Sixth Meeting of the Cross Polar Trans East Air Traffic Management Providers' Work Group (CPWG/6)

(Hong Kong 3-5 November 2008)

Agenda Item 7: ANSP and Airline Updates

REPORT ON THE DEVELOPMENT OF NAV CANADA's REVISED NORTHERN CONCEPT OF OPERATIONS

(*Presented by Canada*)

SUMMARY

This paper presents information on the development of the revised Northern Concept of Operations including Automatic Dependent Surveillance-Broadcast (ADS-B) installation plans in the Airspace and procedural changes being considered.

1 Introduction

1.1 NAV CANADA has revised our Northern Concept of Operations (NOR Con Ops*)* to include procedural changes and expansion of the ADS-B installations to Northeastern Canada, Southern Greenland and the Northwest Arctic airspace. (Appendix A)

1.2 NAV CANADA has installed a network of 5 ADS-B ground stations in the Hudson Bay area. The stations are installed, certification is underway and the system is expected to be operational November 2008.

1.3 NAV CANADA does not anticipate a sufficient number of airlines will have completed aircraft certification and crew qualification in order to be ADS-B eligible at the time of implementation (November 2008) to warrant instituting ADS-B exclusionary airspace. As such, no airspace will initially be designated as ADS-B exclusionary or ADS-B segregated. All aircraft will benefit from the DCPC coverage of the VHF transmitters with additional benefit to ADS-B aircraft through surveillance services.

1.4 ADS-B eligibility requires that aircraft perform to the Minimum Operational Performance Standard (MOPS) defined in RTCA DO-260 or DO-260/A.Airworthiness and operational approval criteria are defined in Transport Canada Advisory Circular No. 700-009 Issue No. 01 effective 31 July 2008 and draws on the contents of EASA AMC 20-24 for the majority of the approval. Transport Canada will issue an operational approval in the form of an Operational Specification (Ops Spec) for Canadian operators. Foreign carriers, upon receipt of appropriate documentation demonstrating compliance with the Canadian Ops Spec, will have their Canadian Foreign Air Operator Certificates amended to allow ADS-B based services to be used. The use of EASA AMC 20-24 as the basis of approval is furthering its acceptance as a worldwide standard for ADS-B non-radar airspace (NRA).

1.5 ADS-B is significantly less costly to implement than radar, it has global interoperability which result in operators adopting technology that can be used seamlessly around the world.

1.6 NAV CANADA has proposed to industry a second set of ADS-B and VHF installations along Canada's north eastern coastline and southern Greenland, to extend surveillance further north and offshore. These installations are expected to be completed by the fall of 2009. (Appendix A, Revised NOR Con Ops).

1.7 NAV CANADA is working on a business case and will proposed to industry a third set of ADS-B and VHF installations along Canada's north western artic airspace. ADS-B services in areas where radar surveillance has not demonstrated a positive business case will present the opportunity for airlines to make significant reductions in fuel burns resulting in cost savings and reductions in greenhouse gas (GHG) emissions. The ADS-B proposal supports the Istanbul Declaration by IATA June 2-3, 2008. (Appendix D--. *Istanbul Declaration)*. (Appendix A, Revised Nor ConOP*s)*.

1.8 NAV CANADA has developed a ***Revised Northern Concept of Operations*** that outlines the short, medium and long term plan for our northern airspace. (Appendix A , Revised Nor ConOP*s)*.

2 Discussion

2.1 Canada will commission ADS-B over the Hudson Bay area of Canada in November 2008 with future plans of expanding into ICAO airspace in the later part of 2009. Safety analysis, testing and implementation of the Hudson Bay project shall enhance the implementation of ADS-B into Oceanic airspace.

3 Recommendation

a. The Meeting is invited to note the information;
b. Review the ***Revised Northern Concept of Operations***; and
c. Provide feedback.

1.1 Northern ATM Concept of Operations (Revision October 2008)

Traffic levels in the northern part of the Edmonton and Montréal FIR/CTAs are rising as customers increase service on Atlantic, Pacific and Polar routes. These routes cross in different areas, during different time periods and outside areas of reliable surveillance and communications, meaning that it is difficult for ATC to allow customers to follow preferred trajectories, resulting in delays and inefficiencies.

The Northern ATM CONOPS proposes that various technologies, control techniques and airspace changes be used to address customer concerns. Concepts are grouped into the near (2008-10), medium (2011-12) and long (2013-15) terms.

1.1.1 Current Northern Operations

As depicted in Figure 5.1, northern airspace is designated Canadian Minimum Navigation Performance Specifications (CMNPS) north of 70º north (approximately) and RNPC to the south. In CMNPS airspace, separation standards are very similar to the rules used in the NAT (route spacing is 60NM or 1 degree of latitude, longitudinal standard is 10 minutes using Mach number technique). There is surveillance north of Rankin Inlet and Coral Harbor, via ADS-B and very good VHF communications capability south of 75N. North of 75N communications are generally via HF through Gander IFSS, or Satellite Communications through TELNOR via the NAVCAN Star system and no surveillance exists. 20NM longitudinal separation as well as other GNSS based longitudinal standards may be applied between GPS-equipped aircraft, DCPC permitting. A Northern OTS system is in use for the westbound NAT flow.

In RNPC airspace, lateral separation is 10NM either side of track. If Direct Controller-Pilot Communications (DCPC) is available, longitudinal separation can be reduced from 10 minutes (≈80NM) to 30NM (or 20NM between GPS-equipped flights). ADS-B installation will provide surveillance separation (5nm) for eligible flights in the vicinity of Hudson's Bay. The southern portion of this airspace is under radar surveillance, where it is possible to apply 5NM separation and to more easily support random routing.

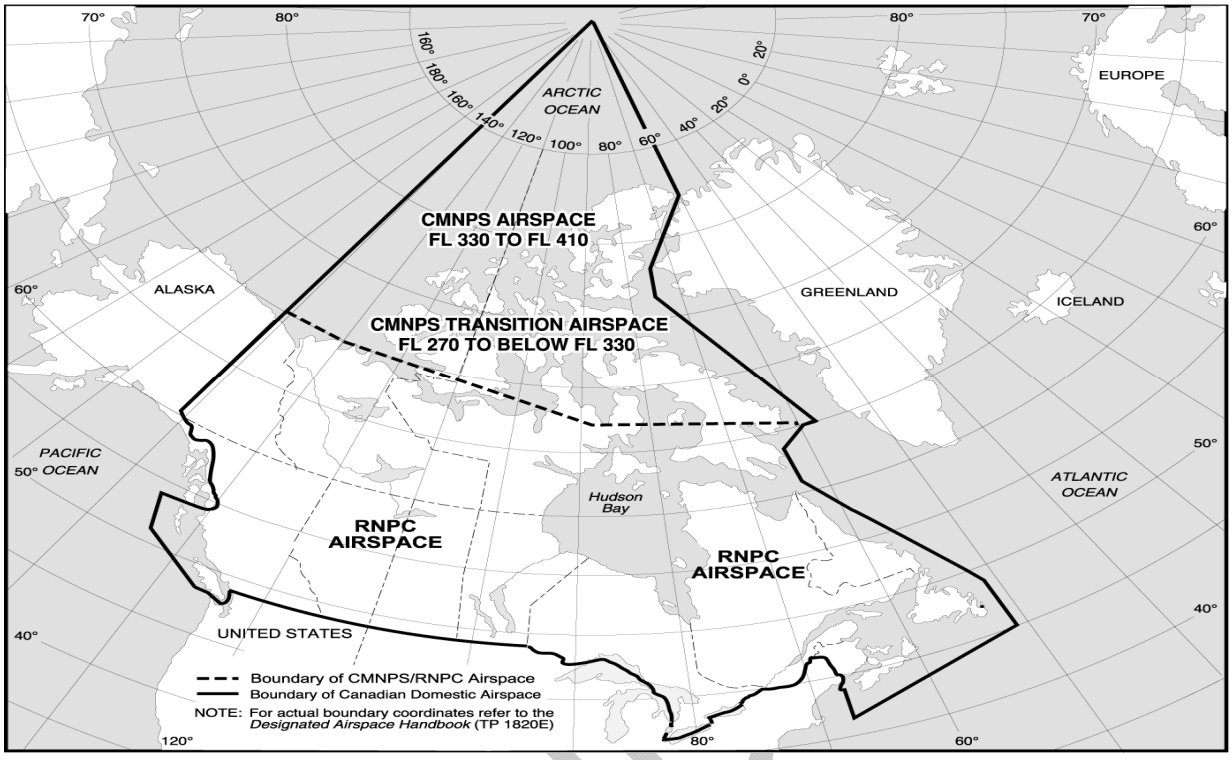


Figure 5.1

1.1.2 Near Term CONOPS (2008-2010)

The goal of the near-term CONOPS is to improve airspace capacity and overall service via expanded flow management capability. and to use an RNP10 standard where DCPC and /or CPDLC is available . CPDLC implementation is scheduled as soon as practical post CAATS implementation in Edmonton Area Control Centre. The intent is to accomplish all of this as quickly as possible with minimal impact on customer service delivery. The Northern Airspace Display System functionality will be integrated into the CAATS platform for Edmonton implementation.

1.1.2.1 Expanded Flow Management Capability

NAV CANADA is adding capability in the National Operations Centre (NOC) and in Edmonton ACC to support better detection and planning, allowing for the resolution of potential conflicts for Polar traffic well in advance. This will reduce and possibly eliminate the need for last minute tactical intervention that adversely affects efficiency. The NOC will use Flight Schedule Monitor to assist in flow control into domestic Oil Patch airports. When a conflict is detected at a Polar entry fix, the NOC will notify Edmonton. Edmonton has access to the Gateway Reservation List (GRL) via the NOC community page, on the NAV Canada Intranet.. ETMS has a re-route tool that has the potential to assist in resolving flow problems. ETMS will be used to assist in early identification and resolving Polar traffic conflicts. In January 2007 procedures where introduced to allow aircraft subject to an ATFM plan precedence over past practices of “First Come First Served”.

1.1.2.2 Expanded VHF Communications Capability

1.1.2.3 *NAV CANADA has installed 26 VHF voice communications facilities (PALs) in the north to expand the provision of direct controller-pilot communications (DCPC) throughout nearly all RNPC airspace and some parts of CMNPS airspace. Refer to Figure 5.2. Expanded coverage for the Hudson Bay area was completed in September 2008 with the installation of the long range Churchill PAL. The availability of DCPC enables controllers to apply 30NM longitudinal separation or GNSS longitudinal standards, rather than 10 minutes (≈80NM), meaning increased airspace capacity. Improved communications also allows controllers to respond more flexibly to requests for route and altitude changes. This work has been completed.*

1.1.2.4

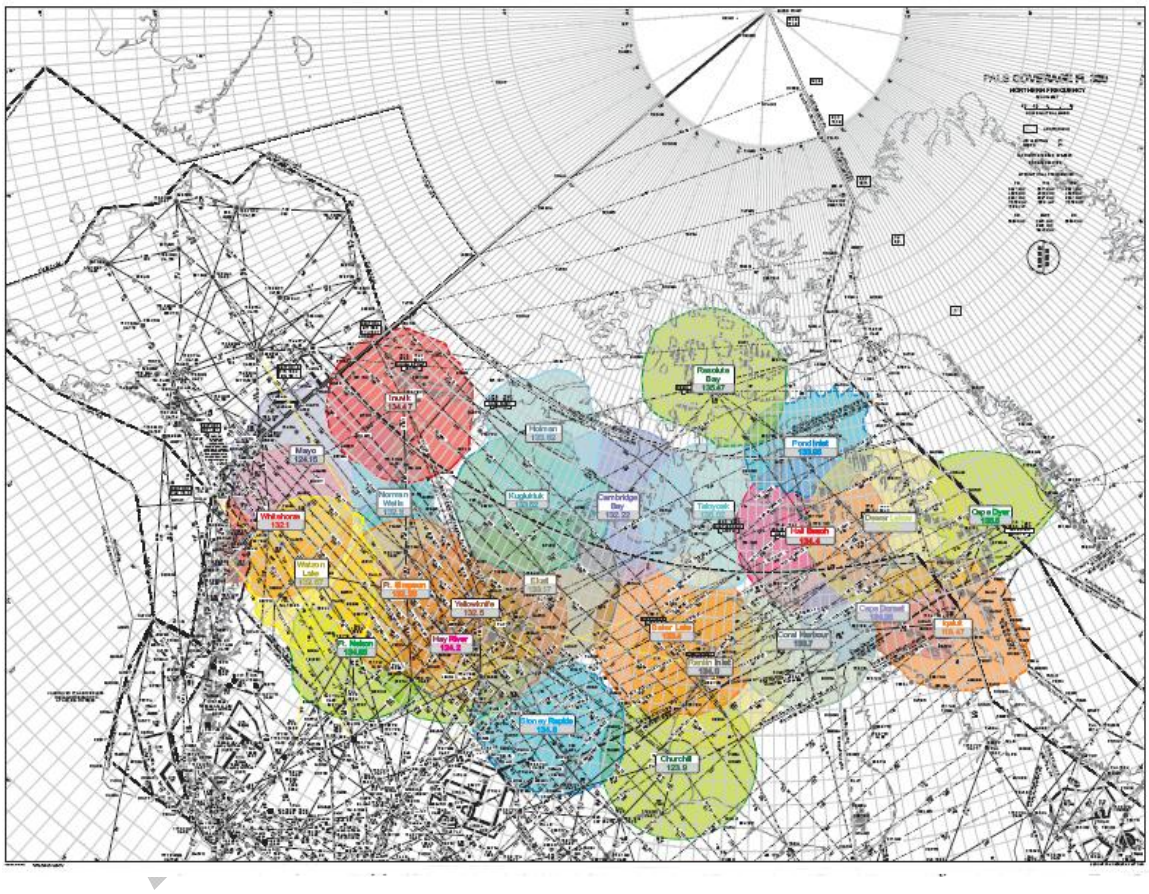


Figure 5.2

1.1.2.5 Data Link (ADS-WPR)

1.1.2.6 *Edmonton ACC has been able to accept automatic dependant surveillance waypoint reports (ADS-WPR) via data link since early 2007. ADS-WPR is a capability supported by ADS – contract (ADS-C), where the contract specifies that an ADS position report be sent to the ACC each time the flight transits over a waypoint. Because data*

link messages will be relayed via geostationary satellites orbiting over the equator, there is a large area near the North Pole where this service is not currently available. Use of Low Earth Orbit Satellites to transmit position information has the potential to eliminate any coverage hole in Northern Canadian Airspace.

1.1.2.7

ADS-WPR is used instead of HF through Gander IFSS or DCPC VHF to provide position reports. As a result, ADS-WPR does partially mitigate the impact of HF black-outs. Further, the ADS-WPR software has provided safety enhancements as conformance checking software verifies a flight's altitude and route.

1.1.2.8 Northern Organized Track System (OTS)

1.1.2.9 *The Northern OTS was implemented in January 2007 in collaboration with the customers based on their calculated savings of US$6M annually (using $70 US per barrel for oil) for the North Atlantic traffic only. Edmonton ACC has an improved ATC environment and controller efficiency because an OTS provides optimized routes that are always laterally separated, and aircraft following identical routes that are separated by the minimum longitudinal spacing. Each OTS organizes a flow through non-surveillance airspace.*

The initial implementation serves the westbound North Atlantic flow, starting at the airspace boundary with Reykjavik and ending a few miles within current radar surveillance coverage at approximately 60º north. A flight level allocation scheme ensures vertical separation where flows cross in non-surveillance airspace.

The Northern OTS is supported by Edmonton ACC without any change to NADS or other operational systems, so long as filed flight plans specify route details (all waypoint coordinates) rather than track designators. CAATS is scheduled for implementation in Edmonton ACC in the spring of 2009 and will include NADS functionality adapted to meet all ATC automation requirements for northern airspace. It is important to note that the TC AIM amendment, publication date of October 2008, will allow customers to file the track description if the TMI is filed in field 18 of the ICAO flight plan.

1.1.2.10 ADS-B Implementation

The availability of surveillance and DCPC are the keys to minimum (5NM) separation, maximum airspace capacity and the ability to support random routes. Radar is more costly than ADS-B, but all aircraft operating in the subject area, can participate in radar surveillance (transponder equipage is the only requirement), whereas today only about 60-70% of these aircraft are equipped to participate in ADS-B surveillance. It is expected that equipage will increase significantly, due in part to a European mandate that requires equipage with Mode S transponders by March 2007. The addition of GPS supports ADS-B, just as it supports RNPC and the PBN standards being developed by ICAO. Analysis of IATA estimates for aircraft equipage indicates that 90% of the flights operating in the airspace will be equipped for ADS-B by 2010. Operators, however, need to obtain approval to qualify their aircraft for ADS-B separation, and it is expected that this will delay full implementation. Sections 4.3.1 and 4.4.1.2 provide additional information on ADS-B implementation.

ADS-B will be implemented in the Hudson Bay area in November 2008 to provide continuity of surveillance from the Baffin Island/Ungava Bay area already served by Iqaluit and Kuujjuaq radars, through to southern airspace. ADS-B ground stations will be co-located with VHF PALs whenever possible to minimize the cost of site preparation. Refer to Figure 5.3.

Hudson's Bay ADS-B Coverage

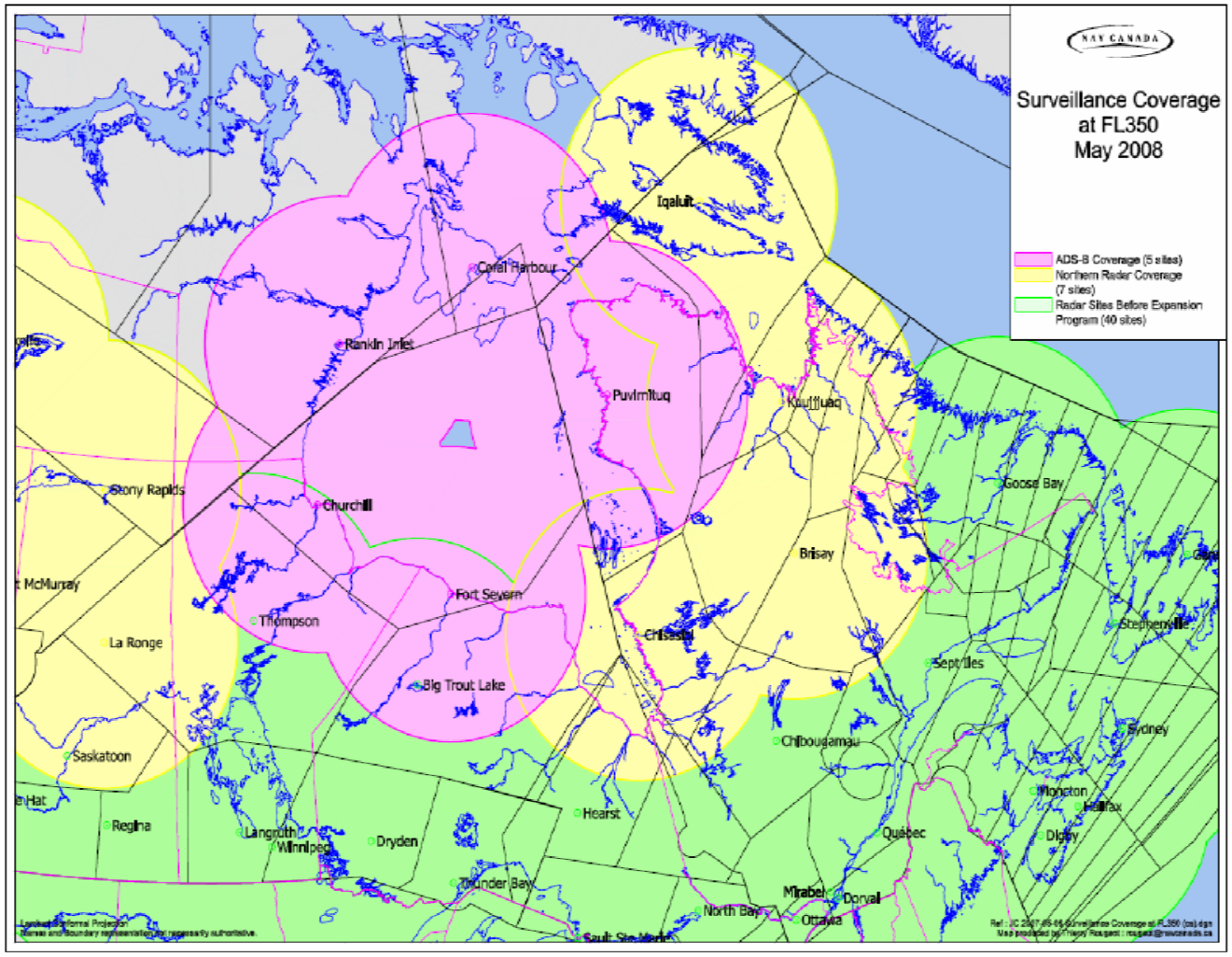


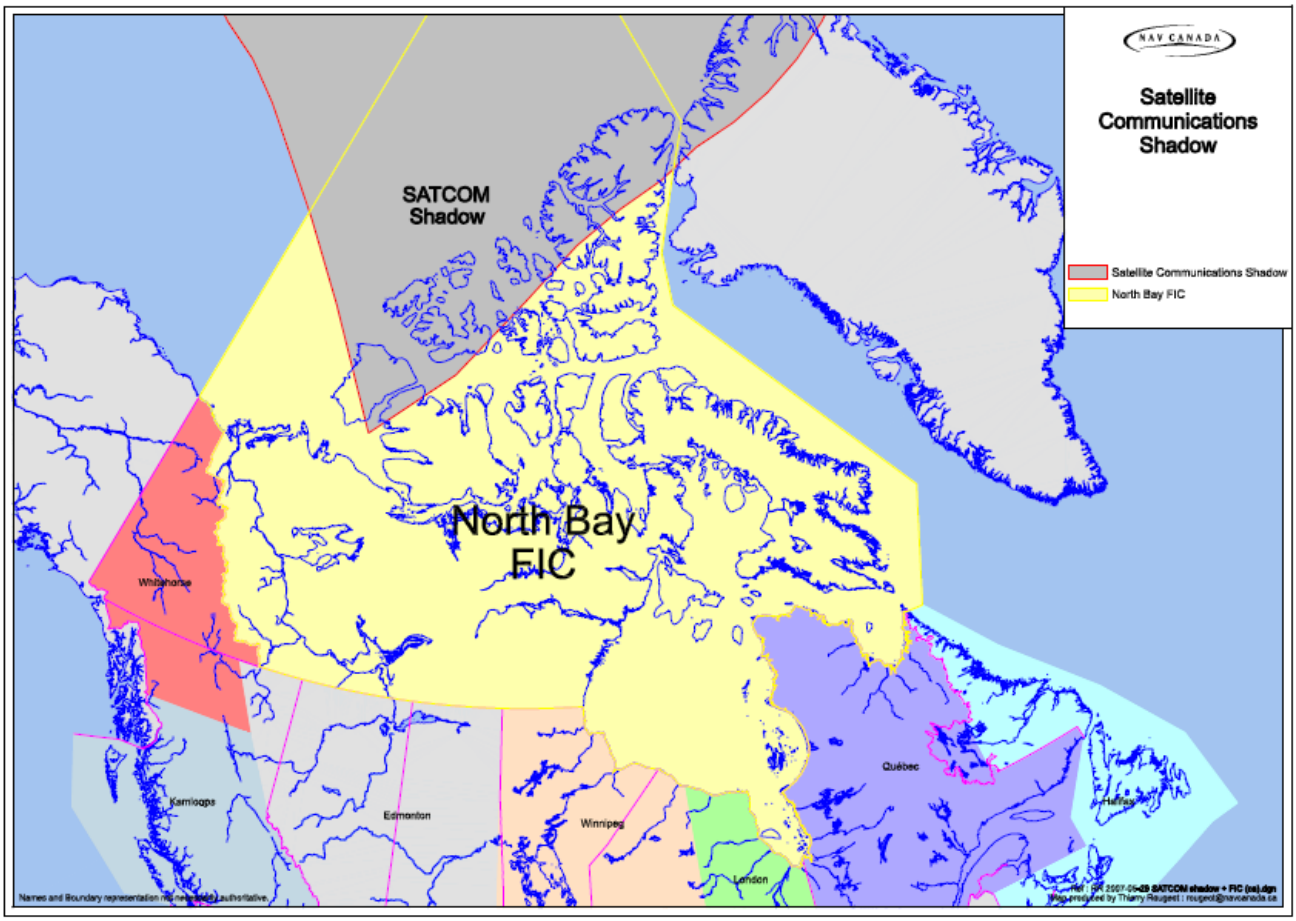
Figure 5.3

Starting in November 2008, controllers will apply ADS-B (5 miles) separation tactically, providing benefits to certified aircraft. Based on consultation with customers and assessment of equipage levels, airspace will be segregated vertically in Phase 2 (mid summer 2009), allowing only ADS-B aircraft from FL 350 to FL 400 inclusive. Eventually all levels FL290 and above will be restricted to ADS-B aircraft.

1.1.2.11 SATCOM Voice

A proof of concept trial for the use of SATCOM voice for routine ATS communications in the Edmonton FIR commenced in late 2006. This trial involved replacing all HF communications with SATCOM Voice communications for a short period of time (1-3 months) between Arctic Radio and a limited number of volunteer operators. The goal was to gather performance data and identify any areas where mitigation may be required to address security, technical or operational concerns.

Results of the proof of concept trial were successful and procedures were developed to support an operational trial, which began in mid 2007. The operational trial served to provide operational and performance data to finalize procedures for the use of SATCOM voice for routine ATS use, as an alternate means of communications to HF voice. Northern SATCOM was approved for routine ATC operations in the northern airspace in the fall of 2007.



1.1.3 Medium Term CONOPS (2011-2012)

The goal of the medium-term CONOPS is to:

- complement the Northern OTS by: expanding areas of surveillance (via ADS-B) and DCPC coverage to allow for more random routing;
- apply ICAO RNP standards to all of the airspace to reduce separation standards outside surveillance coverage;
- improving data link communications to serve areas without VHF DCPC; and,
- employ SATCOM voice to augment and possibly replace HF voice.
- enhance ATM systems through automation to enjoy the full advantage of RNP standards

As well, the development of improved controller decision support tools, such as Medium Term Conflict Detection (MTCD), is expected to assist in increasing airspace safety, capacity and efficiency.

1.1.3.1 Expanded ADS-B

Over time, NAV CANADA has the following objectives:

- direct controller/pilot VHF/CPDLC communications everywhere;
- surveillance, initially by radar, then a combination of radar and ADS-B; and,
- RNAV everywhere, with RNP where beneficial to customers.

The business case, with the key element being customer fuel savings, will determine the extent of expansion of ADS-B surveillance throughout northern airspace. In the meantime, the northern OTS provides fuel-efficient routes from the boundary of Canadian FIRs to just inside surveillance airspace. The remaining efficiency benefits will determine the scope and pace of ADS-B expansion.

Coordination with the FAA regarding their surveillance plans will ensure that radar/ADS-B data sharing will be explored where an operational advantage exists.

ADS-B North eastern Canada and Southern Greenland 2009-10

NW Arctic ADS-B (Date TBD)

1.1.3.2 Expanded VHF Communications Capability

Current VHF coverage supports the future expansion of ADS-B. An additional one or two sites are being planned to complete coverage over the North American Continent and Arctic Archipelago, as, there may be areas without surveillance that would benefit from DCPC.

1.1.3.3 Data Link (ADS-C and CPDLC)

CPDLC will be implemented so as to provide a seamless data link service between the NAT and the North.

ADS-C may support reduced longitudinal separation when Flight Data Processing System enhancements allow the application of periodic position reports. Trials planned for the NAT in the near term may provide the necessary data to support the use of Iridium data link for ATS applications (CPDLC and ADS); this would allow the expansion of data link services into the Inmarsat satellite shadow, thereby possibly enabling reduced time-based longitudinal separations to migrate into that area as well. Further

analysis is required to determine the Required Communications Performance (RCP) for RNP longitudinal separation. It will be necessary to prove that CPDLC meets this required communication performance to be able to consider CPDLC equivalent to DCPC for the application of reduced longitudinal separation requiring DCPC. Current ICAO data seems to support CPDLC is a suitable substitute for DCPC in support of RNP-10 and RNP-4.[1]

Discussions are currently underway concerning the possibility of reducing time-based longitudinal separation in the North Atlantic (NAT) Region. Such reductions would be applied between flights using ADS-C and CPDLC (FANS-equipped aircraft). If this initiative is successful in the NAT Region, the necessary analysis will be completed to implement the same reductions in Northern airspace.

1.1.3.4 SATCOM Voice

It is anticipated that SATCOM voice will be well established as a means of communications for routine ATS purposes between flight crews and FSS. Further development will allow SATCOM voice to become a reliable means of communications from the ACC to the aircraft for non-routine purposes. This may eventually provide sufficient ATC intervention capability so as to support separation reductions.

1.1.3.5 Convert All CMNPS and RNPC Airspace to ICAO RNP

Current CMNPS and RNPC airspace designations were developed in Canada to allow customers to benefit from first generation RNAV avionics; these standards are not applied elsewhere. It is desirable to base airspace design on global standards to minimize regulatory and aircraft certification issues and increase harmonized, consistent and seamless operations across FIRs. ICAO is now moving toward performance-based RNAV standards that rely on the accuracy and reliability of GPS. Required Navigational Performance (RNP) specifications require on-board monitoring and alerting of navigational performance.

The RNP-4 specification currently supports the application of 30NM lateral and longitudinal separation in low density oceanic airspace (parts of the Pacific). To ensure interoperability and consistency of service and requirements between regions, the intent is to “migrate” the NAT solutions to reduce lateral spacing into the Northern airspace. Implementing RNP-4 in the Northern airspace would improve upon RNPC and support a significant lateral reduction if implemented in current CMNPS airspace.

Significant efficiencies become possible whereby an automated system obtains position reports from a flight at 14 minute intervals, in the case of RNP-4. Controller workload is reduced significantly and more flights can be accommodated at the same flight level. An automated system provides for the possibility of controllers handling more aircraft at reduced separation standards safely. Modifications to the controller workstation may be

[1] PBN Manual Working Draft v5.1

required, as well as either DCPC or CPDLC. Where DCPC exists GNSS longitudinal standards may be used (ie.20NM longitudinal)

1.1.4 Long Term CONOPS (2013-2015)

The goal of the long term CONOPS is to further exploit technology to improve service, based on a positive business case. Decisions on specific elements of the long term CONOPS will have to await assessment of service and demand after the near and medium term CONOPS are implemented.

1.1.4.1 Expanded ADS-B and DCPC

Maximum airspace capacity is possible with surveillance and DCPC. This suggests that expanded ADS-B and the deployment of more VHF PALs, or possibly the use of SATCOM Voice, could be considered in the long term.

1.1.4.2 Satellite Shadow

Just as GPS is the preferred navigation system for remote and oceanic airspace, SATCOM avoids the need for ground stations in areas where installation is very difficult and costly. Current SATCOM via geostationary (GEO) satellites does not serve polar areas, but systems like Iridium, which use Low Earth Orbit (LEO) satellites, overcome coverage problems. It is possible that these systems could be certified to support ATS data link (ADS and CPDLC) and/or DCPC via SATCOM, thus resolving communications issues throughout the Northern airspace. Resolution of the SATCOM shadow may allow for future expansion of RNP-4 airspace with reduced 30nm longitudinal and 30nm lateral separation, in an automated system.

1.1.4.3 Airborne Separation Assistance System (ASAS)

The ICAO Future ATM Concept considers the potential to exploit airborne equipment to transfer some responsibility from ATC to the flight crew for separation under certain conditions. This would require a major change in philosophy, but could provide benefits.

1.1.5.4 Summary

The Northern ATM CONOPS provides a phased approach aimed at meeting customers' efficiency goals. It will provide significant benefits in the first phase at minimum cost via the Northern OTS and ADS-B Phase1 & 2 that can be implemented with minimum changes to operational systems. It provides a path to the future based on the implementation of CNS/ATM technology when it is supported by a business case. It relies on coordinated investments by NAV CANADA and its customers, and therefore it requires the participation of customers to refine the concept and pursue implementation in the near, medium and long term.