Project Reports
International Interfaces

Automation Interface and Radar Handoff Update

Presented To: NACC

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Date: April 8-11, 2019

Federal Aviation Administration

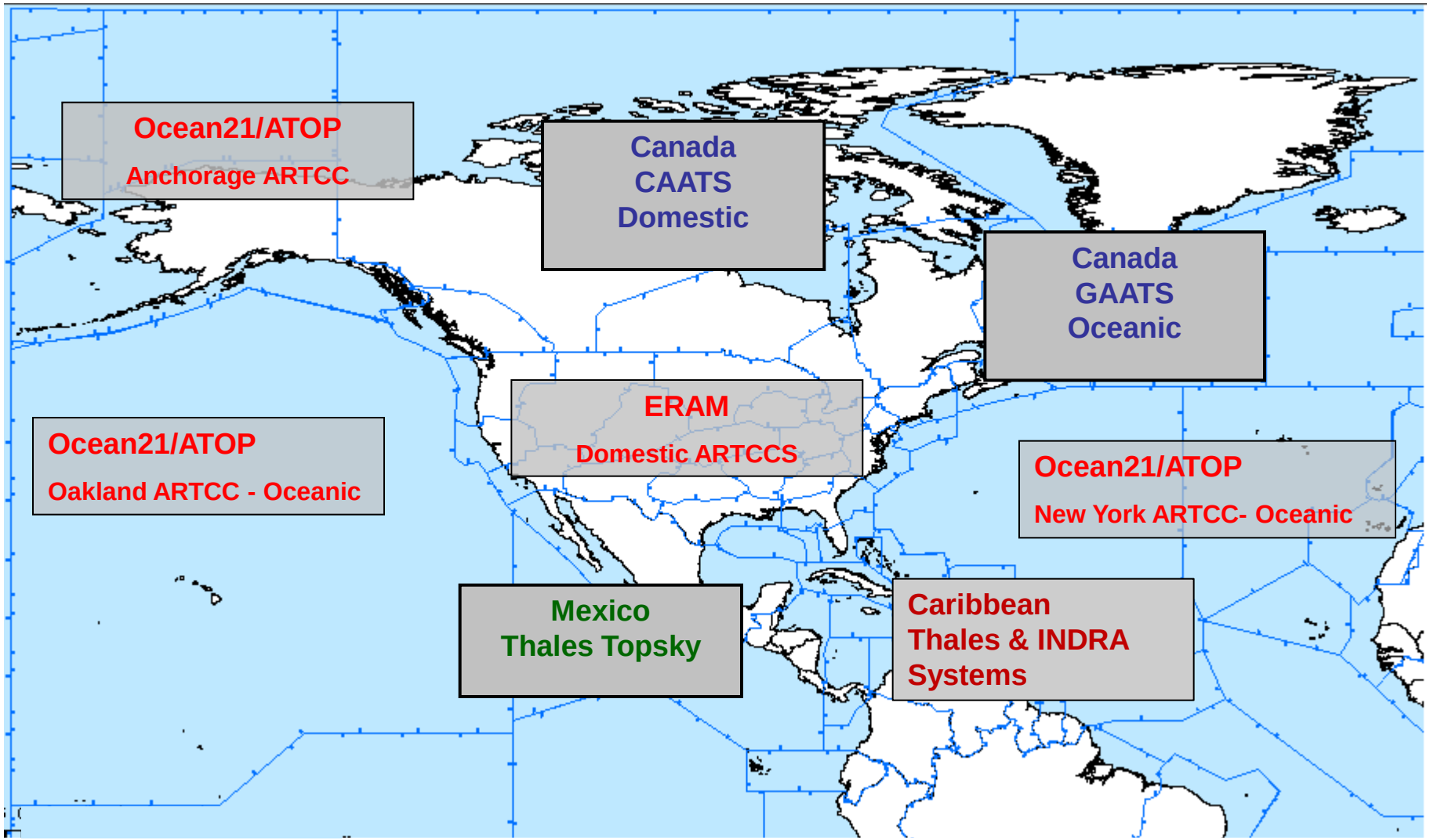
Automation Harmonization

- Support for bilateral solutions & user collaboration needed to ensure automation compatibility as interface systems evolve
- Solutions must provide extensible compatibility with our North American & international neighbors
- Goal is to extend operational efficiencies through contiguous computer-to-computer coordination across country and system boundaries

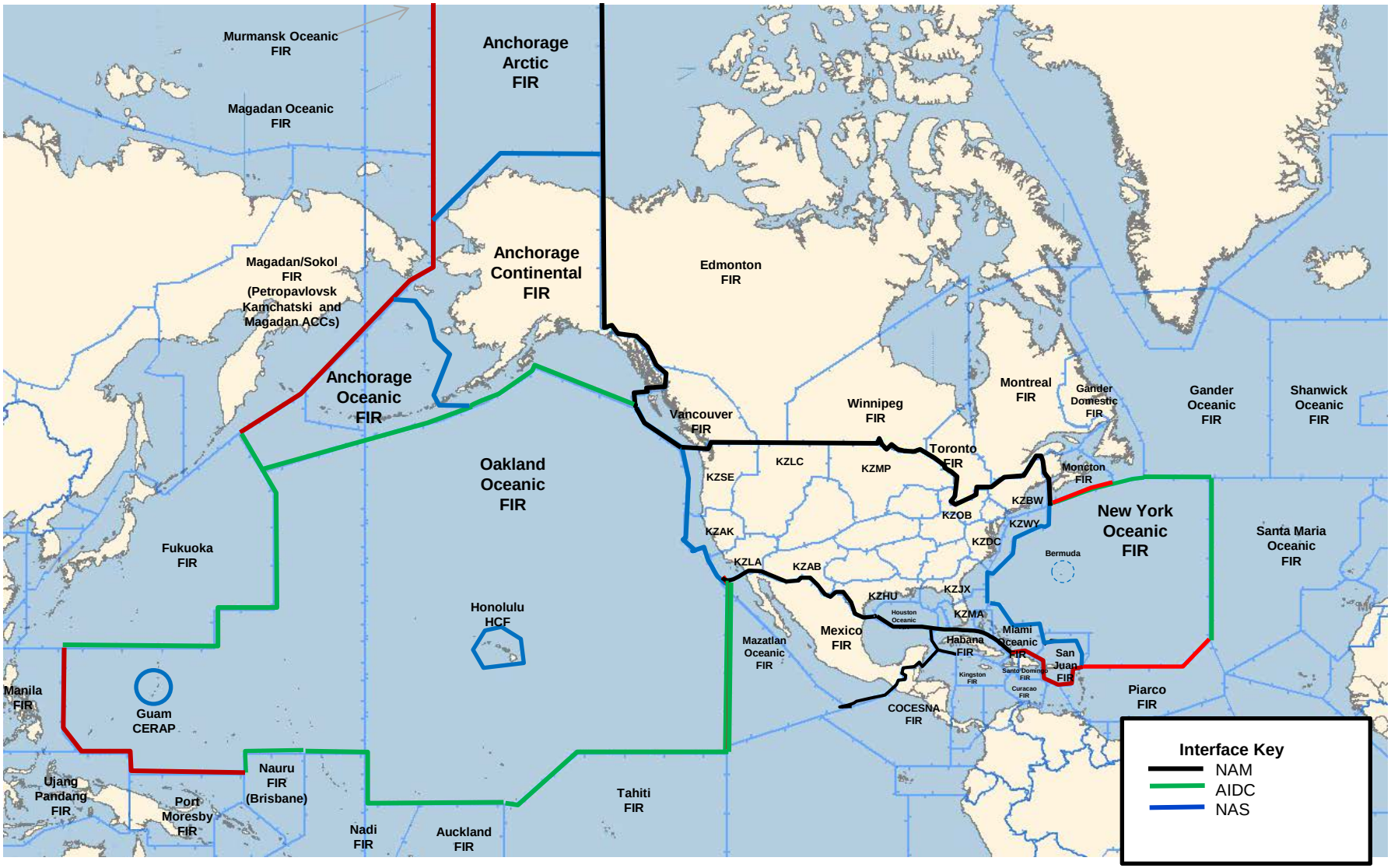
Automation Benefits

- Our customers' safety and efficiency interests extend beyond the borders of our airspace system. Operational efficiencies gained in our airspace extends automation borders as aircraft travel into other regions and transit service providers. Provides direct benefit to 13 border ARTCCs, indirect to all ARTCCs
- Traditional benefits from automation include*:*
  - Reduced workload for controllers;
  - Reduction of readback/hearback errors during coordination;
  - Reduced "controller to controller" coordination errors; and language barrier issues
  - Enabler for performance based navigation initiatives and emerging technologies with automation
  - Voiceless coordination

En Route/Oceanic Systems



Automated International Boundaries



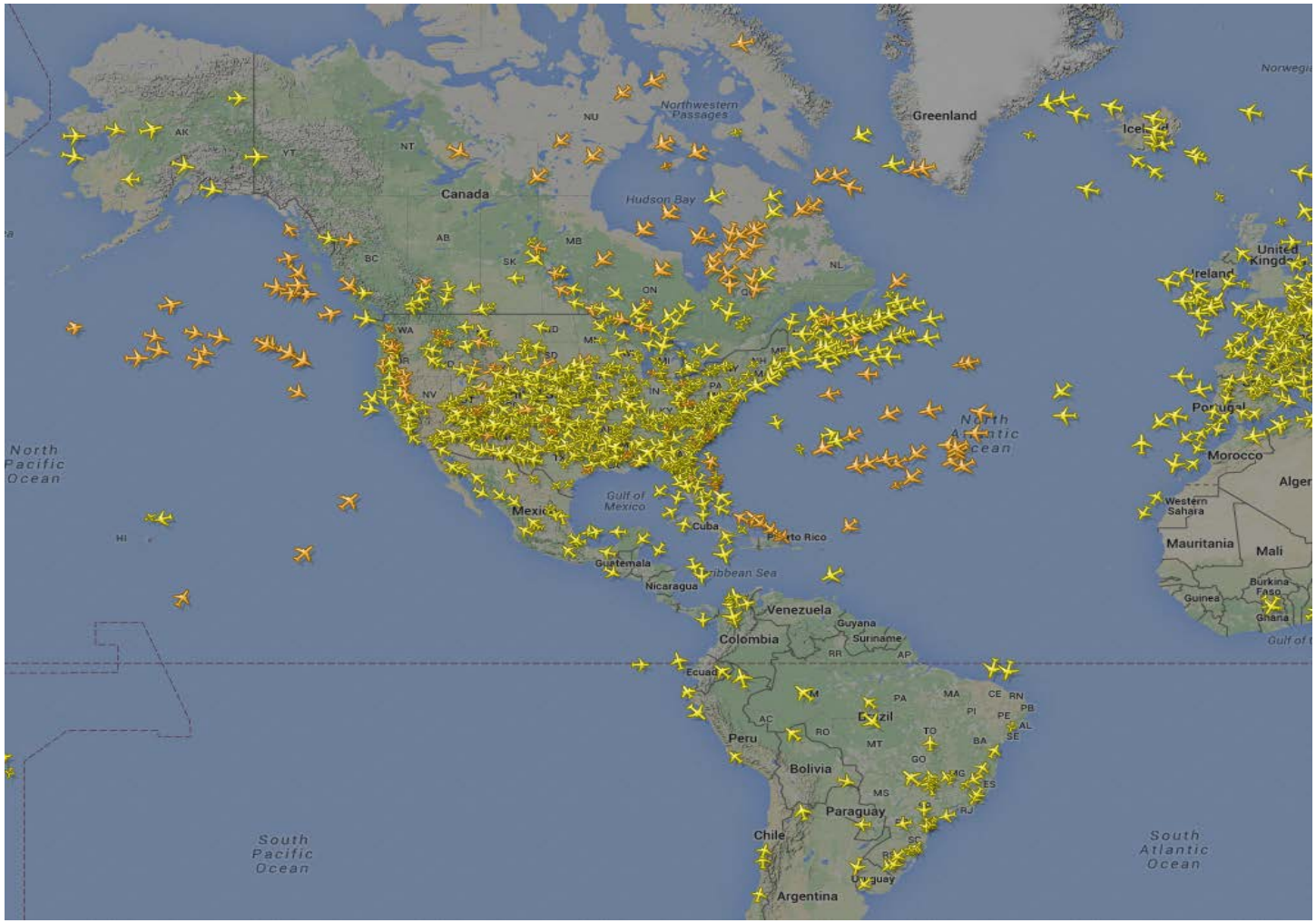
Extending US automation beyond our borders with interfaces - NAM Cross Border Beginnings

- Within North American Aviation Trilateral (NAAT/5) Canada, Mexico & U.S. agreed to cooperate on development of **seamless** interface between countries and automation systems. North American Common Coordination Interface Control Document (NAM ICD) was adopted as guidance document
- NAM ICD defines message formats for implementation of interfaces between automation systems:
  - U.S. & Canada 2009, 6 Area Control Centers, 5 ARTCCs
  - U.S. & Mexico 2008, 3 Area Control Centers, 3 ARTCCs
  - Cuba added in Dec 2011, Miami ARTCC to Havana Area Control Centre
  - COCESNA has since interfaced with both Cuba and Mexico (Merida)
- NAM ICD standard used as guide for Caribbean flight data automation compatibility

Annual US – NACC FIR Border Crossings

FIRs	Traffic	Notes
Canada	2,400,000	6 Domestic FIRs
Mexico	410,000	3 Domestic FIRs
Habana	245,000	ZMA
Santo Domingo	171,000	ZMA & ZSU
Piarco	82,000	ZNY & ZSU
Maiquetia	13,000	ZSU
Curacao	6,900	ZSU

Interfaces support the US sharing of 100,000 flights per day



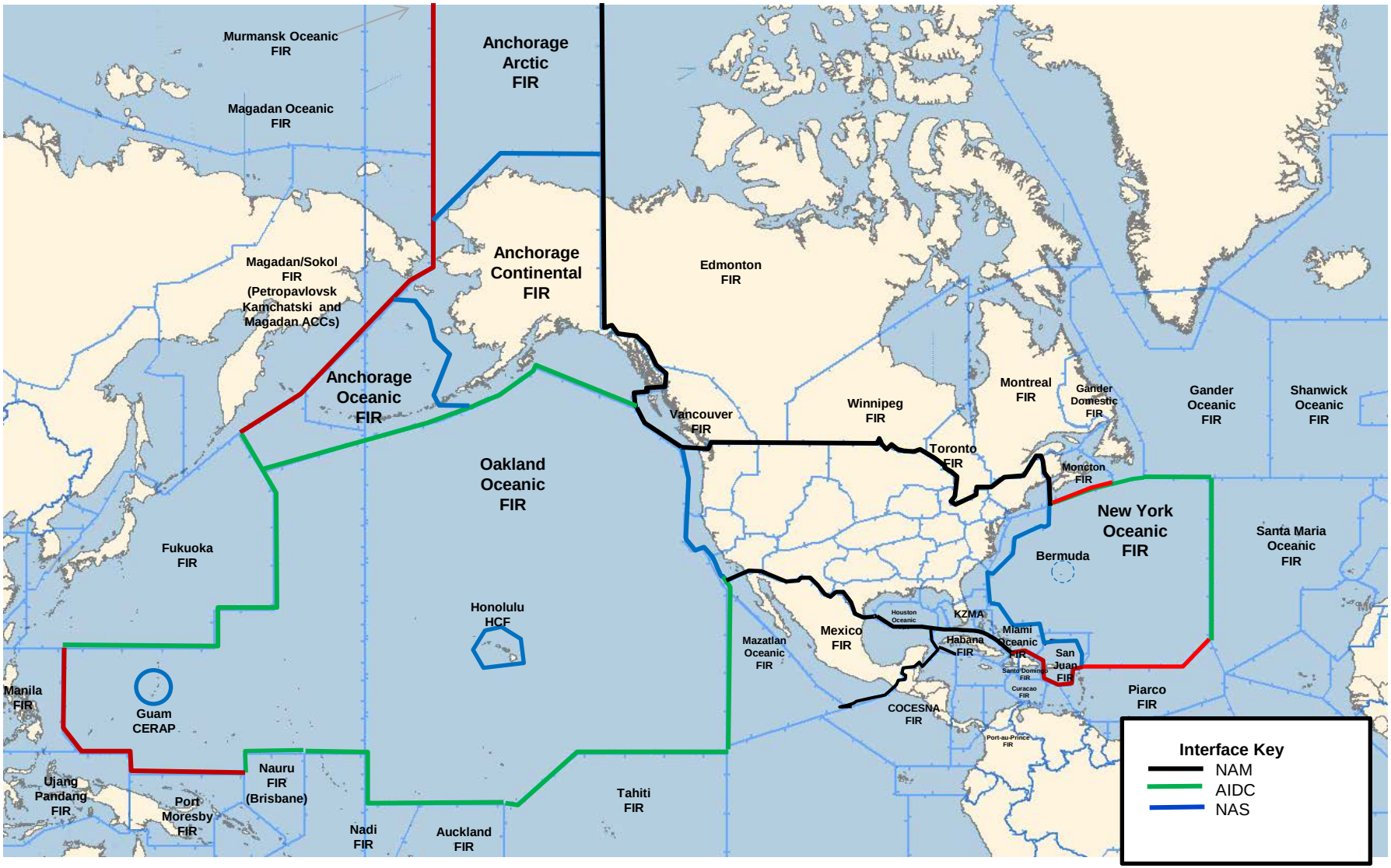
North American Interface Environment

- In most NAM environments, radar/surveillance is the operational norm and non-radar the exception, where in many traditional AIDC interfaces non-radar is more the norm and radar is the exception

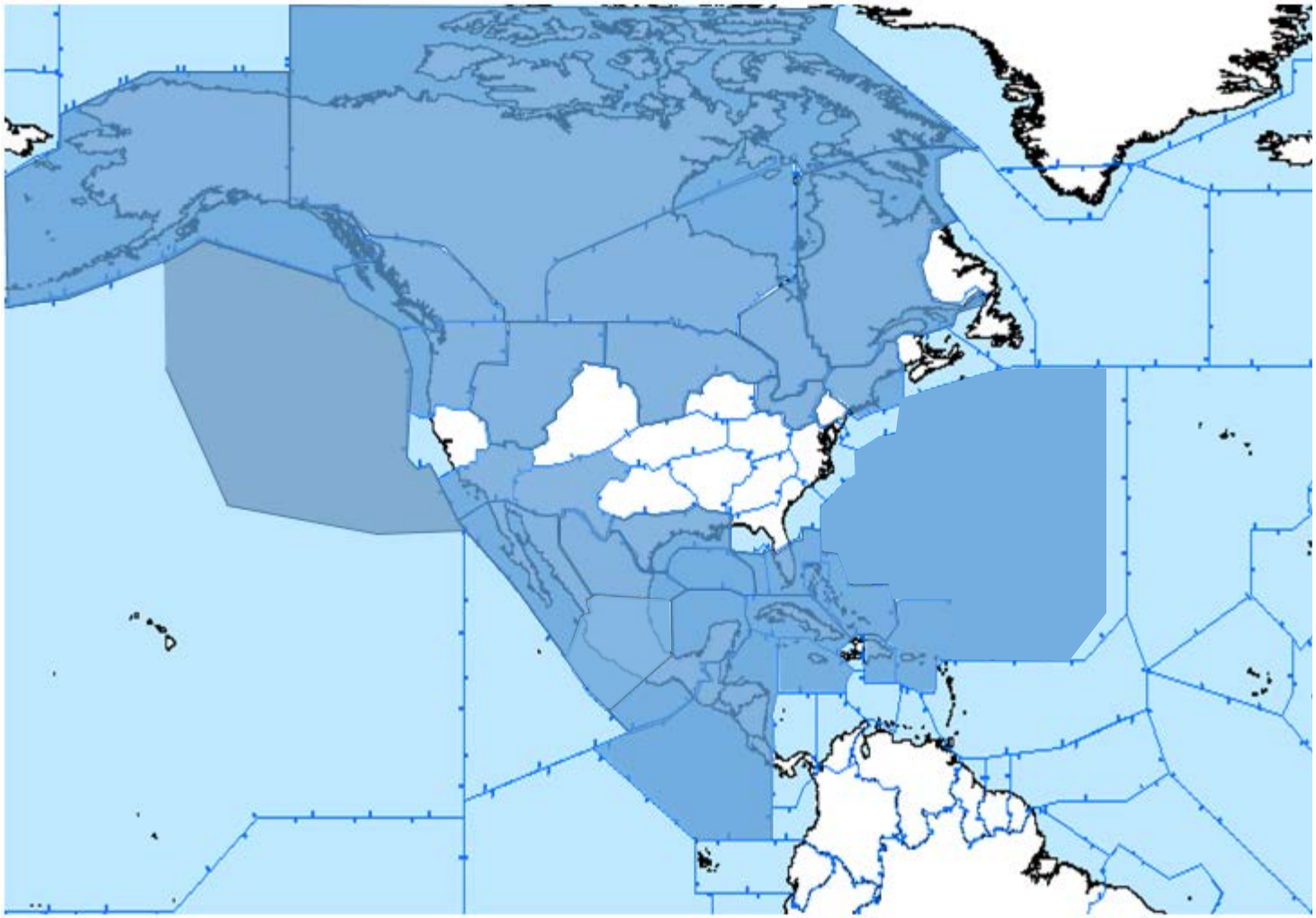
- The NAM messaging is used throughout North America and may be likened to the domestic protocol such as European Online Data Interface (OLDI). The NAM protocol provides the advantage of extensibility to handoff and point-out functionality, enhancing a positive controlled radar environment.

- Five miles cross border separation is an achievable goal and is currently used in U.S.–Canada cross border operations

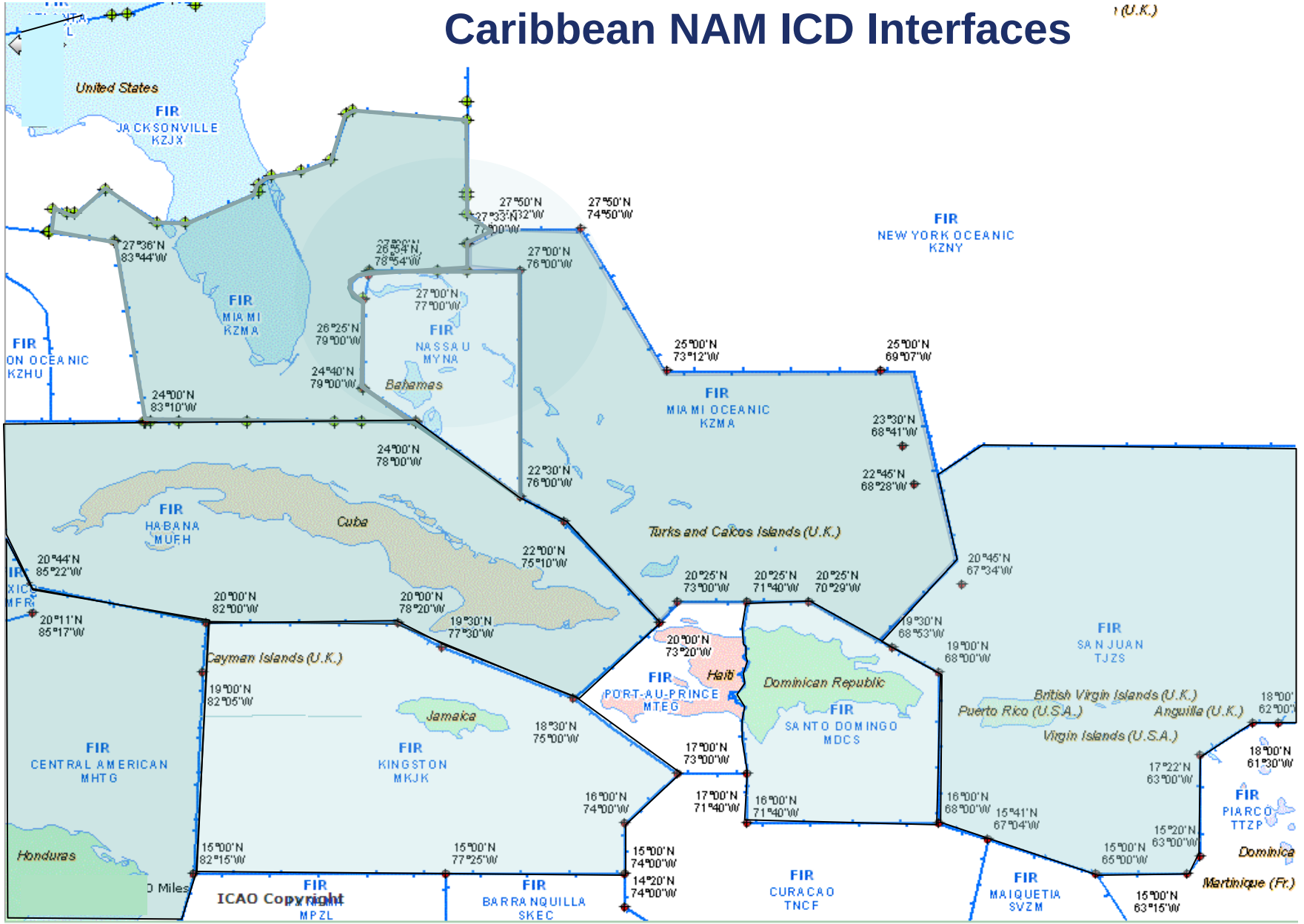
Automated International Boundaries



NAM ICD Interfaces Support the ICAO North American, Central American and Caribbean Region



Caribbean NAM ICD Interfaces



Extending the US Automation Standard – NACC Adopted NAM ICD

- Compatibility management between existing/emerging international automation systems is essential to optimize capabilities and meet user needs
- U.S. centralized geographic position requires taking the lead to assure compatibility is maintained
- Near term countries wanting to interface/enhance interface with the U.S.
  - Dominican Republic *
  - Bahamas *
  - Cuba *
  - Mexico
  - Canada *
  - St Maarten

  * expressed desire to implement automated handoff

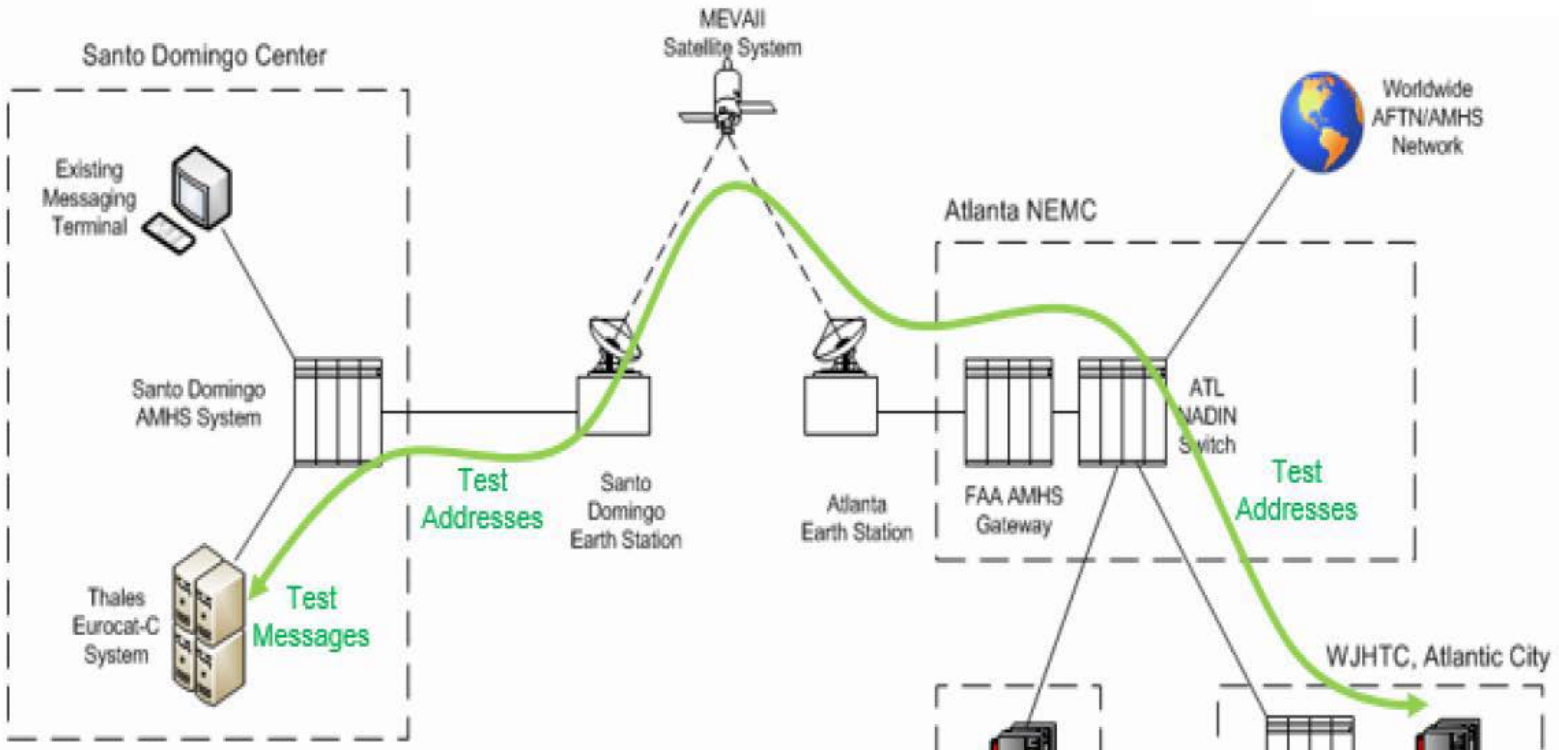
Automation Benefits per RTCA

- Assuming that automation saves just one minute of controller time per flight, Automated Data Exchange (ADE) will save six hours of controller time per day for flights between ZMA-MDSD
- A conservative estimate when considering the savings at peak traffic periods and seasonal demands
- ADE allows for improved utilization of the airspace capacity as controllers have more time to focus on separating and managing traffic and less time manually coordinating information. This drives a better use of capacity and a possible reduction in separation standards

Benefits (Continued)

- Near Term Regional Automation activities
  - Cuba has upgraded their legacy ATC system and is looking to transition to the Galaxy System in the 2019-20 timeframe and up-level the NAM ICD interface to Class 2
  - Cuba plans to upgrade their NAM ICD Class 1 interface with COCESNA to Class 2 when the INDRA software is available
  - Jamaica is operational with their Thales TOPSKY system and will be coordinating with both Cuba and COCESNA for implementing NAM ICD interfaces in 2019-2020
  - Santo Domingo ACC is currently testing Class 1 with Miami ARTCC via the FAA Technical Center with very positive results prompting optimism the interface can be operational in 2019.

Interface Testing Configuration



- ATL NADIN routes messages with test AFTN/AMHS addresses to WJHTC for testing with ERAM

Automated Handoff

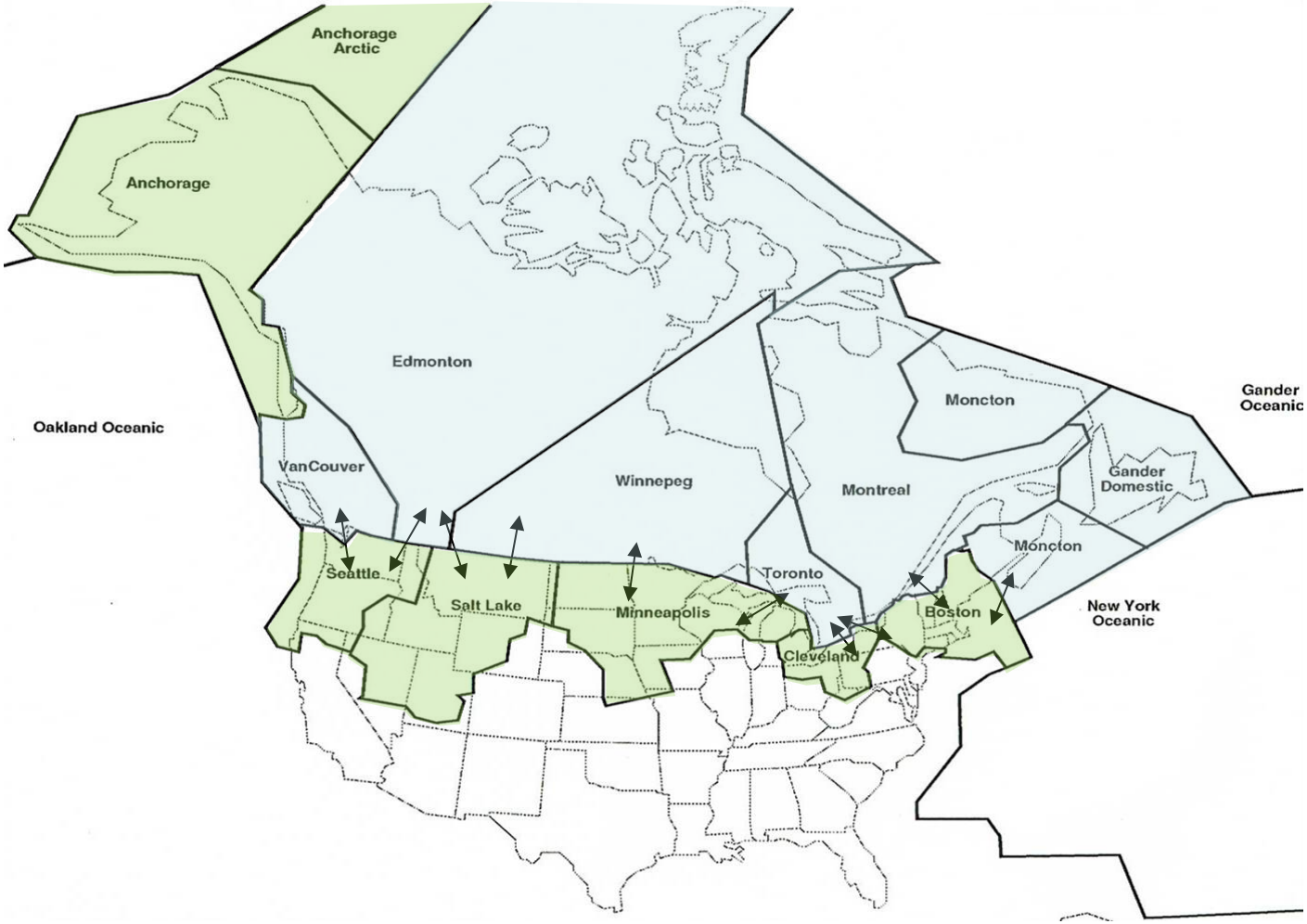
Automated Handoff – Class 3

- NAM ICD Automated Handoff for the international interfaces is based on the architecture and messaging used domestically in the U.S. and is termed NAM ICD Class 3

- Domestically the FAA has used automated handoff operationally for over 30 years
  - En Route to En Route
  - En Route to Terminal
  - Terminal to Terminal

- The Handoff capability advances the “voiceless” computer-human transfer of control interface technology enhancing automated data exchange

Cross Border Handoffs Initially includes Canada and the US between CAATS and ERAM



2019 Automation Infrastructure ERAM Enhancements 2 Cross Border Handoffs

- Automated ‘voiceless’ transfer of control between U.S. and Canada helps shift the controller’s workload from manually intensive coordination tasks and focus on job-related tasks

- Performance Enabler
  - 24 X 7 Handoff capability provides controller benefits to existing automated data exchange between countries

- Preserves the five miles cross border separation standard currently used between U.S. and Canada

NAM ICD Message Classes Overview

- Class 1 Capabilities
  - Active flight plans for IFR Flights (via CPL)
  - Proposed flight plans for IFR flights (via FPL) – where agreed between ANSPs
  - Logic Accept Message (LAM)

- Class 2 Capabilities
  - Filed flight plans for IFR flights (via FPL and EST)
  - Modifications to CPL/FPLs that were activated by an EST (via MOD)
  - Modification of an FPL (via CHG)
  - Cancellation of CPL/FPLs (via CNL)
  - Logical Reject Message (LRM)

- Class 3 Capabilities – Handoff
  - Radar Handoff (via RTI, RTU, RTA, RLA)
  - Point Outs (via POI, POA, POJ)
  - System Messages Application Status Message (new NAM message in Version E - IRQ, IRS ,TRQ ,TRS

Handoff Developmental Interest Items

- NAM Telecommunication - Direct Connectivity Required
  - Due to real time handoff messaging per NAM ICD

- ICD Messages should be software selectable to maintain flexibility with adjacent ANSPs

- First Order Dependency of Interface Messages
  - CPL Success Required/ FPL-EST Success Required then Handoff Sequence RTI – RLA – RTU - RTA

NAM ICD Communications Extract

PART III – COMMUNICATIONS AND SUPPORT MECHANISMS

1. Introduction

The communications protocols and physical path are not dictated by this ICD. This ICD addresses only the application message content.

2. Telecommunications Requirements and Constraints

2.1 Use of Aeronautical Fixed Telecommunications Network (AFTN)

AFTN may be used for the flight data interface in Class 1 or Class 2, subject to verification of performance. Any interface exchanging radar/surveillance position data, including radar handoffs and point outs, shall not use AFTN.

When AFTN is used as the communications mechanism:

a) The AFTN IA-5 Header as described in ICAO Annex 10, Aeronautical Telecommunications (Amendment 71) will be used for exchange of messages.

b) ATS messages will be addressed to each ATS unit using an eight-character facility address where the first four characters are the appropriate location indicator from ICAO Doc. 7910, and the last four characters are routing indicators defined by the ATS unit in accordance with ICAO Annex 10.

Each message shall be sent with the priority indicated in Table 2 of Part II.

2.2 Use of a Wide-Area Network

Use of existing wide-area networks (e.g. using TCP/IP protocol) may be used if the speed, capacity, and security characteristics are verified as adequate to support the interface.

2.3 Use of Direct Lines

In cases where speed, capacity, and/or security require it, a direct line interface may be used between facilities.

Cross Border Communication

- Upgrade current AFTN to Internet Protocol (IP) and AMHS service
  - Direct IP service through NADIN MSN Replacement required
    - Load balancer is scheduled to extend the IP support for the ERAM – CAATS interfaces to NAV CANADA and SENEAM interfaces within the near term; testing is being planned for 2019 and implementing existing Class I and II messages using the new communications infrastructure to include the new system messages will be deployed 2019-2020

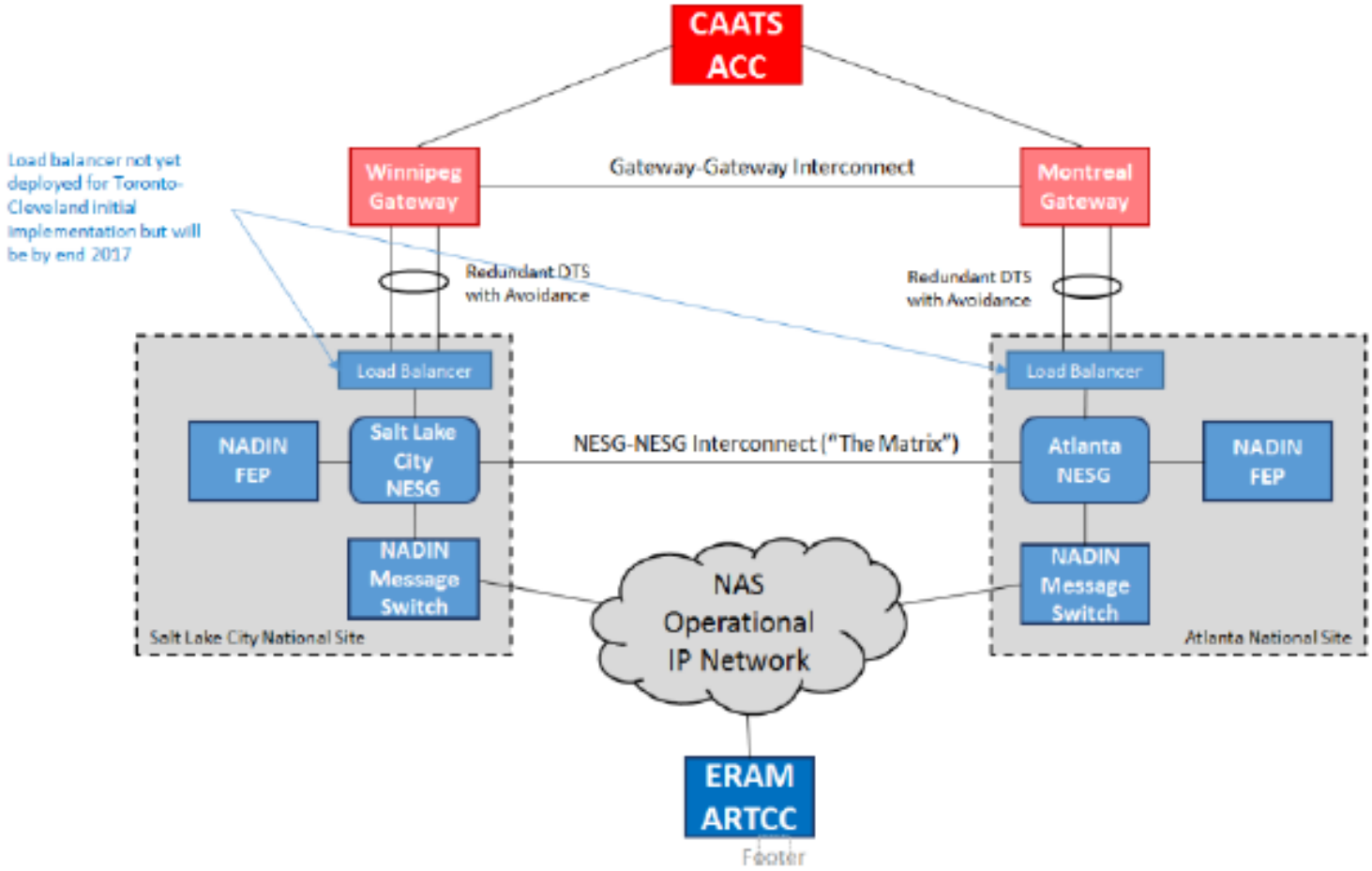
    - MEVA III is being looked at to support enhanced capabilities between the U.S. and NACC partners for future interface support

Communications Interface Control Document and Interface Requirements Document

- **Interface Requirements Document** (IRD) NAS-IR-82422100 was prepared in accordance with FAA-STD-025f. It provides the requirements to support Direct TCP/IP interfaces between the En Route Automation Modernization (ERAM) system and Non-US ACC systems via the FAA NAS Enterprise Security Gateway (NESG) and the FAA Telecommunications Infrastructure (FTI).

- **Interface Control Document** (ICD) NAS-IC-82422100 was prepared in accordance with FAA-STD-025f. It specifies the design characteristics to support Direct TCP/IP interfaces (NAM Direct IP) between the En Route Automation Modernization (ERAM) system and Non-US Area Control Center (ACC) systems via the FAA NAS Enterprise Security Gateway (NESG) and the FAA Telecommunications Infrastructure (FTI).

Planned TCP/IP Messaging Connections



Automation Infrastructure ERAM Enhancements 2 Cross Border Handoffs

- Automated ‘voiceless’ transfer of control between US and Canada is scheduled in two phases

  - SIG 1814 consisting of infrastructure communications enhancements and ERAM-CAATS system to system messaging is scheduled for deployment in 2019
  - SIG 1815 consisting of new handoff messages and the legacy NAM ICD messages which will travel on the communications infrastructure enhancements between ERAM-CAATS is scheduled for deployment in 2020-21

NAM ICD Changes

- Changes in support of the upgrade from NAM ICD Class II to Class III Handoff will be documented in the subsequent version of the document

- Most of the changes will be captured in the US – Canada boundary agreement

- The RTA message will contain sector and frequency to automate the voiceless CPDLC transfer of control functionality

NAM ICD Changes (Continued)

- No changes to NAM ICD Class I or Class II will be required to implement Class 1 or II or continue operations
- Canada's request to adopt the NAM ICD system messages coincidentally within Class 3 functionality was agreed to by the US
  - System messages include:
    - Initialization Request (IRQ) - Initiates interface activation
    - Initialization Response (IRS) - Response to IRQ
    - Termination Request (TRQ) - Termination of interface
    - Termination Response (TRS) - Response to TRQ
    - Application Status Monitor (ASM) - Confirms an adjacent system is online and working (heartbeat)
    - Logical Acknowledgement (LAM) - Acceptance of message, including an ASM

NAM ICD Changes (Continued)

- The U.S. is implementing a new secure communication infrastructure to process most of the changes will be captured in the U.S. – Canada boundary agreement
- Canada and the U.S. have agreed to link Data Comm transfer of voice communications across the border using the NAM ICD automated handoff i.e. “voiceless transfer of control “ in the automation transaction
- Examples of some boundary agreement changes will include:
  - Field 07(c) Implementation in RTI, RTU, and POI Messages
    - If the track for the flight does not have an established beacon code, RTI and POI messages will not be sent.
    - If the beacon code for a flight in handoff becomes dis-established, RTU messages will not be sent.
    - RTU messages will resume if the beacon code becomes established while the flight is in handoff

Examples of some boundary agreement changes will include (cont)

- Field 32 Implementation in RTI, RTU, and POI Messages
  - Field 32, including all subfields, is included in RTI, RTU, and POI messages
  - If the track for the flight being handed off or pointed out does not have an established ground speed, Field 32(c) will be set to N9999.
  - If the track for the flight being handed off or pointed out does not have an established heading, Field 32(d) will be set to 99999.
  - If the track for the flight does not have an established reported altitude, RTI and POI messages will not be sent.
  - If the reported altitude for a flight in handoff becomes dis-established, RTU messages will not be sent. RTU messages will resume if the reported altitude becomes established while the flight is in handoff.

Examples of some boundary agreement changes

- **HAND-OFF Related Messages**
  - **“Not Established” Values in Handoff/Point Out Messages**
  - The material relating to “Not Established” Values in Handoff/Point Out Message may be added to the Boundary Agreement specific default values to be used in certain cases. Values are required in all the messages (RTU, RTI, POI).
  - Re RTUs: If beacon code or alternate become not established during a handoff, the proposal is that we not send the RTU
  - Special cases require special values which should be identified in the boundary agreement

Conclusion

- Safety and efficiency interests extend beyond the borders of our airspace and systems. Operational efficiencies gained in our airspace should be continuous to the extent possible as aircraft travel into other regions and service providers.
- Taking a harmonized approach ATC automated systems extends our capabilities

- As our aircraft operators invest in aircraft technology, they expect it to be compatible with systems and procedures used by other air navigation service providers.

- Standardization of automated data exchange technologies and procedures is critical to cross-border, regional and multi-regional interoperability. This, in turn, drives the seamless operation of regional and global systems.

- Harmonization supports safety objectives through standardization and promotes economic efficiencies. A harmonized system cannot be built without developing partnerships with our international counterparts.