

# NAV CANADA

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## Data Link equipage and usage within NAV CANADA

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## Outline

### Data Link

- What is Data Link?
- Data Link equipage and usage in NAV CANADA
- Data Link Performance



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## What is Data link?



## Data Link Infrastructure

### Complicated network of:

- Avionic equipment
- Aircraft Communications Addressing and Reporting System (ACARS) network
- digital VHF and HF ground stations and satellites
- Communication Service Providers
- ATS units flight data processing equipment





## Data Link Benefits

- Flight crew requests and controller instructions transmitted and processed more quickly.
- Reduces congestion and reliance on HF radio channels – Remote and Oceanic areas
- Reduces congestion on VHF by moving routine transmissions to CPDLC – Continental areas
- Allows automated monitoring and alerting of aircraft position and conformance to clearance
- Reduction of read back/ hear back errors
- Support for procedural separation standards.



## Communication Service Providers

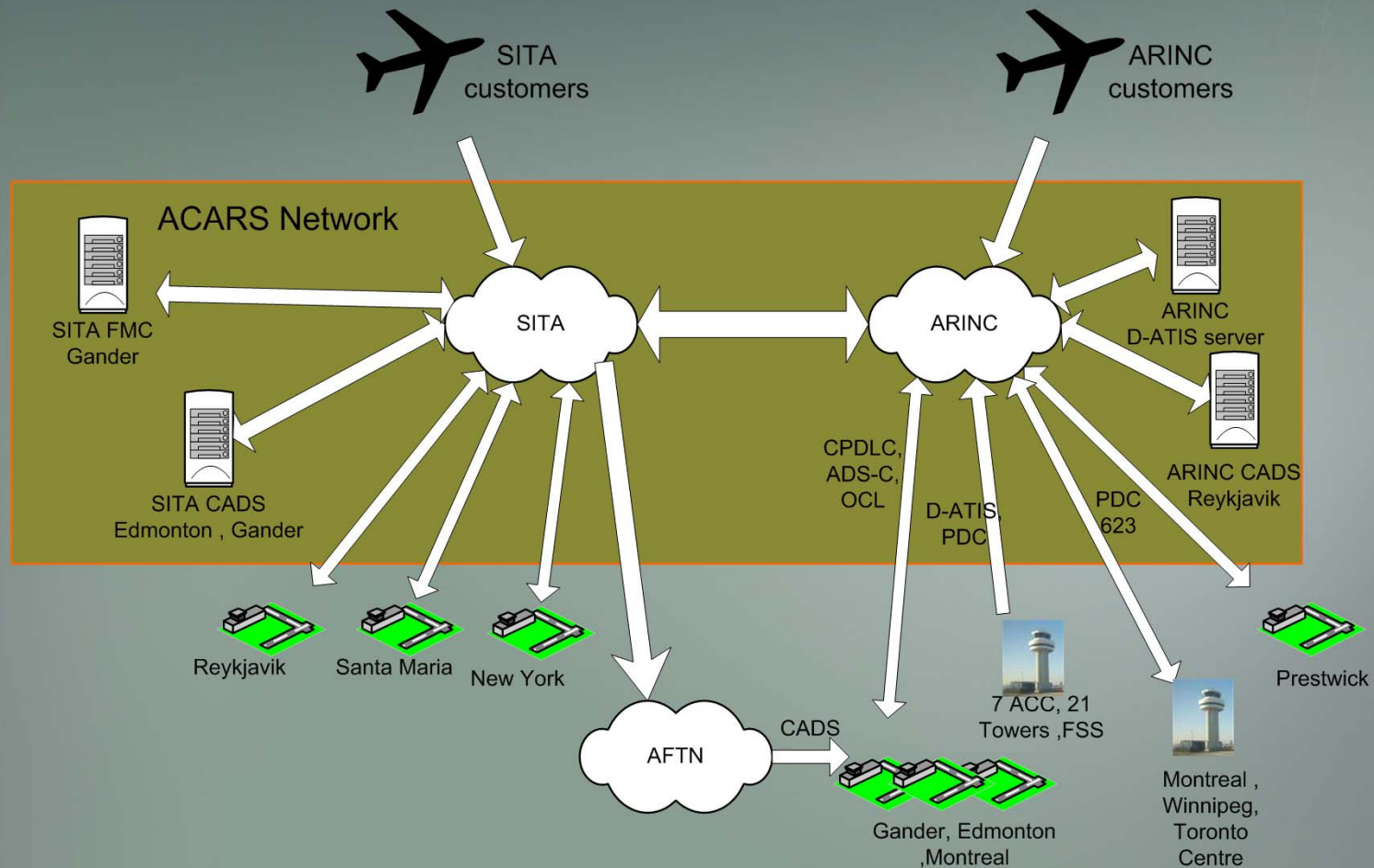
- ARINC and SITA have an inter-network agreement to route data link messages between each other.
- This agreement allows :
  - ATS unit or Airline to signup with either ARINC or SITA
  - Transparency of message routing to customer




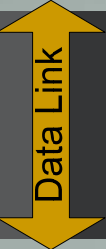

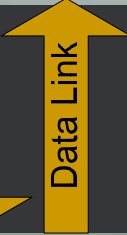
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## Network



## Type of messages

|   |  |                              |
|---|--|------------------------------|
| CPDLC – Controller Pilot Data Link<br>ADS-C – Automatic Dependent Surveillance<br>AFN – ATS Facility Notification Message             |   | FANS1/A<br>219<br>745<br>622 |
| VOICELESS :<br>OCL – Oceanic Clearances<br>PDC – Pre-departure clearances<br>D-ATIS – Auto. Terminal Information system               |    | 623                          |
| Voice Requests or “unsolicited”:<br>OCL – Oceanic Clearances<br>PDC – Pre-departure clearances<br>D-ATIS – Auto. Terminal Information | <br> | 620                          |



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## AFN Logon

- Flights entering a FANS service area from airspace where no FANS 1/A ATS data link services are being received should perform an AFN logon:
  - a) 15 to 45 minutes prior to entering the airspace; or
  - b) prior to departure if departing airports are adjacent to, or underlying, the airspace.
- A CPDLC connection is then initiated by the ground system in response to the AFN logon received from the aircraft.
  - It is important, when initializing the flight management computer (FMC), to ensure that aircraft identification matches the identification displayed in the filed ATC flight plan message.
- These messages are sent before entering and exiting the ATS unit and are defined in ARINC 622
- Flights transiting data link service areas should not need to perform another AFN logon. Under normal circumstances, the current and next ATS units automatically transfer CPDLC and Automated Dependent Surveillance–Contract (ADS-C) services. The transfer is seamless to the flight crew.

### Major messages

FN\_CAD – AFN Contact advisory  
FN\_CON- AFN Contact  
FN\_RESP –AFN response  
FN\_AK – AFN acknowledgement  
FN\_COMP- AFN complete

# CPDLC Visual Demonstration



AFN contact

AFN Response

AFN complete

Connect Confirm

Disconnect request

CPDLC messages

End service

Next Data Authority

AFN Contact advisory

CPDLC messages

Connect Request



ATS Unit1- Reykjavik

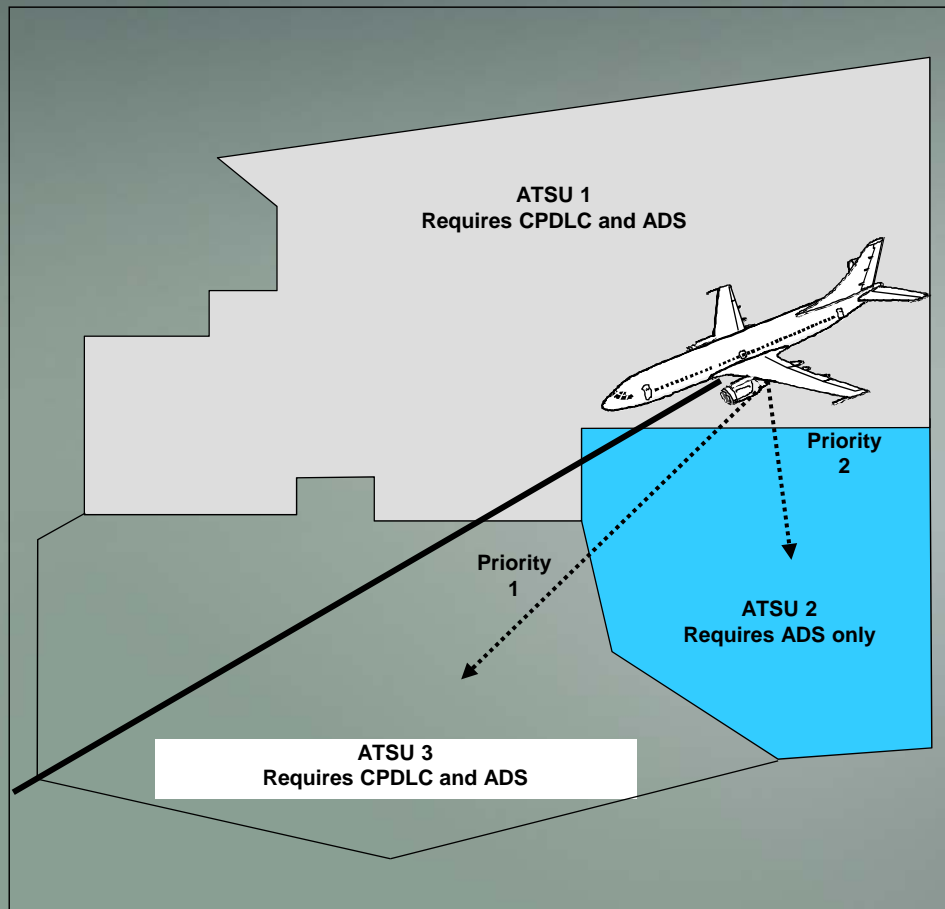


ATS Unit 2- Gander

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## CPDLC and ADS



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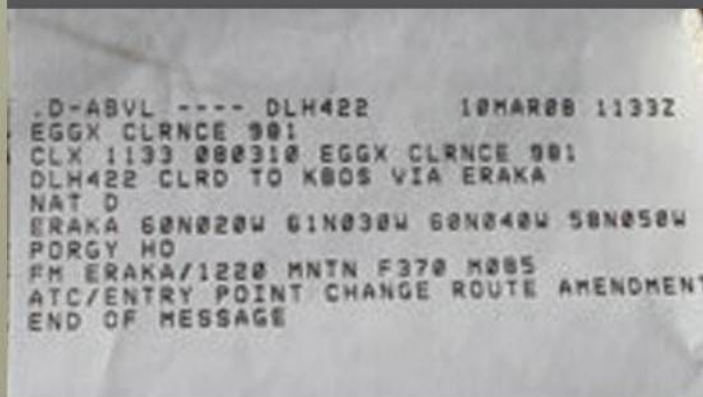
## In the Cockpit

### FANS1/A



623

620





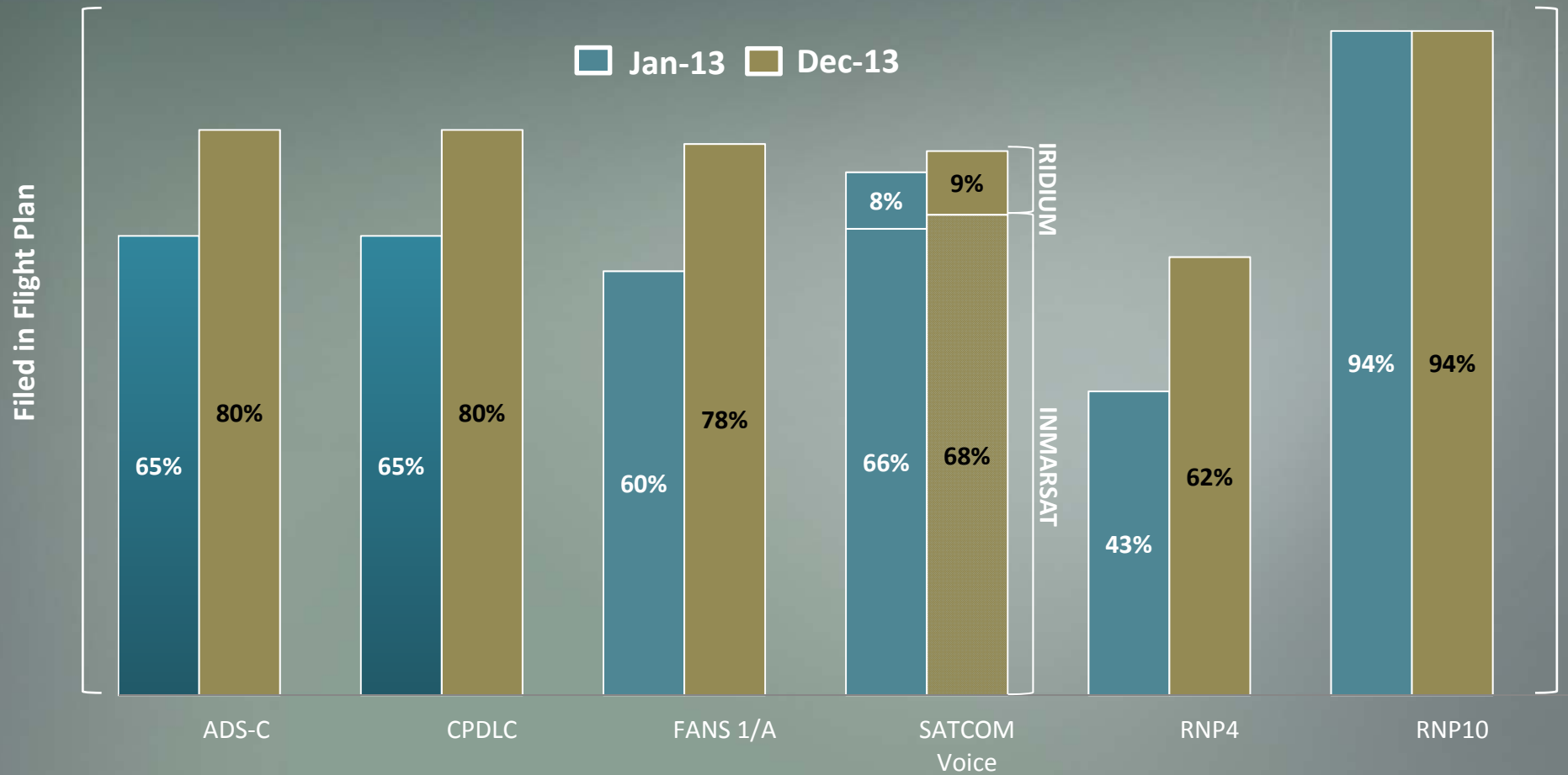
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## Data link in NAV CANADA?

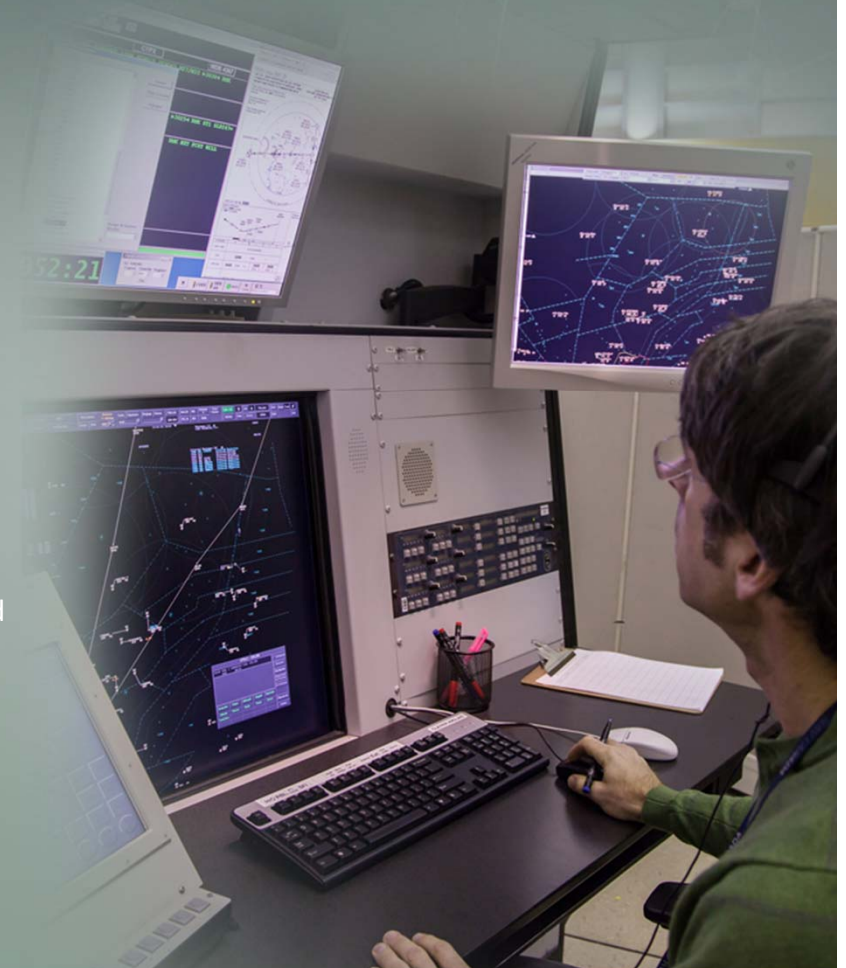


## Oceanic Equipage by Flights



## Data Link in Canadian Domestic Airspace

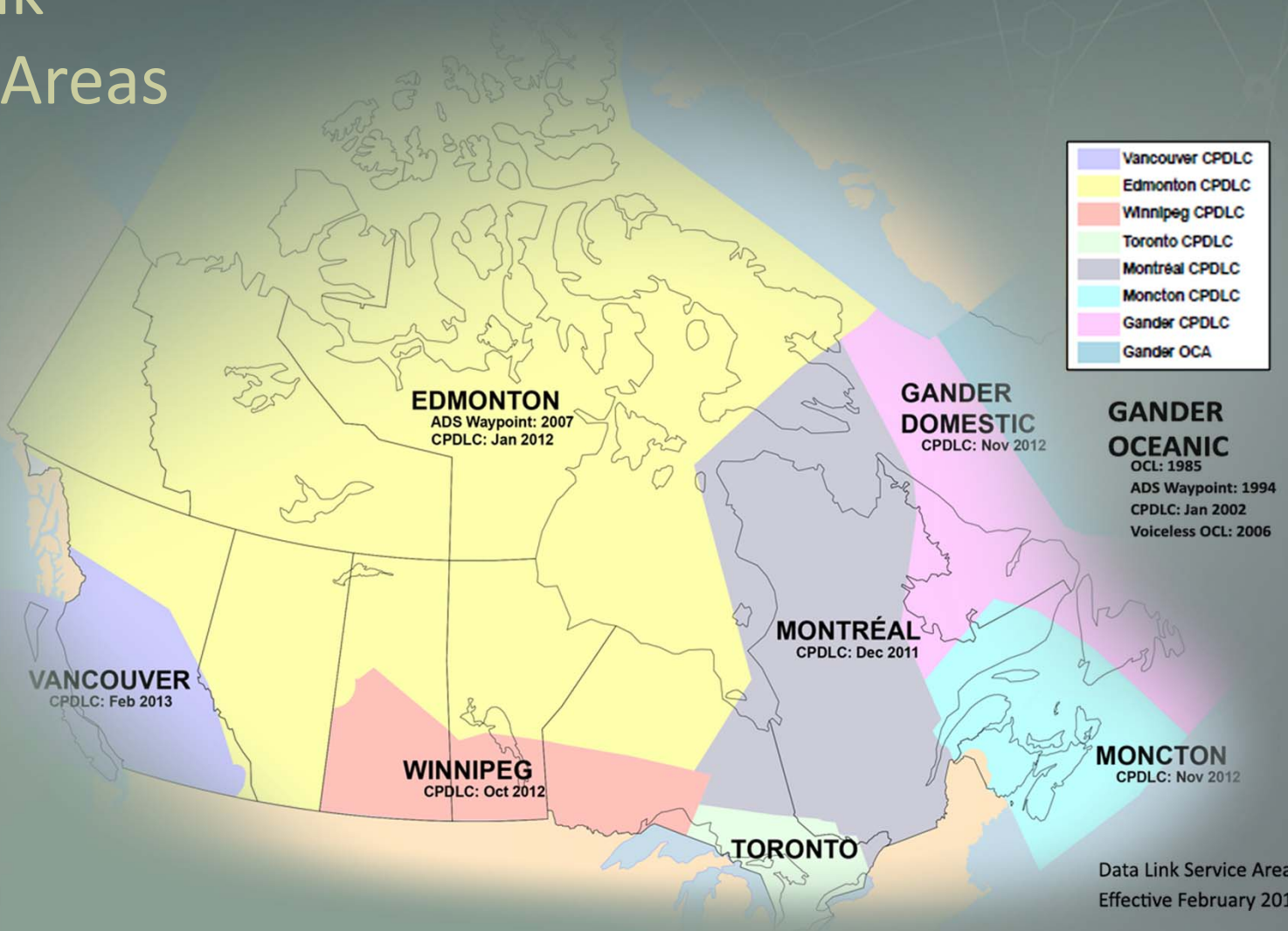
- Current FIR Implementation Status
- CPDLC
  - Montreal, Moncton, Edmonton and Gander Domestic, Winnipeg, Vancouver in CPDLC Phase 3
  - Toronto commenced Phases 1 & 2 April, 2014
- ADS-C
  - Vancouver and Edmonton planned for 3<sup>rd</sup> Quarter of 2014
  - Montreal planned of 4<sup>th</sup> Quarter 2014



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## Data Link Service Areas





## CPDLC



- CPDLC provides direct controller pilot communications (DCPC) using data link instead of voice.
- Services include clearances, requests, reports, and related ATC information.
- Predefined uplink and downlink messages are sent while aircraft is within the control area of the ATS Unit.
- Free text capability is also provided to exchange information not conforming to defined formats.
  - Free text is used for functions or situations where an appropriate predefined message does not exist
  - Free text messages can be preformatted (preferred) or involve manual typing (discouraged)
- Message and protocol defined in ARINC 219

## Canadian Domestic Equipage - December 2013

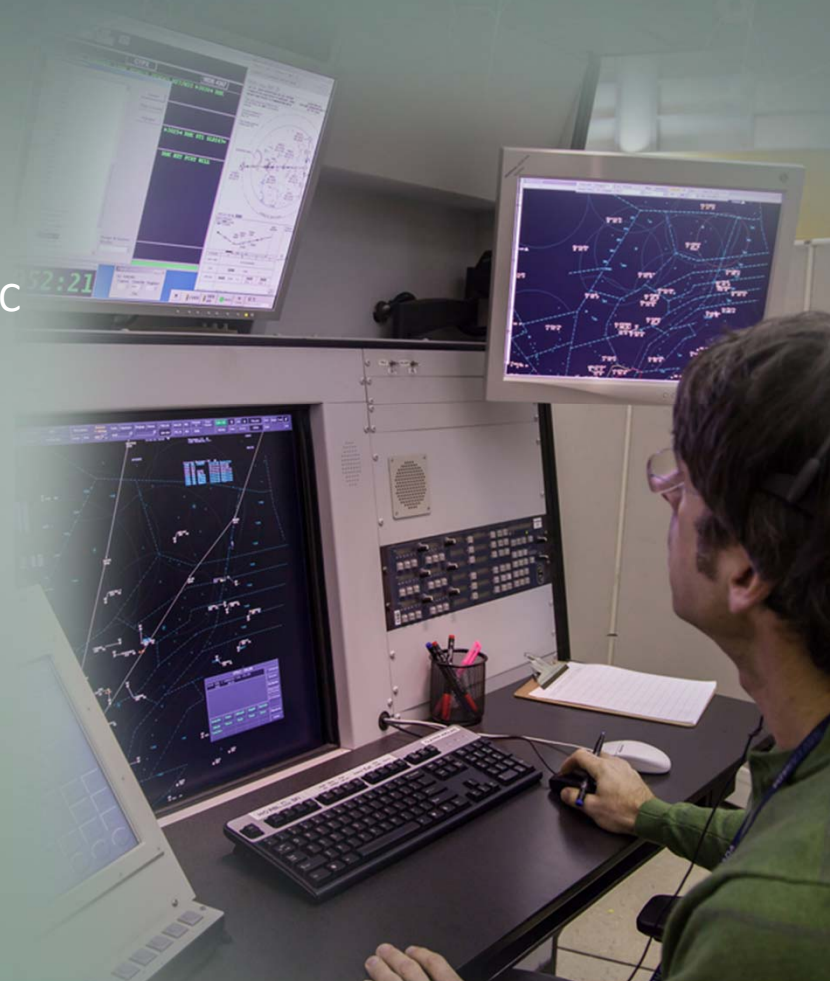
Percentage of High-Level IFR flights that were CPDLC (FANS) capable:

- **79%** of Gander Domestic
- **68%** of Moncton
- **51%** of Montréal
- **28%** of Winnipeg
- **27%** of Edmonton
- **29%** of Vancouver



## CPDLC Phased Implementation

- **Phase 1 – Basic Request Phase**
- This initial phase will enable an aircraft to make various speed and altitude requests using CPDLC.
- The response from the ACC ground system will be a free text acknowledgement that the request had been received and that a response from air traffic control (ATC) will be provided by the appropriate ACC via voice.
- **Phase 2 – Advising Domestic Frequencies**
- This phase introduces the assignment of domestic contact frequencies via CPDLC. Analysis of voice traffic indicates that such messages represent a significant proportion of existing voice traffic, and using CPDLC to carry out this function would be a useful contribution to reducing voice congestion.



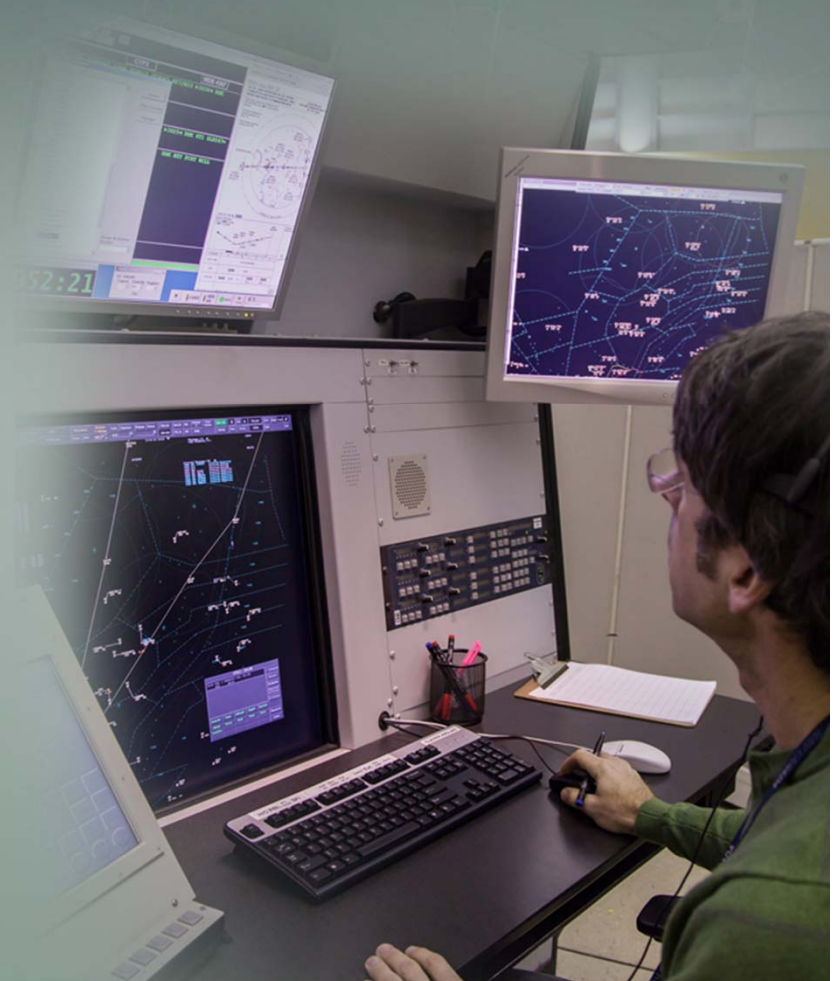


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## CPDLC Phased Implementation

- **Phase 3 – Support En Route Altitude Changes and Speed Changes**
- Enables aircraft requests for en route altitude changes, speed changes and to report Leaving/Reaching Levels via CPDLC.
- Responses to these requests from the ACC will also be via CPDLC.
- **Phase 4 – Full Implementation**
- With the exception of those messages deemed unsafe by ICAO, specified downlink elements will be supported. Domestic ACCs will develop appropriate procedures to respond to all received downlink message elements.





## Top 5 Pilot Requests

### Oceanic

- DM9 – request climb to level
- DM6 –request level
- DM9 DM66 – request climb to level due to aircraft performance
- DM67 - free text
- DM9 DM65 request climb to level due to weather

### Domestic

- DM9 – request climb to level
- DM 67 - free text
- DM9 DM66 – request climb to level due to aircraft performance
- DM6 –request level
- DM8 – request cruise climb to level

## Top 5 Controller Instructions

### Oceanic

- UM119 – at time contact unit frequency
- UM27 UM129 – climb to reach report level
- UM27 UM129 UM169 – climb to reach by position report level at position free text
- UM111 increase speed to
- UM113 reduce speed to

### Domestic

- UM 117 – contact unit frequency
- UM 120 – monitor unit frequency
- UM 20 UM129 climb to and maintain level report level
- UM123 – Squawk code
- UM 074 UM 169 proceed direct to free text

## Looking Forward

Systems updates to provide better services include:

- Continued expansion of CPDLC services throughout Canadian Domestic FIRs
- ADS-C capabilities for Edmonton North and Vancouver Pacific Airspace
- Data Link Mandate on an increasing number of tracks in the NAT Region
- Separation reductions such as RLatSM
- Tower Data Link capabilities
- Better sharing of information between onboard and ATM Systems
- ATN on commercial systems



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## Data Performance





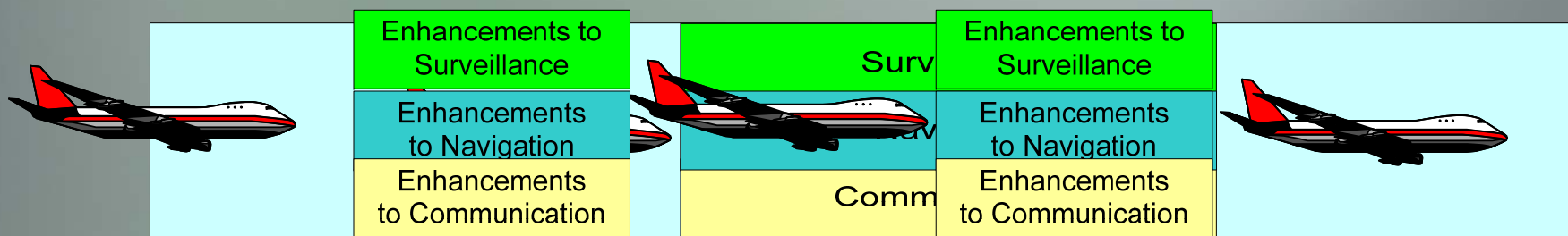
## Focusing on Data Link Performance

- Clear and efficient communication improves safety, allows separation reductions and results in better service for our customers.



## Separation Reductions in Procedural Environments

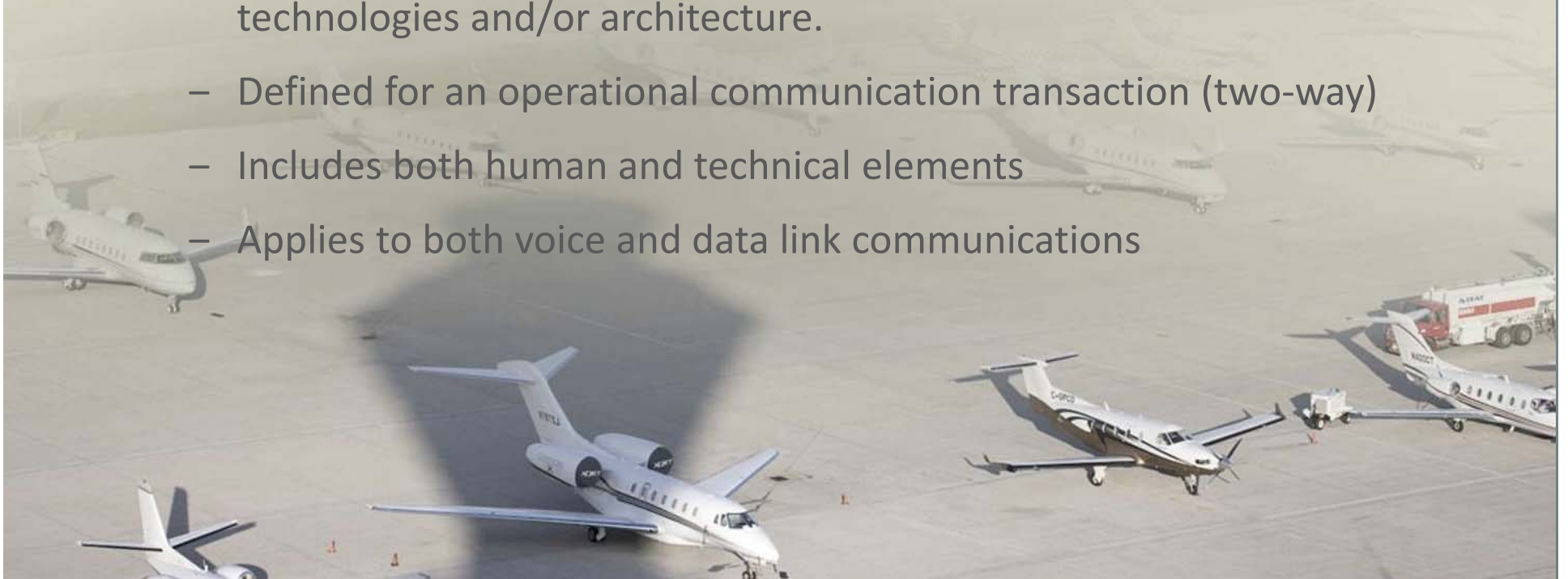
- Enabled through improved Communication, Navigation and Surveillance capabilities
- Increases flexibility - leading to efficient use of airspace, cost savings for our customers and smaller environmental footprint



## Required Communication Performance (RCP)

**A statement of communication performance necessary for a particular operation or service.**

- Operationally derived and not based on any specific techniques, technologies and/or architecture.
- Defined for an operational communication transaction (two-way)
- Includes both human and technical elements
- Applies to both voice and data link communications



## Guidance Publications For RCP and RSP

- ICAO Doc 4444 and ICAO Annexes 2,6,10, and 11
- Global Operational Data Link Document (GOLD) 2<sup>nd</sup> Edition, April 2013
  - Derived from these documents
    - RTCA DO-306 Safety and Performance Standard for Air Traffic Data Link Services in Oceanic and Remote Airspace (Oceanic SPR Standard), 11 October 2007
    - ICAO Document 9869, Manual on Required Communication Performance, First Edition, 2008





## GOLD / RTCA DO-306

The RCP concept provides a means to ensure the acceptable performance of communication within a complete Air Traffic Management system.

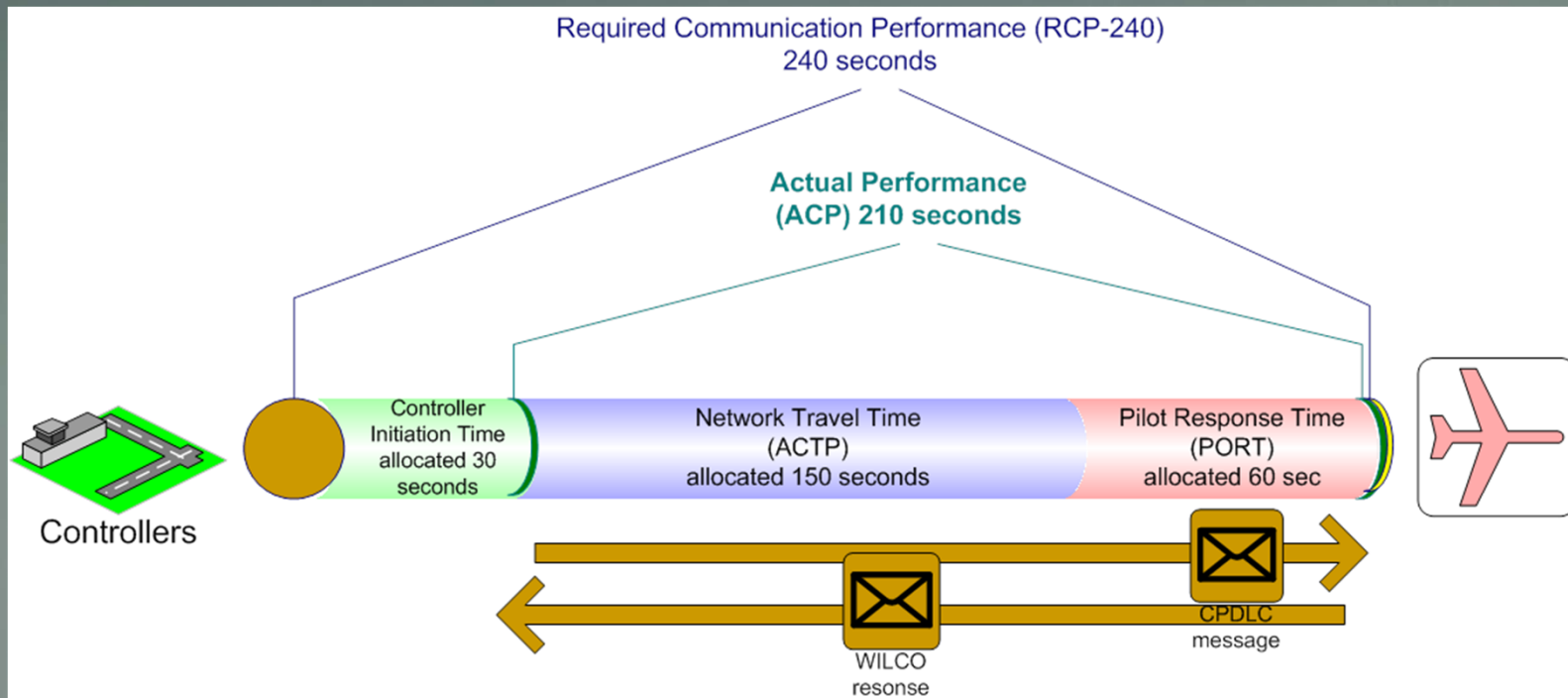
| RCP Specifications | Intended uses for which RCP specification is applicable  |
|--------------------|--|
| RCP 400            | <ul style="list-style-type: none"> <li>- Technology other than HF voice radio is normal means of communications</li> <li>-- <u>Lateral separation <math>\geq</math> 50 NM</u></li> <li>-- <u>Time-based longitudinal separation (10 min or greater)</u></li> </ul> |
|                    | <ul style="list-style-type: none"> <li>- Technology other than HF voice radio is alternative means of communications</li> <li>-- Lateral separation = 30 NM lateral</li> <li>-- Reduced longitudinal separation minima</li> </ul>                                  |
| RCP 240            | <ul style="list-style-type: none"> <li>- CPDLC is the primary means of communications</li> <li>-- Lateral separation = 30 NM</li> <li>-- Reduced longitudinal separation minima</li> </ul>   |

## GOLD – RCP Metrics and Benchmarks

- The GOLD defines the calculations for the CPDLC bilateral communication performance measurements; namely Actual Communication Performance (ACP), Actual Communication Technical Performance (ACTP) and Pilot Response Time (PORT) and the RCP 240 benchmarks at the 95% and 99.9% targets.
- Using the GOLD definitions, the RCP 240 benchmarks for CPDLC bilateral communication are :
  - 95% must be completed within 180 seconds.
  - 99.9% must be completed within 210 seconds.



## RCP240 For CPDLC



To Meet the 99.9% RCP Standard - 999 out of 1000 messages must be delivered and have a reply received (ACP) within 210 seconds

To Meet the 95% RCP Standard - 950 out of 1000 messages must be delivered and have a reply received (ACP) within 180 second

## Factors Affecting Pilot Reaction Time

### Human Machine Interface

- Alerting system in the aircraft: sound or visual; uniqueness
- Number of: screens; button presses
- Data entry





## Factors Affecting Pilot Reaction Time

### Pilot Procedures

- Must dispatch be consulted?
- Verification of aircraft capability
- Entry of data before WILCO

### Complexity and Clarity of Instruction

- Clarity of the message and display of message in cockpit



## Aircraft Sending Priority for Messages

Aircraft will send messages on VHF first, then SATCOM then HFDL (if available).

1



2



3



## Factors Affecting Network Time

### VHF/SATCOM data link transition areas

- VHF/SATCOM data link transition areas
- VHF retries in non-VHF areas
- Internetworking of service providers and “find aircraft” algorithms
- Gaps in coverage area

### Network Congestion

- Priority and queuing in avionics
- Airline company messages (AOC) to and from the aircraft
- Repetition of messages



## Improving Performance

- Clarify, standardize and prioritize CPDLC messages for timely WILCO responses
- Reduce/eliminate VHF retries in limited or non-VHF areas
- Improve network traffic, distribution and performance
- Improve inter-networking between aircraft, satellite providers, service providers, and ATS units





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Thank you