Automation Interface Update North American, Caribbean and Central America

Presented To: CAR/SAM AIDC Workshop

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AJV-724, Requirements and Validation

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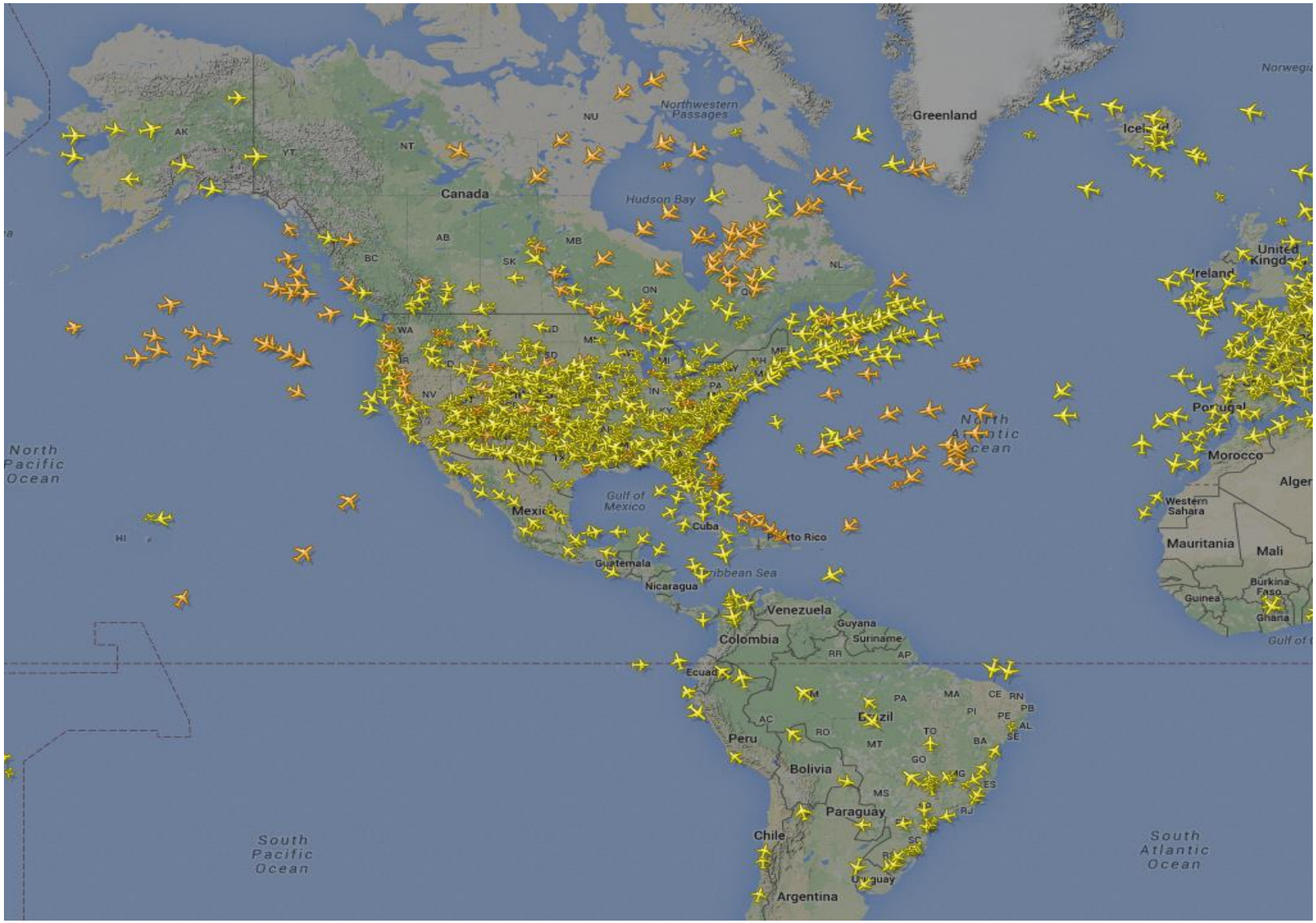
Introduction

- The FAA provides air navigation services to over 29 million miles of domestic and international airspace with approximately 43 million aircraft handled annually.
- Operations across international boundaries can be based on domestic en route radar separation procedures, as is the case along most of the U.S. border with Canada, Mexico, Cuba and in the Caribbean.
- Oceanic operations within international airspace and international boundaries can be based on non-radar procedural or Automatic Dependent Surveillance (ADS) separation, such as the oceanic operations at New York, Oakland and Anchorage Center.

Harmonization is Goal

- Support for bilateral solutions & user collaboration needed to ensure automation compatibility as interface systems evolve
- Solutions must provide extensible compatibility with our North American, Region & international neighbors
- Goal is to extend operational efficiencies through contiguous computer-to-computer coordination across country and system boundaries
- Direct benefit on our collective ability to integrate new technologies and provide ‘automation buyback’ for traffic efficiency


Northwestern Passages
Greenland
Canada
Hudson Bay
North Pacific Ocean
North Atlantic Ocean
Gulf of Mexico
Cuba
Guatemala
Nicaragua
Venezuela
Guyana
Suriname
Colombia
Ecuador
Peru
Bolivia
Paraguay
Chile
Argentina
Uruguay
Brazil
Portugal
Morocco
Western Sahara
Mauritania
Mali
Guinea
Burkina Faso
Ghana
South Pacific Ocean
South Atlantic Ocean


Bermuda
New Orleans
Gulf of Mexico
Mexico
Havana
Cuba
Turks and Caicos Islands
Cayman Islands
Jamaica
Port-au-Prince
Puerto Rico
San Juan
British Virgin Islands
Montserrat
Belmopan
Belize
Guatemala
Honduras
El Salvador
Nicaragua
Managua
Costa Rica
San Jose
Panama
Caribbean Sea
Aruba
Curaçao
Barranquilla
Maracaibo
Caracas
Cartagena
Bucaramanga
Venezuela
Merida
Cancún
Veracruz
Acapulco

Harmonizing ATC Automation

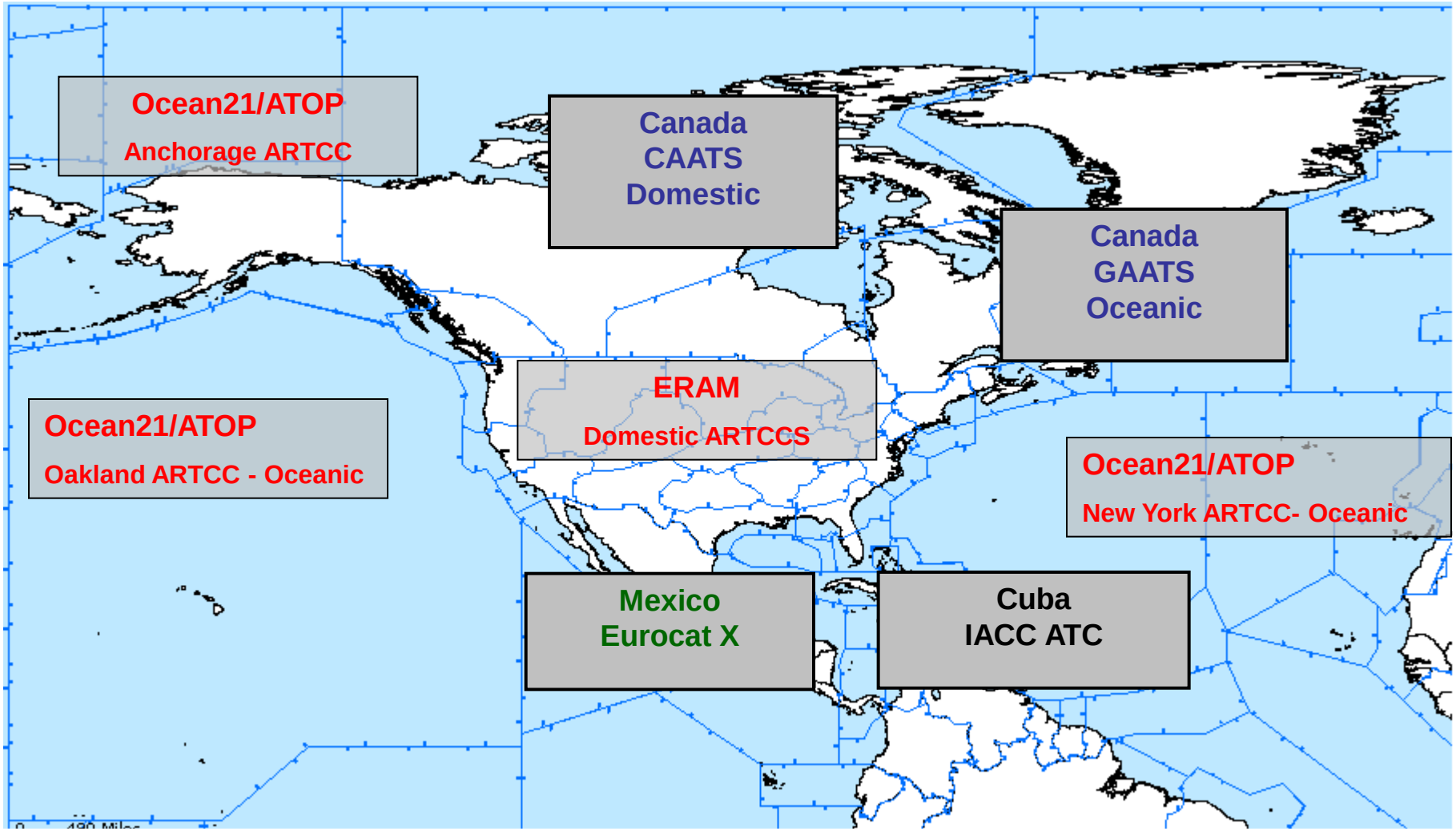
- The increasing demand of international traffic between Flight Information Regions (FIR) drives the need to improve efficiency and maintain the data accuracy for the Air Traffic Control (ATC) providers.
- Developing a harmonized process and using standardized protocols for exchanging data between multiple States/Territories/ International Organizations within and across regions is critical to achieving efficiency through automation.

Automation Benefits

- Our customers' 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.

- Traditional benefits from automation include*:*
  - Reduced workload for controllers;
  - Increased accuracy and completeness of flight information
  - Reduction of readback/hearback errors during coordination;
  - Reduced "controller to controller" coordination errors; and language barrier issues
  - Increased in support for performance based navigation initiatives and emerging technologies with automation

En Route/Oceanic Systems



US International Border Crossings

Neighboring FIR	CY 2012 Number of crossings	CY 2013 Number of crossings	CY 2014 Number of crossings
Canada FIRs	2,489,122	2,513,329	2,556,999
Mexico FIRs	390,280	402,499	413,821
Habana	230,212	233,922	241,641
Japan	125,961	130,515	133,490
Santo Domingo	88,751	92,715	101,822
Piarco	79,640	81,027	85,000
Santa Maria	72,281	73,459	76,726
Port Au Prince	46,090	47,978	49,886
Russia FIRs	39,665	39,894	40,365
Maiquetia	11,948	13,536	13,338
Port Moresby	10,721	10,672	10,770
Auckland Oceanic	6,463	7,250	7,580
Curacao	6,054	5,941	6,519
Manila	5,794	5,565	6,184
Nadi	2,703	2,941	3,104
Tahiti	2,984	2,571	2,791
Nauru	552	609	618
Ujung Pandang	255	224	235
Grand Total	3,609,476	3,664,647	3,750,889

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Piarco	79,640	81,027	85,000	**AIDC Pending**
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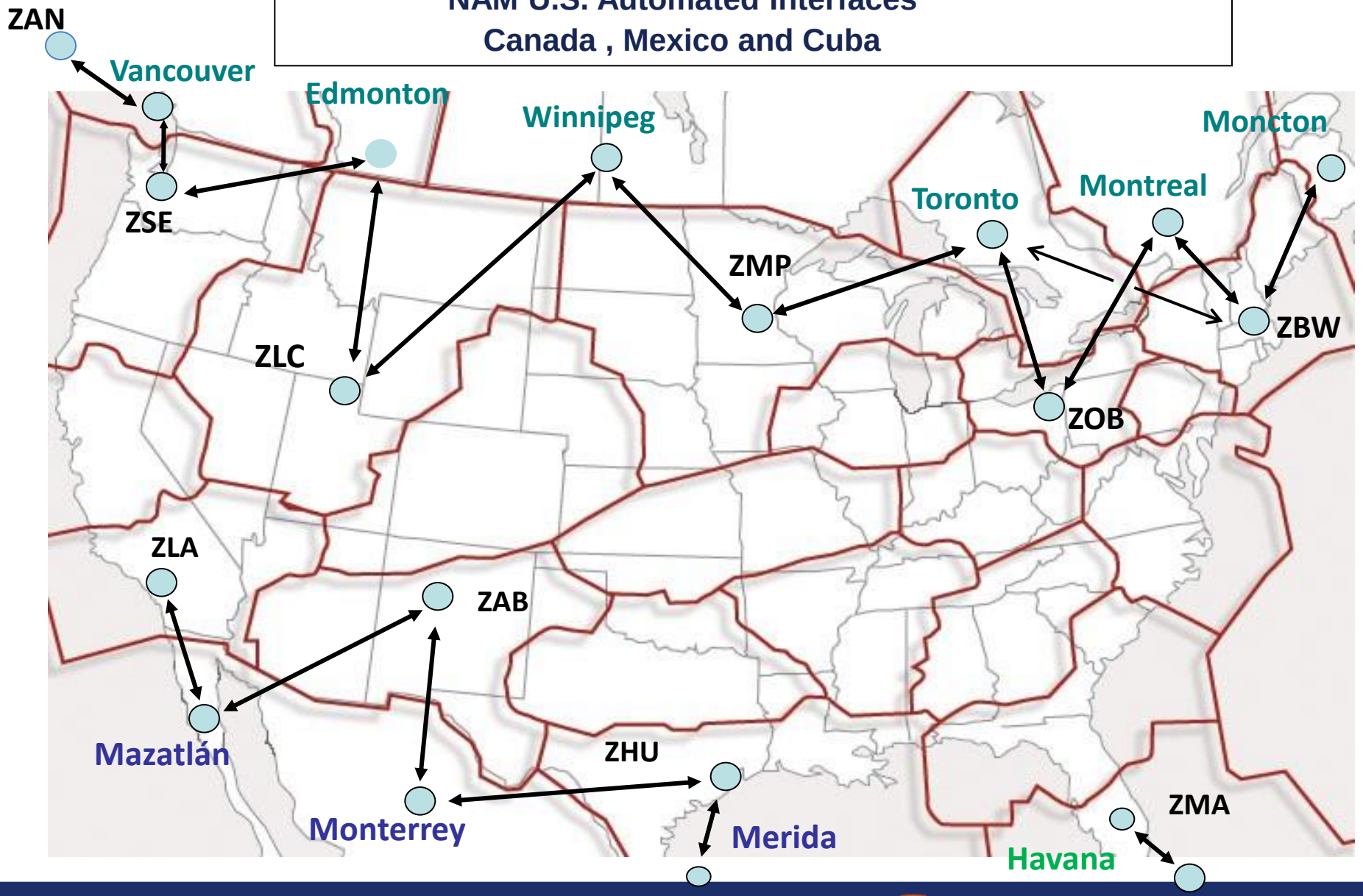
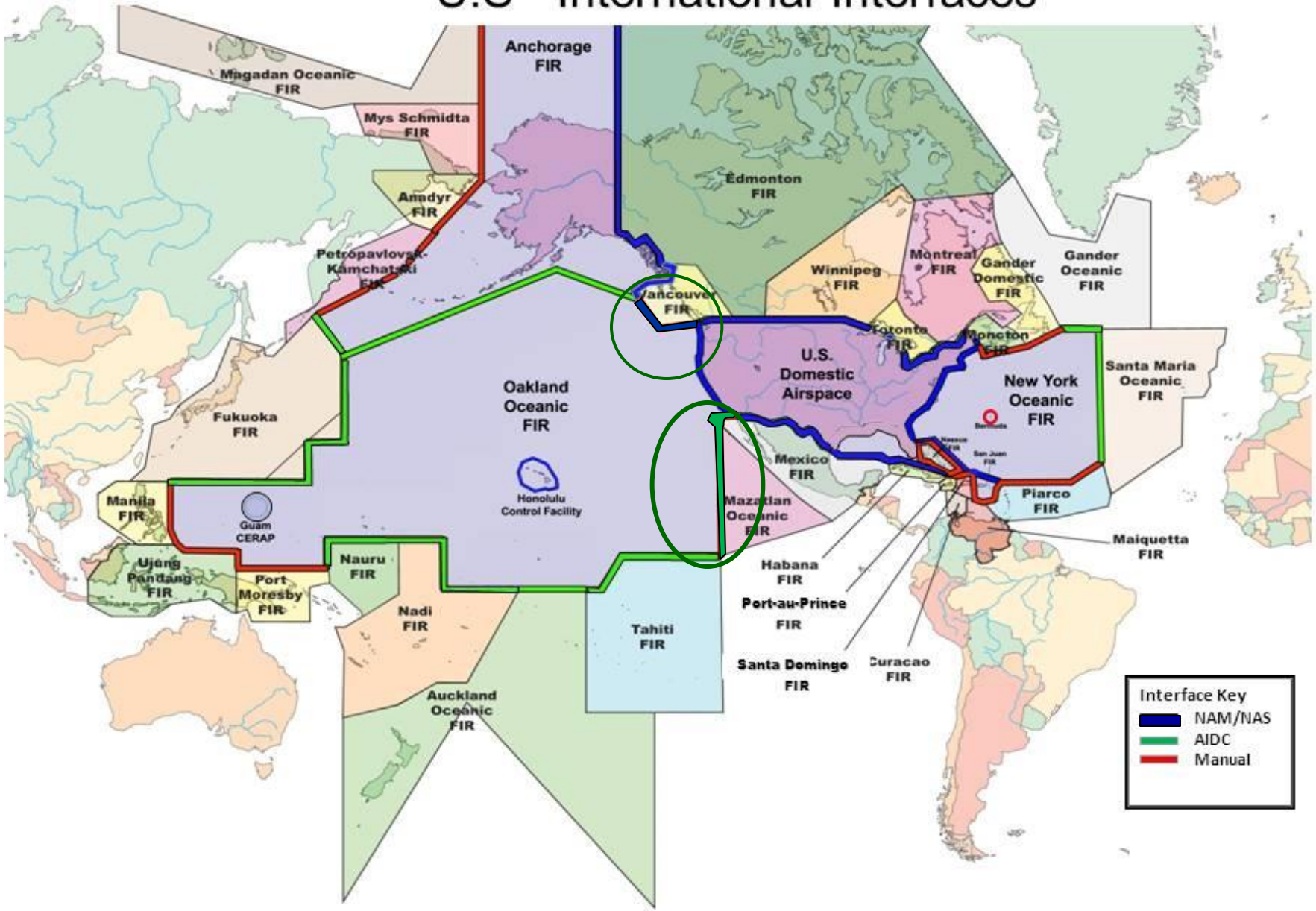
NAM U.S. Automated Interfaces
Canada , Mexico and Cuba



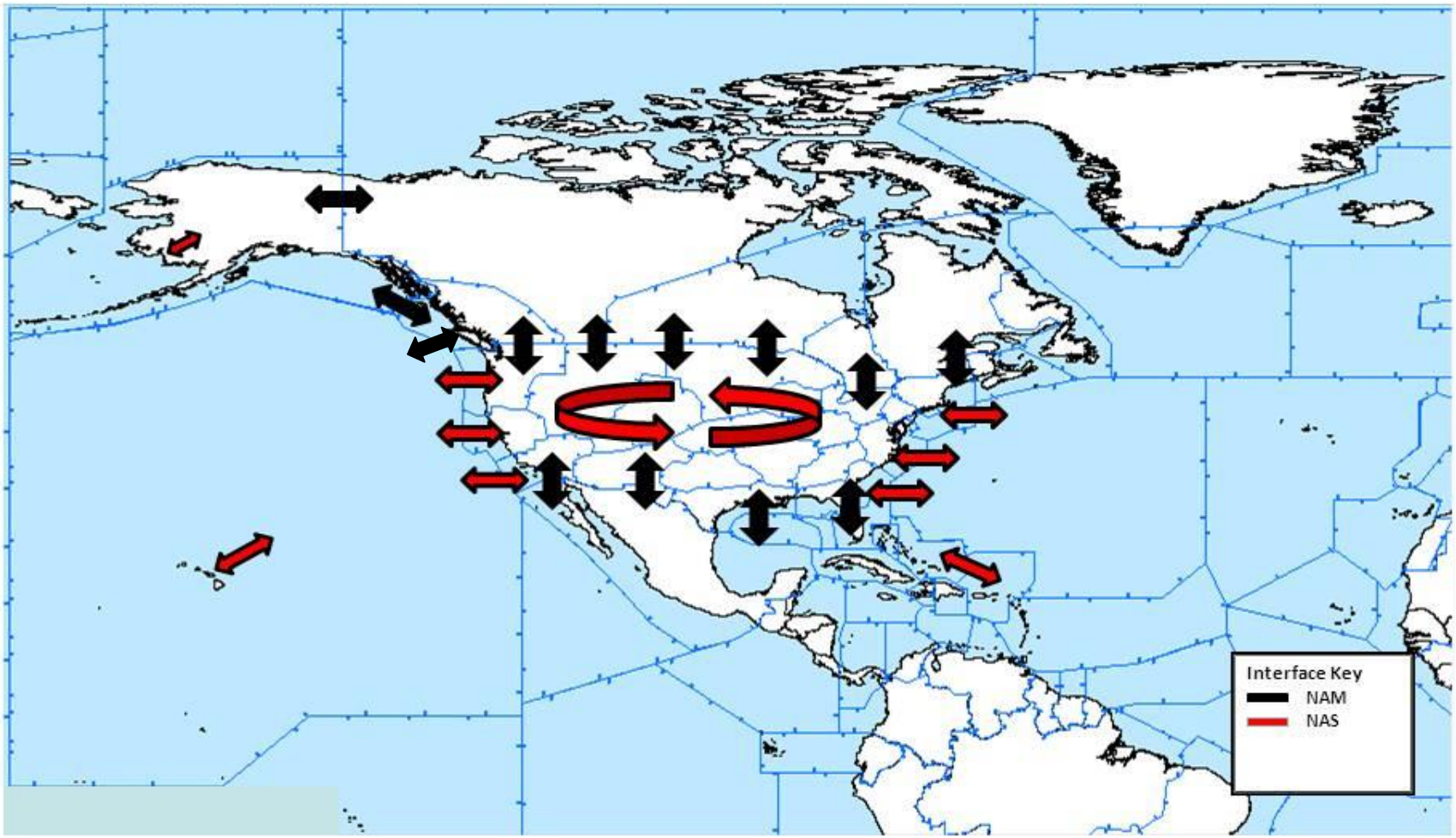
U.S - International Interfaces



Automation Infrastructure

- Air Traffic Service (ATS) Interfacility Data Communications (AIDC), North American Common Coordination Interface Control Document (NAM ICD) and the custom NAS protocols provide the means for automated data exchange both domestically and internationally.
  - AIDC PAN ICD
  - NAM NAM ICD
  - NAS US National Airspace System
- These three protocol sets utilize the contiguous automation infrastructure for ATS automated data exchange between adjacent FIRs.
- A communications and data interchange infrastructure significantly reduces the need for verbal coordination between Air Traffic Service Units (ATSUs) delivering more efficient and streamlined services.

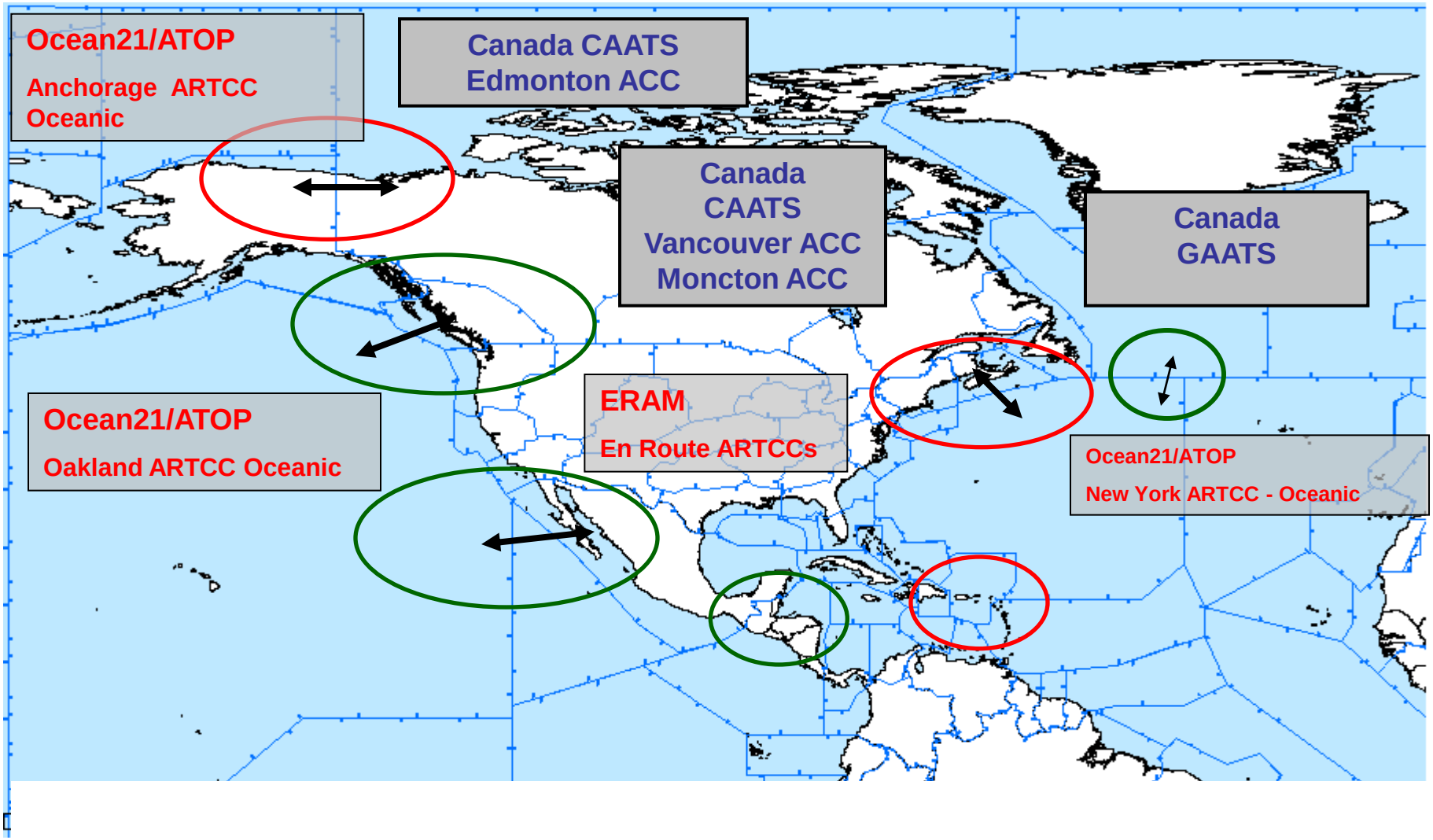
North American NAS/NAM Interfaces



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 - 2001
  - Focus on automated exchange of ICAO flight data with goal being ‘voiceless’ handoff between countries
- NAM ICD defines message formats for implementation of interfaces between automation systems:
  - U.S. & Canada 2009 / Vancouver – Oakland 2015
  - U.S. & Mexico 2008 /
  - Cuba added in Dec 2011
- Same standard used as guide for Caribbean flight data automation compatibility
  - International neighbors installing new systems look to maximize benefits of their automation investment
  - An AIDC Interface was implemented between Mazatlán – Oakland in 2015

Current Initiatives
En Route/Oceanic Systems



North American Interface Environment

- In most NAM environments, radar 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.
- The NAM ICD has defined automated radar handoff messaging definitions within the document as a goal of cross-border interoperability evolution.
- Full AIDC capability also supports extended equipment capabilities in time, altitude and distance based operations where different separation minima are being used in adjacent airspace.

Recent Successes

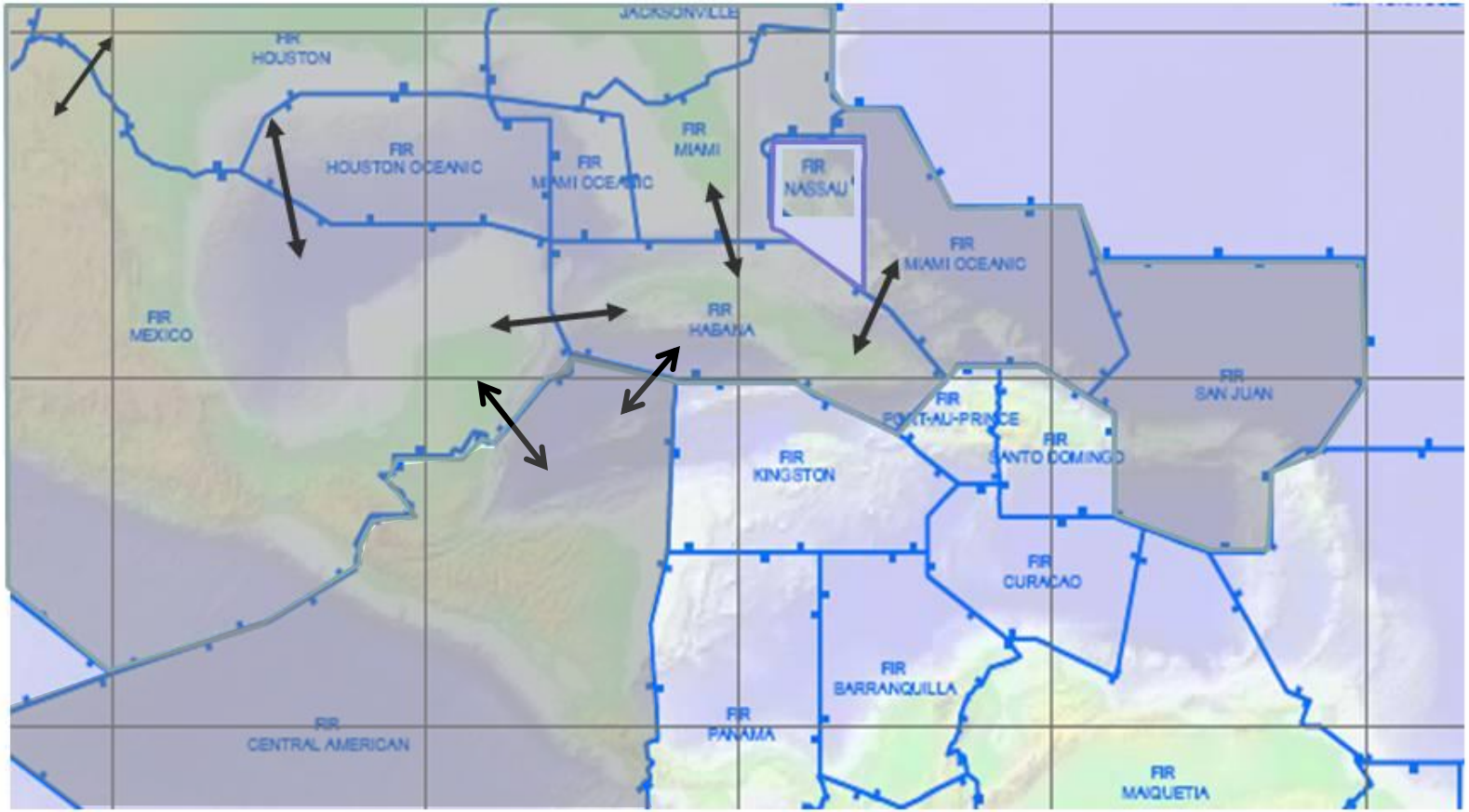
- In 2010 Havana ACC (MUFH) and Miami ARTCC (KZMA) agreed to pursue the NAM interface between the facilities.

Scoping the effort;

  - US – Mexico interfaces was offered as a model for the Cuba effort.
  - adjacent airspace was radar to radar operations and the NAM ICD protocol functionally supported that choice
  - the NAM protocol message sets were a scalable solution allowing the implementation of a basic Class I CPL-LAM interface initially with the ability to grow the capabilities to Class II and Class III handoff.
  - Cuba internally developed the software in accordance with the NAM ICD and was committed to providing the requisite effort and technical proficiency.
  - The interface was implemented in December 2011

- Using the implementation experience gained in the KZMA – MUFH interface, Mexico and Cuba were able to connect with a like interface between Merida – MUFH only one month later
- In 2015 *Honduras (COCESNA) implemented NAM interfaces to Havana, Cuba and Merida, Mexico Interface. These are* significant accomplishments and one which continues to have positive influence on the Caribbean and Central American Regions

North America – Caribbean
NAM ICD



Extending the US Automation Standard

- Compatibility management between existing/emerging international automation systems is essential to optimize capabilities & meet user needs
- U.S. centralized geographic position requires advocating that a position of compatibility is maintained
- The US is active in ICAO North American, Central American Caribbean (NACC) Region interface activities, and the FAA also participates in Caribbean & South American (CARSAM) ATC automation ICD development
- Near term interface/ enhanced interface activities with the U.S.
  - Dominican Republic
  - Bahamas
  - Cuba
  - Mexico
  - Canada

North American Common Interface Control Document (NAM ICD)

- Within the North American Aviation Trilateral (NAAT/5) Canada, Mexico, and US agreed to cooperate on development of a seamless interface between automation systems, focusing on automated exchange of ICAO flight data. Radar/surveillance operations is the key environment targeted by the NAM ICD protocol
  - NAM ICD was based on ICAO 4444, North Atlantic Common Coordination ICD and Pacific Common Coordination ICD
  - ICD outlines current and long-term guidelines for harmonized development of automation systems
  - ICD is designed as a living document that will be updated to reflect the needs of the member states

NACC Operational Environment

- In most NAM environments, radar/surveillance is the operational norm and procedural/non-surveillance the exception. In many traditional AIDC interfaces procedural/non-surveillance is more the norm and radar/surveillance 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.
- Both the NAM and traditional AIDC protocols support the **notification, coordination and the transfer of communications and control phases or functions** to different degrees between ATSUs.
- Full AIDC capability also supports extended equipment capabilities in time and distance based operations where different separation minima are being used in adjacent airspace. The NAM ICD has automated radar handoff messaging definitions within the document as a goal of cross-border interoperability evolution.

ICAO 4444 Coordination Environments
NAM ICD and AIDC

- ATC procedures vary significantly, depending on the surveillance capabilities of the coordinating ATS units in a given boundary environment. For the purpose of ICAO 4444 Appendix 6, the coordination environments are identified as **either surveillance or procedural**.
- In some instances the same type of message may require the inclusion of different or additional data to accommodate the demands of differing environments. Depending on the environment, the timing of the transmission of these messages may also vary. The environment may also affect whether the AIDC message is automatically processed, or displayed to the controller for manual processing.
- A **surveillance environment** is an environment where an ATS surveillance system is in use, and allows controllers to positively identify the traffic. Radar and/or ADS-B are available to the controllers at sector positions on both sides of a common boundary, and traffic is identified by information presented on a situation display. Such facilities permit surveillance coordination procedures to be used.
- A **procedural environment** exists in those areas where surveillance coordination procedures are not available because at least one of the coordinating ATS units does not have a surveillance capability, or the surveillance capabilities differ. For example, surveillance substitutes in oceanic and remote areas is often achieved with ADS-C, CPDLC or voice position reports; in such areas, coordination procedures differ from those used in a surveillance environment.

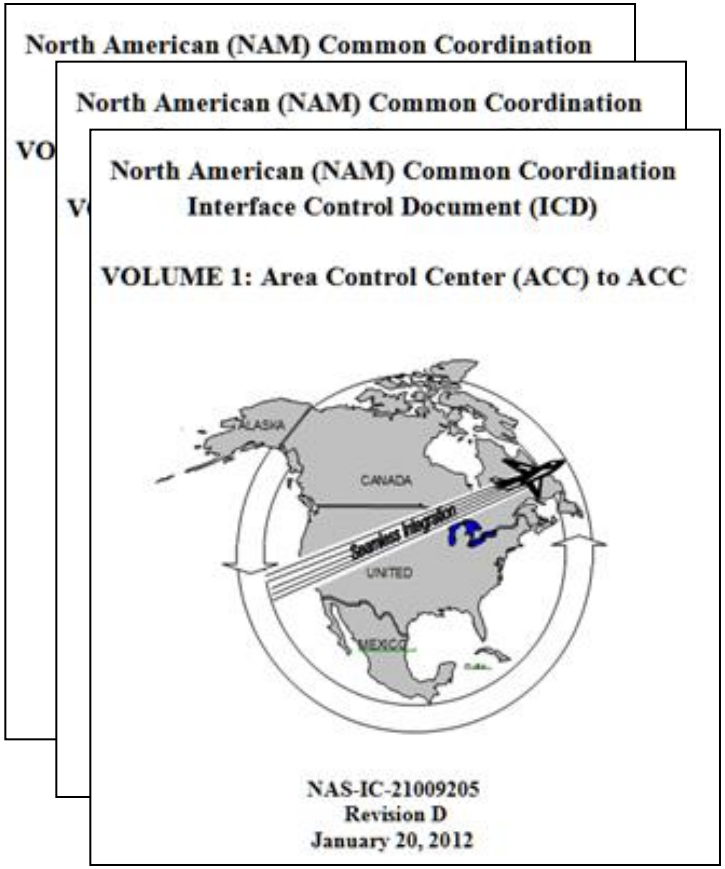
AIDC vs NAM and Automated Data Exchange

- AIDC functionality originally described in Asia Pacific and North Atlantic ICDs were consolidated into the PAN ICD in 2014
  - Provides the needed guidance for messaging, coordination and transfer to support non-radar functionality used in oceanic operations.
  - It can be confusing when these primarily domestic environments are referred to as AIDC which is a protocol itself
- The NAM ICD is currently used mostly in North American international-domestic operations and domestic/oceanic transition areas.
  - Many times operations do not fit neatly into one or the other category.
  - Many systems today will allow interface protocols to be tailored to a particular interface; NAM or AIDC.
- A full set of messages may not be needed to achieve automated flight data exchange for a particular interface.
  - Protocols which can support incremental levels of capabilities provides tremendous implementation flexibility; AIDC and NAM
  - Supports a reduced set of interface messages

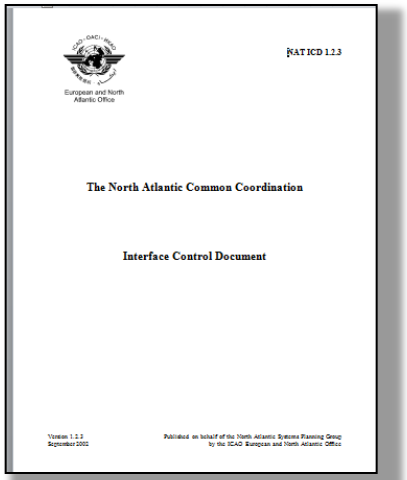
NAM ICD Evolved from 4444, AIDC ICDs

ICAO 4444 →

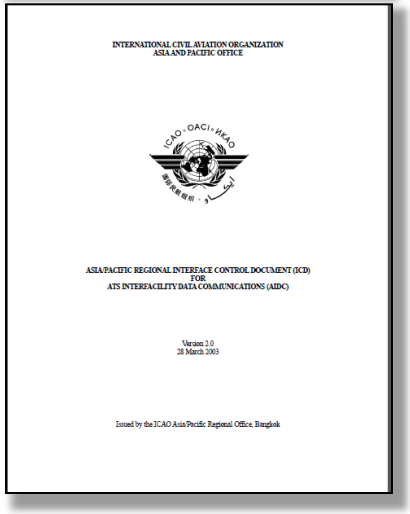
NAT & PAC AIDC ICDs →



Pan Regional (NAT and APAC) Interface Control Document for ATS Interfacility Data Communications (PAN AIDC ICD)



NAT ICD



PAC ICD

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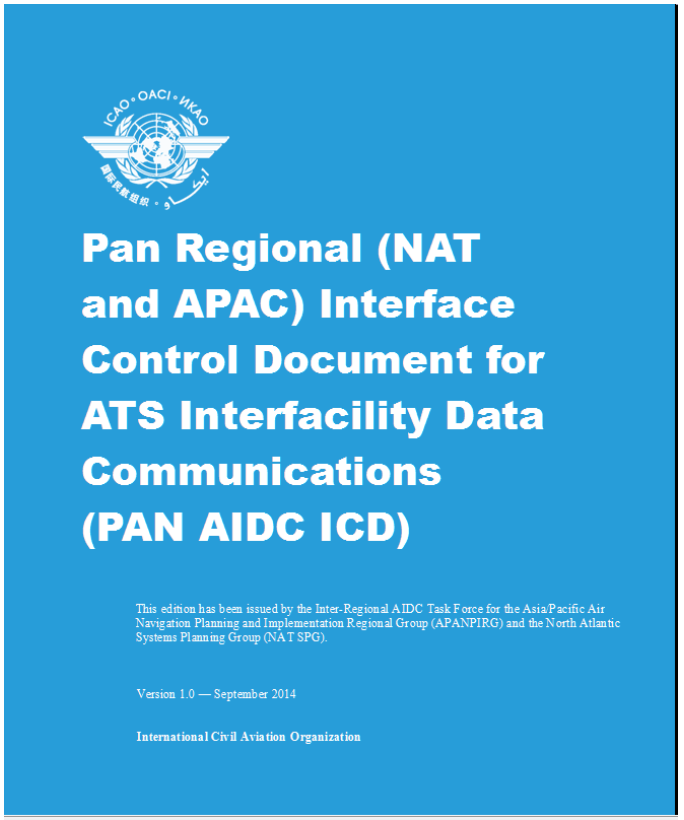
PAN ICD



NAM ICD Version 'E'
Overview

- **SURVEILANCE ENVIRONMENT -** The NAM ICD operational environment within North American, Central American and Caribbean area is primarily a surveillance environment. Existing interfaces are supported by NAM ICD automated data exchange operations within the NACC.
- While the **surveillance environment is the standard for NAM ICD operations**, it is also recognized that **procedural environments exist** between some Air Traffic Service Units (ATSU).
- Providing ATC units the ability for voiceless **radar handoff and radar point out** as well as message support for **procedural transfer of control** progresses the application's ability to apply standardized automation in both radar/surveillance and procedural environments.
  - This approach is consistent with the goal to reduce the need for verbal coordination per ICAO Doc 4444, Chapter 10, in Section 10.1.

North American (NAM) Common Coordination Interface Control Document (ICD) Revision E - 2015

- The NAM ICD Version ‘E’ document change addresses messages exchanged between Air Navigation Service Providers (ANSP) or Area Control Centers (ACCs) for IFR aircraft. Within the NAM ICD, ATC operations units forward from unit to unit, as the flight progresses, necessary flight plan and control information. NAM ICD usage supports the Notification, Coordination, Transfer of Control phases outlined within the ICAO Doc. 4444, Pan Regional Interface Control Document (PAN ICD) for ATS Interfacility Data Communications and (AIDC) ICAO Doc 9694-AN/955 Manual of Air Traffic Services Data Link Applications.

- **The NAM ICD Version ‘E’ (NAM ICD-E) update does not change the automated data exchange conventions for any existing operational interface. Existing NAM ICD member states do not have to implement any changes in support of NAM ICD-E.**

NAM ICD Version ‘E’
Changes

- **Changes, activations and corrections which will make up the NAM ICD-E activities include:**
- Radar Handoff messaging and Interface Management Support
  - US – Canada to Initiate Radar Handoff/Point Out messaging development to support existing domestic interfaces
  - US – Canada Boundary Agreement will reflect Handoff implementation specifics
- Radar Point Out messages added as Class 3 capability
  - Point Out – Basic Added/Identified for Implementation
  - Point Out – Enhanced , Added for Future Implementation
- Supplemental Messages ABI, TOC/AOC messages defined

Lessons Learned

- When analysing a proposed interface, the operational environment should always be examined when formulating the strategy for the project. Additionally. the following factors are among those which should be considered:
  - A determination is needed of which system protocols are already being used in bordering FIR interfaces or what protocols adjacent systems are capable of supporting.
    - If a significant systems investment is required by a potential interface partner in support of a unique adjacent interface, the effort may never happen. It is very important that achievable automation decisions be made
  - Analysis of FIR operation is needed; surveillance to surveillance interface, a non-surveillance to non-surveillance interface should be examined.
  - To provide the most effective automation between FIRs, operational environment should be matched with the proper automation protocol for a successful interface.
  - System needs coupled with current and new system capabilities/limitations should also be factored into the interface protocol decision.
  - Phased protocols allow increased development of messaging capabilities as states/facilities develop expertise in what is best for their operation with adjacent states/facilities

Lessons Learned (continued)

- Additionally, the FAA believes that partnering with an adjacent facility who already has operational interfaces using the same protocol NAM or AIDC can also lead to a successful, timely implementation. In the absence of FIR–FIR interface experience, regional expertise should be used.

- The system vendor should be on the same page programmatically with the local site to ensure the state and regional goals are being properly planned

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 with our En Route and Oceanic systems extends our collective 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. Substantial progress has been made between the US and NACC neighbor countries but more can be done to increase automation compatibility and efficiency . Both the NAM ICD and the PAN ICD extends the region's interface capabilities.

- Harmonization supports safety objectives through standardization and promotes economic efficiencies. A network of harmonized ATC systems cannot be built without developing partnerships with our international neighbors.