ICAO South American Region Data Link Applications Workshop

10-12 September, 2012

ARINC

DEDICATION BEYOND EXPECTATION








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ARINC is a portfolio company of The Carlyle Group.

History of ARINC

- Incorporated in 1929
- Served as the airline industry's single licensee and coordinator of radio communication
- Responsible for all ground-based, aeronautical radio stations and compliance with FRC rules and regulations
- Originally owned by airlines
- Revenue of $1 billion USD, with more than 3,000 employees worldwide
- Customers in over 102 countries
- Employees in 143 locations

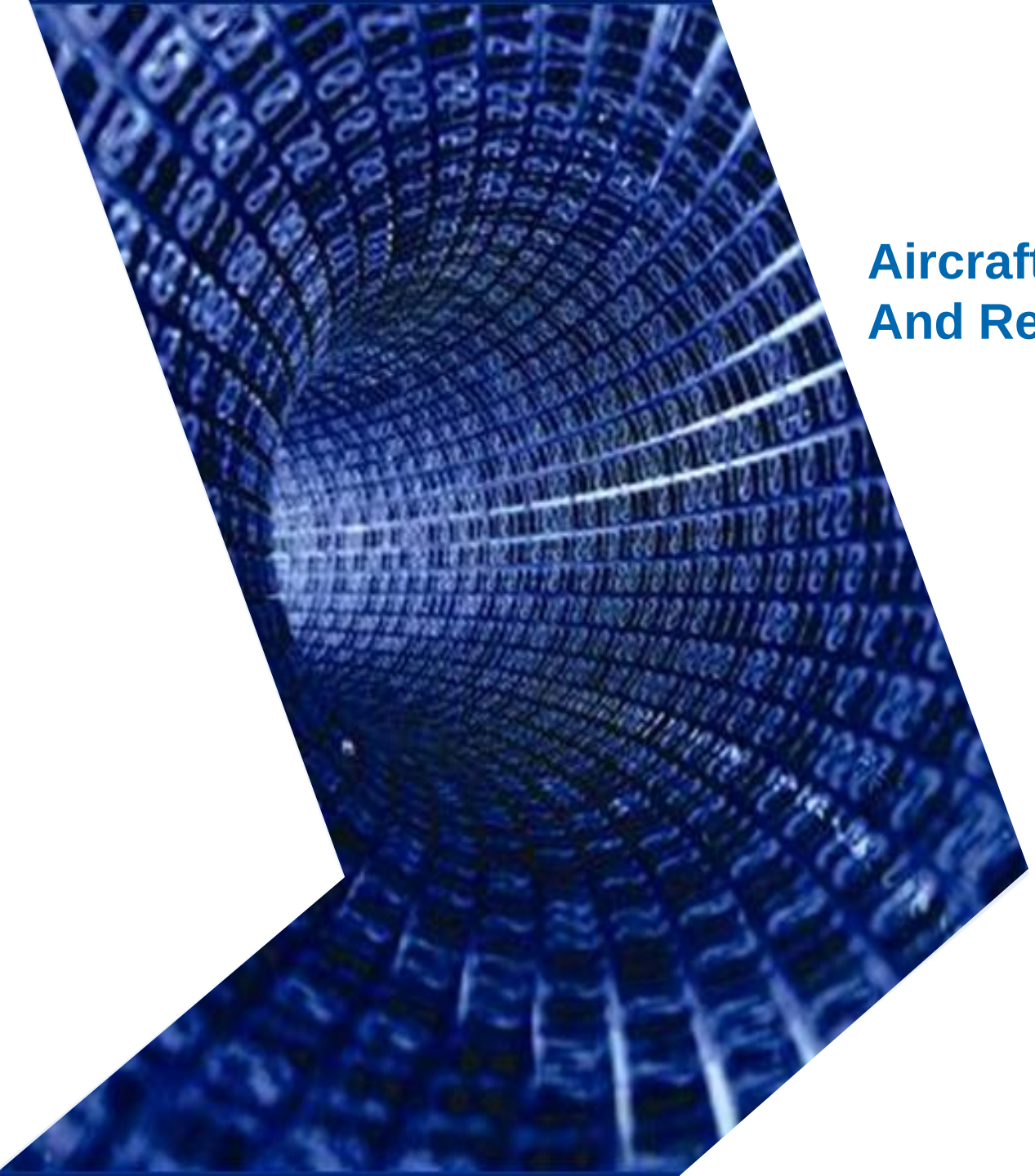
Worldwide Products & Services

- Aerospace & Defense
- Commercial Aviation
- Airports
- Networks
- Public Safety
- Security
- Transportation
- Video en Español: Aviación y Aeropuertos - Panorama Global

Mission-critical solutions for Communications, Engineering and Systems Integration

AGENDA

- GLOBALink Media and Coverage
- Applications
- Central and South American Trails and Implementation



Aircraft Communications And Reporting System

ACARS

GLOBALink/VHF Statistics: In the beginning…

- 1978: ARINC began offering ACARS Service in the USA
- Two Customers: TWA and Piedmont Airlines
- Primary Application: OOOI Messages
- Media: VHF for domestic coverage
- Data Rate: 2400 bps

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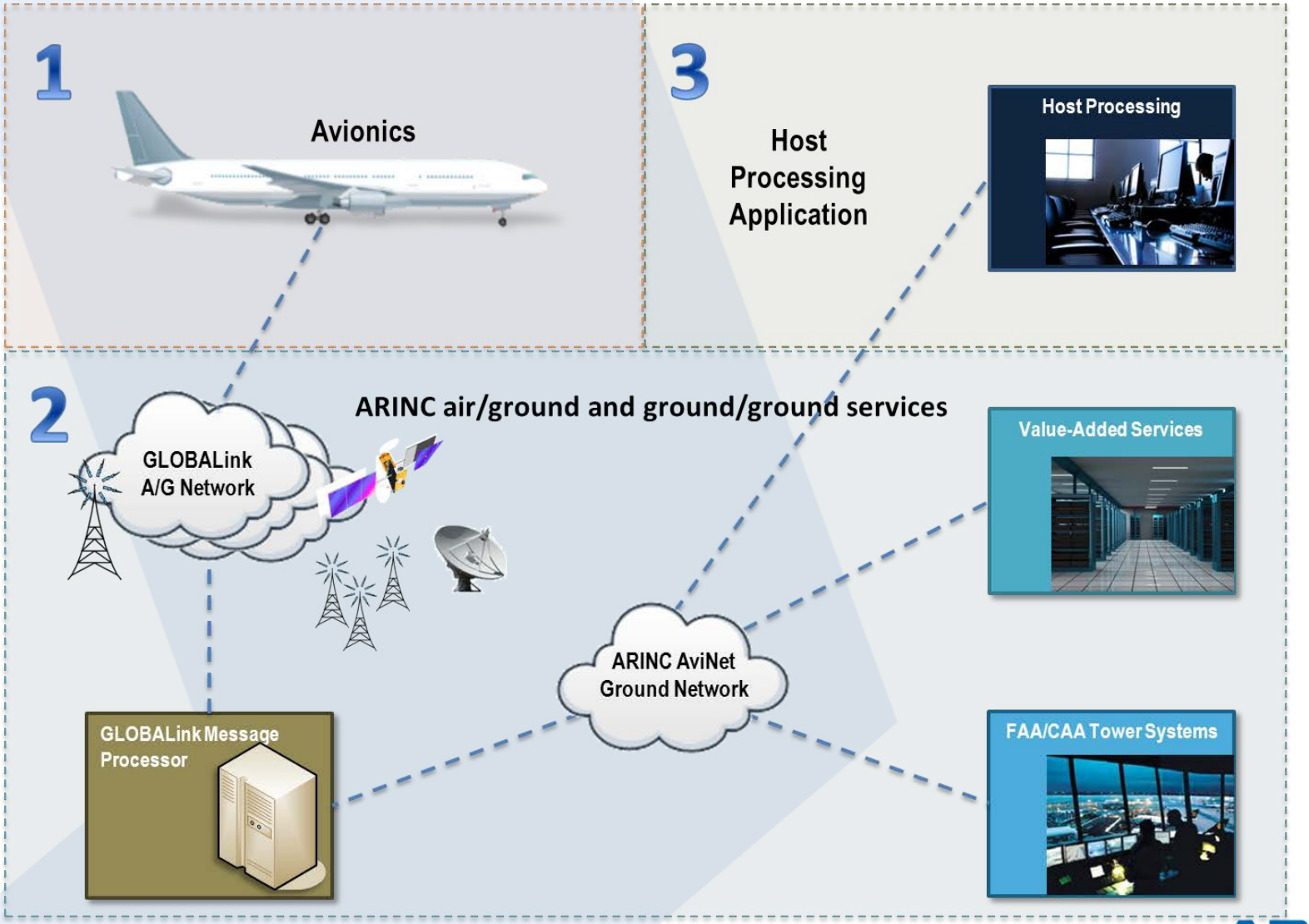
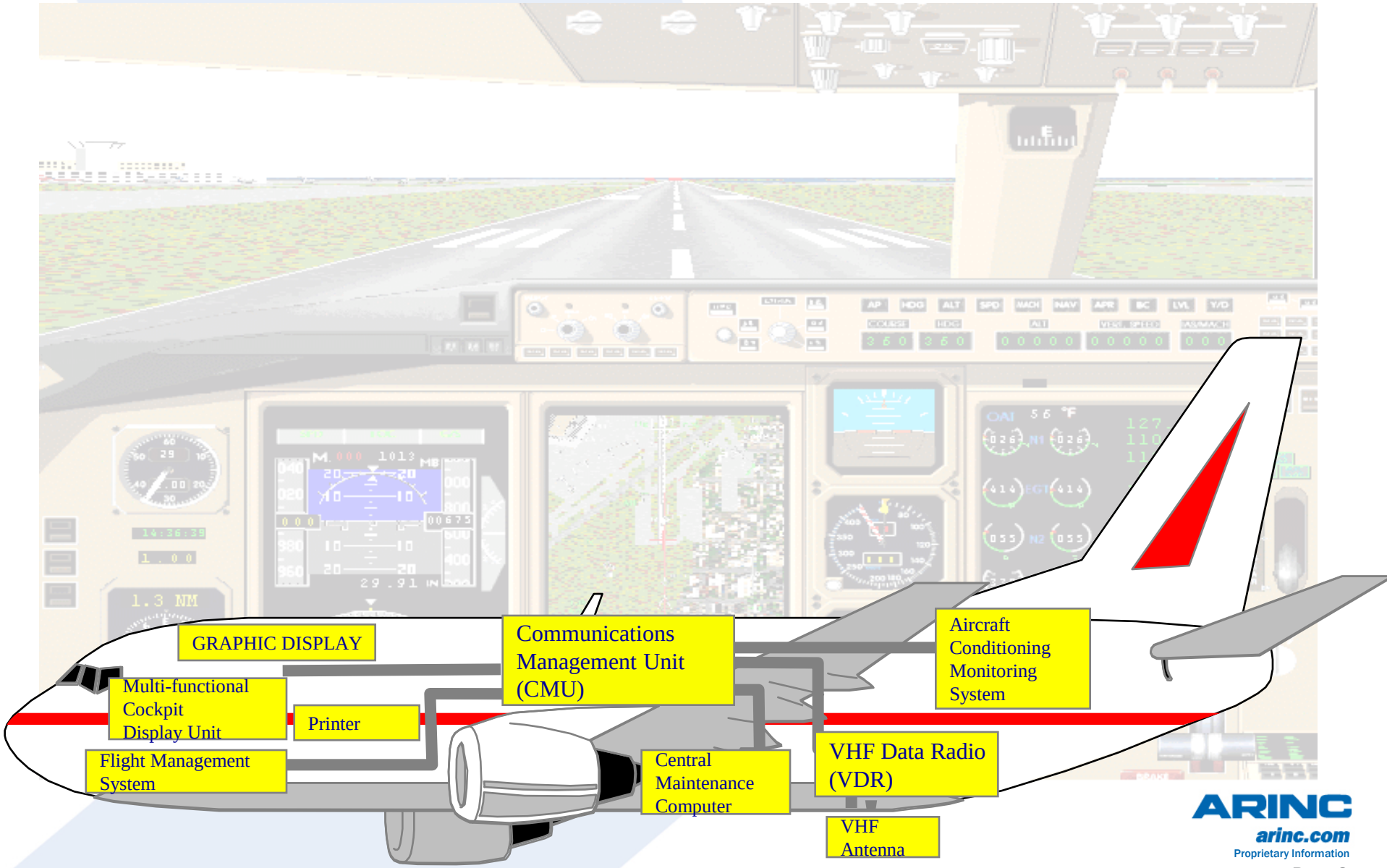
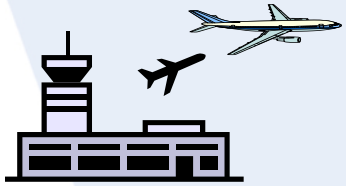
What's Needed to do Data Link?



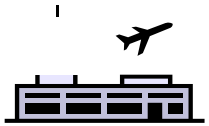
ACARS Airborne Architecture



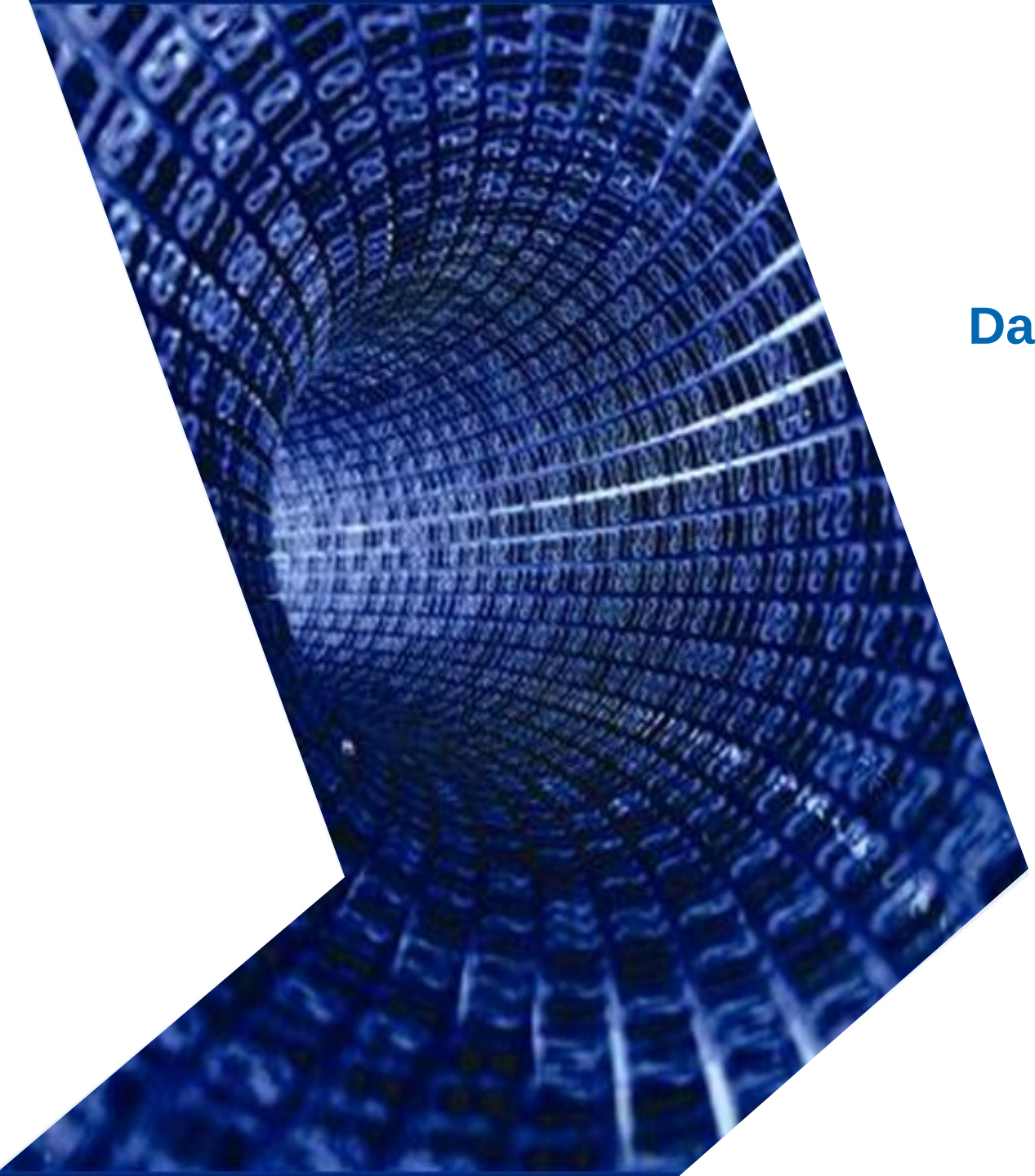
Data Link Uses During Phases of Flight



- Pre-flight to take-off
  - Data link initialization
  - Link test / clock update
  - Flight plan
  - Weight & balance
  - Airport / runway analysis
  - Enroute weather
  - Load manifest
  - Crew information
  - PDC
  - Departure D-ATIS
  - OUT
  - Delay report
  - OFF
  - Fuel on board
  - Take-off engine data
  - Free-text messages from dispatch, maintenance, etc…
- Enroute
  - APU and engine operational data
  - ATC services (OCD,CPDLC, FANS)
  - Position reports
  - Arrival D-ATIS
  - Enroute weather / winds
  - Delay / ETA
  - Amended releases
  - Irregular operations messages (diversion, emergency situation)
  - Special requests, gate assignment, connecting gate info for passengers and crew
  - SELCAL
  - Free-text messages from dispatch, maintenance, etc…



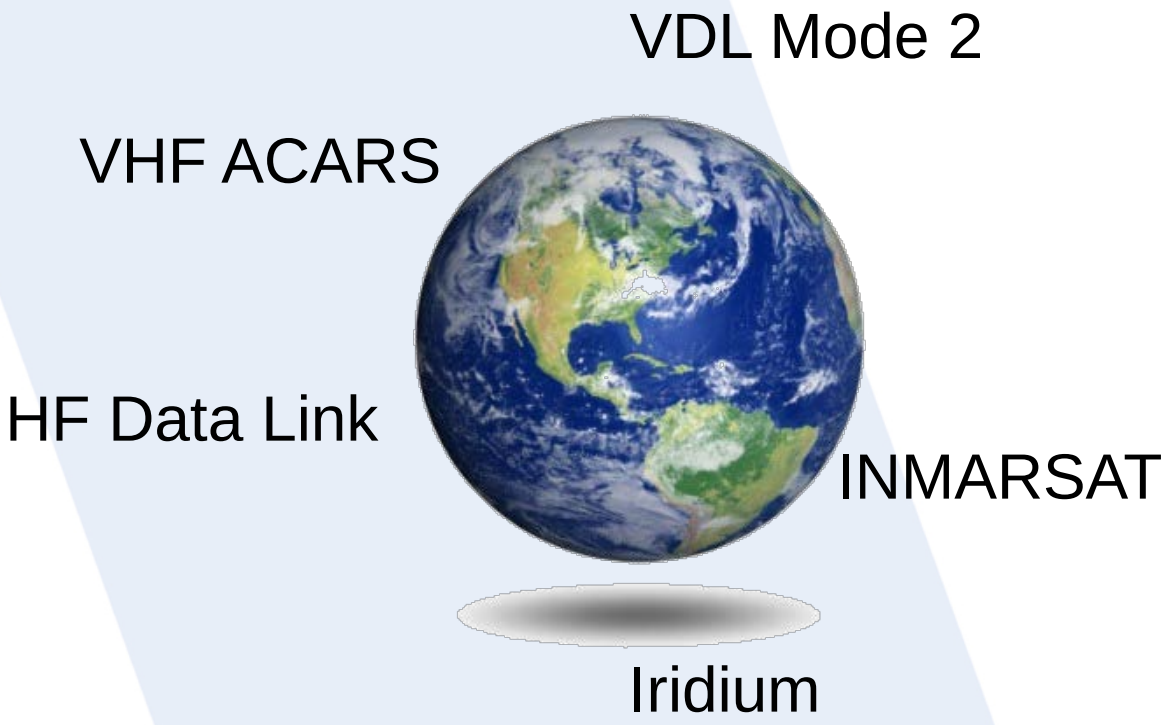
- Landing and post-flight
  - ON
  - IN
  - Post-flight crew report
  - Post-flight engine and APU operational data
  - Fuel data
  - Free-text messages from dispatch, maintenance, etc…



Data Link Media

ARINC Data Link Media

Truly Worldwide coverage



- Delivering over 1.5 million messages per day
- Serving 200+ customers

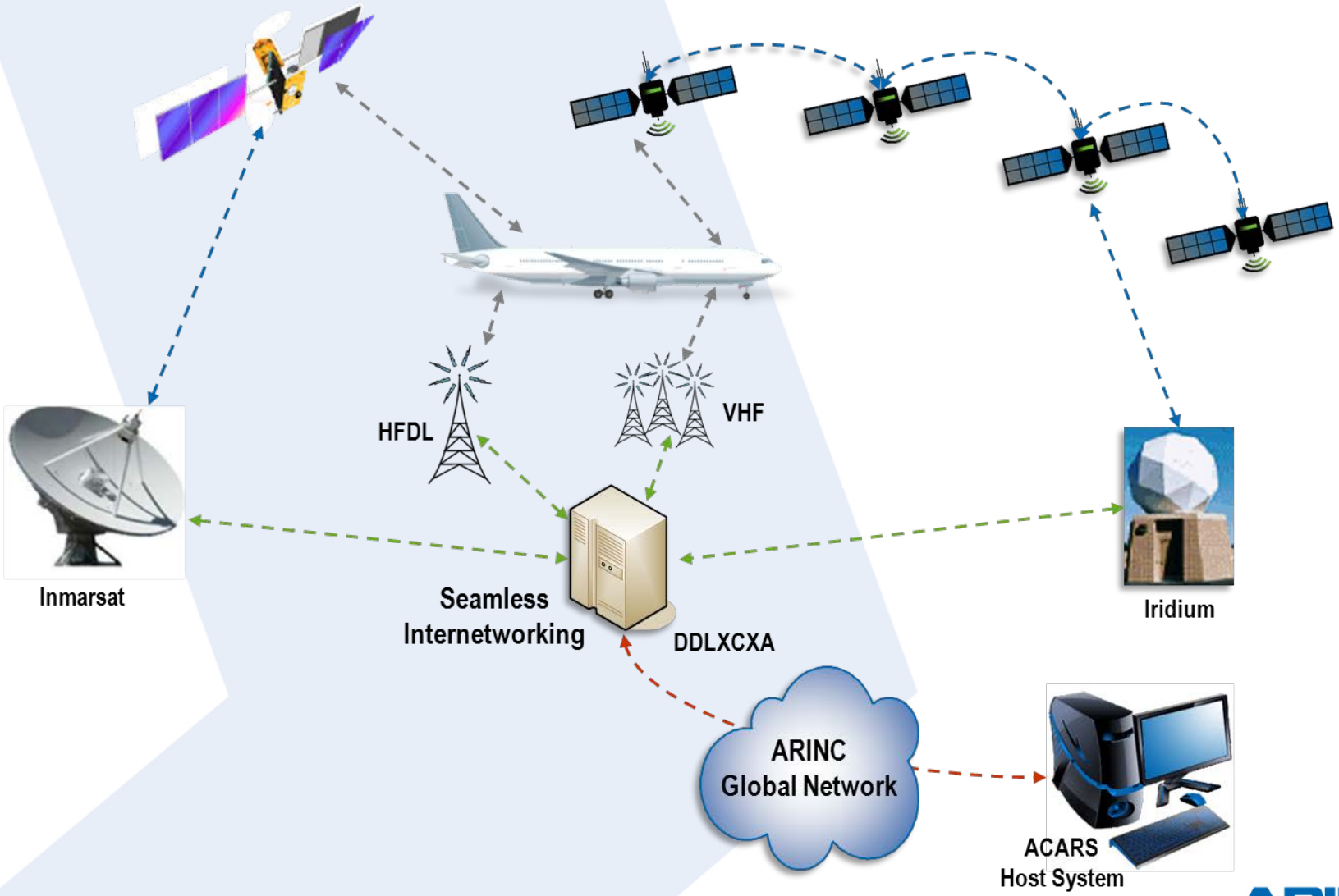
ARINC HF/VHF Communications Media

- VHF ACARS
  - 1100 ground stations around the globe
- VDL Mode 2
  - 428 stations in 19 countries
- HFDL
  - 15 HF Ground stations using multiple frequencies
  - Double, even triple redundancy in geographic coverage, including polar regions
  - The FAA has accepted PARC CWG's recommendations to approve FANS Over HFDL for RCP/400 Operations as defined in GOLD

ARINC Satellite Communications Media

- Inmarsat
  - Continuing to offer Classic Aero services over the I-3 and I-4 satellite networks
  - ARINC was named Distribution Partner (DP) by Inmarsat for SwiftBroadband service
- Iridium
  - 66 low-earth orbit (LEO) satellites providing global coverage
  - Iridium NEXT Service life extension to 2025 and beyond is planned
  - Currently supporting ~400 aircraft

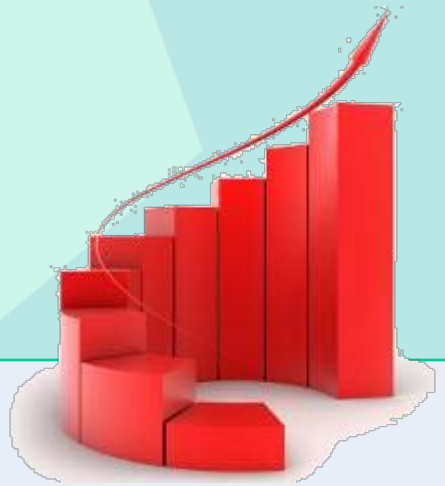
Message Delivery in a Multi-Media Environment



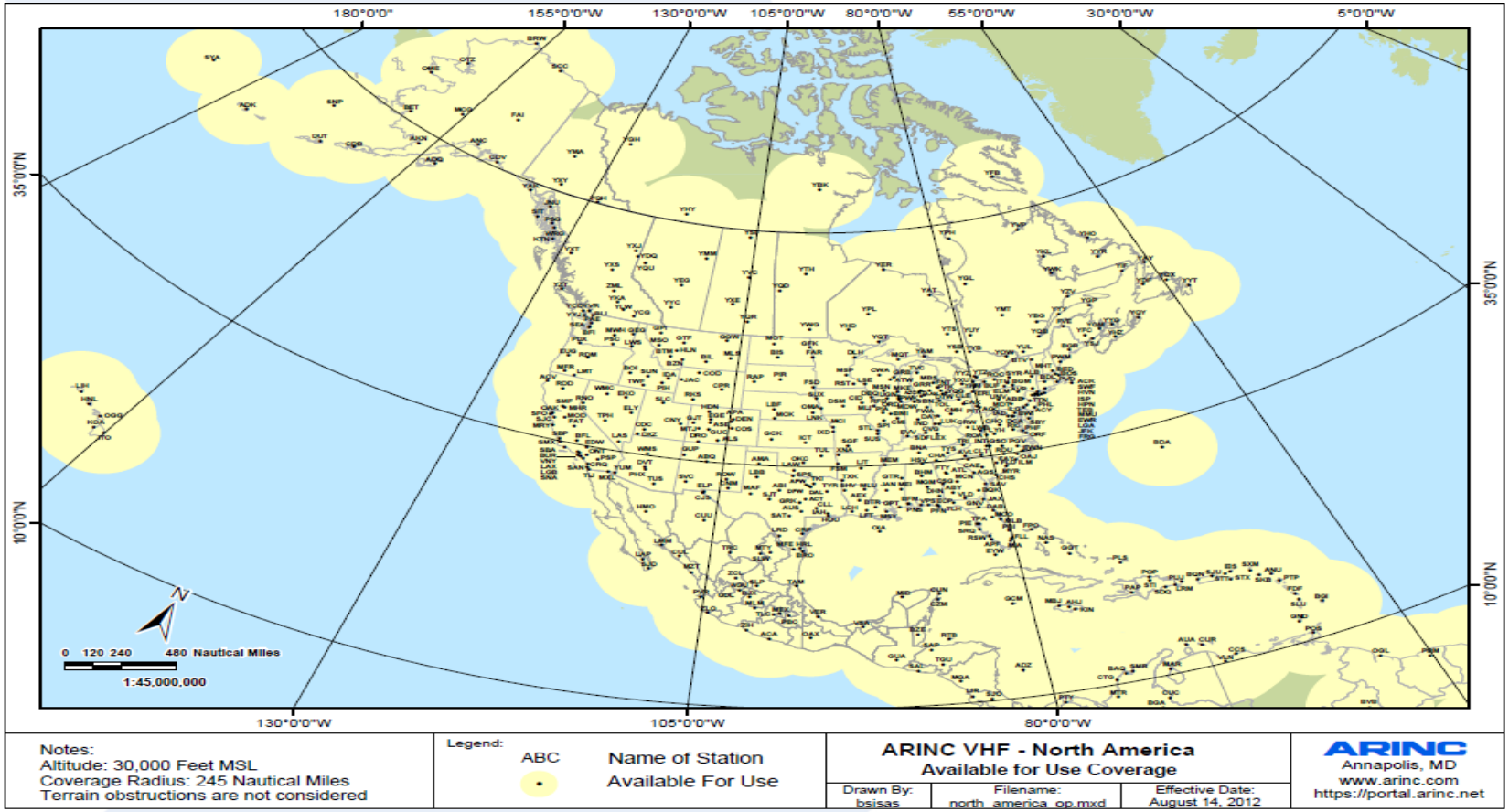
ACARS Data Link Coverage

GLOBALink Service Statistics

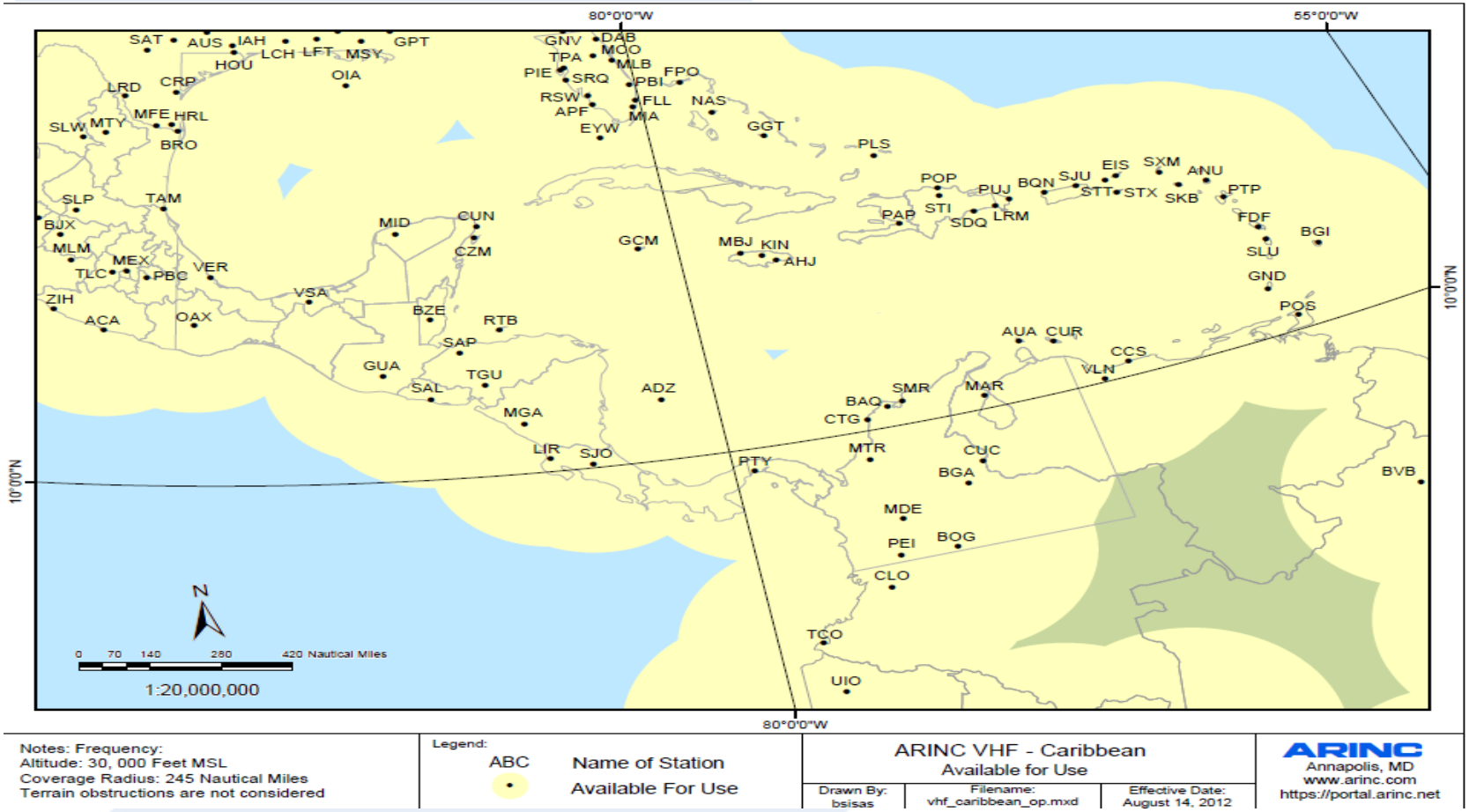
Messages per Month:	47 Million >1 Billion VHF Kbits in 2011
Monthly Aircraft	17,000+ globally
Classic VHF Stations	1,100+ stations
VDL Mode2 Stations	400+ stations
2012 YTD Uplink Message Success:	98.9% (POA) / 99.0 (AOA)
VDL Block End-to-End Transit (Ave):	1.9 seconds
Major Growth Areas:	Latin America; South Pacific; India, Malaysia; Eastern-Europe/Middle-East 162 Stations in South/Central America Adding 40+ VDL RGSs in Europe in 2012



GLOBALink/VHF Coverage Map – North/Central America



GLOBALink/VHF Coverage Map – Caribbean



Notes: Frequency:
Altitude: 30, 000 Feet MSL
Coverage Radius: 245 Nautical Miles
Terrain obstructions are not considered

Legend:
ABC Name of Station
Available For Use

ARINC VHF - Caribbean
Available for Use

Drawn By:	Filename:	Effective Date:
bsisas	vhf_caribbean_op.mxd	August 14, 2012

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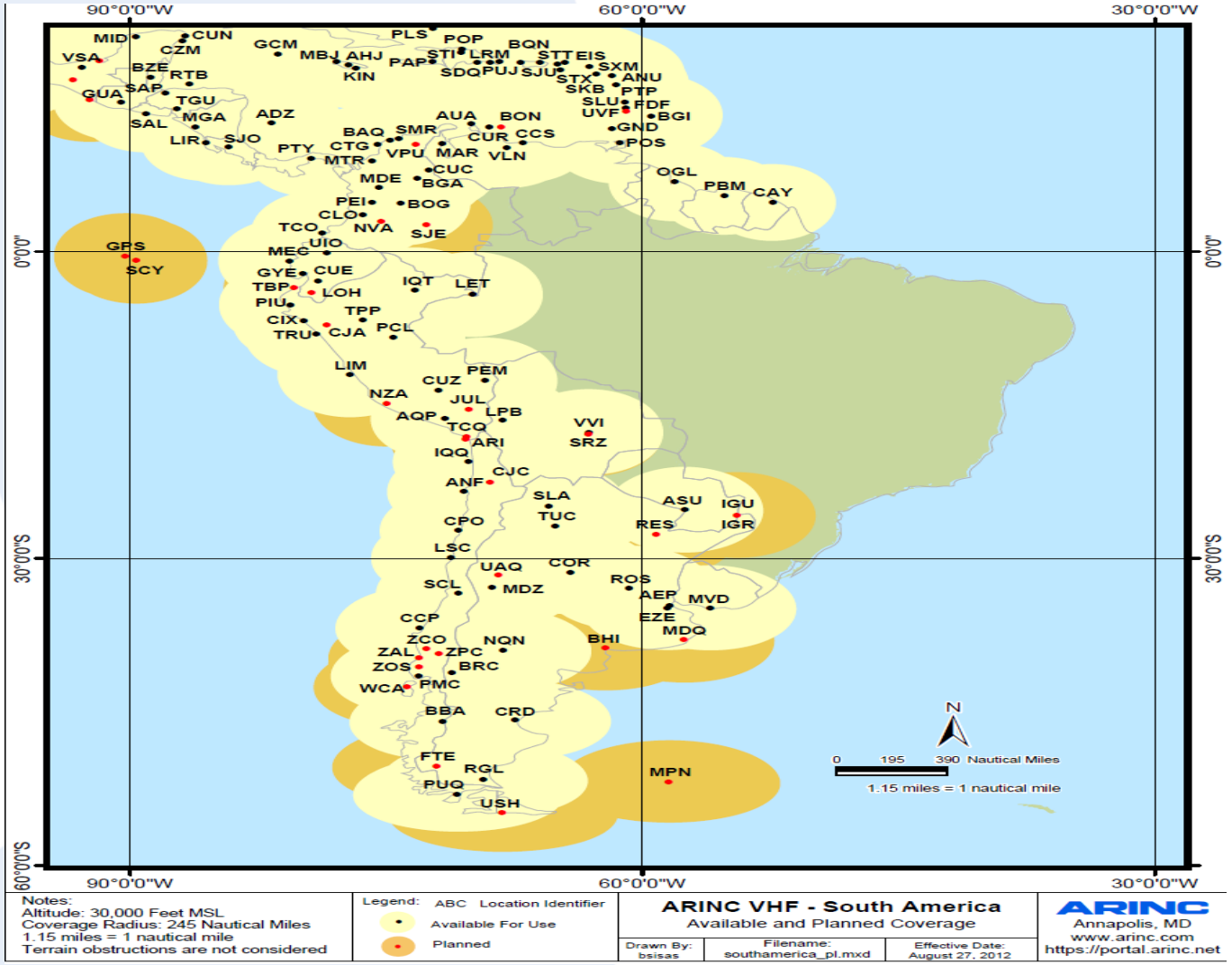
https://portal.arinc.net

GLOBALink/VHF Coverage Map – South America



Notes:
Altitude: 30,000 Feet MSL
Coverage Radius: 245 Nautical Miles
1.15 miles = 1 nautical mile
Terrain obstructions are not considered

Legend: ABC Location Identifier
Available For Use
Planned

ARINC VHF - South America
Available and Planned Coverage

Drawn By:	Filename:	Effective Date:
bsisas	southamerica_pl.mxd	August 27, 2012

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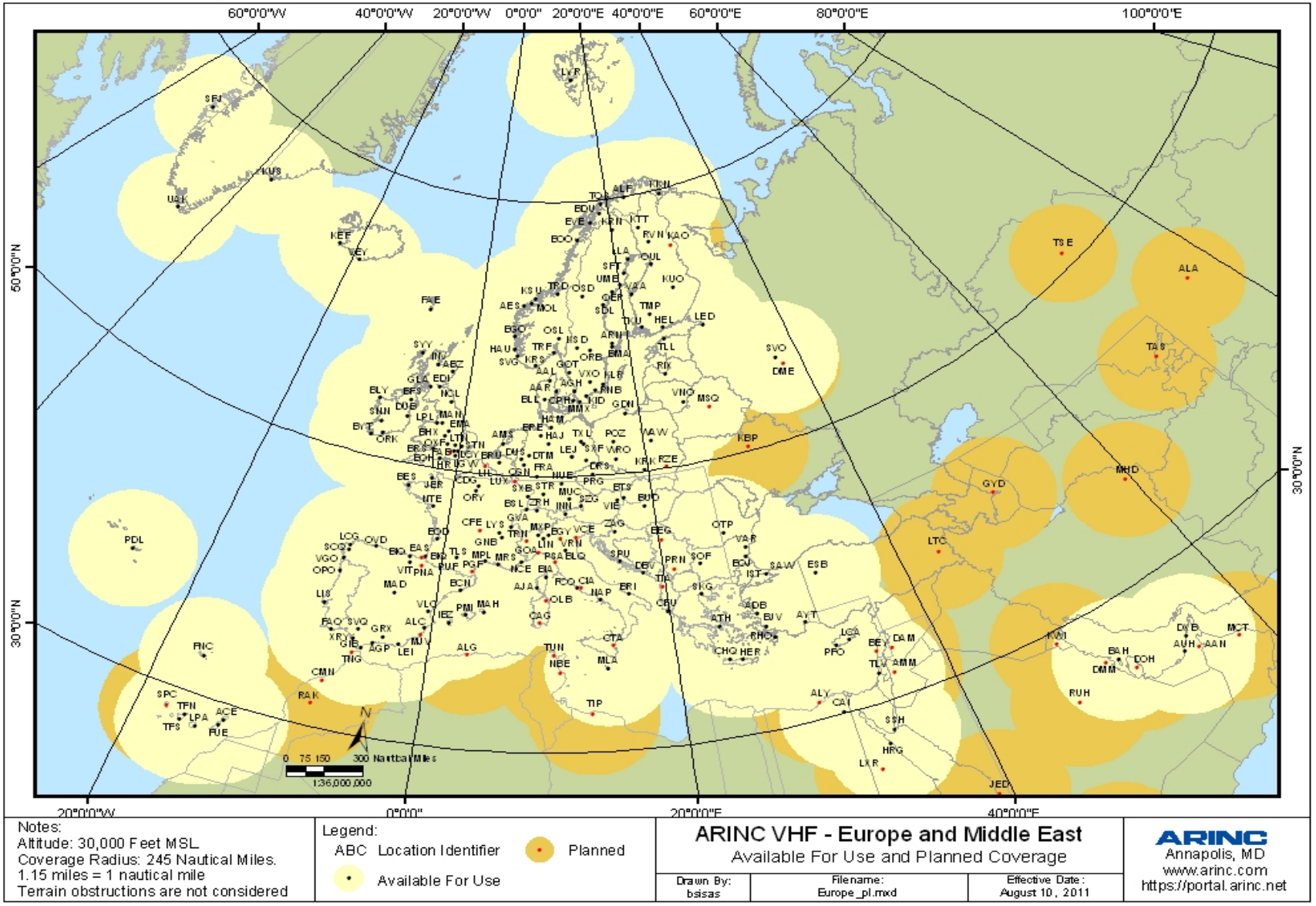
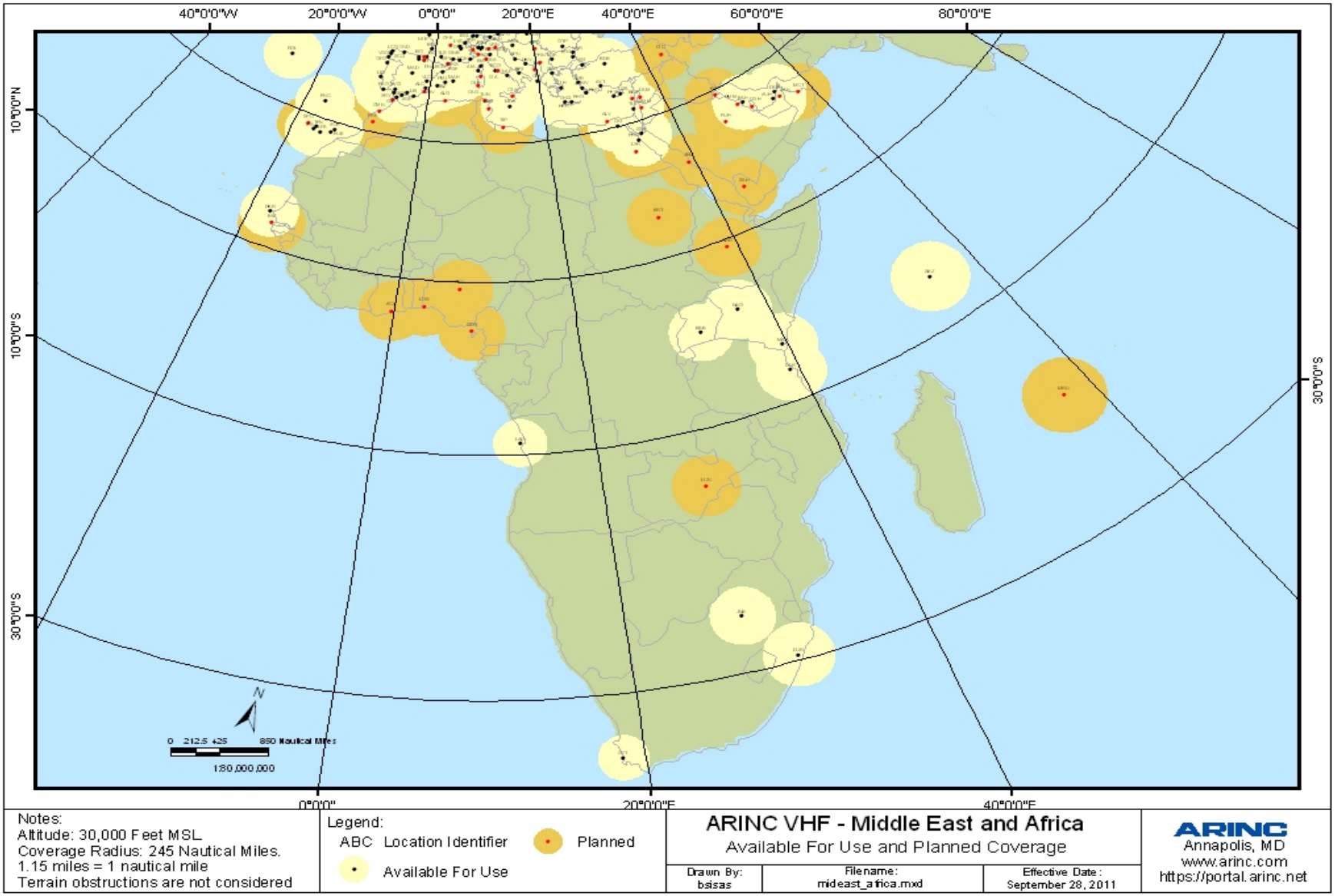
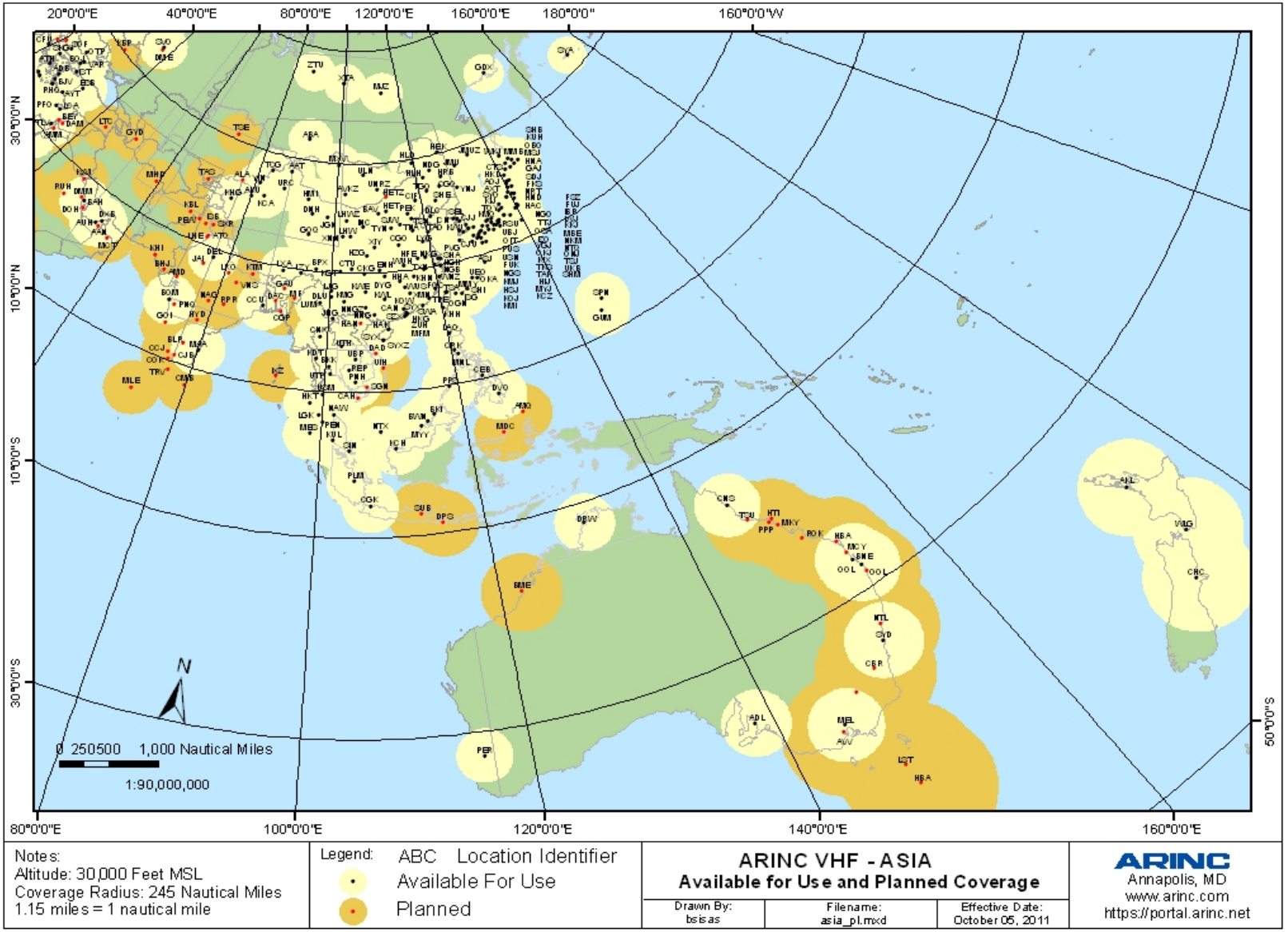
GLOBALink/VHF Coverage Map – Europe



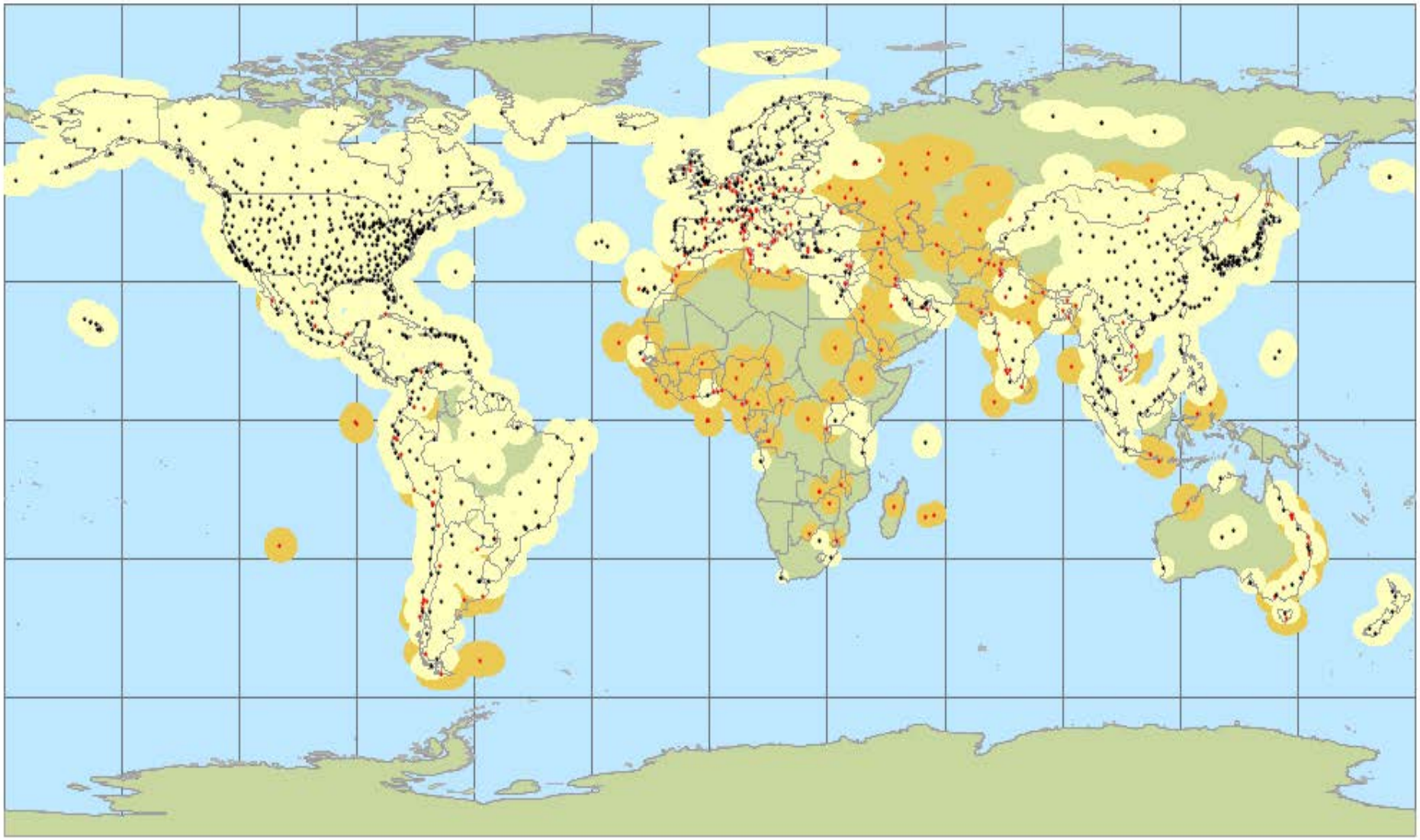
GLOBALink/VHF Coverage Map – Africa and Middle East



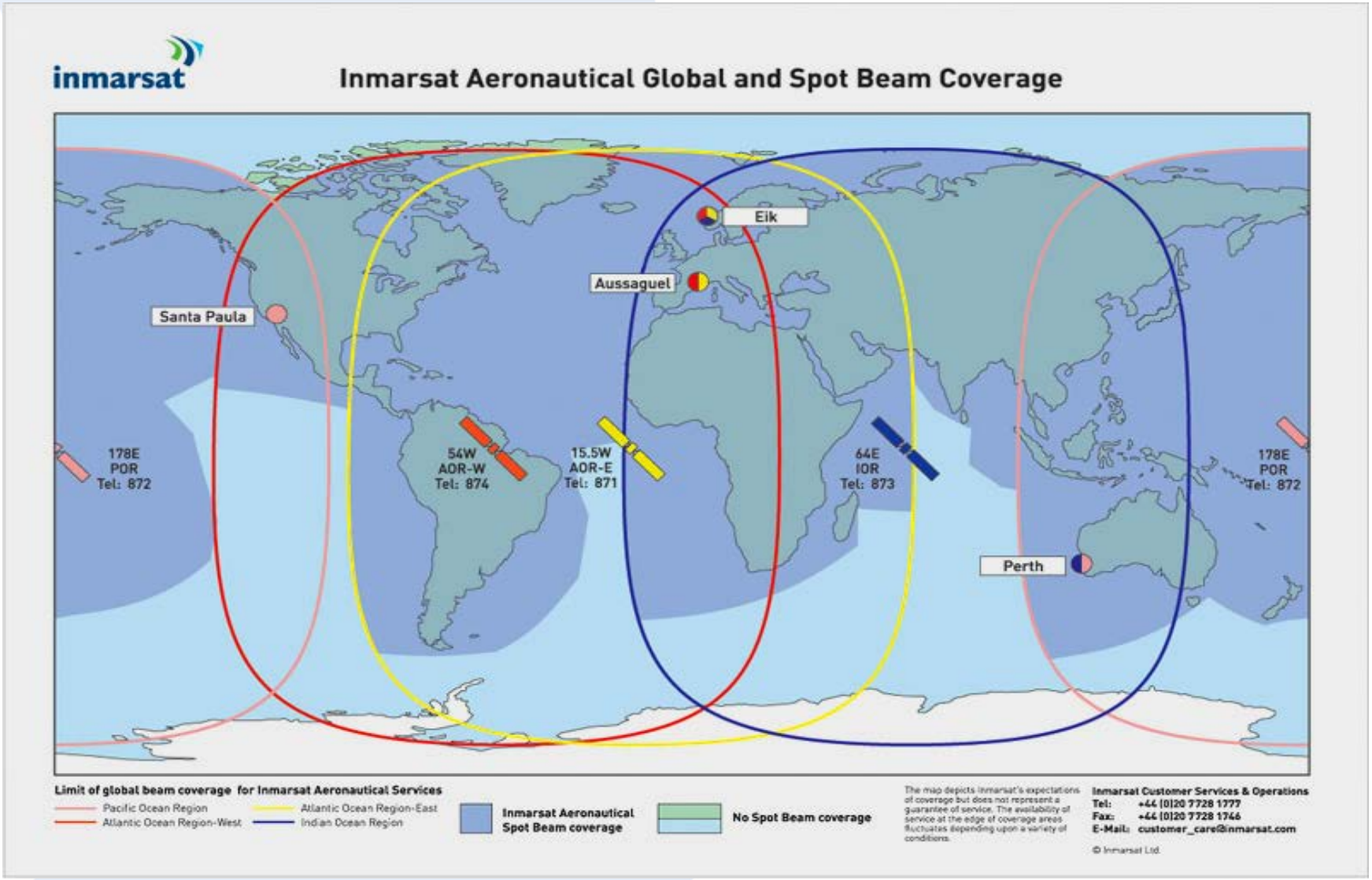
GLOBALink/VHF Coverage Map: Asia & South Pacific



GLOBALink VHF Coverage

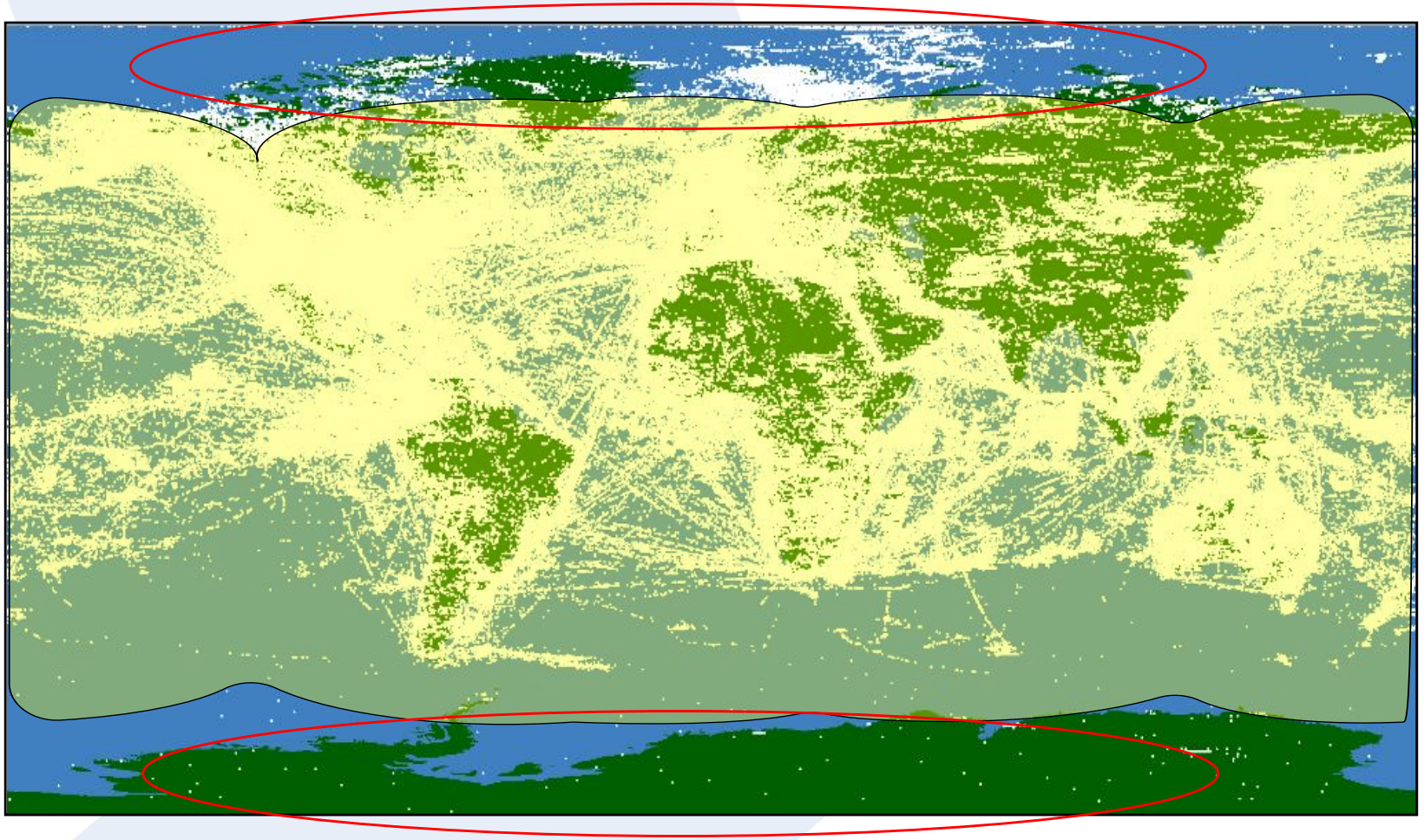


Inmarsat Coverage Map

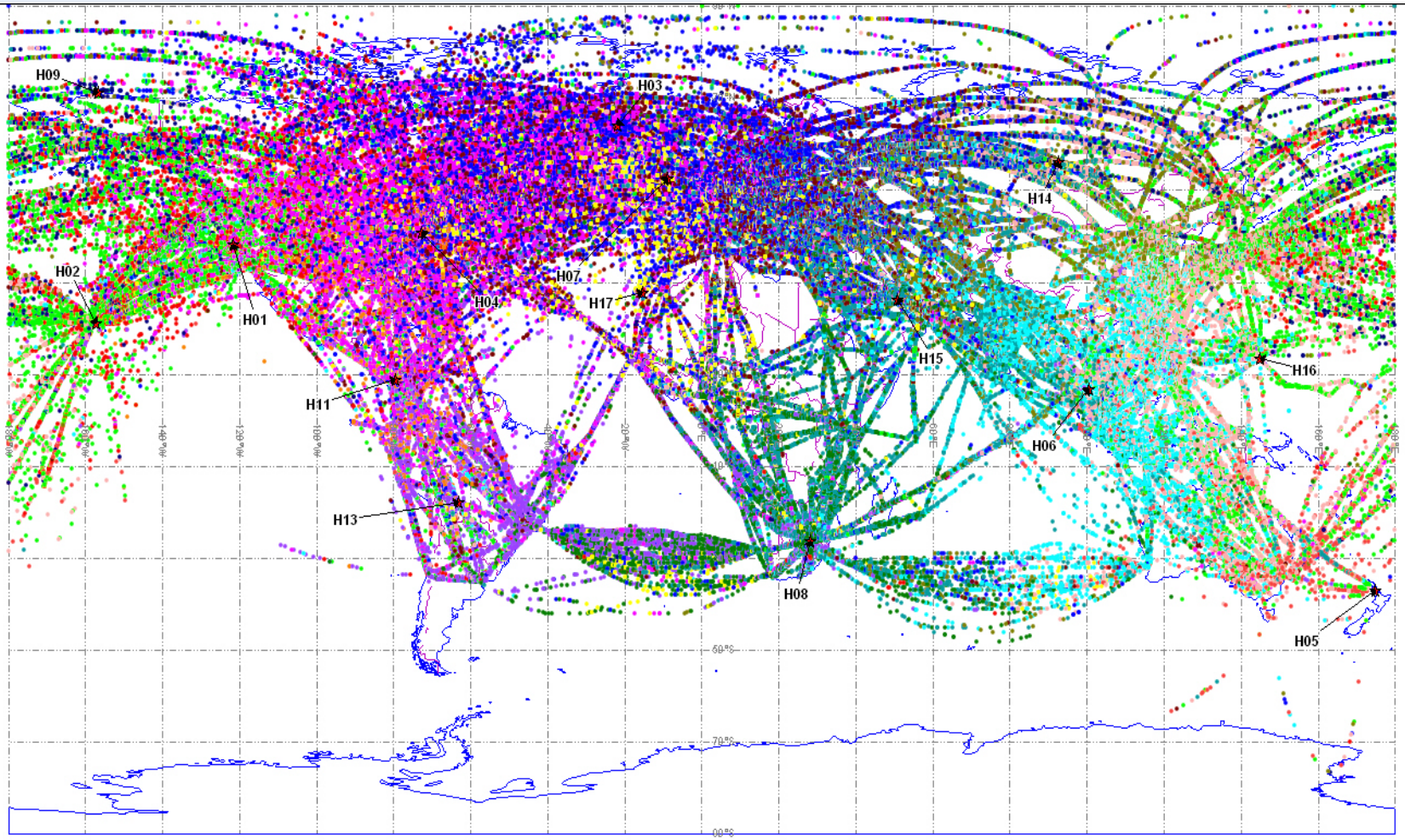


Iridium Coverage

Iridium complements HFDL in GLOBALink coverage



HFDL Coverage/Usage



- H01 - California, USA
- H02 - Hawaii, USA
- H03 - Iceland
- H04 - New York, USA
- H05 - New Zealand
- H06 - Thailand
- H07 - Ireland
- H08 - South Africa
- H09 - Alaska, USA
- H11 - Panama
- H13 - Bolivia
- H14 - Russia
- H15 - Bahrain
- H16 - Guam
- H17 - Canary Is.

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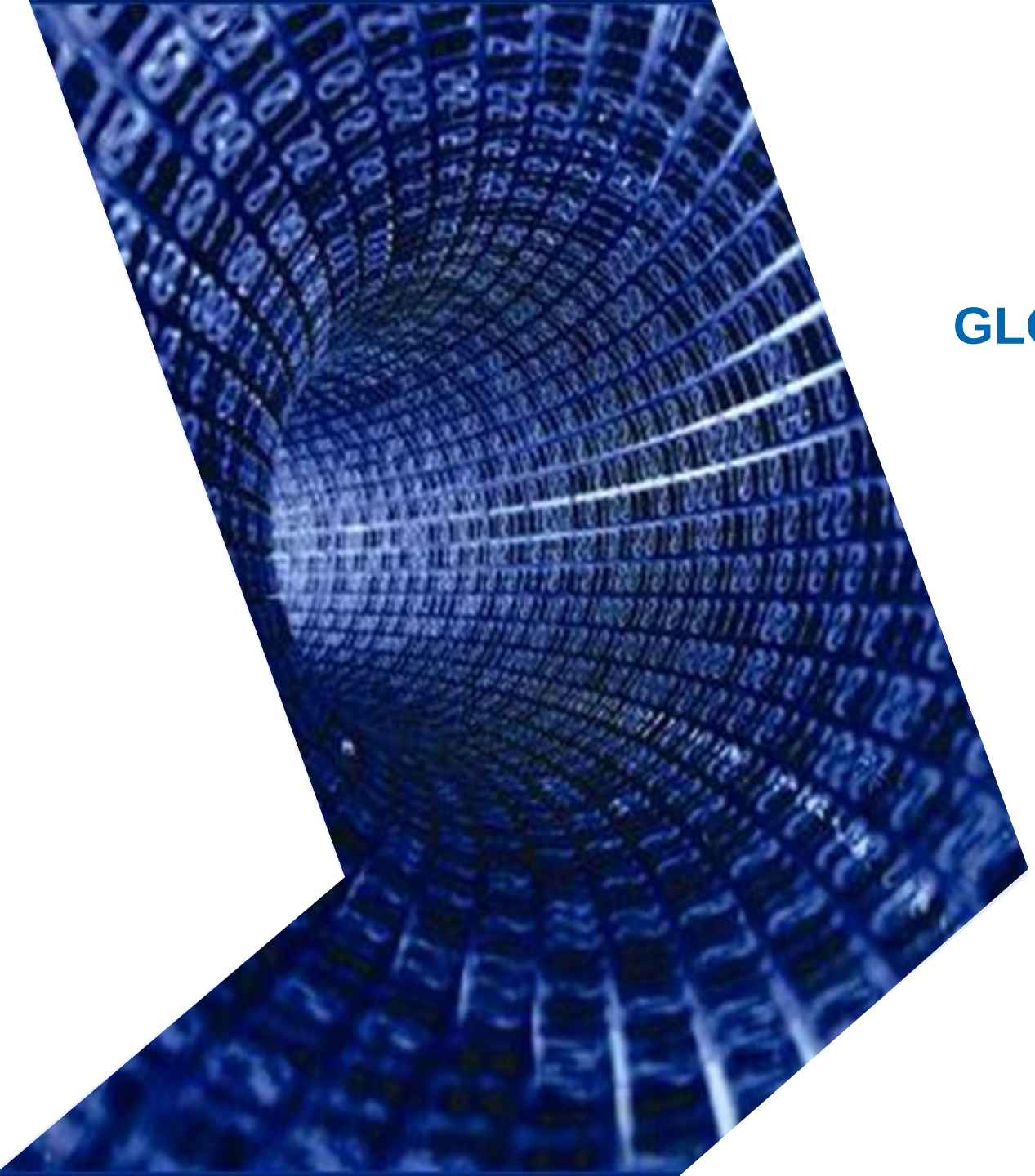
GLOBALink - HFDL

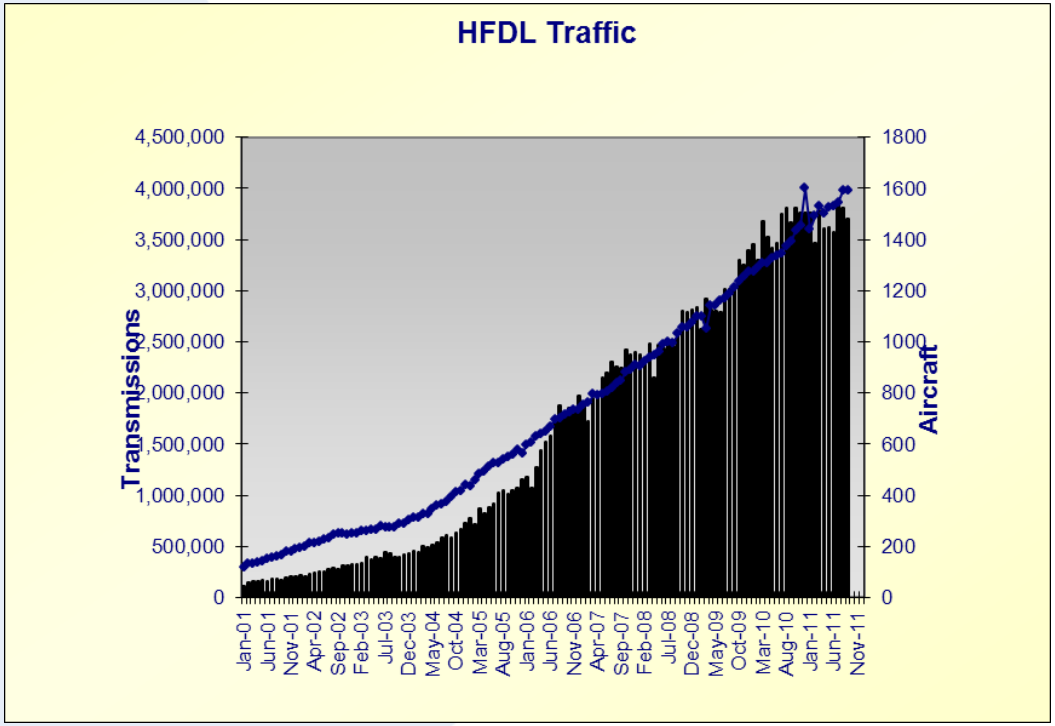
December 2011



GLOBALink HFDL

HFDL General Overview

- ARINC launched the world's only High Frequency Data Link (HFDL) system in 1998
- 73 worldwide customers
- Over 1600 equipped aircraft with 3.6 million transmissions per month
  - 2011 traffic up 22.92% over 2010



HFDL 101… *The Basics*

- Long-range, beyond the line-of-sight communications take place in the HF radio spectrum from 2-30 MHz
  - Over 167 frequencies used by the HFDL system worldwide
  - Over 31 different frequencies operating at any one time

Frequency	Designation	Abbreviation
3-30 kHz	Very low frequency	VLF
30-300 kHz	Low frequency	LF
300-3,000 kHz	Medium frequency	MF
2-30 MHz	***High frequency***	***HF***
30-300 MHz	Very high frequency	VHF
300-3,000 MHz	Ultrahigh frequency	UHF
3-30 GHz	Superhigh frequency	SHF
30-300 GHz	Extremely high frequency	EHF

HFDL

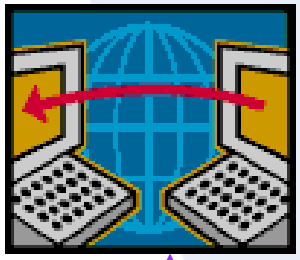
VHF

SAT

SAT

  - Air-ground message transmission speed varies depending on radio wave propagation conditions
    - 300, 600, 1200, 1800 bps

Architecture



Ground End Systems
- Airline host processing
- DSP services
- CAA systems
- Tower systems

We ran out of peanuts!

Then serve pretzels.

ARINC Global Network

VHF (POA) VDL SATCOM

Then serve pretzels.

We ran out of peanuts!

ARINC's Central Processing System (CPS)

Then serve pretzels.

We ran out of peanuts!

Transmit Antenna

Ch 1

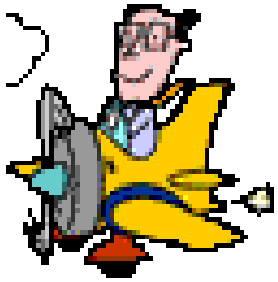
Ch 2

Ch 3

Then serve pretzels.

Then serve pretzels.

We ran out of peanuts!



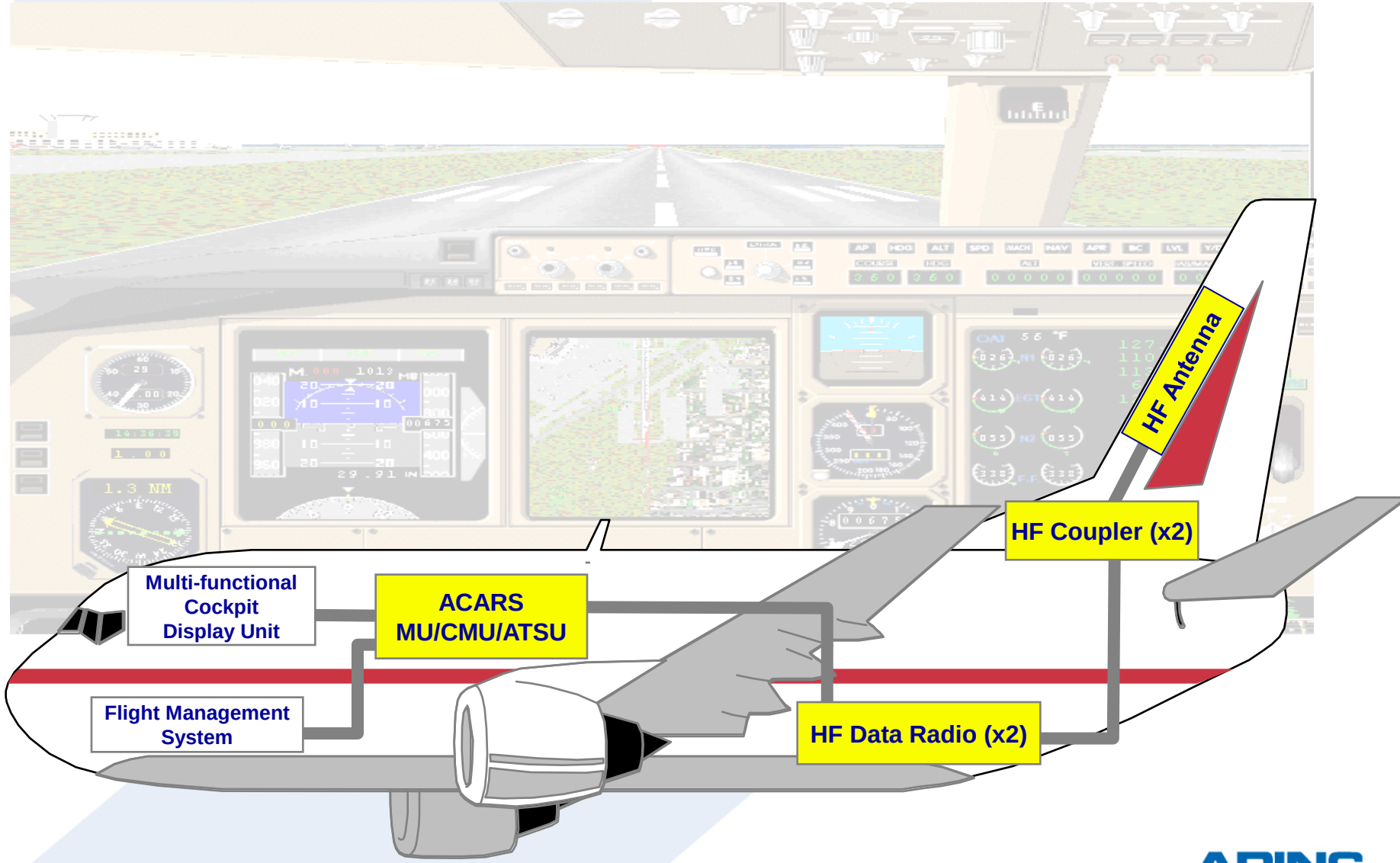
We ran out of peanuts!

Receive Antenna

We ran out of peanuts!

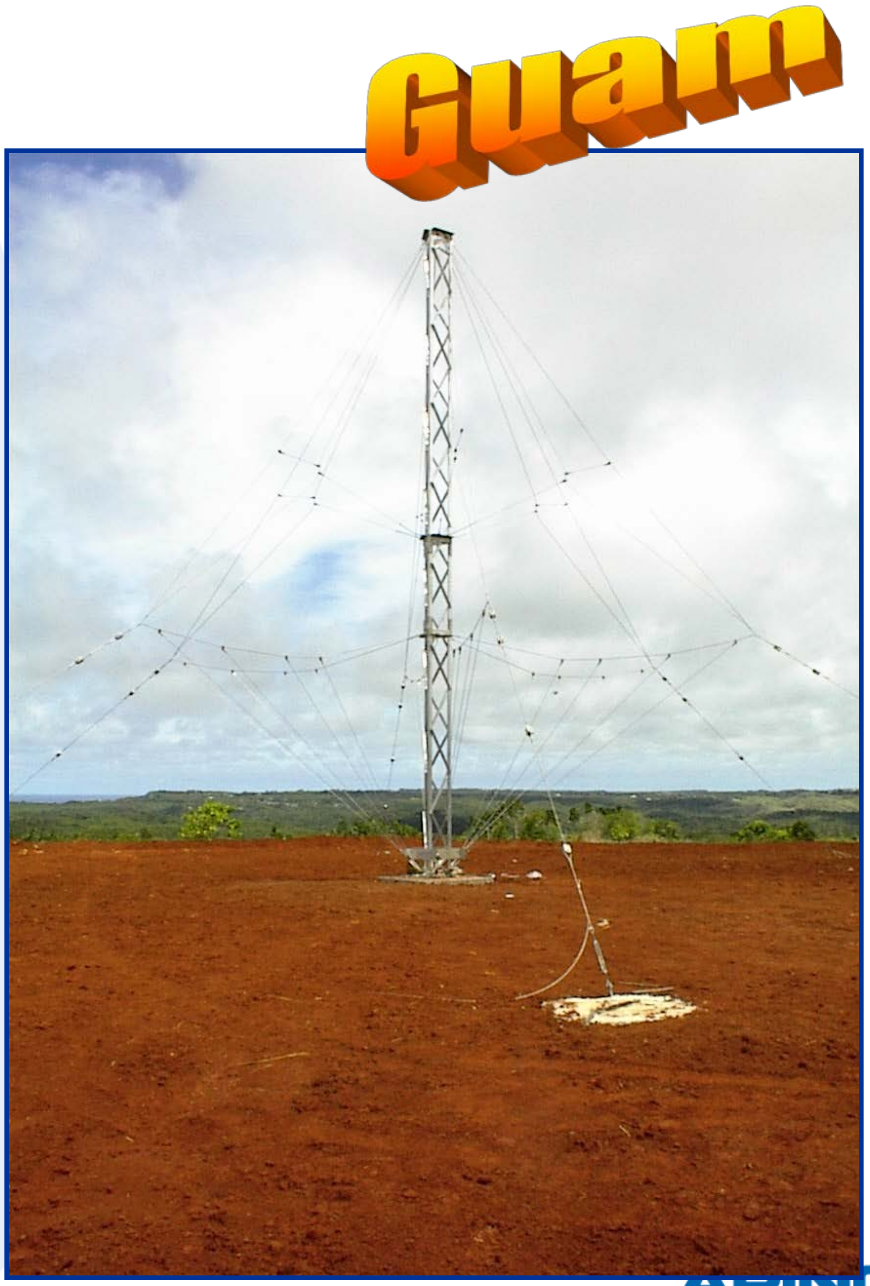
HFDL Ground Station (HGS)

Airborne Architecture

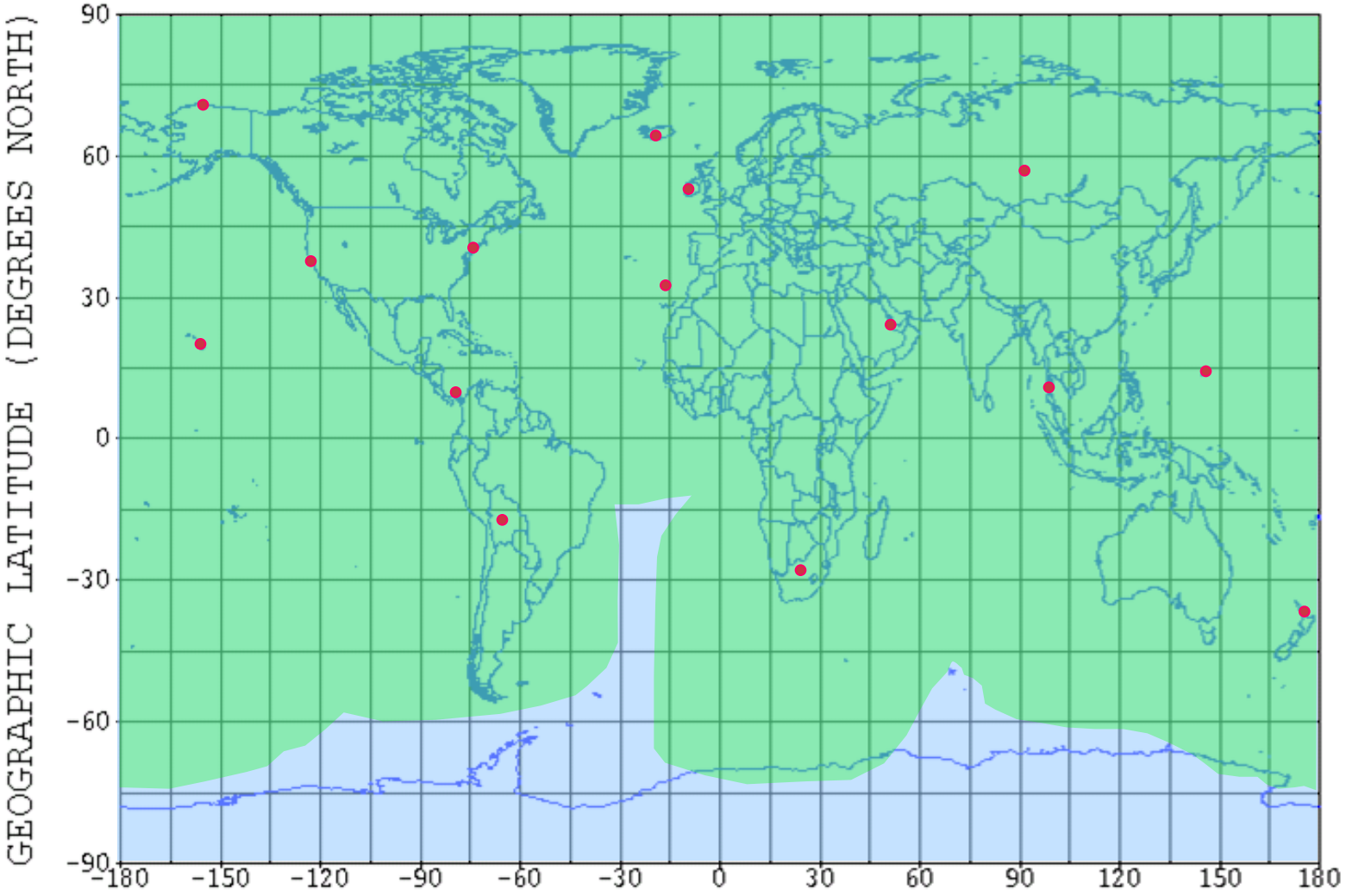


HFDL Ground Stations

- San Francisco, CA, U.S.A (H01)
- Molokai, HI, U.S.A. (H02)
- Reykjavik, Iceland (H03)
- Riverhead, NY, U.S.A. (H04)
- Auckland, New Zealand (H05)
- Hat Yai, Thailand (H06)
- Shannon, Ireland (H07)
- Johannesburg, South Africa (H08)
- Barrow, AK, U.S.A. (H09)
- Panama City, Panama (H11)
- Santa Cruz, Bolivia (H13)
- Krasnoyarsk, Russia (H14)
- Al Muharraq, Bahrain (H15)
- Yona, Guam (H16)
- Telde, Canary Islands (H17)



Worldwide Coverage



HF Ground Stations

Alaska
Bahrain
Bolivia
California
Canary Islands
Guam
Hawaii
Iceland
Ireland
New York
New Zealand
Panama
Russia
South Africa
Thailand

Legend

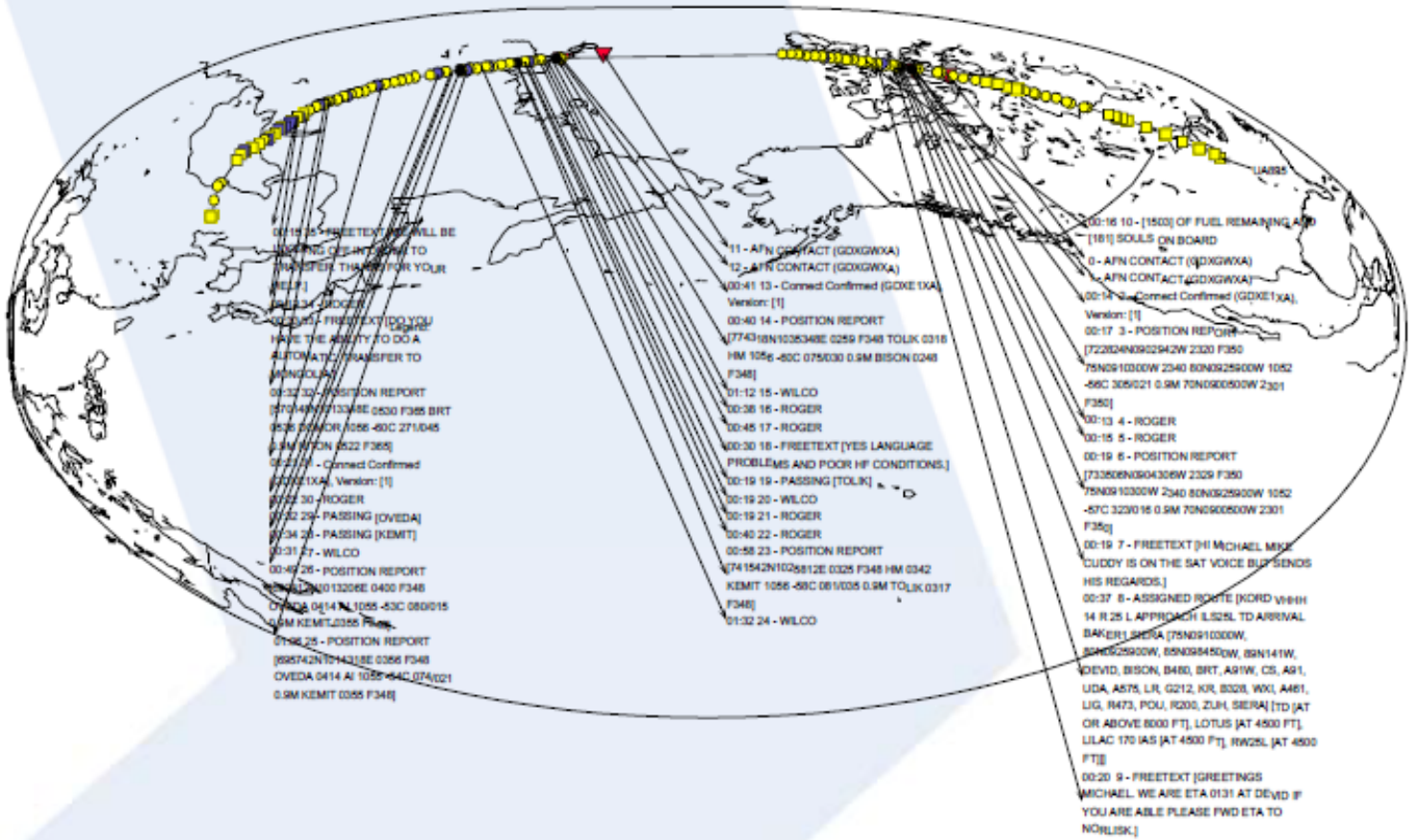
- HFDL ground station

Areas of Primary coverage

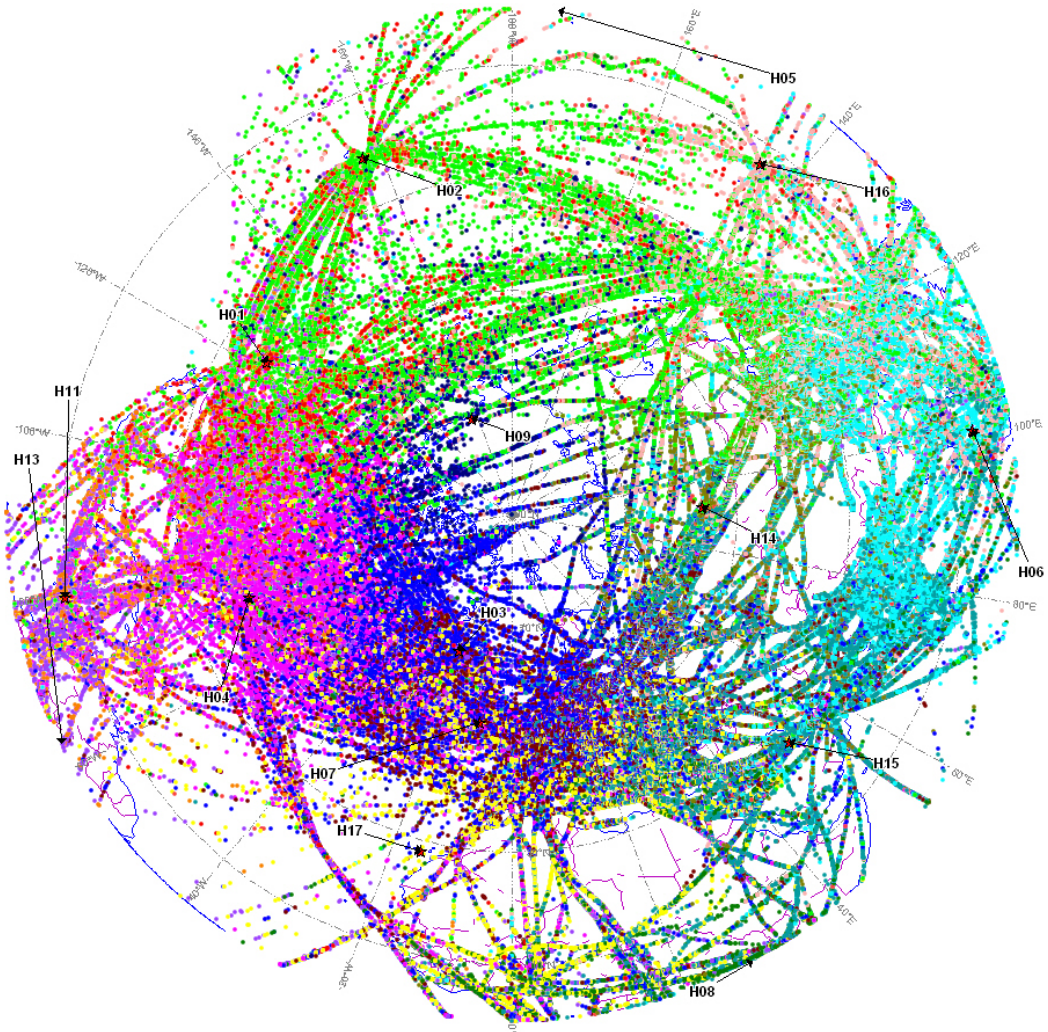
Areas of Secondary coverage

First United Polar Flight

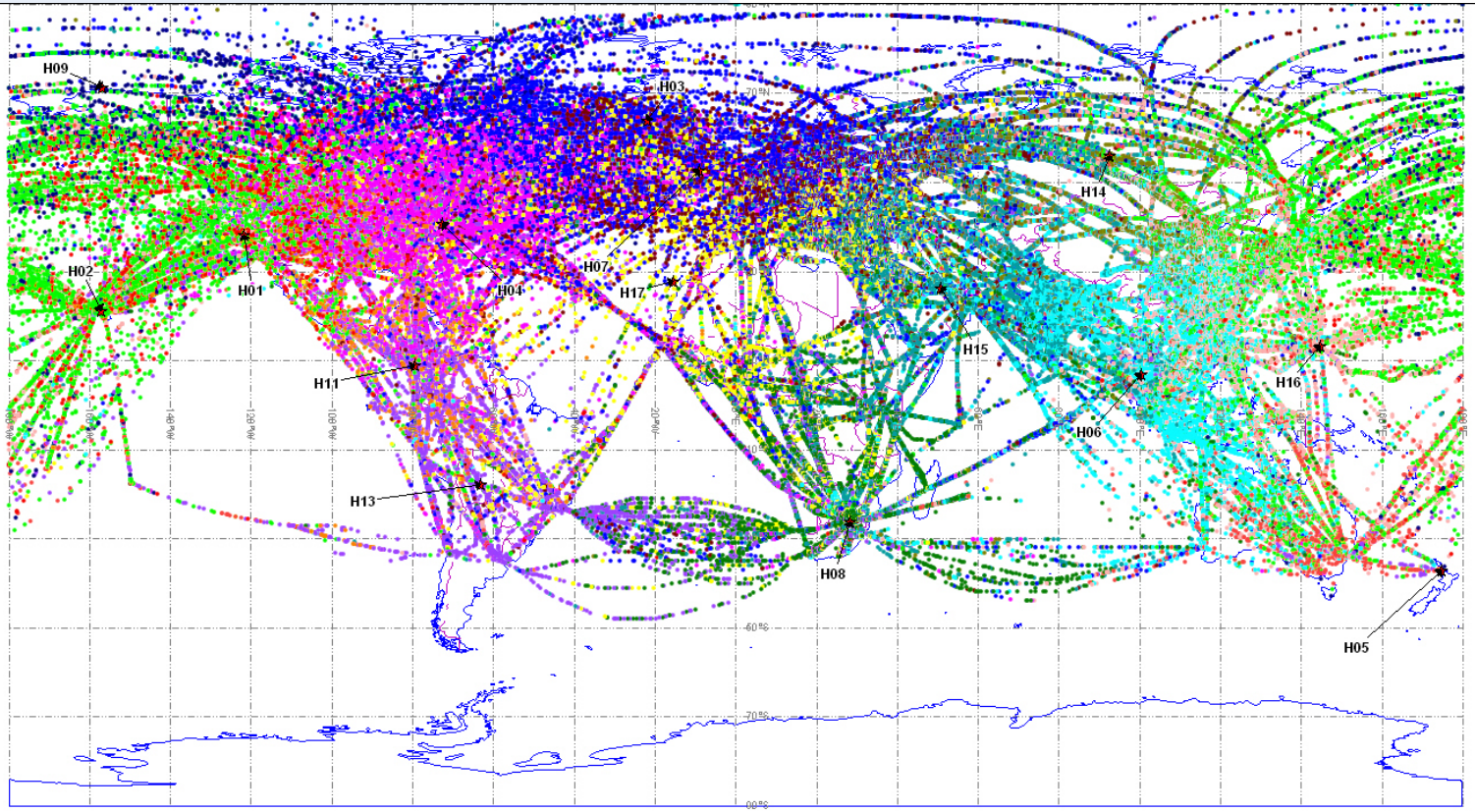
Flight UA895 (N107UA) Chicago-Hong Kong = Jan 20, 1999



HFDL Polar flights – September 2011



HFDL Flights – September 2011



H01 - California, USA
H02 - Hawaii, USA
H03 - Iceland
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H05 - New Zealand
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H07 - Ireland
H08 - South Africa
H09 - Alaska, USA
H11 - Panama
H13 - Bolivia
H14 - Russia
H15 - Bahrain
H16 - Guam
H17 - Canary Is.

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GLOBALink - HFDL

September 2011

VDL Mode 2 - AOA/ATN

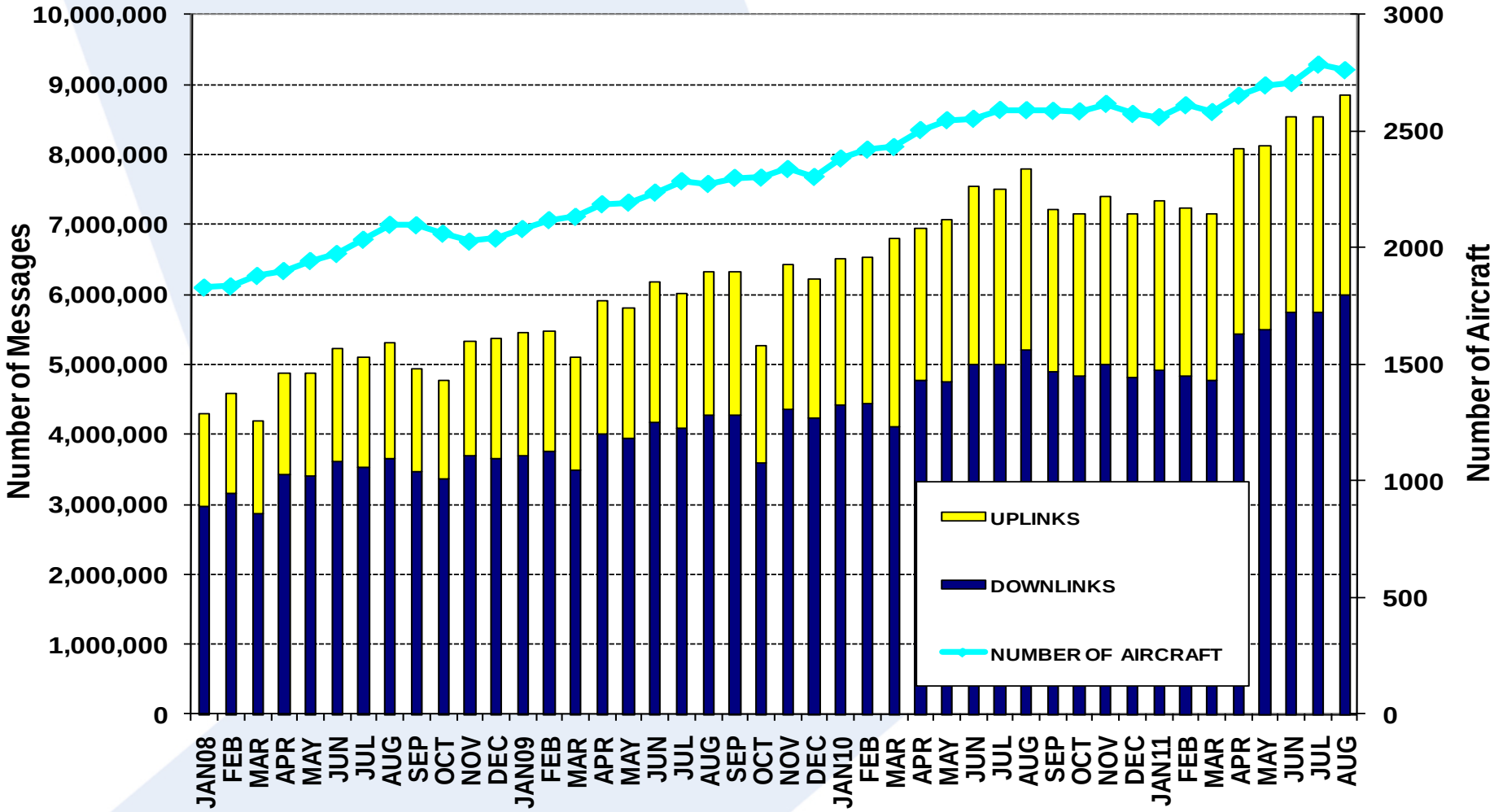
Comparing VHF ACARS and VDL Mode 2 AOA

	ACARS	AOA
Standards	AEEC standard	ICAO standard AEEC derivative
Bit or Character	Character	Bit
Data Rate over RF	2.4 kbps	31.5 kbps
Frequencies for equivalent RF capacity	8-10	1
Avionics	ARINC 716/724 ARINC750/758 - Mode A	ARINC 750/758 AOA S/W & Provisions
Host ACARS	ACARS	
Messages	ARINC 618/620	ARINC 618/620
Availability	Now	Now

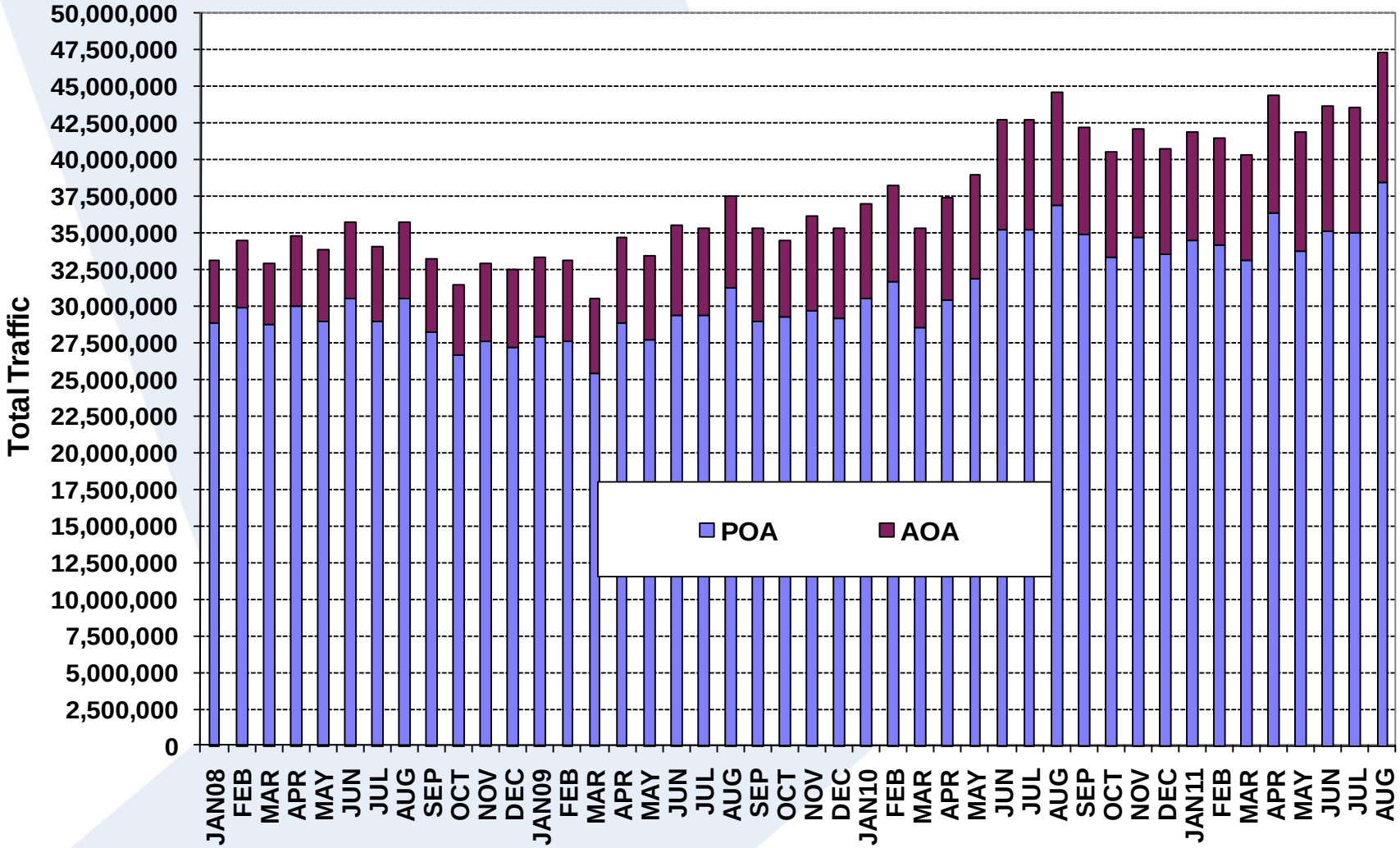
Comparing VHF ACARS and VDL Mode 2 AOA

	AOA	ATN
Standards	AEEC standard ICAO standard	ICAO standard
Designed for CPDLC	No	Yes
Data Rate over RF	31.5 kbps	31.5 kbps
Avionics	ARINC 750/758 AOA S/W & Provisions	ARINC 750/758 ATN router S/W & Provisions
Host ACARS	ATN for bit	Applications
Messages	ARINC 618/620	ATN & ARINC 618/620
Availability	Now	Now

GLOBALink/VHF VDLM2/AOA
Message Traffic

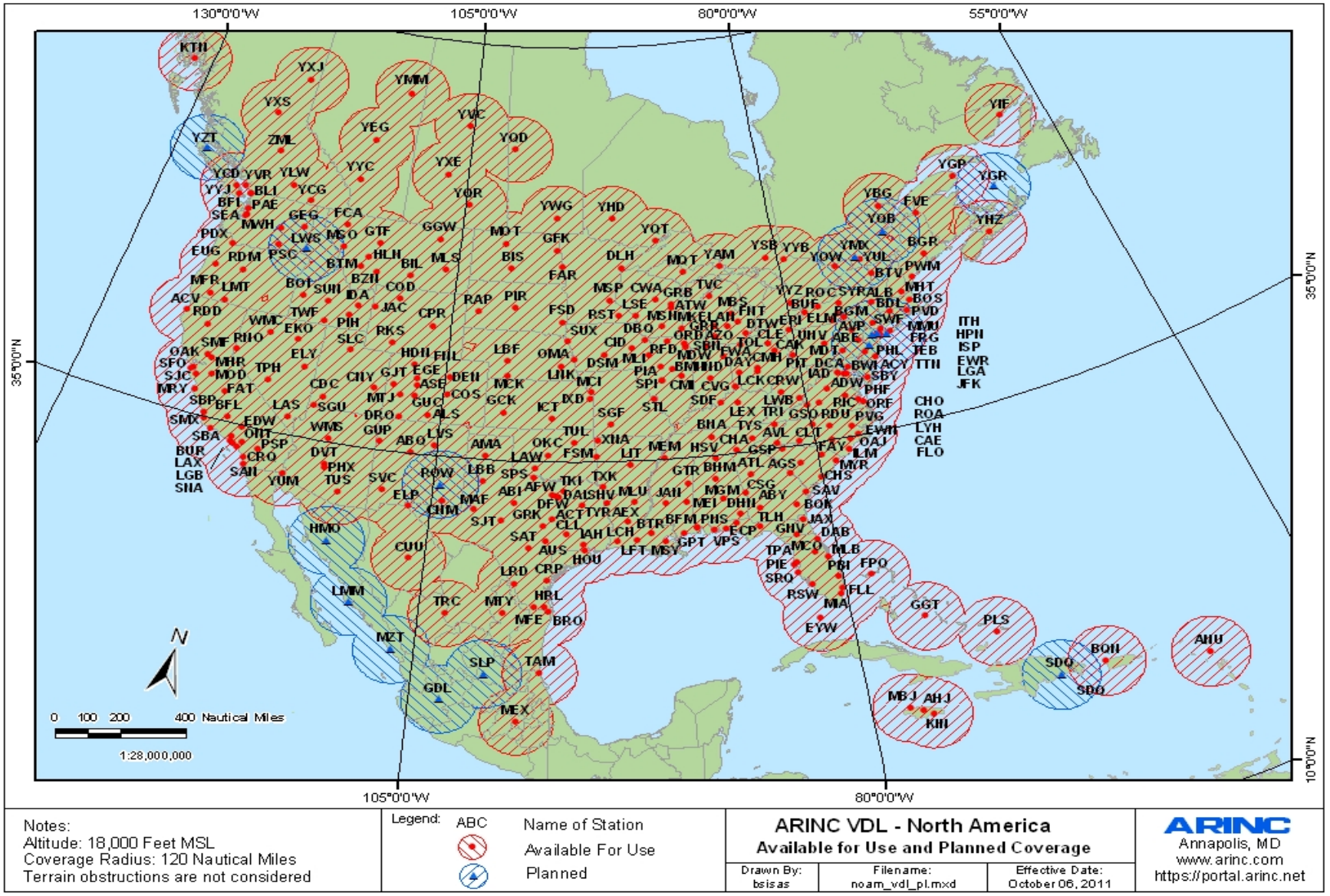


Ratio of POA and AOA Message Traffic

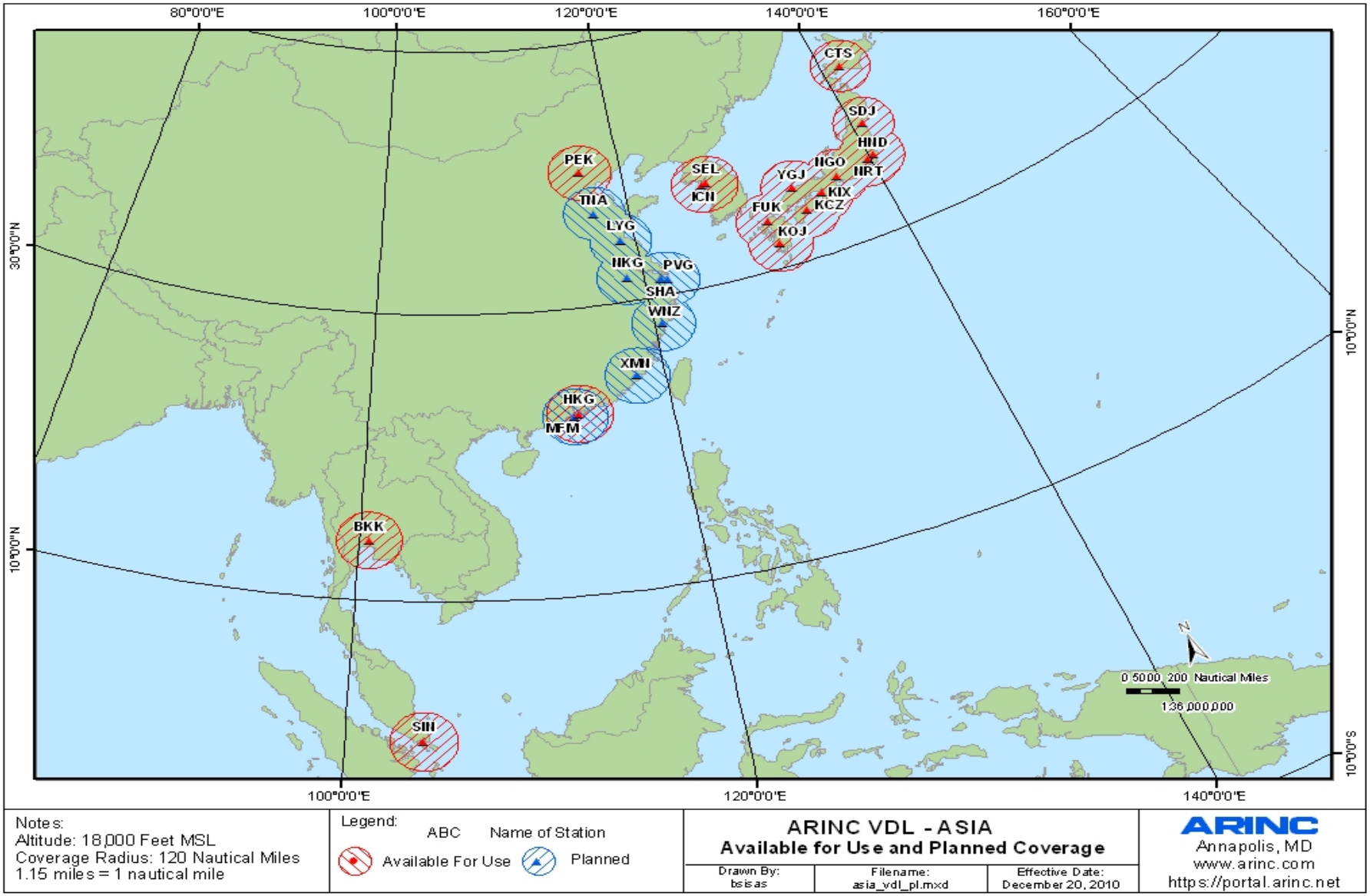


REPORTS/ACARS/ACARS.XLS:TRAFFICAOAPOA/08-11-09/DMS

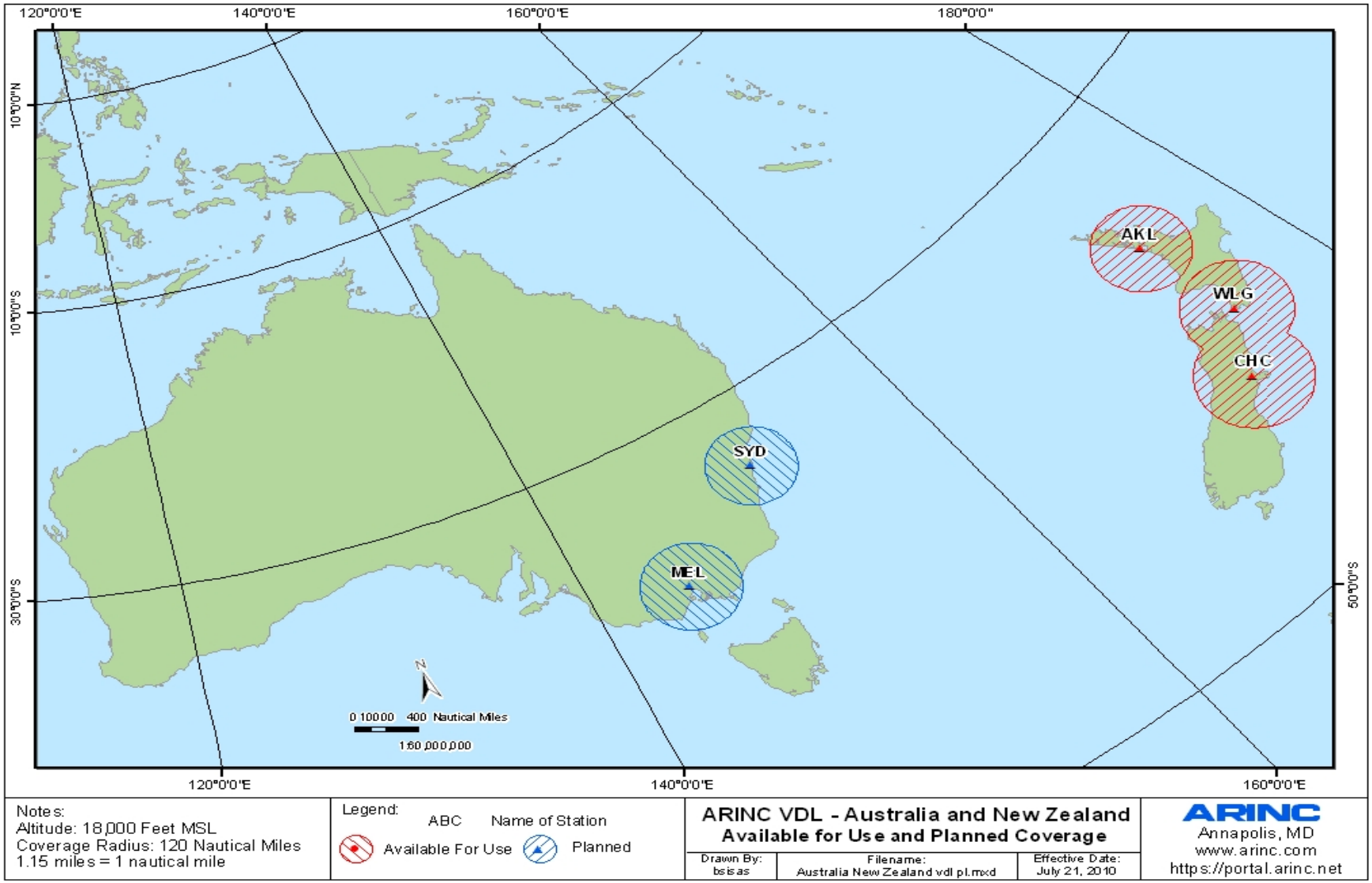
VDL Mode 2 Coverage: North and Central America



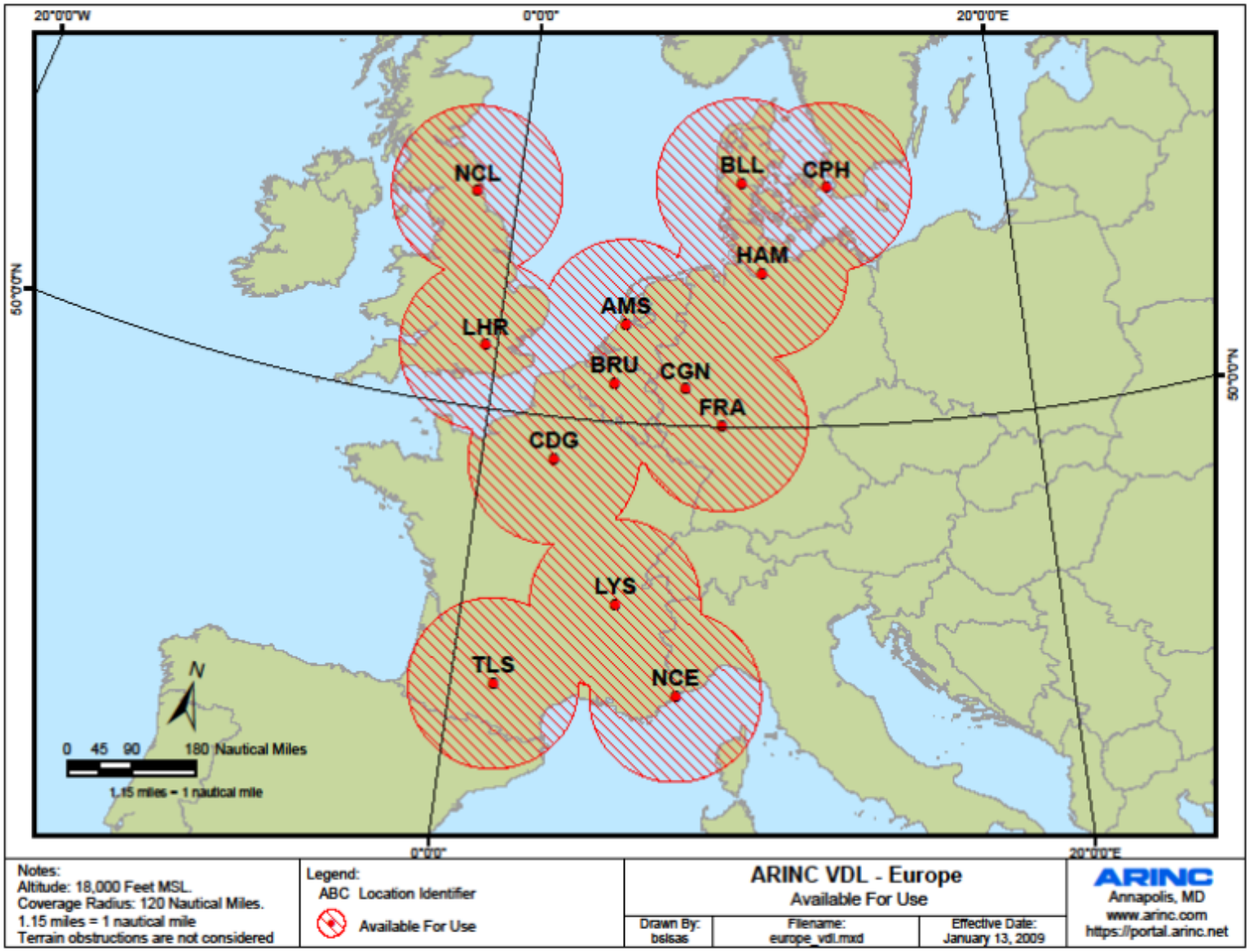
VDL Mode 2 Deployment in Asia:

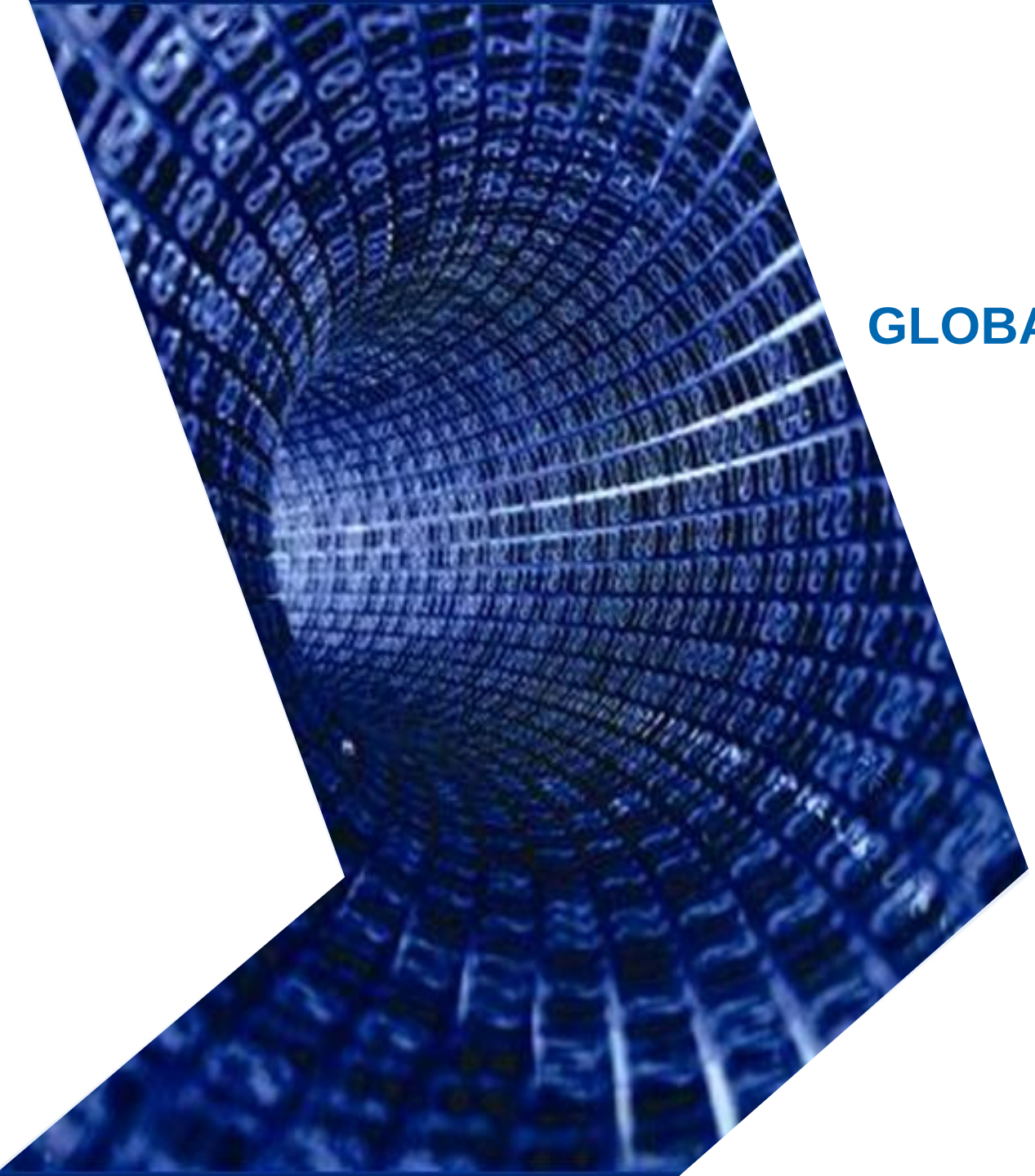


VDL Mode 2 Deployment in South Pacific:



VDL Mode 2 AOA/ATN Coverage in Europe





GLOBALink ATS Services

CNS/ATM Functions

- AFN – ATS Facility Notification
- CPDLC – Controller Pilot Data Link Communications
- ADS-C – Automatic Dependent Surveillance – Contract
- CADS/CFRS – Data link position reporting in the North Atlantic
- PDC – Pre-Departure Clearance in U.S. and Canada
- DCL – ARINC 623 Departure Clearance, Worldwide
- D-ATIS – Digital Automatic Terminal Information Service

ARINC FANS Connections

- FANS Messaging
  - ATS Facility Notifications
  - CPDLC
  - ADS-C
  - (Departure Clearance)

  - Currently Connected through ARINC
    - FAA Oakland
    - NavCanada
    - New Zealand
    - UKNATS
    - Magadan (Russia)
    - Trinidad & Tobago (pending)

- Requires AGN connection and routing to ARINC ATC Gateway

CNS/ATM Functions with non-FANS ATC Centers - CADS

- Centralized ADS – CADS
- Is a service provided by the Data Link service Provides
  - CADS translates FANS/ADS POS and MET for CAA's non equipped with CNS/ATM capable system
  - Message is converted to free text and send it via AFTN
  - Message applications
    - ATS facilities notification (AFN)
    - Automatic dependent surveillance (ADS)
    - Meteorological messages
  - Same information can be provided to airlines flight operations centers

CNS/ATM Functions with non FANS aircrafts - CFRS

- Centralized Flight Management Computer (FMC) Waypoint Reporting Service (CFRS)
  - Allows non-FANS-equipped aircraft to send position reports in a manner similar to CADS
  - Position Reports from aircraft that have FMC WPR (Flight Management Computer Way Point Reporting) capability
  - Honeywell PIP (Product Improvement Package) or Pegasus avionics required
    - Boeing 757-200, Boeing 767-300, Airbus 310, Airbus 319

Departure Clearance (DCL)

- Request for Departure Clearance over data link
- Departure Clearance service enables the flight crew to communicate directly with the airport tower via data link to obtain clearances
- DCL replace the voice communications between pilots and controllers, thereby reducing the number of voice messages sent over congested VHF frequencies
- The main benefits are fewer ATC delays at busy airports, a safety improvement from having fewer communication errors between pilot and controller, and a reduced controller workload

D-ATIS: Digital Automatic Terminal Information System

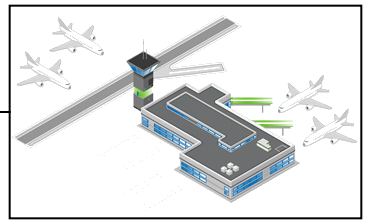
- Contains weather observation, runway information, Notices to Airmen (NOTAMs), and airport advisories
- Request/Response
- 620 Format – Bit oriented messages, user defined labels
- 623 Format – Character Oriented ATS Messages – B9 label
- Updated by CAA approximately every hour (sometimes we poll for data)
- Expire after 80 minutes in U.S. (can vary by country)

- TWIP – Terminal Weather Information for Pilots
  - Now known as Integrated Terminal Weather System
  - Provided by Doppler Weather Radar in Terminal Area
  - Wind Shear, Microburst, Gust Fronts, Tornado, Moderate to Heavy Precipitation

D-ATIS Message Flow

ATS Server

Library of about 150 stations – U.S., Canada, Australia
Germany, Thailand, China, Mexico
Can handle both 620 and 623 requests
Also contains TWIP (U.S. only)

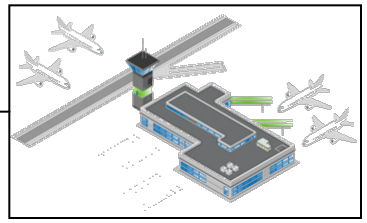


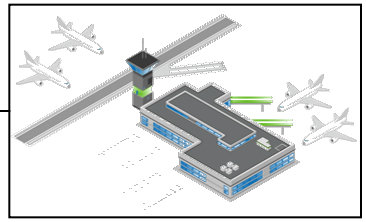
StarCaster

Mexico City

GLOBALink
Message
Processor

SITA





623 to airport

ARINC DCL and D-ATIS Messaging
Caribbean, Central and South America

Departure Clearance

- Colombia
  - Bogota (BOG)
- Mexico
  - Mexico City (MEX)
- Panama
  - Panama City (PTY)

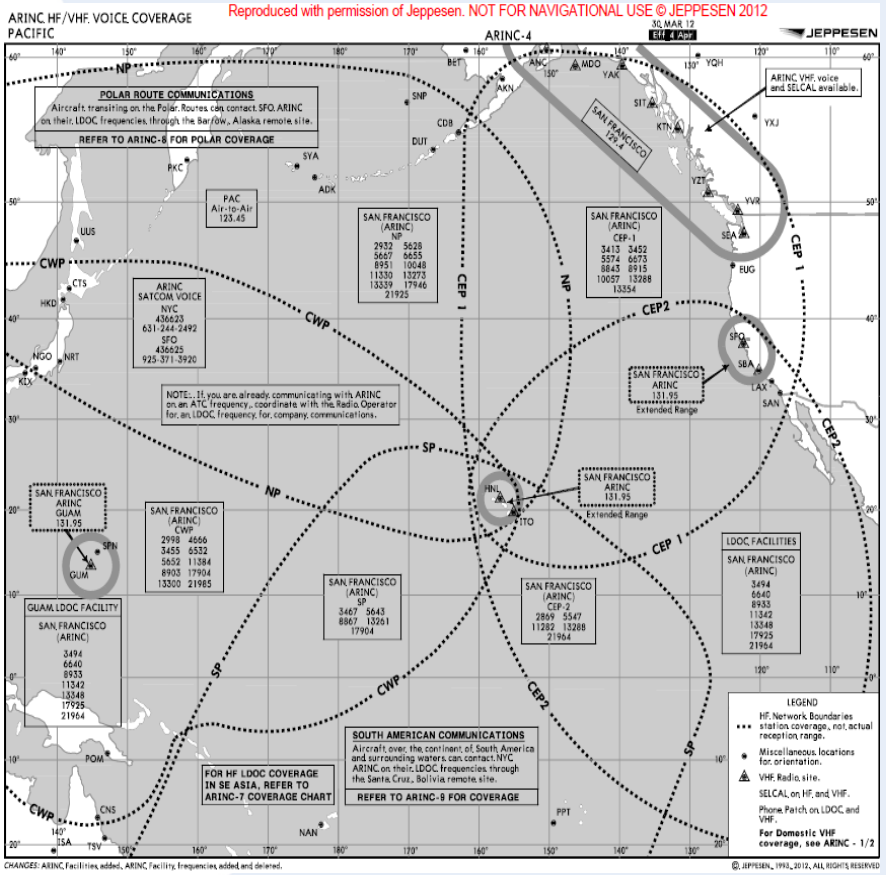
D-ATIS

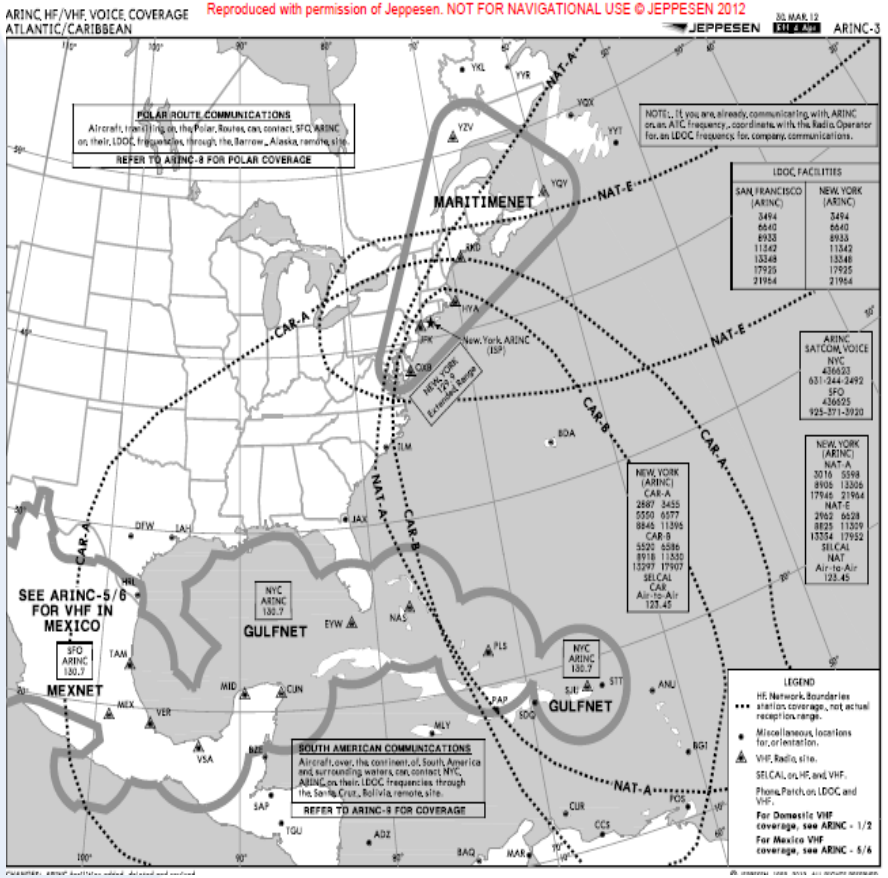
- Argentina
  - Buenos Aires (EZE)
  - Cordoba (COR)
- Aruba
  - Aruba (AUA)
- Mexico
  - Mexico City (MEX)

GLOBALink FAA/Airline Operation Center Communications

- Air/Ground International HF Voice Service
- New York and San Francisco Long-Distance Operational Control Facilities
- Atlantic, Caribbean, Central and South America, Pacific Oceanic Canadian and Arctic Region, Gulf of Mexico
- Airline Operations Centers messaging

GLOBALink FAA/AOC HF/VHF Voice Coverage (NYC/SFO)



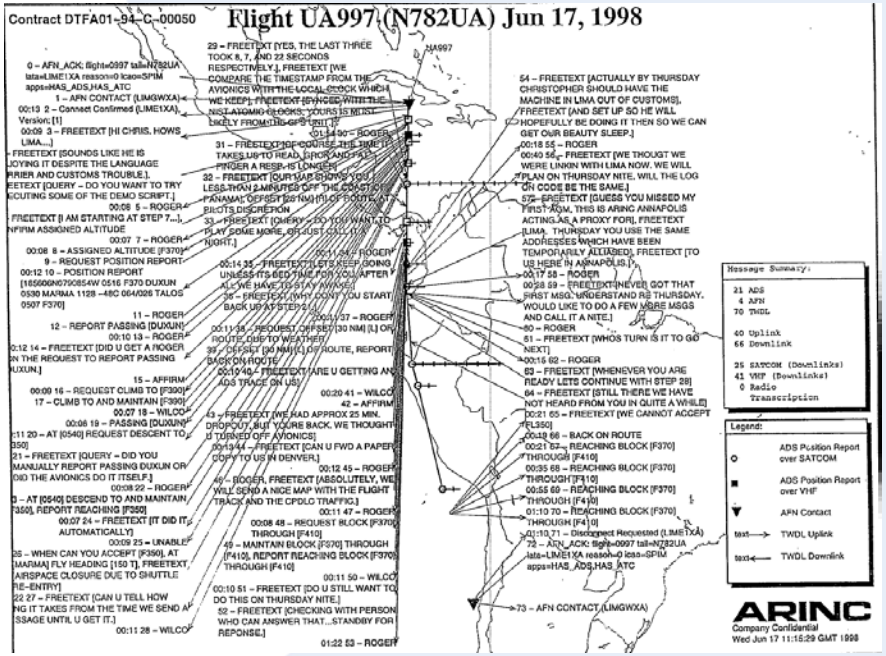


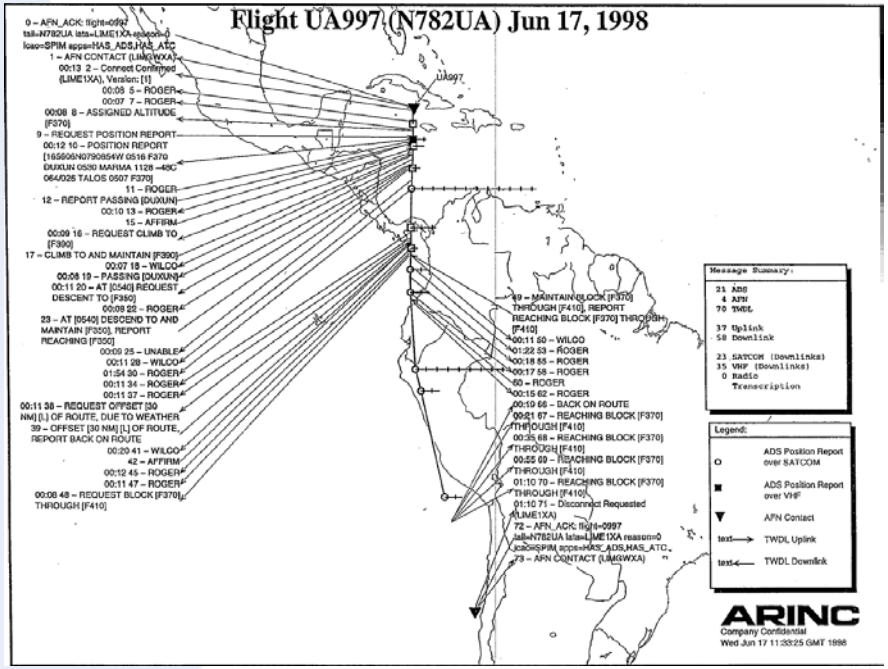
Technical Support Services

- FANS and ATN Test Support
  - Customer Support for OEMs conducting rollout testing on avionics
  - Can mimic ATS facility for pre-flight or in-flight verification of FANS equipment, SATCOM links, etc.

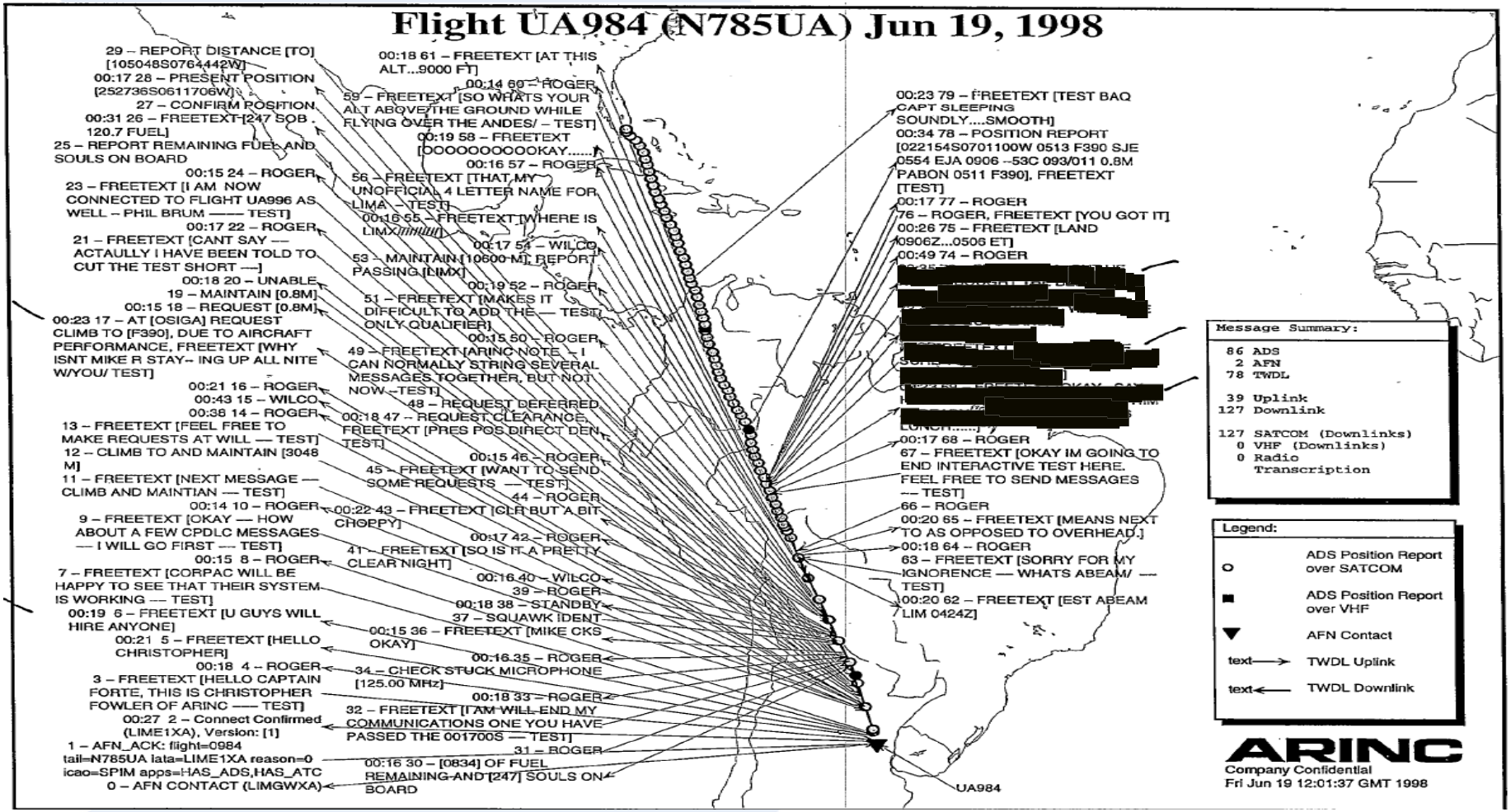
Our ANSP Partnerships

First ADS/CPDLC - Latin America FANS Trials in Cooperation with CORPAC and United Airlines
MIA - SCL

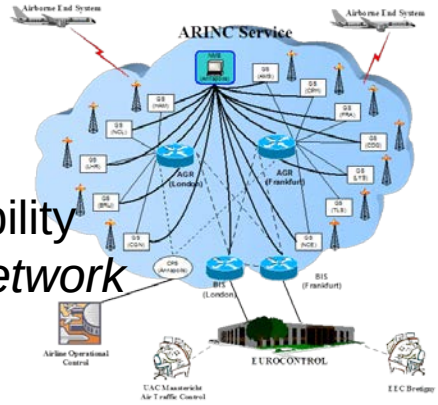




First ADS/CPDLC - Latin America FANS Trials in Cooperation with CORPAC and United Airlines MIA - EZE



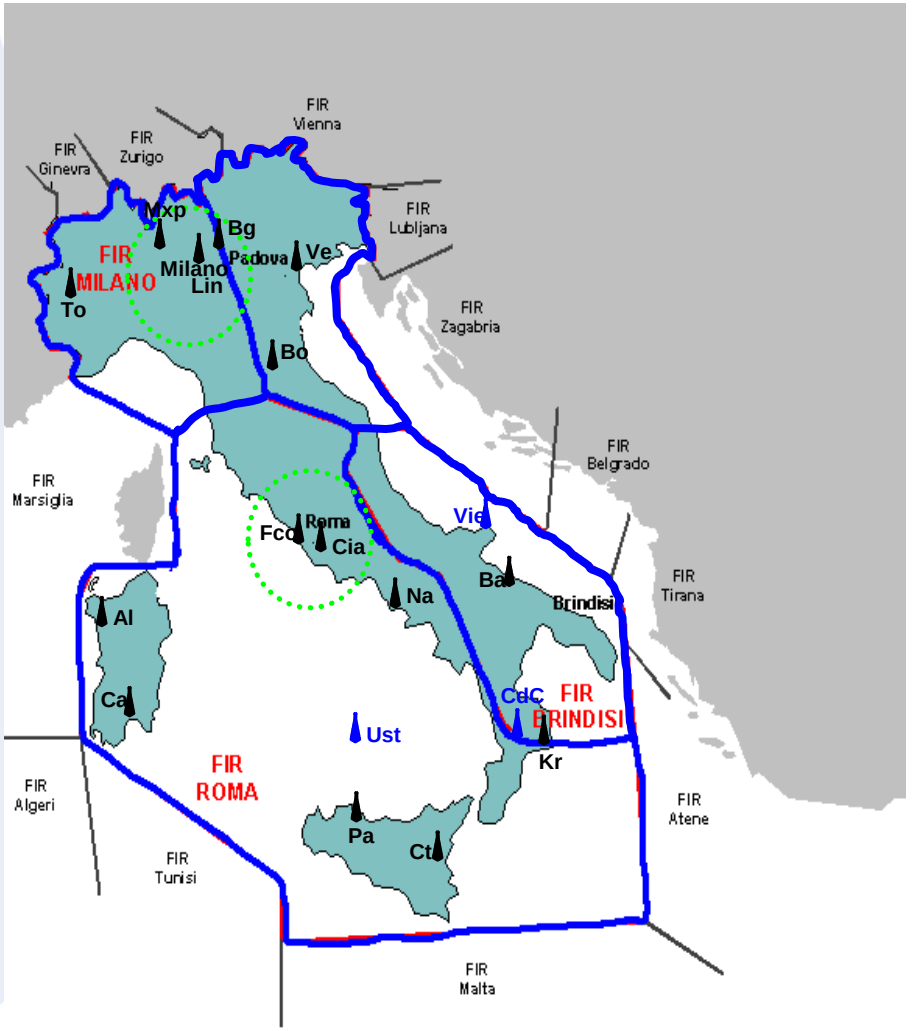
ARINC and ATN: Review and Work-in-Progress



- ARINC's European ATN/VDL Mode 2 network:
  - In operation since 2004; proven: 99.99% service availability
  - *Most European ATN flights handled by ARINC's ATN network*
- ARINC ATN service contract with Maastricht since 2004
- ARINC/ENAV partnership agreement covering POA, AOA and ATN services
- ARINC partnership agreements for POA with NavPortugal, AENA, Skyguide, DFS and AustroControl.
- Meetings with ANSPs to extend the POA partnerships and include ATN-VDL Mode 2
- Supporting avionics ATN certification activities with Boeing, Airbus, Rockwell Collins, Honeywell, Garmin, Spectralux, Dassault, Bombardier, Embraer, Cesna…
- Eurocontrol awarded ARINC the VDL Multi-frequency test bed to be deployed in Bretigny

Next Country to Implement ATN: Italy

- ENAV and ARINC are deploying 15+ VHF/VDL stations in Italy
- SELEX and ARINC have designed a brand new integrated Ground Stations
- ARINC A/G and G/G ATN routers already installed
- CIA is the first ENAV station operational from now
- D-ATIS and DCL services over ACARS will also be implemented



Asia / Pacific Region

- ARINC continues its partnership with Aeronautical Radio of Thailand (AEROTHAI) and Aviation Data Communications Corporation (ADCC) to provide VHF ACARS in the Asia / Pacific region

- ADCC provides coverage within mainland China
  - VDLM2/AOA Stations now operational in Hong Kong and Beijing

- AEROTHAI provides coverage throughout most of Asia / Pacific region
  - VDLM2 AOA operational in Bangkok & Singapore
  - Continued ACARS deployments in Australia, New Zealand, Malaysia, & India

- AVICOM provides coverage within Japan
  - Long standing internetworking arrangement with ARINC
  - ARINC provided AVICOM with a replacement ACARS network
  - Deployment completed in 3rd QTR 2011 – System performance excellent.

- ADCC, AEROTHAI, ARINC, and AVICOM Operate Separate CPS systems

Fueling the Future

- Embarking on our next 80 years, with a commitment to…
  - Exceed our customers' expectations
  - Continue to innovate
  - Retain our leadership in communications