GLOBALink:
New and Status Report

Prepared for:

AEEC Data Link Users Forum
February 2-4th, 2016
Miami, Florida

Rockwell Collins
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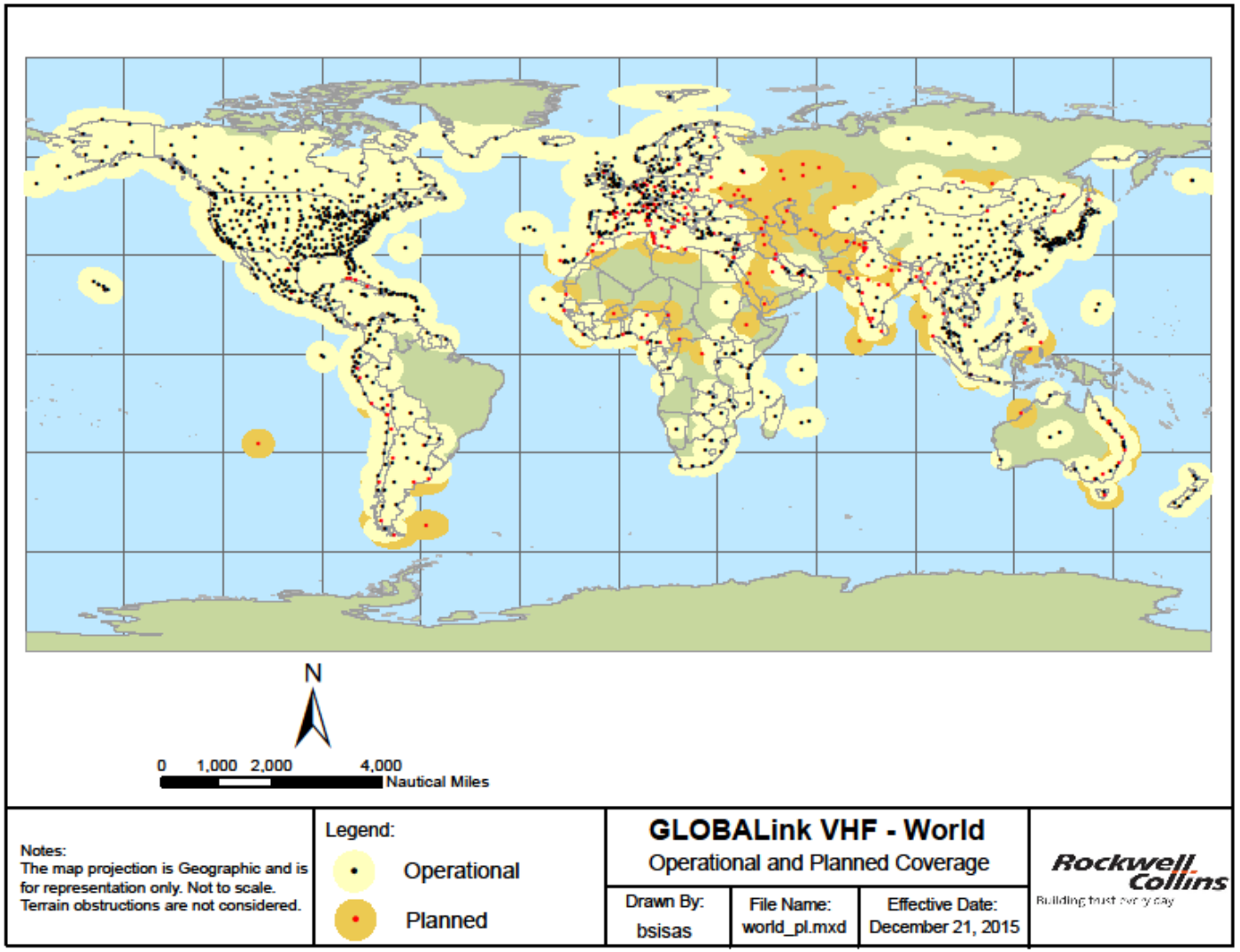
List of Topics

- GLOBALink Headlines: Performance & Statistics
- GLOBALink/VHF Service Expansion: Americas, Asia, & Europe
- VDLM2 AOA and ATN Services and Regional News
- Long Range Media: Satellite and HFDL
- MultiLink
- MIAM Support

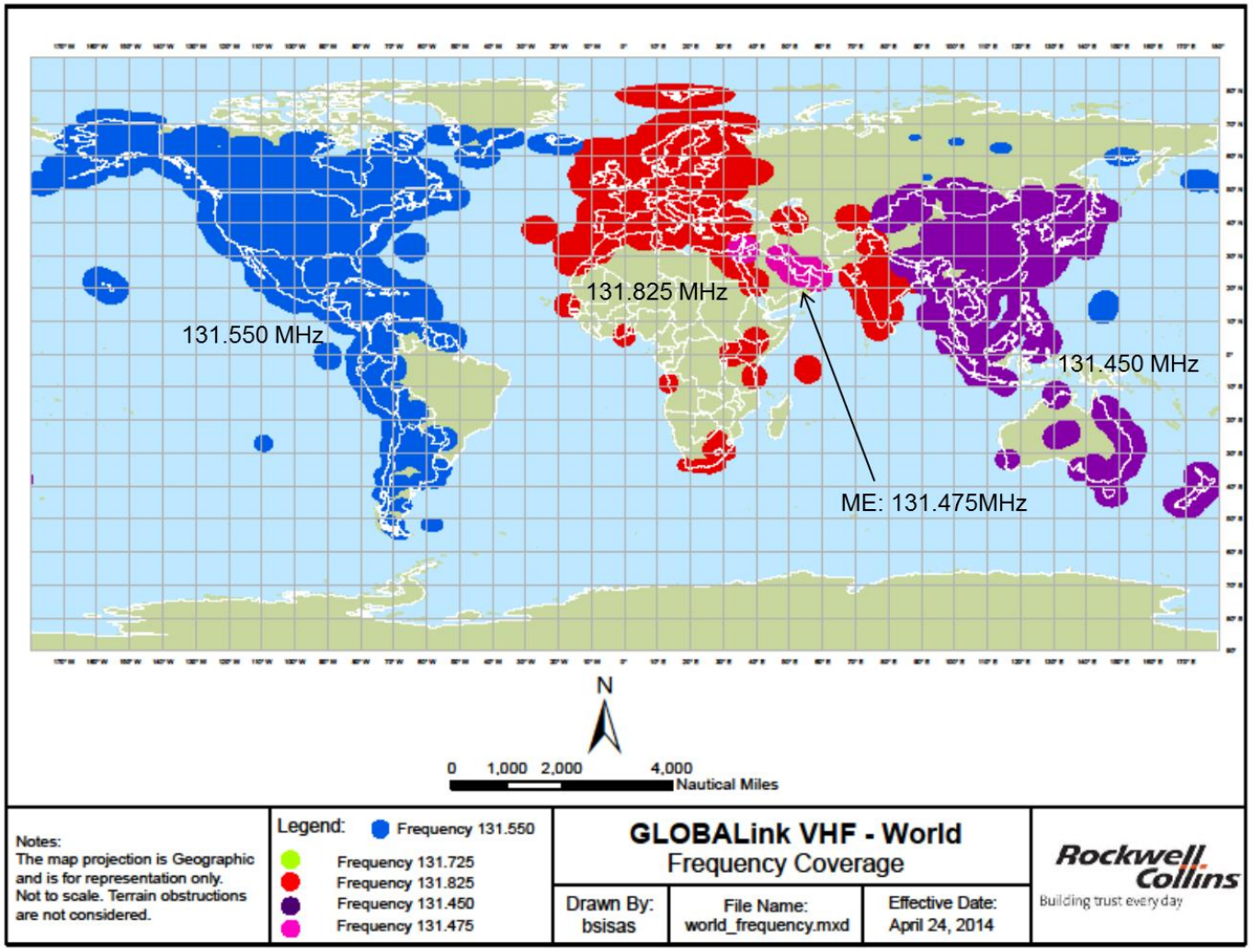
ARINC GLOBALink: Current Statistics

- Worldwide Service
- Approximately 19,000 aircraft delivering more than 80 million messages every month at over 1,050 airports
- System-wide avg. msg. size
  - Uplink message - 330 characters (~2.6 kilobits)
  - Downlink message - 230 characters (~1.8 kilobits)
- GMP Availability: 100.000% (2015)
- Maximum ACARS Message Size: 3850 characters
- 3:1 Downlinks To Uplinks
- Typical round-trip response time: 10-12 seconds (POA) / 2 sec (VDL)
- Eleven frequencies in the Americas
- ~80% of messages are AOC related
- ~20% are ATS (D-ATIS/ PDC/TWIP) related
- Ave. Uplink Success (Nov 2015):
  - 98.8% POA / 97.7%% VDL AOA

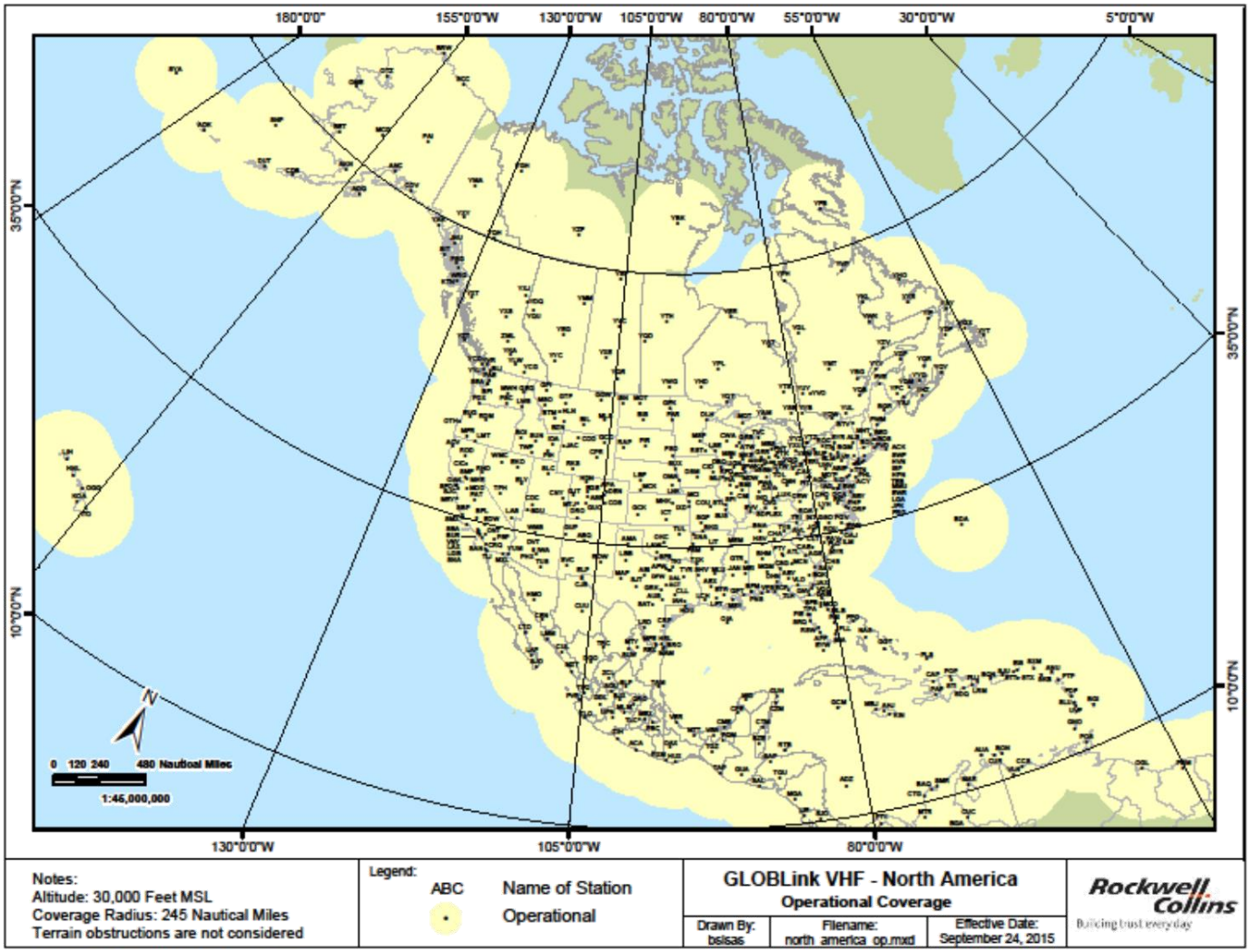
GLOBALink/VHF Service Expansion



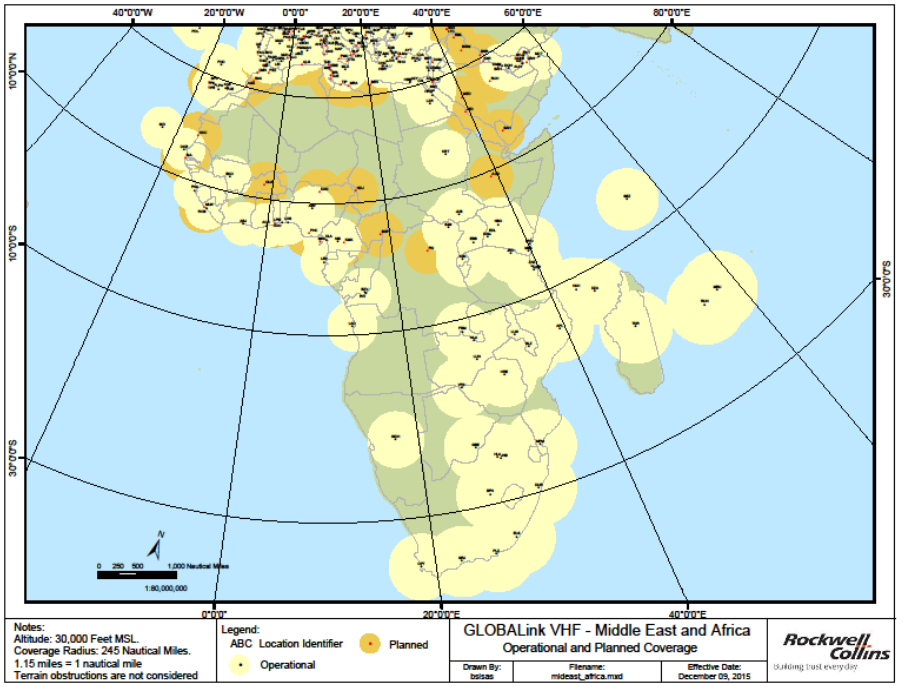
ACARS Base Frequencies by Region

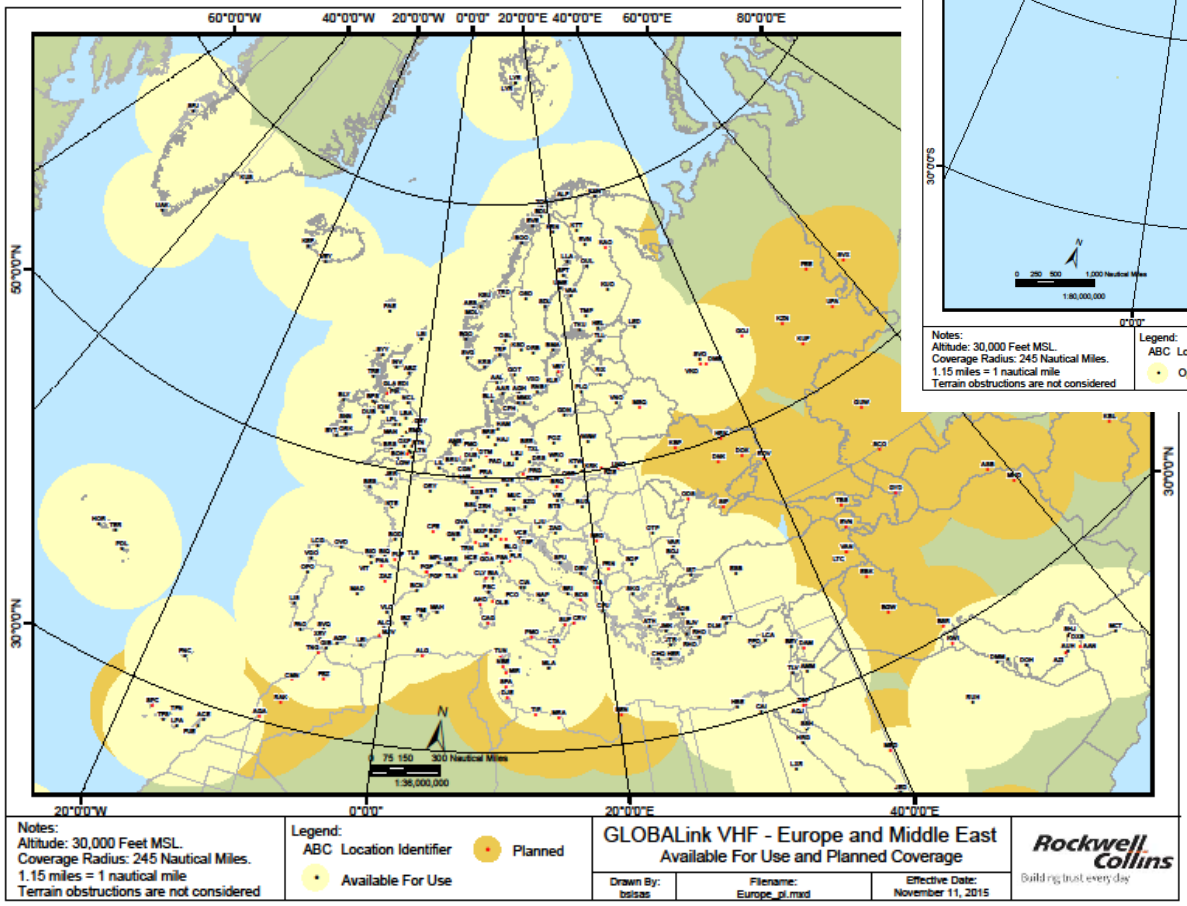


GLOBALink/VHF North America: 2016 Plans

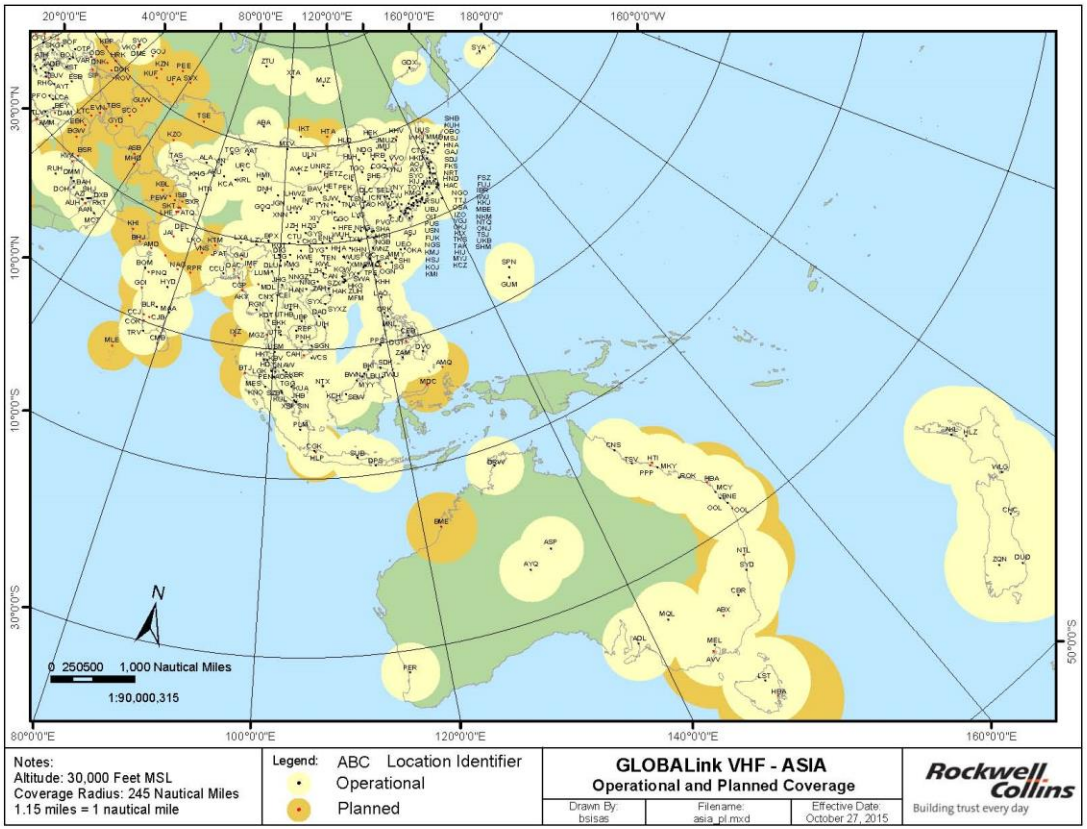


GLOBALink/VHF EMEA

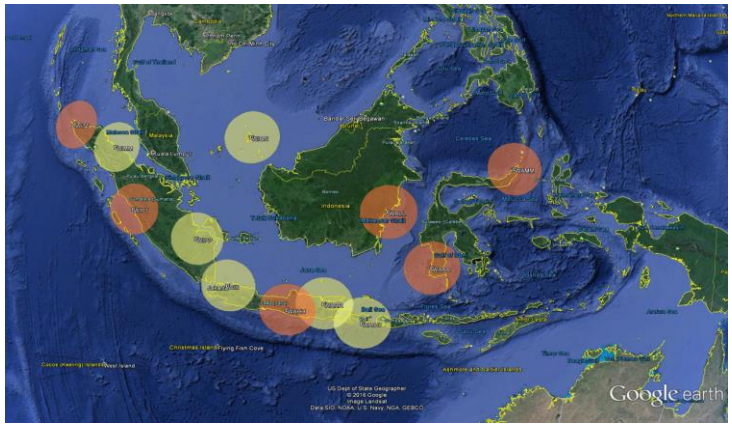




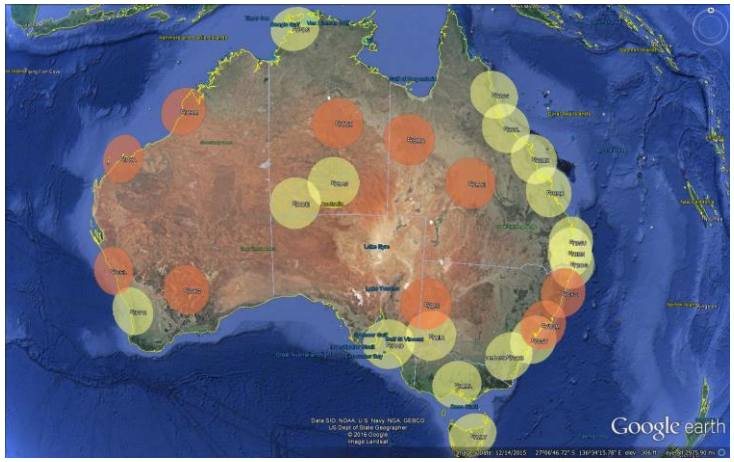
GLOBALink/VHF: Asia



Indonesia planned & existing VHF coverage



Australia planned & existing VHF coverage



VDL Service Expansion and Multi-Frequency Initiatives

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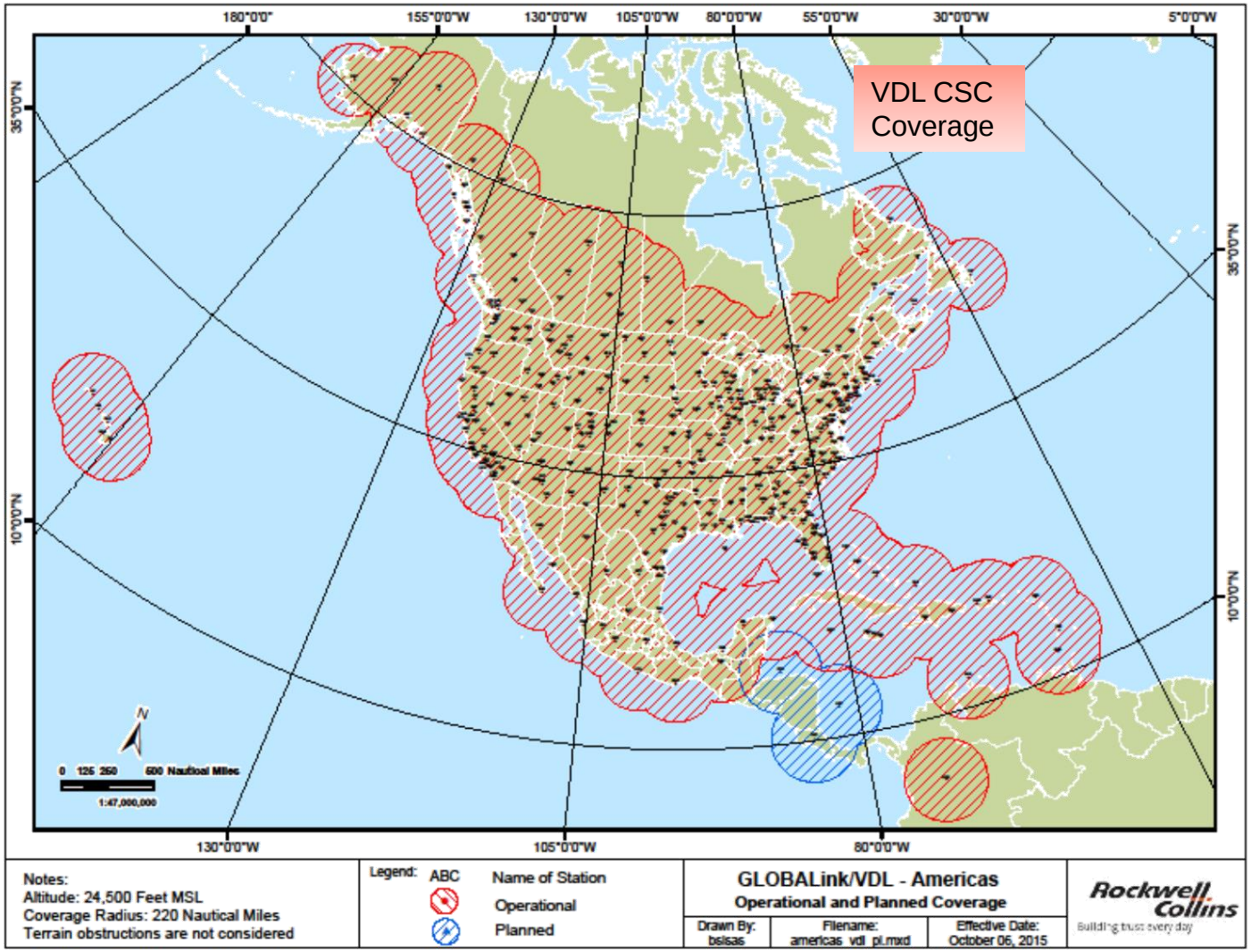
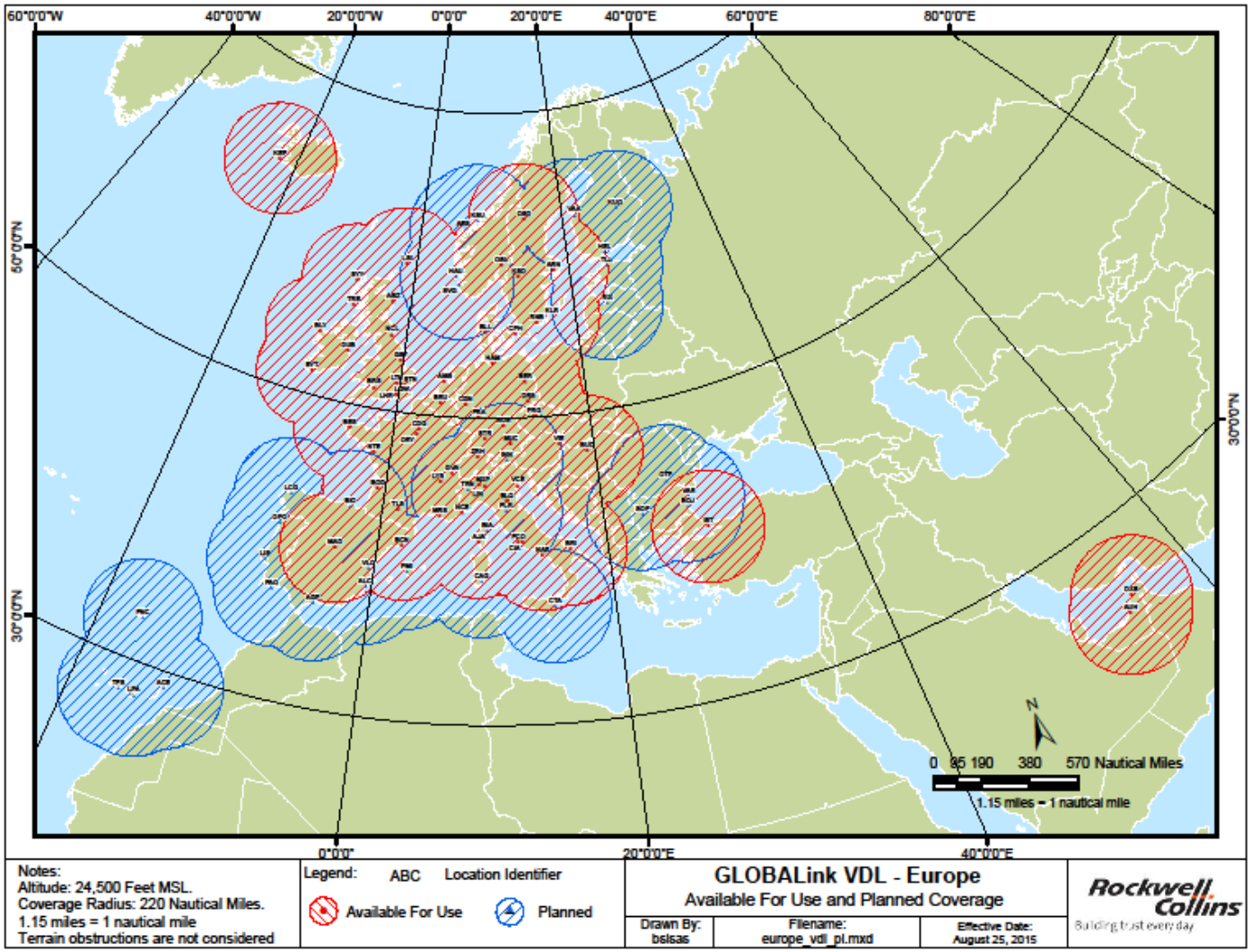
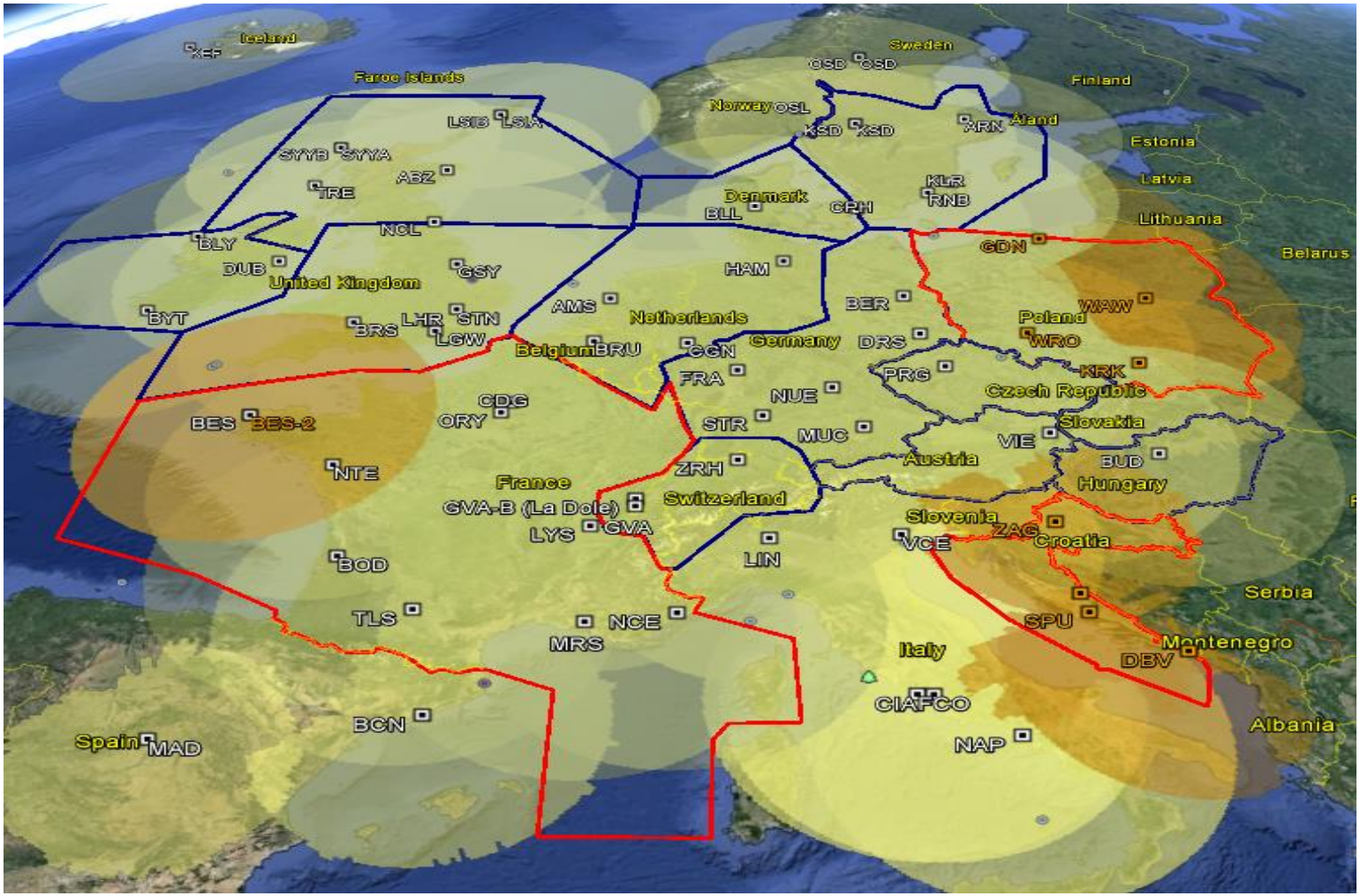
VDL Mode 2 Status: Americas



2016 Planned: European VDLM2 Service Expansion

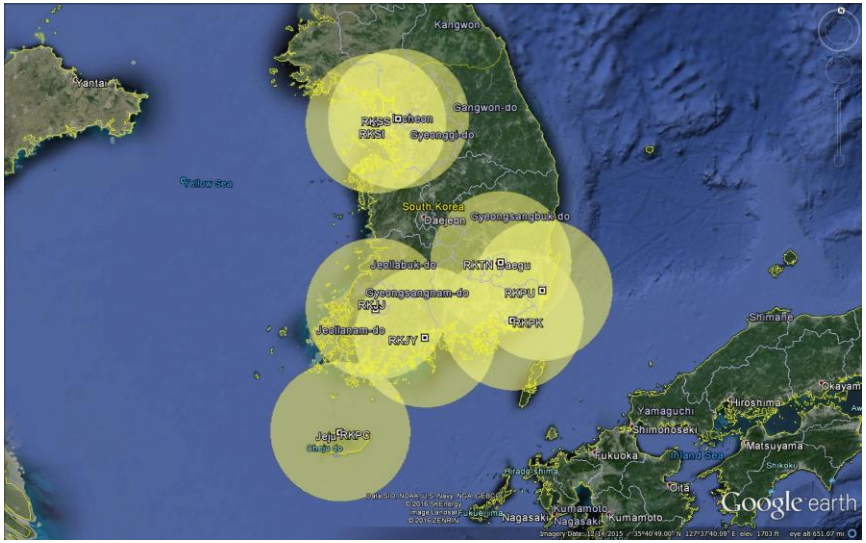


EMEA Air Navigation Service Provider ATN Update

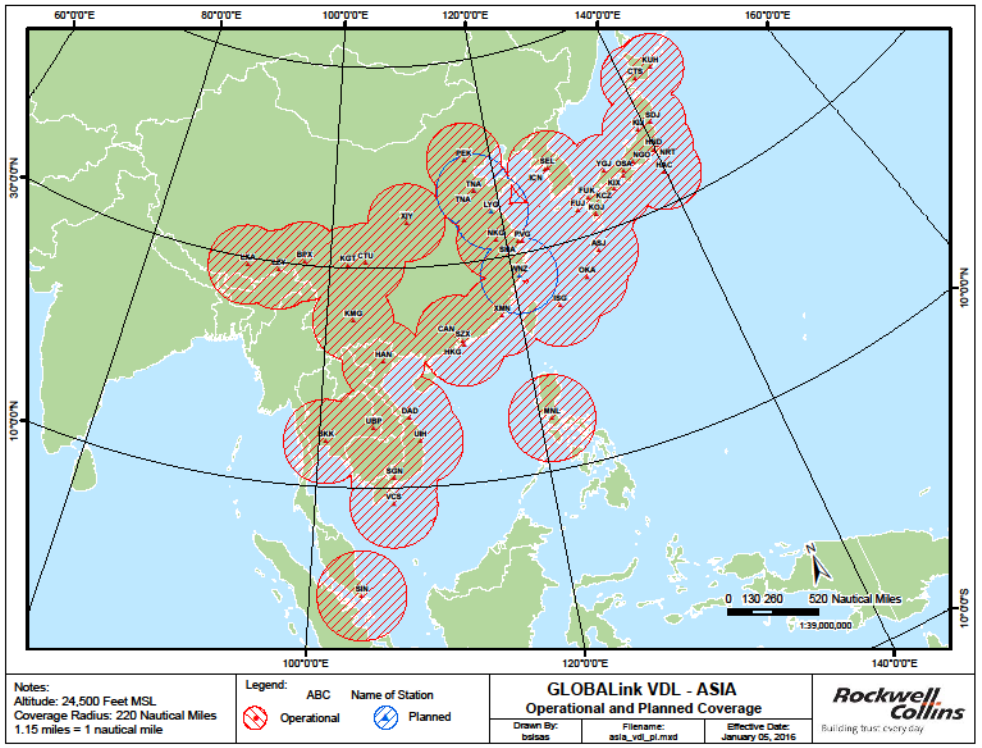


- VDLM2 expansion in Asia driven by customer demands.
  - Japan/AVICOM has comprehensive VDL coverage
  - 2016: Selected airport additions to service customers/fleets needs

- **In Jan 2016, KAC/Korea completed deployment & activated a complete ARINC-turnkey VDLM2 network**
  - **Eight VDL stations in Korea**
  - **Beginning w/AEEC 623 applications before moving toward ATN CPDLC**



KAC/Korea VDLM2 network



VDL Mode 2 in Asia

SATCOM Long Range Media: Classic Aero, SB-S & Iridium

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GLOBALink/Long-Range Communication Services

- GLOBALink Long-Range Comms:
  - HFDL
  - Inmarsat
  - Iridium

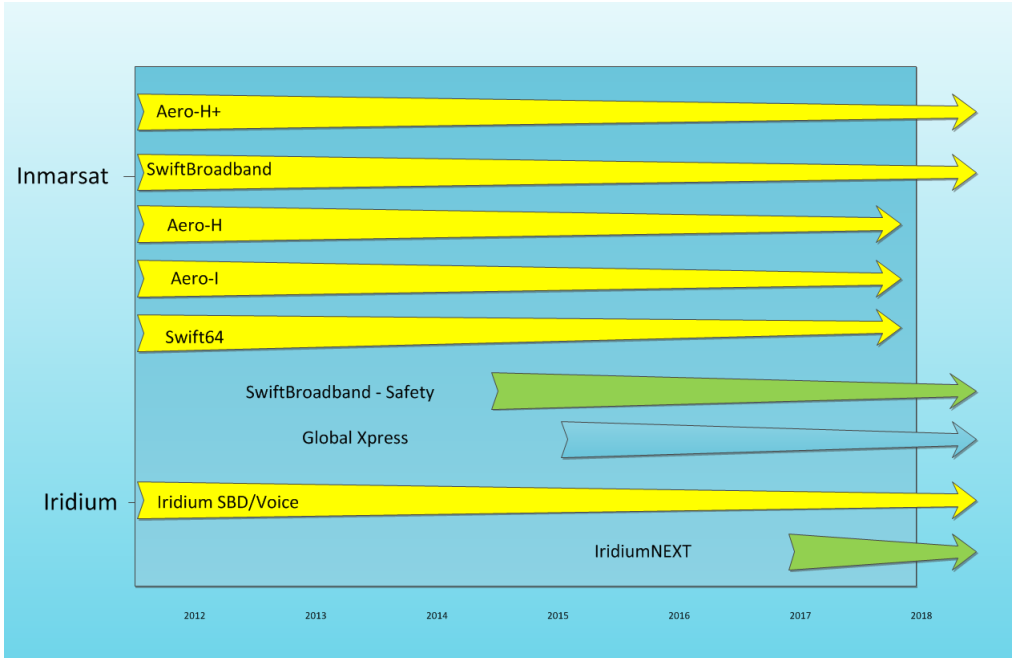
- Complementary long-range data and/or voice service offerings for global aircraft communications

- Independently robust, resilient and redundant networks to ensure safety service operational needs are consistently met

- ARINC is the only company in the world that offers HFDL, SATCOM, and VHF services

Inmarsat I-3 & I-4 Connectivity: Classic/SBB Services

- Continuing to offer Classic Aero services over the I-3 and I-4 satellite networks
- Aero-H and Aero-I services end-of-life scheduled to coincide with the I-3s decommissioning in 2018



- Available Services Over the I-4s:
  - Classic Aero:
    - ACARS (Data-2)
    - Cabin (Data-3)
    - Voice
  - SwiftBroadband:
    - Standard IP/Streaming IP/Circuit-switched Voice
    - Simultaneous voice and broadband data
    - Supporting Inmarsat in SwiftBroadband-Safety Evaluations
    - SB-S FANS:
      - Started mid-2015
      - Commercial services launch estimated for mid-2016

Iridium Services Update

- Service portfolio primarily consists of the following:
  - Voice
    - Includes ATS and AOC SIM card use for safety services to the flight deck
  - Short Burst Data (SBD)
    - Includes ACARS functionality for flight deck ATS/AOC use
- Current 'Block 1' constellation to be replaced by 'NEXT' Constellation
  - Full satellite system deployment expected in 2017
- ARINC (Rockwell Collins IMS) is a direct Value Added Reseller (VAR) for all service offerings

Iridium Services Update (continued)

- Rockwell Collins named as Value Added Manufacturer (VAM) for NEXT constellation in February 2015
  - Value Added Reseller (VAR) process for NEXT to follow this year
- Customer ATS Voice use continues
  - PARC CWG / ATS Voice Tiger Team activities that foster safety switch use for secured calling
  - Industry starting to implement temporary MMEL relief for 2 HF radios when required with 1 HF + 1 SATCOM
- NEXT constellation launches beginning this year
  - New satellites will be positioned within existing orbits in a coordinated approach
  - Certus Broadband
    - Higher data rates (up to 512 Kbps Up / 1.5 Mbps Down) anticipated with full backwards compatibility for new equipment sets
    - Services classes ranging from 100Kbps to 1.5Mbps
    - Smaller form factor avionics with full range of antenna gains

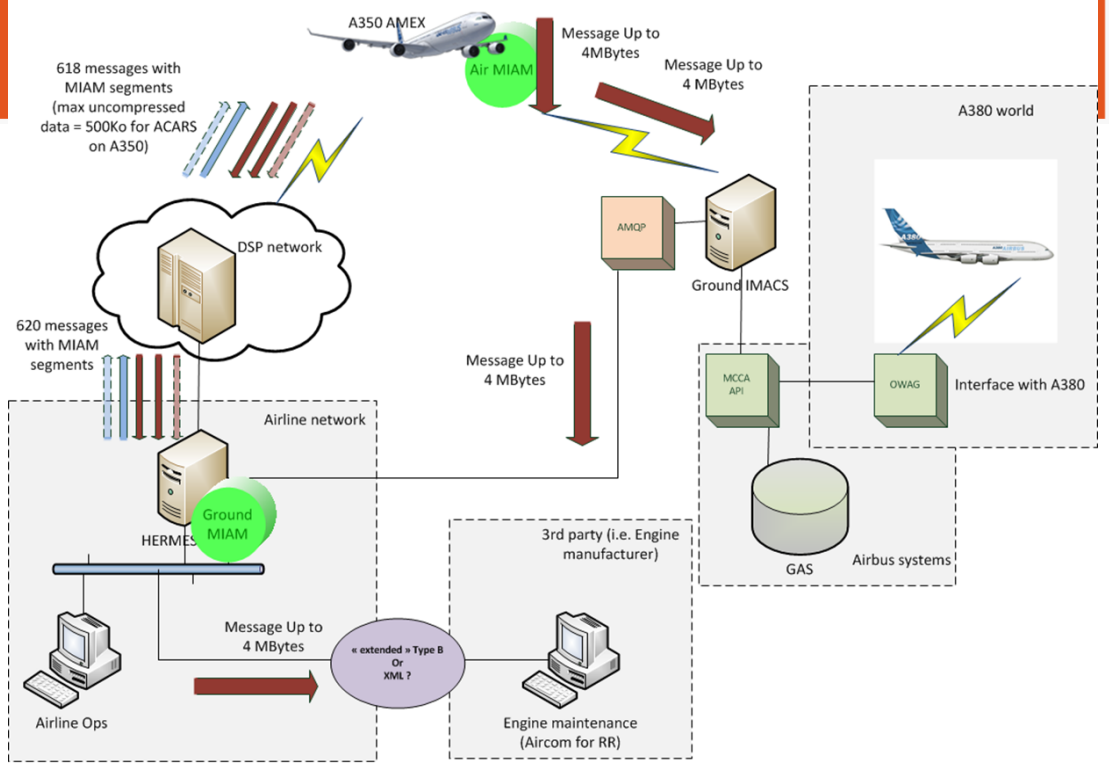
Flight Tracking – The Mandate

- EC mandates focused on operators having flight tracking capability in place by Dec 2018
- Flight tracking capability must have ability to identify distressed flight behavior and provide alert any time outside ATC radar or ADS-B
  - Position updates interval not addressed but expected to be released by European Aviation Safety Agency (EASA) in future
- The International Civil Aviation Organization (ICAO) has recommended 15 minute reporting with one minute triggered by abnormal events
  - Requirement most likely implemented by Nov 2018

MultiLink – Our Solution

- The ARINC MultiLink solution meets today's requirements
  - Combines all aircraft position data feeds available: VHF/VDL, HFDL, SATCOM (Inmarsat and Iridium), ADS-B, ADS-C, ASDI TFM (US, Canada radar feed) and Eurocontrol position data feed
  - Additional feeds will be integrated as they become available (AMDAR, Inmarsat SBB system position data)
  - Provides information pertaining to "Mute Aircraft" which alerts airline length of time from last positional data
- MultiLink upgrades include
  - Flight plan lateral deviation alerting
  - MultiLink aircraft tracking solution display will provide airlines with the capability to change positional downlink rates across all media to meet requirement
- Thirteen airlines current users of the MultiLink product

Support for “MIAM” Media Independent Aircraft Messaging



What is MIAM?

- Much concern and misunderstanding regarding MIAM and AEEC Standard 841:

- Primary intent is to deliver large >50Kb messages from aircraft to/from ground:
  - Protocols defined to leverage ACARS as the transport media
  - Content is segmented & encapsulated within standard ARINC 618
  - General definition & provisions to deliver large messages via some future IP based link. Further standard work is required

- Airbus A350: First MIAM application. Downlinks only

- MIAM requires peer to peer aircraft and ground servers to encode/decode MIAM protocol which can be:
  - DSP-Based
  - Customer premise based

MIAM Solutions Available Today:

- We have two options available today:

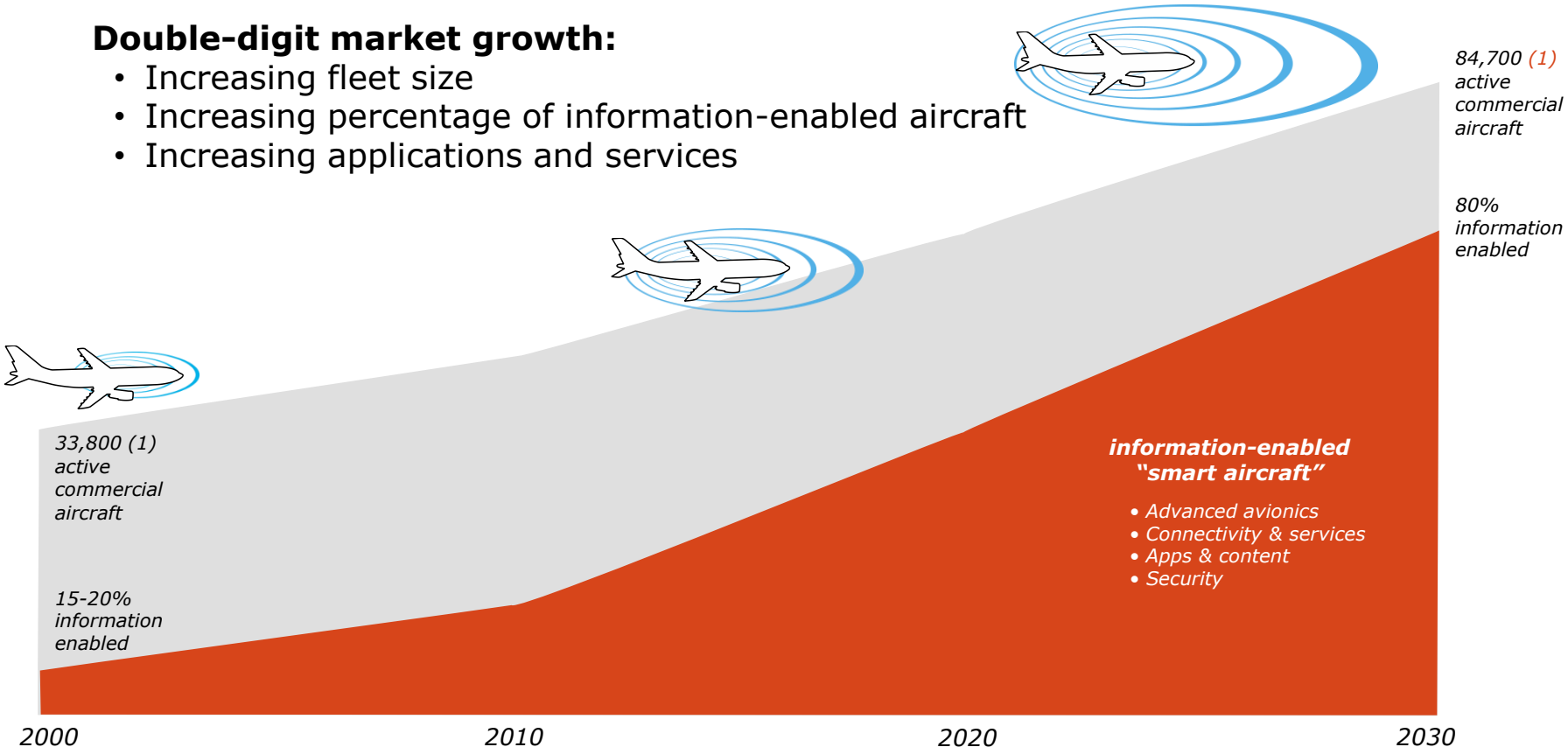
- DSP Based Implementation: GMP (Jan 2016)
  - The GMP has MIAM functions allow customers to keep their seamless ACARS network interface
  - DSP maintains coordinated communication management functions for network optimization
  - Standard AMQS can transport of 64K message packets; other AMQS options allow for 256K packets

- Premise Based Implementation: Hermes
  - Primary implementation method to date
  - Requires operator to operate and maintain necessary network connectivity and servers to support MIAM processing
  - Requires coordination with DSP(s) for MIAM flow control processing

Increasing demand for information enablement

Double-digit market growth:

- Increasing fleet size
- Increasing percentage of information-enabled aircraft
- Increasing applications and services



(1) – Air transport, regional and business aviation aircraft

Summary

- We continue to lead the aviation industry with superior service, availability and technical support

- We continue to invest in GLOBALink infrastructure to enhance existing services, beginning the introduction of new communications services and applications, and are exploring the communications media for use in the next decade.

- We fully support the next era of highly integrated communications and applications that will include CNS ATM services and are working with regional Aviation Authorities to enhance communications and flight safety