# AeroMACS Bandplan, User Community

April 22, 2015

# AeroMACS Bandplan Discussion

- Introduction & background
  - ITU adopted bandplan
  - Network reference model
  - Relevant standards organizations

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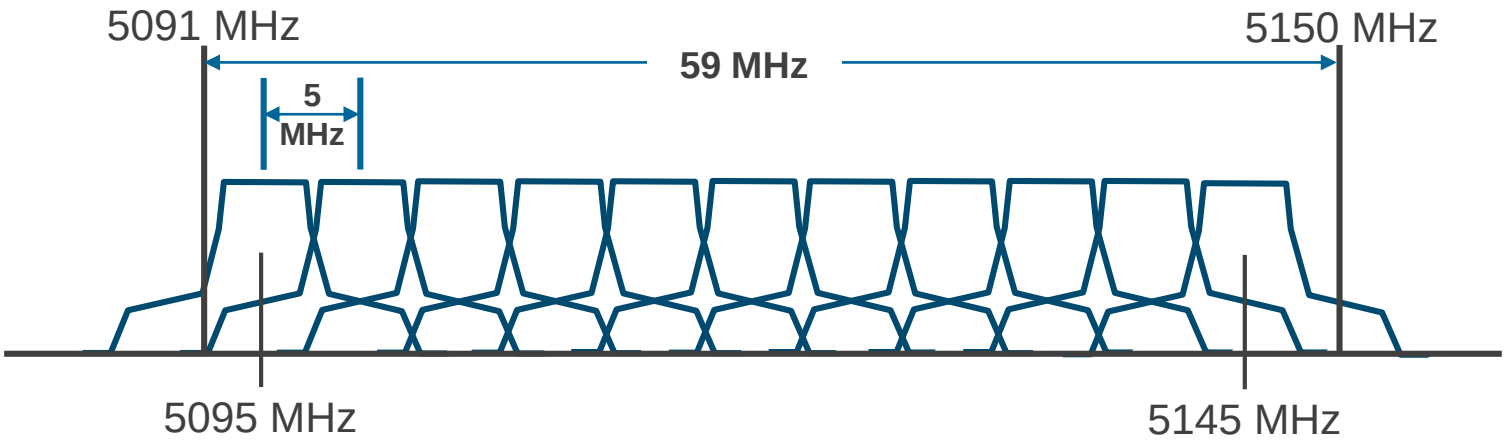
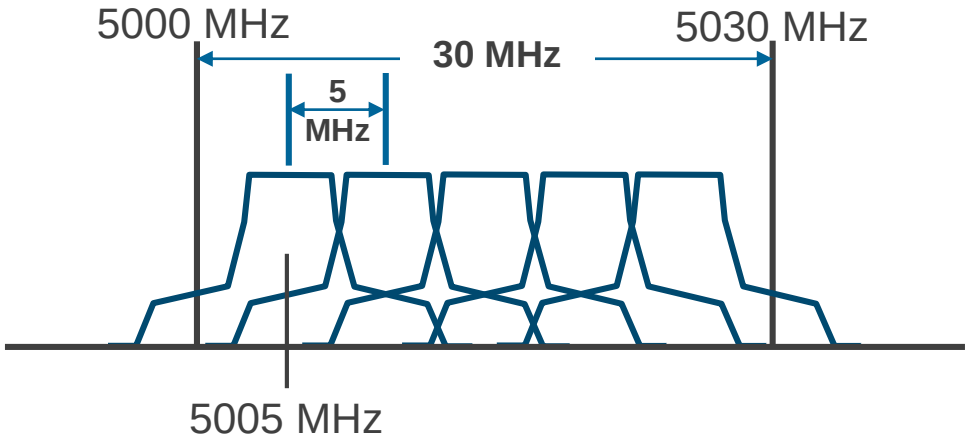
# International Spectrum for AeroMACS

- Adopted by ITU at WRC-07
- AeroMACS SHALL support 5 MHz channels in the 5000 to 5150 MHz band[1]
- Core Band: 5091-5150
  - ITU WRC-07 Adopted (Co-primary AM(R)S allocation)
  - Supports ELEVEN 5 MHz Channels
- Future (as available): 5000-5030 MHz
  - Provides an additional FIVE 5 MHz Channels

[1] *Minimum Operational Performance Standards (MOPS) For the Aeronautical Mobile Airport Communication System (AeroMACS)*

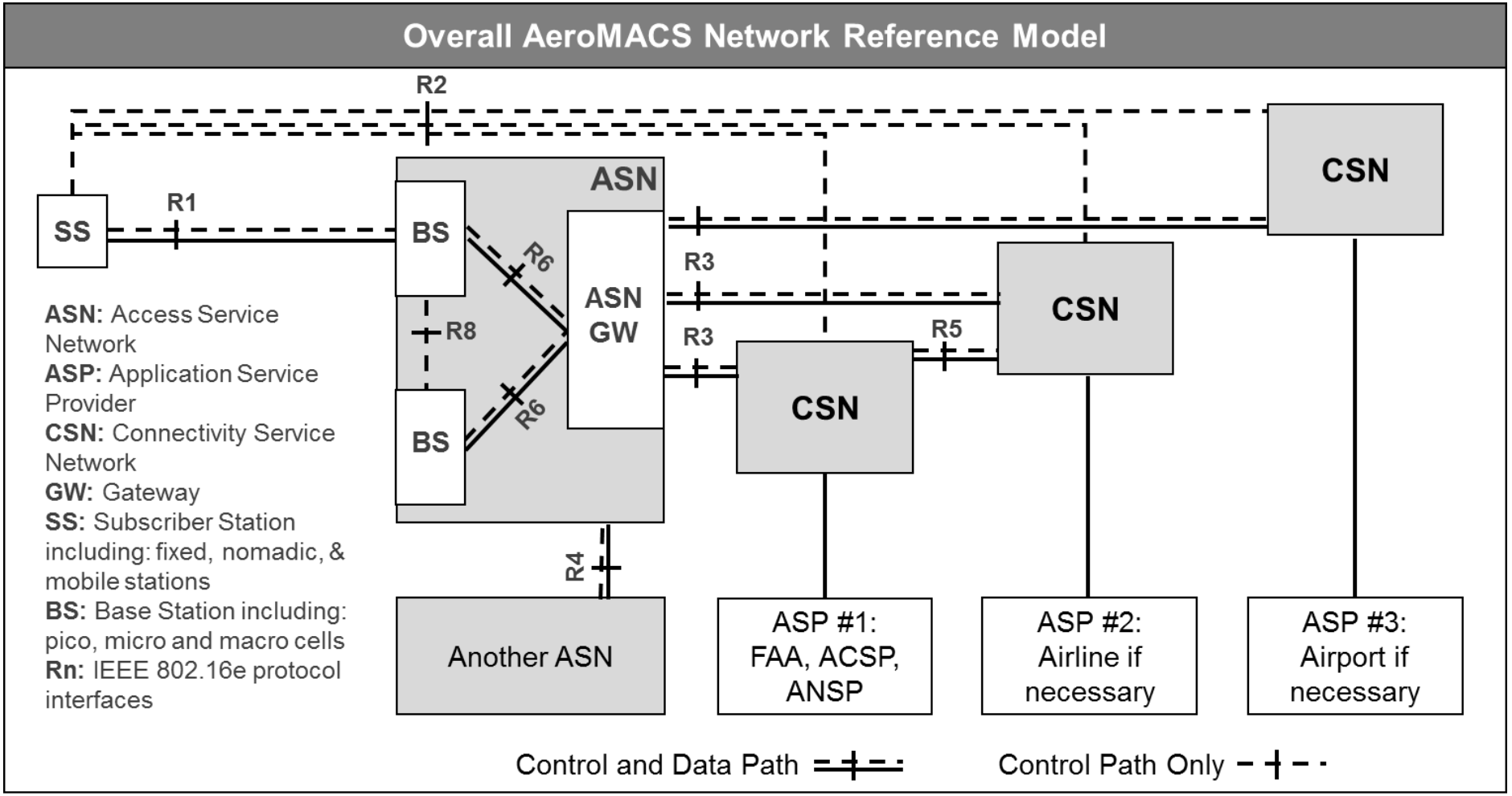
# AeroMACS Bandplan




- 5091-5150 MHz internationally allocated by ITU WRC-07
- 5000-5030 MHz identified as possible additional spectrum as available nationally

# AeroMACS Airport Network




- ***BS Backhaul comprised of wireline (fiber) and/or PtP wireless in AeroMACS band or other suitable frequency band***

# Subscriber Stations Include:

## Category

- Aircraft (A/C)
  - Commercial Passenger
  - Commercial Cargo
  - Private
- Equipment Pods
  - Multilateration pods
  - Weather observation pods
- Airport Ground Handling Equipment (GHE)
  - Tow vehicles
  - Cargo & baggage handling
  - Passenger shuttles
  - Etc.
- Authorized personnel
  - Handheld portable devices

## Mobility Required

- Mobile
  - Up to 50 nautical miles per hour
- Stationary
- Nomadic pico-cell BSs

# Relevant Standards Organizations

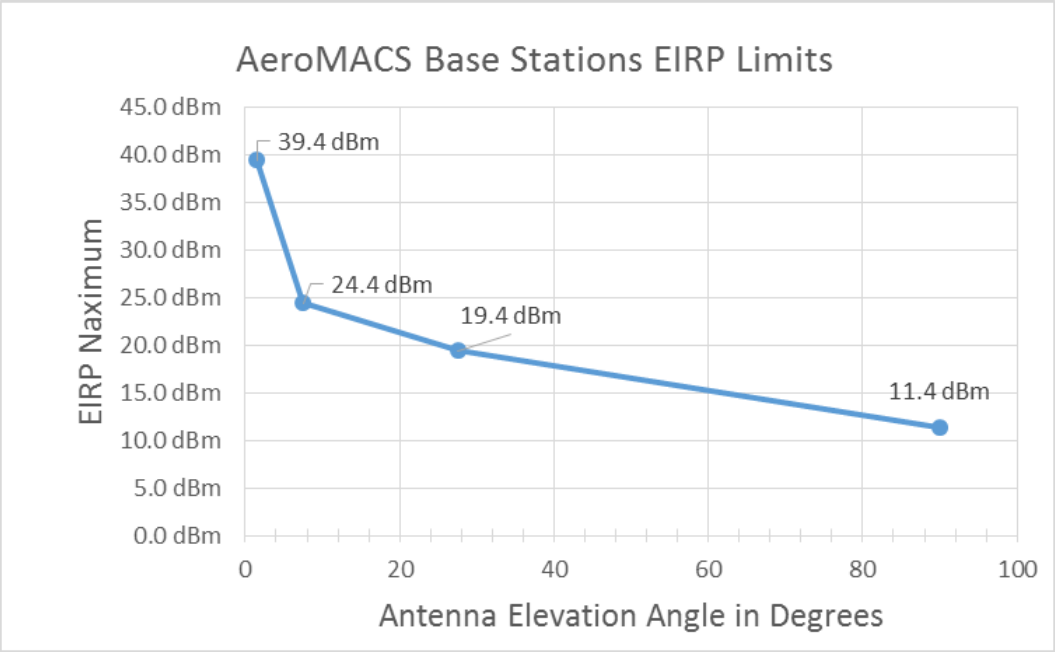
- IEEE: IEEE std 802.16e-2005/9
- WiMAX Forum:  AeroMACS Profile
- RTCA (Radio Technical Commission for Aeronautics): Minimal Operational Performance Standards (MOPS) for the Aeronautical Mobile Airport Communications
- ICAO (International Civil Aviation Organization): Standards and Recommended Practices (SARPs)
- EUROCAE (European Organization for Civil Aviation Equipment): - Minimum Aviation System Performance Standards (MASPs) *draft*

# 1. Technical Parameters

a) Channel BW: 5 MHz channels, 250 kHz step size
b) Duplexing: TDD
c) BS & SS EIRP Limits: ensure 2% noise threshold limit for non-geostationary satellite uplink (Globalstar) *slide 9*
d) BS Antenna Elevation *slide 10*
e) Spectral Mask (i.e. OOBE) *slide 11*

# 1c: BS/SS EIRP Limits[1]

- Base Station:
  - Dependent on elevation angle →
- Subscriber Station:
  - 30 dBm Maximum[2] for A/C and GHE
  - 23 dBm for Handheld portable devices

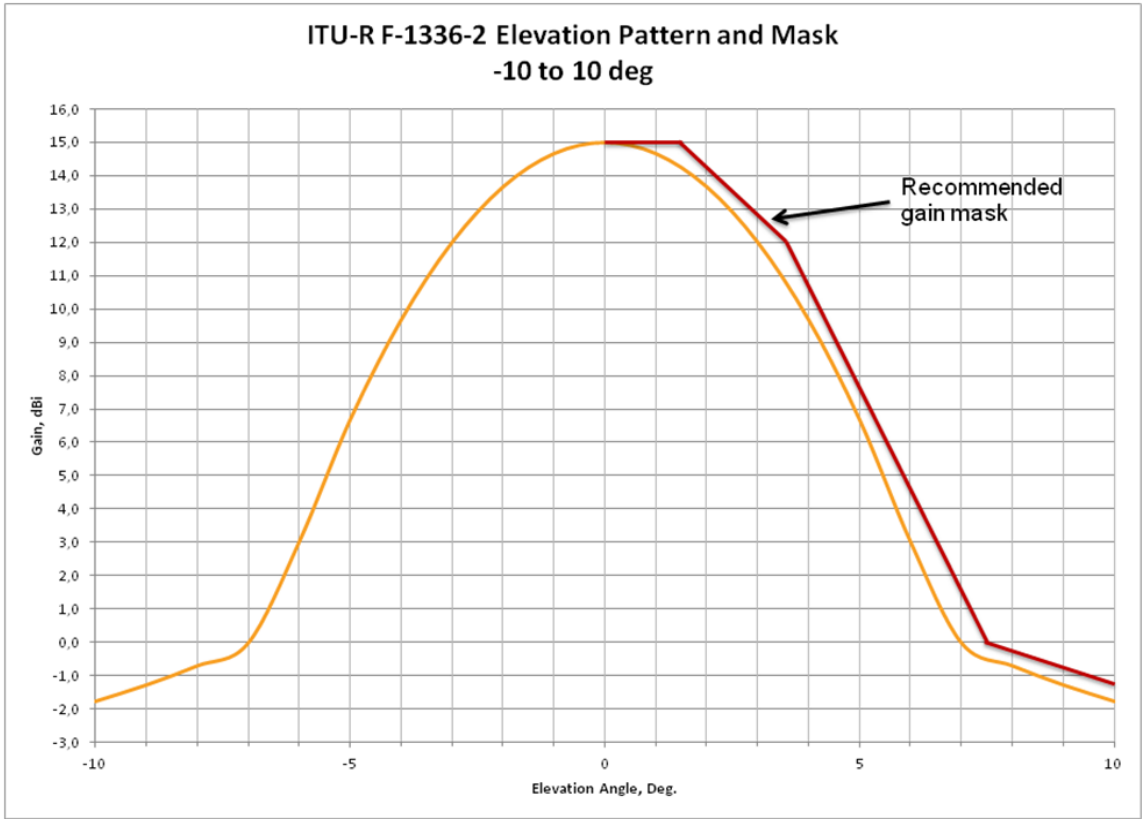



*[1] Based on subgroup of RCTA SC-223 lead by ITT Exelis to ensure ≤ 2% increase in thermal noise temperature for Globalstar feeder links (note: consideration being given to change to 5%, corresponding to 4 dB increase)*

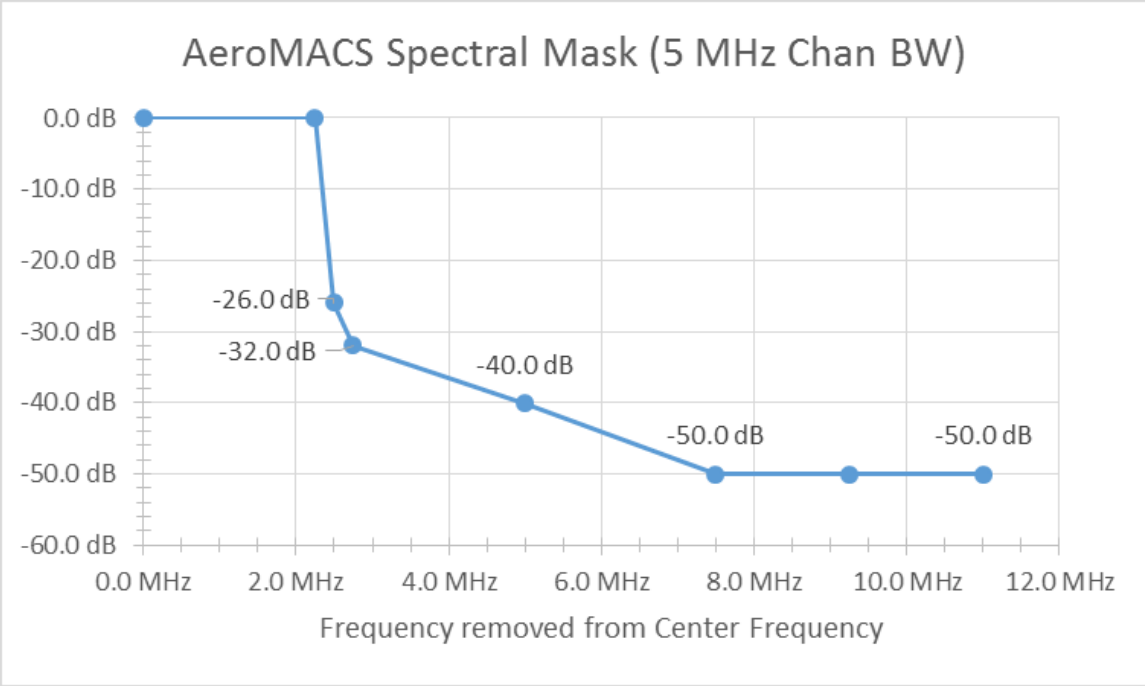
*[2] Typically lower in gate areas in consideration of human safety exposure limits*

# 1d: Recommended BS Antenna Elevation Mask [MASPs]

- 15 dBi sector antenna
  - Azimuth 120 degrees
- Elevation as shown →



# 1e: AeroMACS Spectral Mask




Per: MOPS and SARPs

# 2. Eligible Licensees/Users

- Potential Licensees
  - Network Access Provider (NAP) or,
  - Aeronautical Communication or,
  - Airport Operator or,
  - FAA
- Users
  - FAA
  - TSA or local authorized Security Organization
  - Airport Operator including authorized sub-contractors
  - Airline Carriers (passenger and cargo)

# 3. Process for Channel Access

- Advanced security measures (PKMv2) will prevent unauthorized access to the AeroMACS network
- AeroMACS SHALL support Quality of Services (QoS) and Class of Service (CoS)
  - Ensures critical services get appropriate priority access to channel capacity and ensures each authorized user has adequate access

# 4. Federal vs. Non-Federal Users

- Federal Users
  - FAA, TSA
- Non-Federal Users
  - Airline Carriers
    - Medium & large hubs will have multiple commercial passenger & cargo carriers
  - Airport Operator
    - Local municipality, port authority, private airport owner, law enforcement, authorized sub-contractors such as fueling, catering services, etc.

# 5. Services & Applications

- Data and Video will be primary, voice will be secondary
- Authorized services fall into 5 domains:
  - Air Traffic Management (ATM)/Air Traffic Control (ATC)
  - Aeronautical Information Services and Meteorological Data (AIS/MET)
  - Aircraft Owner/Operator
  - Airport Authority
  - Airport Infrastructure
- Some examples on next slide

# 5. Services & Applications (cont.)

| Aviation Authority<br>FAA, EUROCONTROL, ACSP, ANSP, etc. | Airport<br>Airport Operator/Port Authority/TSA Applications | Airline Carrier<br>Airlines (passenger & cargo) Applications |
|---|---|---|
| • Air Traffic Control (ATC)<br>• Air Traffic Management (ATM)<br>• Surface Communications, Navigation, Surveillance (CNS)<br>• Weather Sensors (Weather Observation Improvement, WOI) | • Security Video<br>• Routine and emergency operation<br>• Aircraft de-icing, snow removal, etc. | • Advisory Information (to aircraft)<br>• Aeronautical Operational Control (AOC)<br>  • System Wide Information Management (SWIM)<br>  • Aeronautical Information Services (AIS)<br>  • Meteorological (MET) data services<br>• Airline Administrative Communications (AAC) |

- Enhanced ATM is essential for minimizing “Taxi-out” times (significant financial benefit)
- Can expect growth in video surveillance for enhanced airport safety and security
- Capacity permitting, other lower priority applications may include the uploading of a/c entertainment services, etc.

# 6. Geographical Coverage Limits

- AeroMACS MUST provide connectivity anywhere on the airport surface where aircraft are located. This includes two airport domains:
  - Runway and Taxiway areas
  - Gate and/or Ramp areas
- AeroMACS coverage will not, intentionally, spill over to areas beyond airport surface. Exceptions for security purposes, may include:
  - Non-aeronautical airport-controlled areas, such as long & short term parking areas, shuttle bus routes, maintenance areas, etc.

# Concluding Remarks

- AeroMACS is a proven technology based on numerous trials and test-beds over the past several years
- Large airport hubs (DFW for one) are interested in moving forward with “Standalone Applications Phase” (MLAT, WOI, etc.)
- AeroMACS will be one of the key enablers for “NextGen,” a high priority congressionally approved and funded program

# Relevant References & Standards


1. IEEE Std 802.16™-2009 (Revision of IEEE Std 802.16-2004) IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems 29 May 2009
2. WMF-T32-001-R010v09 - WiMAX Forum® Network Architecture -Architecture Tenets, Reference Model and Reference Points Part 0 - Release 1.0
3. WiMAX Forum Network Architecture (Stage 2: Architecture Tenets, Reference Model and Reference Points) [Part 1] WMF-T32-002-R010v05 (2009-03-19)
4. MOPS: Minimum Operational Performance Standards (MOPS) For the Aeronautical Mobile Airport Communication System (AeroMACS) - RTCA
5. MASPs: MINIMUM AVIATION SYSTEM PERFORMANCE STANDARDS For ENHANCED VISION SYSTEMS, SYNTHETIC VISION SYSTEMS, COMBINED VISION SYSTEMS And ENHANCED FLIGHT VISION SYSTEMS The European Organisation for Civil Aviation Equipment L'Organisation Européenne pour l'Equipement de l'Aviation Civile, ED-179, December, 2008
6. SARPs: Standards and Recommended Practices, ACP SWG N1/11 WP 13**,** INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES AERONAUTICAL TELECOMMUNICATIONS ANNEX 10 TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION VOLUME III - COMMUNICATION SYSTEMS