATM industry cooperation is close to non-existent
- Airline and ANSP/airport cooperation is fragmented and faces desires for improvement
- ANSP/airport and ATM Industry cooperation is fragmented, but it is in good development.

These networks are not combined in a way that ANSPs, airports, airlines, ATM industry and other Nordic ATM stakeholders meet to discuss common interests.

Another issue that was discovered during the interviews is that not all stakeholders are satisfied with the cooperation with other ATM stakeholders on a national basis. This was particularly the case concerning people involved in environmental issues. They did not find that the cooperation with e.g. the traffic department of the hub airport and the whole flow of air traffic, was optimal in terms of environmental benefits.

Airlines in the Nordic countries did not mention any Nordic cooperation. In addition one ANSP has expressed that it would be good to see a “Nordic Airline Association” in order to have a dialog with more users of the Nordic ATM system. One airline company mentioned that a broader dialogue/cooperation with ANSP/airports on environmental optimization of air traffic would be beneficial.

Cooperation between the Nordic countries and Europe and between the Nordic countries and USA were mainly mentioned by Icelandic ATM stakeholders who would like better cooperation particularly with USA.

It seems to be the case that some stakeholders are not fully satisfied with the committees and forums they participate in, as they do not always find the cooperation beneficial. In those cases, when some of the Nordic countries stop participating, the groups seem to fall apart eventually over time. Indistinct views on “who is whom’s customer” and lack of quantified network enabled profits and values, might be a reason. Availability on network based information is not enough, the way of working must be changed before possible profits can be quantified. It seems to be essential that such groups are professionally managed and with a scope that gives benefit to all participants.

A general conclusion is that Nordic and Baltic cooperation in the ATM environment appears to suffer from lack of structured and aligned networks. Even though none of the interviewed organizations mentioned particular needs for a more structured Nordic network within ATM, it was mentioned that they are interested in forums that can improve their operations and where they can learn from each other. Due to anticipations on future needs for business development and collaborative decision making, it seems to be some potential in optimizing the Nordic ATM network.

3 Description of needs for collaborative information sharing and environmental-friendly operations

3.1 Avinor

Avinor is monitoring the SESAR-activities. The final goal is to have systems which all communicate with each other. The rather slow progress in implementation is mainly due to the complex procedure in handling changes in national and international regulations and directives. Several government offices could be involved with their internal case procedures. For changes, which involve other countries, the financial matters must also be agreed.

An Air Traffic White Paper (Luftfartsmelding) will be presented to the Parliament (Stortinget) in November 2007. A subsequent strategy paper will be developed.

3.1.1 Communication

Conversations have started with ESA / Norwegian Space Center regarding possible participation in the IRIS programme. IRIS is working on the use of satellite relay to replace terrestrial stations for Air-to-Ground and Ground-to-Air communication.

The use of data link will be increased to reduce the ATC workload, obtain better information exchange and obtain a more efficient traffic flow. Avinor will await the implementation until the de facto concept (ADS-B or other) has been established.

Harmonisation of AFTN messages data formats opens possibilities for additional information exchange.

3.1.2 Navigation, CDA, 4DT

Enroute navigation RNAV/Single European Sky will in the future be based on GNSS, with DME/DME as a fallback system. Several new stations (in the order of 30-40) will be established. In 2008 up to 10 new DME will be installed in Eastern Norway and at Spitsbergen.

Continuous Decent Approach (CDA), or Green Approach, has a significant potential for fuel savings and reduced noise. By using concepts as CDA, Four Dimension Trajectory (4DT), and RNP/Performance Based Navigation fuel savings in the order of 1,000 kg per landing should be possible at large hubs like Heathrow and Frankfurt. SAS is now gaining experience with CDA at some Norwegian airports with lower traffic, as Evenes and Bardufoss. A 100 kg fuel saving per landing could be obtained. The use of CDA depends on collaboration between the ANSP and the airline, plus the pilot's understanding of the intention of the concept. Simulations done by Saab show that the air traffic capacity can be maintained with 4DT. By using 4DT it is possible to program the aircraft FMS to obtain an arrival time with ± 10 seconds margin.

Regarding CDA/4DT, Avinor follows the tests going on and will take the required action in due time to implement the procedural changes.

3.1.3 Surveillance

The air traffic control system NATCON, based on Raytheon and Indra products (radar and ATM), is under expansion to cover all ATC centres within 2012, and later add on features like improved weather forecasts. Further development will be in accordance with the SESAR results.

For airports in mountainous surroundings with radar coverage problems Avinor will evaluate the use of other techniques, as multilateration, for (A)-SMGS and in the approach phase.

M-ADS/ADS-C is implemented along the Norwegian West Coast to survey the helicopter traffic. Together with the Norwegian CAA and the offshore oil industry, Avinor is looking at the next generation concept; expanded M-ADS, may be with a VHF-data link Mode 4 through the NEAN (North European ADS Network) Update programme (NUP/II).

There are initiatives to transfer radar data from Northern Norway to Sweden and Finland. Commercial terms between the involved ANSPs must be clarified.

It is too early for Avinor to take a position regarding the Remote Tower concept.

3.1.4 Landing

Nearly all Avinor's airports have either ILS or LLZ/DME for precision approach. OSL has CAT IIIB, and Stavanger Sola CAT II, the remaining ILS are CAT I. For the next five years, there are no plans to introduce CAT II/III at more runways.

To improve the vertical guidance and hence reduce the pilot workload, SCAT-I is under implementation at around 20 regional airports now with LLZ/DME.

Due to no operational needs, there are no plans to replace ILS with GBAS at any of the airports.

3.2 ISAVIA

ISAVIA mentioned the ICAO work and its initiatives to look at the effect on the environment, fuel burn on various flight levels (altitude), contrail altitude and the effect on the green house. Of such initiatives there are financial benefits for the customers either directly or indirectly. However it is a matter of chicken and egg. The ANSPs plan 3-5 years ahead, but the airlines only plan 6 months ahead. The question is who will make the investments? It was the opinion of ISAVIA that a political push is essential.

The regulation on airport licensing is based on ICAO. In Iceland there is a new requirement for airports concerning noise, but there are no requirements concerning emission. They have requirements by the municipality regarding noise. They have to report noise calculations once per year (use the Danish model, traffic type of aircraft and noise). The health administration of Reykjavik has a special requirement. They have noise registration around Reykjavik airport. The information is used by the engineering faculty of the university who provides reports on noise.

The regulator (ICAA) will probably start to put some key performance indicators to reach environmental goals after the ICAO assembly.

ISAVIA informed that IATA is pushing for differential pricing (incentive pricing) benefits for their investments regarding equipment. The initiative does not come from airlines or ANSPs.

Swedish airports have lower fees for environmental friendly operations, but this is not the case in Iceland.

ISAVIA expressed the need for fulfilling their environmental obligations, but they can best deal with them if they have technical capability such as green flights and 4D. It will make them a better service provider.

Volcanic ashes was mentioned by ISAVIA and the fact that it is part of the local environment. It is a matter for great concern and a contingency plan has been made for the North Atlantic. IFALPA was concerned about this phenomenon, aircraft has had engine failures (some examples were given from Indonesia). It is dangerous. EUROCONTROL CFMU has been heavily involved in questions such as how much airspace should be protected, what is the dissemination of the information, what is the reaction of the ATC and the flow management etc. Simulations and trials have been made in Norway and Paris and Tern systems did some simulations too based on an ash distribution model. It is a new thing for ISAVIA to involve others in it, but it is not a new thing for themselves.

3.2.1 Communication

CPDLC is approaching phase IV in the Atlantic area (January 2008). One of the main features seen from ISAVIA's perspective is the possibility to utilize the increased message set. The region relies on only two earth ground stations, which implies limitations in backup capabilities.

3.2.2 Navigation

The standard ground based NAVAIDS (VOR, DME, NDB) are used for enroute and terminal navigation. Tests have been done with EGNOS to determine the signal coverage and quality for a future use.

3.2.3 Surveillance, CDA, 4DT

Radar surveillance is the main tool in use. ADS-B is however seen as an interesting option for the future. This is due to the fact that large proportions of the area of responsibility is without radar coverage. ISAVIA is currently looking into the ADS-B technology, and is interested in opening an ADS-B corridor from east to west over the Atlantic, just south of Iceland. By doing this, the surveillance capability will increase dramatically. In addition, the communication means of ADS-B could be utilized to convey flight-data / 4DT-data, and thereby enable green landings. Green landing capabilities is seen as interesting in its own rights.

3.2.4 Landing

The precession of the current landing systems (ILS) are seen as adequate for the moment. There are currently no plans to introduce higher precision systems.

3.3 Naviair

Naviair is closely monitoring the SESAR activities.

In May 2007 Naviair signed CANSO Environmental Voluntary Code of Practice for Air Navigation Service Providers. This code of practice establishes a framework within which ANSPs can seek to offset the environmental impacts of growth through own initiatives and collaboration with other industry stakeholders.

Naviair is not utilizing any special airport or ATM fees connected to environmental impact.

3.3.1 Communication

Data link is used at CPH for ATIS and DCL.

3.3.2 Navigation, CDA, 4DT

Continuous Descend Approaches (CDA) are used in low traffic into CPH. However Naviair has a feeling that these procedures are seldom used and not generally known by pilots.

Naviair is working with Eurocontrol ENV01/ENV02 (LCIP) to implement BCDA and Collaborative Environmental Management (CEM) at airports.

Naviair would like to remove the holdings, but that would have an impact on the capacity at CPH. However this is an item that the SESAR concept is looking at.

3.3.3 Surveillance

In the middle of the 90's Naviair participated in the North European ADS-B Network, NEAN and its extensions (NUP I and NUP II), an EU funded project looking at the usage of ADS-B as a mean of surveillance. The validated application was to look at helicopter operation into oil rigs in the North Sea. Today Naviair is not involved in any R&D projects.

3.3.4 Landing

ILS CAT I is use at most of the airports (Roskilde, Aalborg, Aarhus, Esbjerg and Bornholm), Billund has CAT III.

3.4 Finavia

Finavia have started the work to construct an Energy & Climate policy which may impact the airport environment reports and handling.

They have a small fee for night departure at Vantaa airport due to noise, but it has marginal impact on the airlines timetable.

3.4.1 Navigation, CDA, 4DT

In order to serve the airlines and be environmental friendly Finavia will start the work to implement CDA in 2008. They have contacted EUROCONTROL and who will be support with expertise. To start with they will analyse how the aircraft will fly their profiles and they hope to

have all necessary procedures for ATCO and trained pilots within two years. However, when discussing with the costumers they request also high capacity which will have an impact of the utilization CDAs (only in low traffic).

Thorough work has been done the last couple of years with the airspace design at Vantaa in order to fulfil the capacity needs and they do not force any major changes the next 20 years. Finavia have all the necessary means of competence in route design and therefore they are able to approve their own work.

In order to minimize the noise exposure Finavia have introduced Noise Abatement Procedures for SID and on top of that they can select different SID for different aircraft types. An interesting reflection is that these NAP procedures are general longer and therefore have an impact on GHG.

Since a couple of years they have RNAV STARs to ILS at Vantaa airport, which have been operated with good results. However, at this moment they have no plan to introduce RNP approaches and they are following the standardization work closely.

3.4.2 Surveillance

In the middle of the 90's Finavia were part of the North European ADS-B Network, NEAN, an EU funded project looking at the usage of ADS-B as a mean of surveillance.

3.4.3 Landing

They will start flying independent parallel approaches into Vantaa in Nov-07, but the flow bottlenecks remains for the ground movements.

At Vantaa Airport they have special operational guidance for noise procedures to the ATCOs.

Today they have no possibilities to have predictable taxi times at Vantaa Airport.

Finavia mentioned during the discussions that Noise and GHG in some way worked against each other. Noise friendly procedures normally result in additional the emission GHG as these procedure results in longer flying time. In addition the implementation of certain EUROCONTROL standards also results in additional emission as the standards also results in additional flight time.

3.5 LFV Group

LFV is both the ANS Provider in Sweden and owner/operator of 16 airports. The largest airport is Stockholm Arlanda (approx. 17M passengers a year). LFV put the environmental aspects high on their agenda, first comes safety of course, but then it's the environment. The ANS division have incorporate environment in their business plan, and were the first ANS Provider who got an environmental certificate according to ISO 1400 (October 2007). LFV keep statistics on key performance indicators for also environmental activities (e.g. the volume of CDAs).

LFV have taken part in and also managed several EUROCONTROL/EU Research & Development projects. With that knowledge in mind, they have just recently launched an internal

development program called RAMP (Regional Advanced ATM Mitigation Program) which covers technical, overall system, operational procedures and time plan for implementation of new services. One vital success factor is the airline companies' judgment on value or benefit. New services with good potential will be implemented as soon as practical possible. One important vision is to introduce a time based operation in- and out of Swedish Airports (Stockholm Arlanda/Malmö Sturup/Gothenburg Landvetter/Umeå to begin with).

3.5.1 Communication

LFV have been involved in datalink projects and programs since several years and they can provide airlines with datalink clearances at Gothenburg airport.

LFV have used VDL M4 for point-to-point communication during trials and the latest is for Taxi Services at Arlanda Airport within NUP2+ Project. Another trial is the D-AIM (Digital Aeronautical Information Management) using VDL M4 to broadcast Aeronautical information to all users within VHF coverage.

3.5.2 Navigation, CDA, 4DT

LFV have with its work within the NUP2+ project, in cooperation with SAS Sweden, introduced Advanced Continuous Descent Approaches (Green Approaches) on trial bases at Arlanda Airport. The results look very promising and during tests in low-traffic a reduction of 90-100 kg of fuel per approach can be seen with SAS B737 aircraft. When introduced in a 24 hrs operation the potential is averages of 200kg fuel savings per flight.

In the RAMP project the implementation of "Green Flights" (Radar based CDA, B-CDA, Echo-flights and Green Approach) is established both in a technical and an operational time plan. A more capable (4D) AMAN is planned for implementation in 2011. Gothenburg Landvetter Airport will be the first airport with the very first advanced applications.

3.5.3 Surveillance

LFV have since early 1990 been involved and very much driven the ADS-B trials with VDL M4 in Europe (NEAN/NEAP/NUPI-II/NUP2+). Through the RAMP program ADS-B will be operational first at Kiruna using VDL M4.

LFV, Arlanda Airport and SAS Sweden have during the NUP2+ project tested A-SMGCS level II applications (Runway Incursion) with very good and promising results.

3.5.4 Landing

LFV have a RNP approach procedure operational into Ängelholm Airport RWY 32, and they have also tested a curved RNP approach into 01R at Arlanda Airport with very good results. The plan is to have RNP approach operational through the RAMP program in a few years time.

For the NUP2+ project low traffic R-NAV STARs have been used and tested. These have now been modified and will be published during 1Q 2008.

Parallel approaches into Arlanda Airport is planned to be introduced in 2008.

3.6 Oslo Airport

Oslo Airport AS (OSL) is a wholly-owned subsidiary of Avinor. The OSL control is limited to approximately an area within 10 nautical miles. The airport has an environmental protection department. There are no communication with the airlines related to ATM environmental protection activities .

The planning of a possible new terminal to be opened in 2012 includes environmental protections. OSL has involved the airlines SAS, Norwegian and AOC (other airlines operating at OSL) in this planning, including the optimisation of taxiing routes.

The SMGCS at OSL will be extended in 2008 to include multilateration to increase safety and capacity.

OSL has no activity regarding CDA or other ATM-related environmental efforts except noise reductions. However, OSL is interested to evaluate participation in a CDA test program.

3.7 Stockholm Airport

Arlanda Airport is also focused to have environmental friendly operations and have invested SEK 200M the last five years in environmental improvements. The airport has a restriction/max level on Green House Gas, GHG (CO₂/NO). They are not allowed to have more GHG in year 2011 then in 1990 (342 300/1930 ton/year). In this figure all traffic (cars, aircraft, etc) on- and in/out from the airport is measured and calculated up to 3000 ft (the only place within the Nordic and Baltic area with this kind of restriction).

Arlanda Airport has tested a DMAN system as a part of the NUP2+ project with good results during the autumn 2007, and will hopefully have it incorporated in the RAMP project. Arlanda Airport has a special noise fee for aircraft, which is a part of the landing fee.

3.8 Keflavik Airport

Ten airlines companies are operating at Keflavik Airport. There are two to three peak periods per day. 21 movements of commercial planes per hour was the busiest they have been. The ATC and the runways can operate a lot more, but the terminal has only 14 gates and they are being used in the peak hours.

At present Keflavik Airport does not have a surface movement radar. A surface movement radar combined with a ground control system will improve their operations in low visibility conditions. Before that they can only allow one aircraft at a time in low visibility conditions.

Keflavik Airport is also looking at how to increase the runway capacity. One runway (RWY07-25) has not been used for 1½ decade, but with the implementation of A-SMGCS this runway can be in use again. There is no apron manager at the moment.

The average taxi time at the airport is about 10 minutes (7.2 minutes at the average). They would not allow anyone out in holding if they know they cannot take off.

Today they have more centralised monitoring control of how people behave in adverse weather. The slot manager monitors the weather and gives out warnings to the ground handlers etc. The idea is to avoid traffic coming to Keflavik in bad weather conditions. When the wind is very strong, the bridges cannot be used. Keflavik Airport sends out warnings to avoid aircraft to arrive if the weather is bad. This would have too much consequences on the environment. Very strong winds usually last for a couple of hours.

Today they are also using a scanning system where sensors scan for slippery runways. This process has also resulted in better communication and less chemicals are used because they only use it when its necessary. The de-icing fluid is just running out on the ground.

ADS-B will eventually come in operation here, a single antenna, full communication with the aircraft, with GPS information we could see the routes.

Continuous descend procedures are commonly used, however sometimes the aircraft are descending in levels. This is due to some changed rules in Icelandair.

There is one common databank at Keflavik Airport and all the stakeholders plan their work from that information. In a few weeks they will get information directly from the CFMU. They will be able to read SITA messages and it will also be linked to AFTN later this year. The system will talk to the FDPS system.

Keflavik Airport state that it is a fully coordinated airport. They have some problems with the United States, as American flights state that they are always on time, but that means from push back (off-block) and then they are not airborne until one hour later¹.

There has not been any discussions to reduce landing fees for environmental friendly aircraft at Keflavik Airport.

3.9 SAS Group

SAS has a new environmental strategy which, amongst others, handles the question of an update of part of the aircraft fleet. The environment strategy will be finalised in October 2007 and will be effective until 2015.

In the SAS aircraft fleet, the SAS MD80 fleet with an average aircraft age of 17.5 years holds the greatest impact on the environment. Already today there are restrictions for SAS MD80 to operate during certain hours at CPH. It is the intention of SAS to wait a few years to invest in new types of aircraft to be able to buy next generation flight types that are more environmental friendly.

¹ It appears to Integra that updates on movement messages are not in place. Otherwise off-block times from the States would be irrelevant. Information about airborne time and flight time and ETA would be more important.

SAS has initiated a fuel saving programme and the initial target is to reduce the fuel cost by 3%. They have received funding from the EU for the green approaches initiative at Arlanda Airport. There is an average saving in fuel of approximately 150 kg during each landing.

SAS has invested in the new B737 NG engines with dual combustion chambers in order to reduce NOx, and SAS is disappointed that this engine is used by very few other airlines. They find great conservatism from other airlines. They also expected to avoid a bigger amount of NOx charges when flying with these engines, however only few airports up till now have introduced these charges which is not what SAS expected. Where NOx charges are implemented SAS has the benefit of using the engines with reduced emissions.

In general, SAS considers the environmental impact and the societal necessity when they take decisions. Some time in the future it is expected that the environmental consideration will be among the most important.

SAS believes in the EU quota allocation system of which they will be a part. They believe it is a necessity seen from a society perspective. Unlike other quota systems this system is considered to be competitive neutral. Obviously the system must be on an acceptable level and a non distortion competition basis.

SAS is very focused on the Single European Sky initiative. In line with AEA and other airlines, they believe that the potential in fuel saving is huge. In the planning of flights it is also important to focus on the destination airport and then go backwards to the airspace and finally fit the departure based on this. Today it is done the other way around which is not beneficial.

3.10 SAS Norge

SAS Norge's Environmental Program includes the following activities to reduce fuel consumptions, and improve the environmental impact:

Technical

- CDA
- PBN
- Winglets (potential for 1-4 per cent fuel reduction)
- Engine Wash (will significantly delay the engine's reduced performance over time, which is in the order of 3-5 per cent)
- Tec Insert (in the order of 0.5 per cent reduction)

Operations

- CDA
- PBN (Performance Based Navigation)
- FCSI (Fuel Cost Saving Initiative)
- Flight Planning
- SID/STAR planning
 - Y/T type
 - Point Merge

- Continues Climb

Flow

- CFMU/4D (Flow Management Unit)
- FCSI
- FAB (Functional Aerospace Blocks)

Economic

- ETS (Emission Trade System)

Environmental protection is an essential driving force in the airline's strategy towards 2018.

SAS Norge has done manual CDA experiments only. It is possible to upgrade the FMS (Flight Management System) to handle CDA. However, the main obstacle to implement CDA is missing transmission of ATM information like the wind profile along the flight path.

The recent centralisation of weather forecast services has resulted in reduced quality of the data to be used for flight planning.

Today the 4D flight planning stops at the time of departure, and is not updated during the flight to obtain a more optimum 4D trajectory.

The main obstacle for more efficient flights is the lack of collaborations between the ANSPs regarding technology used, politics, and income sharing. As seen from an airline's view, the optimum solution is one single ANSP with transparent technology for the complete flight.

There is larger fuel saving potential for CC (Continuous Climb) than for CDA.

SAS Norge recommended the document "Aviation Growth and Global Warning", which gives an overview of efforts for emission savings.

3.11 Icelandair

Icelandair continuously look at ways to save fuel because it will save the costs too. They do not think any organisation will become more environmental if it does not increase the profit at the same time. Otherwise it should be regulated.

Winglets have been installed on seven of Icelandair's aircraft (B757). Next year they will install winglets on 10 aircraft more. Winglets save 4.5% fuel on each flight and reduces noise too.

Icelandair also operates with the flexible weight concept where they fly with only 99.99 tons apart from 130 tons on some flights. In exchange they get lower flight charges at some airports.

Procedures for CDA approaches are planned to be implemented in Iceland.

Noise routings are common in the different airports and they follow the rules. However sometimes the routings are so strict that Icelandair cannot follow them and they choose to be fined instead. There are no noise restrictions at Keflavik airport, however there is a general discussion in the public about environmental issues. Icelandair can take off from Keflavik anytime they want, however they cannot do that due to the congestions in the European airspace.

Icelandair believes that airports should be the motivating factor in reducing emission and noise as it is a huge problem with taxi times and long time at waiting position for take off. Congestions and increased taxi times especially during peak hours in European airports causes huge problems. Icelandair mentioned the huge problems with holding over London (LHR) and the taxi time in New York (JFK). In average Icelandair has about 15 minutes in holding each day 365 days a year. 20 minutes holding costs about 1 tons of fuel = \$750. 45-50 minutes taxi time is about the same, which they burn on each flight to JFK during the taxi time. Icelandair do not experience any of these problems in the Nordic airports.

Icelandair mentioned that private jets (both in Iceland and in other places) are used more common, but with a negative influence on the environment. Due to the fact that it takes a long time to leave an international airport, some people use private jets to continue their journeys.

3.12 Finnair

Finnair has made a plan to reduce fuel costs and the impact on environment by exchanging the old MD11 to new A330/340/350 and Embraer 170/190.

One of the most important markets for Finnair is the traffic to Asia. Several of those flights will arrive at Helsinki-Vantaa around the same time, which creates problems for ground handling, security, passenger flows, etc. To solve this problem Finnair's Operation Department sends an ACARS message to respective flights, when airborne, to slow down or speed up in order to arrive with a 10-15 min time separation at Vantaa Airport. This will then enhance the whole ground operation and take away the cues. This information of the inbound sequence distributes via a mail to Vantaa ATCC, who then can plan the flow in a strategic way.

3.13 Findings and Conclusions

3.13.1 Communication

It seems to be beneficial with more extensively collaboration regarding tests for introduction of data link (ADS-B and CPDLC). Use of data link will improve the information exchange and therefore provide for a more efficient traffic flow.

3.13.2 Navigation, CDA, 4DT

By using the Free Flight concept and RNAV, a shorter distance for the route and hence less fuel consumption can be obtained. Then the NAVAIDS coverage has to be improved, either by implementation of more ground stations (DME) or use of SBAS as EGNOS. It seems beneficial that the ANSPs and airlines have to agree on the optimum strategy for the infrastructure expansion.

CDA can significantly contribute for fuel saving and reduced noise. The use of CDA depends on collaboration between the ANSP and the airline companies. Tools for collaborative information sharing and decision support for 4D arrival management are needed to obtain these benefits. Incentives to increase the testing of CDA seem necessary.

Regarding more environmental friendly operations, the airline companies have identified reduced holding time and taxiing as significant fuel savings potentials. There is a need for better coordination between traffic departments at airports and environment departments at airports and by the airlines to improve the situation at airports (less taxi time and waiting time by the runway).

3.13.3 Surveillance

Increased use of multilateration as a part of a A-SMGCS should make the ground traffic operations more efficient by shorter taxiing routes and improved utilisation of the gates.

Implementation of ADS-B/C needs a collaboration regarding which VHF-data link concept to be used. ADS-B/C should improve the surveillance capabilities and hence alert aircraft deviating from its intended flight path.

3.13.4 Landing

The use of landing systems could significantly increase the airports' regularity and hence be more environmental friendly. All airline companies' aircraft are equipped with ILS, many of them are capable for CAT III landings.

Due to ICAO standardisation the ILS signal format is fully harmonised between the ground and airborne systems. The Category is mainly given by the operational needs. For some few airports it is not economically feasible to install ILS, mainly due to the topographical conditions. For such airports, a GBAS type landing system can be installed. There is a need for collaborative implementation of avionics and ground systems to obtain this benefit.

4 Description of the ATM industries' future market

4.1 Essential factors

The Nordic ATM industry contains of approximately 30-35 different companies. The size of the companies varies and their focus stretches from the local/regional market to the global market.

The Clean Nordic and Baltic Sky group held an industrial seminar on 23rd of October on the premises of Saab, Järfalla Sweden, to present their early findings and get feedback from the Nordic ATM Industry. 28 different companies were invited and 10 attended the seminar.

There is expected to be changes within the European air navigation services in the near future as the Single Sky initiative comes into force. It will have an impact on future cooperation and investments for new infrastructures.

Many sees the SESAR project as the vehicle for implement the Single Sky initiative and a lot of money have been allocated as well as prestige in the project/program.

4.2 Expectations for the future market

4.2.1 General

To support the future growth of the Aviation sector a more pragmatic approach has to be done for both the air and on the ground side. The different systems and technical solutions have to support the future operations and not the other way around.

Innovations from other industrial sectors must be incorporated in a higher degree then today and support a more flexible usage. The time to meet the market has to be reduced and the utilization of ATM R&D has to be better in Europe.

Information and information flows will be a vital part in the strategic set up of the future operation where decisions will be made in a collaborative manor.

The environmental and security aspects are vital parts to be incorporated in the overall system architecture and implementation, this to support a sustainable solutions into the future.

4.2.2 Input from the Nordic ATM Industry

Integra Consult (Denmark): Integra is not producing any products, but work purely with consultancy in the ANSP sector. Integra is an adviser to the European Commission in the areas of Single Sky questions and therefore not involved in the SESAR project at the moment. Other areas are Safety Management System and CDM (advisor for Eurocontrol). Integra have a global market with a focus on Europe, Asia, and the Middle East.

Integra believes that the Nordic ATM Industry has a good chance to become the first venture to implement a SWIM network, which will be beneficial also for the SESAR project in order to validate their concept. However, if there will be a continuation of the CNBS, it is important that it will not be another theoretical project but instead go for implementation of “operational” procedures and infrastructure, otherwise Integra is not interested to participate. Integra would very much support Finland to be part of such continuation. The company believes that it is not feasible to carry out such a complex project with too many participants.

Institutt For Energiteknikk, IFE (Norway): Working mainly with Human Factors (HF) and Safety issues. For the ATM industry IFE have worked with Eurocontrol, Avinor, Park Air Systems. It is important that HF will be incorporated early in the development cycle, already on the conceptual level as it has turned to be very costly to perform changes in an operational system. The safety aspects within any future ATM System will be higher than in today’s system and not only for a small part but for a complete overall system.

IFE is interested to take part in a continuation of CNBS as they see the Nordic ATM cooperation as an important market.

AVTECH (Sweden): Working mainly as consultant for the aviation industry and do analysing/safety work. AVTECH is contracted by Airbus Industry to work in the SESAR project. The company have taken part in several EU funded project and truly believes in the 4DT Air Traffic Management for the future. The aircraft capabilities (airborne systems) has a lot more to give than what is deployed today. An example is the RNP approach, where AVTECH believes some early benefits can be achieved. AVTECH provide analysis tools for RNP approach procedures. The company expect an increased demand for quantitative analysis and measurable indicators, because these are measures that will contribute justified penalty and incitements regimes.

The Nordic market is rather small but can be of interest for AVTECH, which have the global market as prime. However, in the light of Single Sky the European ANSPs will see a new competition where most likely a few larger actors will survive, therefore the Nordic area have to consolidate in order to become one of those players. AVTECH have earlier presented a suggestion on building a Nordic demonstrator for network enabled air transport to the Swedish Ministry of Trade.

Safegate International AB (Sweden): They have approximately 90 employees with headquarter in Malmö, Sweden and a turnover of SEK 500 M. Safegate have four main products, which they sell all over the world. Advanced Visual Docking Guide System guides the pilot/aircraft to the gate and has 75-80% of the world market. Airfield Lighting (taxi and runway edge light) and Airfield Smart Power System usage of already existing lighting system to guide pilot/aircraft from gate to the runway and vice versa. Safe Control manages all lighting system at the airport and can incorporate other functions to the same control display. Their products reduce the environmental impact by decreasing aircraft fuel burn (better guidance) and less energy consumption (led technology in airport lighting).

Safegate support the environmental work within the SEASAR project, which is also in line with their own ideas. For Safegate the Nordic region is important as it is a reference for other markets round the globe.

Opscom (Norway): Opscom is a software company with focus on work flow and human factors, and has good cooperation with all technical suppliers. The company's market is the Nordic region, Great Britain and Poland. In Europe the bottle necks have moved from the airspace to the airports, which they now see as main limiting air transport capacity factor (8 out of 10 airports have problems in peak hours). They believe the Nordic Region has a willingness to invest in new technology and is not so afraid of changes, which is good for ATM development. Therefore they hope that a continuation of CNBS would create some kind of a "lab" environment with a combination of new techniques and humans (new operational procedures), which will support an early introduction of the SESAR concept.

DSE (Denmark): Established 1981 and focus on Airport Automation. As the en-route delays are almost solved the bottle necks have moved down to the airports. DSE think that the bottlenecks at the airports are considerable, close to a reason for chaos. In 2006 the Danish airport traffic delays cost DKK 750 M, and the only way forward is to establish CDM at airports. DSE have established cooperation with one of the Danish Universities to look at how the different CDM solutions could be visualized. They have found that the solutions have to be flexible to suit different needs at different airports. The CDM cooperation also identified that financing of a CDM solution at an airport is not supported with present financing structures. In many cases the CDM solution provides benefits for someone else than the one who is paying for it. Without a new structure to finance CDM and provide the mutual benefits, there are no sufficient incentives for the customers to invest in such a solution.

The ideas behind SESAR are good but the ATM sector are not able to wait until the SESAR project is completed. DSE thinks that SESAR will improve their market by a broader understanding of the factors that might improve airport flow/throughput. The Nordic market is a step stone to the global market. They think it is too early to say yes to a continuation of the CNBS as the funding of the project is not yet finalized.

Park Air Systems (Norway): One of the founding companies goes back to 1918, and has now 200 employees. Is established on the global market and has a turnover of NOK 350 M. Their main product areas are Voice Communication Control Systems (VCCS), NAVAIDS (ILS, SLS, VOR, DME) and Surveillance (A-SMGCS and Approach Control). SESAR might lead to better opportunities for integration of surface movement and guidance systems to other information systems. The Nordic region is important and can be seen as a test bench for SESAR.

Edda Systems (Norway): The company was a "spin-off" effect from Avinor reorganization when Avinor began to focus on their core business. Edda Systems is mainly working with ATM development and ATC control (radar and ADS system). They also do different system studies and supporting work in approval processes. 40% of their work is outside Norway (Eurocontrol, etc) and sees the Nordic market to be very important.

SINTEF (Norway): SINTEF is working very closely with the industry with research and development. It is important to be part of the SESAR initiative and also support the Nordic ATM

industry. If there will be a continuation of CNBS they think it has a very good potential to work as a test bench for the SESAR and Single Sky ideas.

Saab (Sweden): The Saab ATM market is global. The Nordic countries are very important to Saab since most of the initial reference projects have been developed for the Nordic market. Saab is one of the leaders in Net Centric design and has the lead role in the net centric standardisation forum. In the role as the developer of the Swedish Net Centric Warfare design to the Swedish Armed Forces, Saab has also been able to formalize a subset version to the civilian Air Transport which could be used in the CNBS work in the Nordic countries. Saab's close collaboration with LFV in developing future ATM and airport solutions based on data link technologies is also vital for a coming CNBS platform. Saab is also well aware of the Nordic way of nurturing and welcoming new and sometimes bold thinking. Saab thinks that the Nordic region is well suited to embrace an implementation of a basic total airport management system in a few years time which could form the bases of SWIM in the Nordic countries.

4.3 Findings and Conclusions

Even the majority of ATM industry are working with the global market, the Nordic area are is considered as a important reference market and very suited for “first implementations”. The Nordic countries are generally seen as a region well suited for an early implementation of CDM/SWIM. Several ANSPs and airports in the region are seen as open for cost reduction and throughput enhancing solutions. Several CDM test projects have already been developed in the region and the maturity of the stakeholders for this kind of projects are high.

During this feasibility study, the project team has already been approached by the stakeholders to proceed with a plan to speed up the implementation of Nordic CDM/SWIM functionality (in line with the SESAR programme).

This early implementation of a subset of CDM/SWIM in the Nordic countries would also pave way for SESAR related implementations. The Nordic ATM industry network is fragmented today, but the industry could together form a well equipped and knowledgeable group that covers a broad spectrum of ATM and airport capabilities. Together with contributions from ANSP/airports and airline companies, the ATM industry contribution is considered as one of several inputs to an initial CDM/SWIM implementation in the Nordic and Baltic countries.

5 A simplified concept for collaborative information sharing

Based on the interviews performed in the project, experience, lessons learned, and general knowledge about the coming trends in SESAR, it was decided to base the project's information sharing concept on a few vital requirements:

1. Increase the predictability of an incoming flight
2. Improve the planning capability and thereby the accuracy, for all stakeholders on an airport
3. Improve the sequencing capability for the air traffic controllers on the airport and nearby ACC/Approach sector
4. Reduce the holding time and the need for holding patterns surrounding the airport
5. Reduce the environmental impact (fuel consumption, emission, and noise) in the area.

In addition to the above requirements, the objective was to design a concept that supports scalability, is expandable, and is possible to certify safety-wise. In order to fulfill the purpose and ensure the full future benefit, all stakeholders at an airport that may benefit from the concept must be included in the longer term. (I.e. from air traffic control to gate handling, and catering.)

5.1 Conceptual sketch

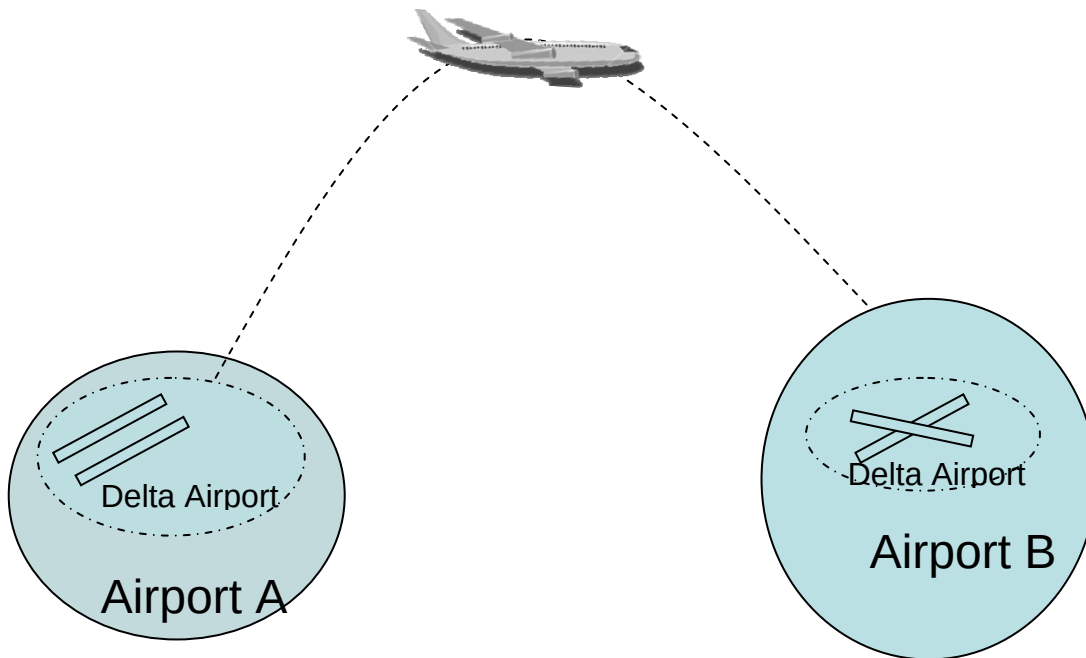


Fig. 1. Airport to airport.

The concept involves information sharing between the CFMU, the departing airport, the arriving airport, and the ACC in between. It might be looked upon as a first step towards a more complete CDM/SWIM solution.

Seen from a technical prospective, the concept is not complicated, but does to some degree, require system modifications and additional new system components. The concept provides information to the different actors on an airport. The utilization and degree of automated refinement of this information may differ between the actors and is not discussed below.

The main necessary system changes are:

1. Sending “OFF” message via datalink, or “departure” message via AFTN to the arriving airport and related ACC’s.
2. Possibility to uplink data messages (information) to the aircraft. (Datalink needed)
3. Distribution of RETA (Recalculated Estimated Time of Arrival) This happens several times during a flight.
4. Implement “AMAN” functionality including “Green Approach calculation/algorithms.
5. Information sharing (as above) across country borderlines,
6. Information sharing to other airport actors. This kind of information has up to now been kept within the air traffic control sphere.
7. Implement the new functionality in the existing presentation systems (HMI)

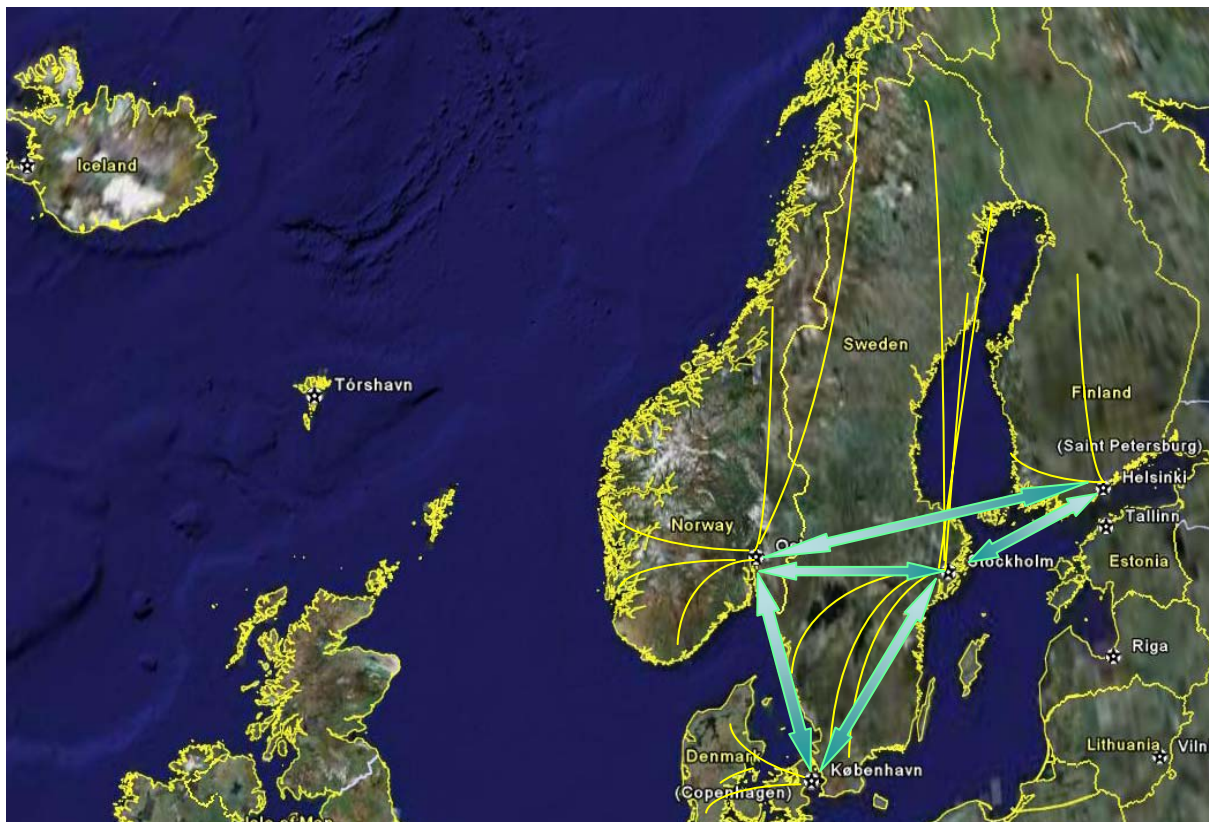


Fig 2. Example of utilization at the main airports in the Nordic countries.

5.2 Technical Aspects

The technical areas to be covered are mainly within the traditional ATM sphere (FMS/avionics, communication link air-ground, AMAN, presentation system etc.). One exception though, is that it probably is beneficial to implement new functionality on a “SOA architecture”. The reason is that SOA is seen as the preferred architecture for the upcoming SESAR project. The SOA (Service Oriented Architecture) architecture has not traditionally been used within ATM. This is however about to change, and an early implementation will in addition be valuable as a test platform and may be used in connection with various “proof of concept” tests.

5.3 Business Aspects

In addition to the technical challenges, there are a few business related issues that will have to be investigated further.

Some essential business aspects are:

1. Legal matters: Responsibility of the different actors with respect to the law. In addition the legal aspects may differ from country to country.
2. Commercial interests of the participating companies
3. How to cover the cost related to sharing information
4. Overall cost benefit (for all stakeholders)
5. Environmental policy (distribution of fees/differentiated fees)
6. Organizational/union agreements and regulations

5.4 Findings and Conclusions

By introducing a simplified collaborative information sharing concept as defined above, the practical operation of the airport can be carried out with improved precision, at less cost, less delay, and less environmental impact due to:

- The air traffic control will be able to plan and sequence the traffic better due to more accurate information.
- Increased precision related to manning of different ground operations: gate operation, fueling, luggage handling, catering, internal airline handling, etc.
- Less environmental impact (ex. CDA/Green approaches)
- Generally easier to operate on the airport, due to more reliable information available.

Based on the above mentioned challenges and the track record of the Nordic ATM industry, it is apparent that they together will cover the required competence areas, except for the SOA area. The SOA area will have to be strengthened prior to the project execution. This is however not seen as an overwhelming issue, considering that taking new technical concepts into use is a quite frequent necessity for organizations open to changes.



norden

Nordic Innovation Centre

Nordic Innovation Centre

The Nordic Innovation Centre initiates and finances activities that enhance innovation collaboration and develop and maintain a smoothly functioning market in the Nordic region.

The Centre works primarily with small and medium-sized companies (SMEs) in the Nordic countries. Other important partners are those most closely involved with innovation and market surveillance, such as industrial organisations and interest groups, research institutions and public authorities.

The Nordic Innovation Centre is an institution under the Nordic Council of Ministers. Its secretariat is in Oslo.

For more information: www.nordicinnovation.net