ASRI
Aviation
Spectrum
Resources, Inc.

AeroMACS Discussion Period

AFC Fall 2014 Meeting

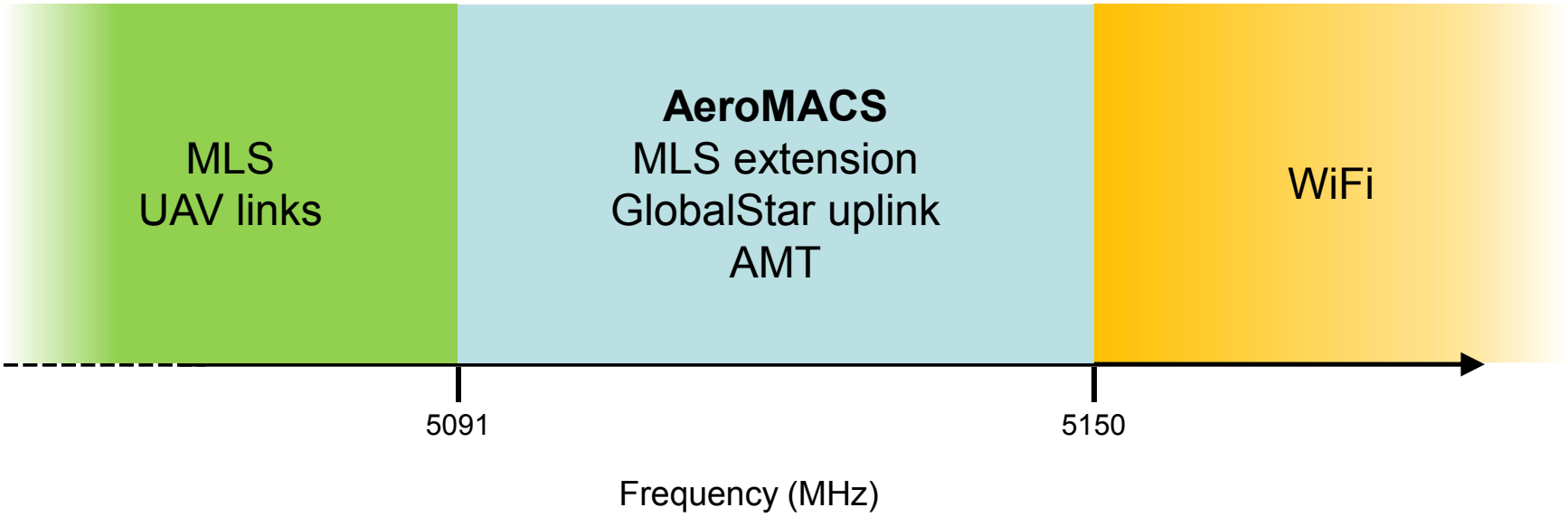
Scope

- To update on AeroMACS implementation in the US spectrum
  - Considering information from the interested organizations
- Objectives
  - Identify unknowns still outstanding
  - What courses of action are now required?

Background Review

- AFC discussion period at the Spring 2014 Meeting identified the following outstanding questions:
  - Coordination with other co-band services?
  - Understanding the FAA implementation?

Coordination with Other Services



AeroMACS

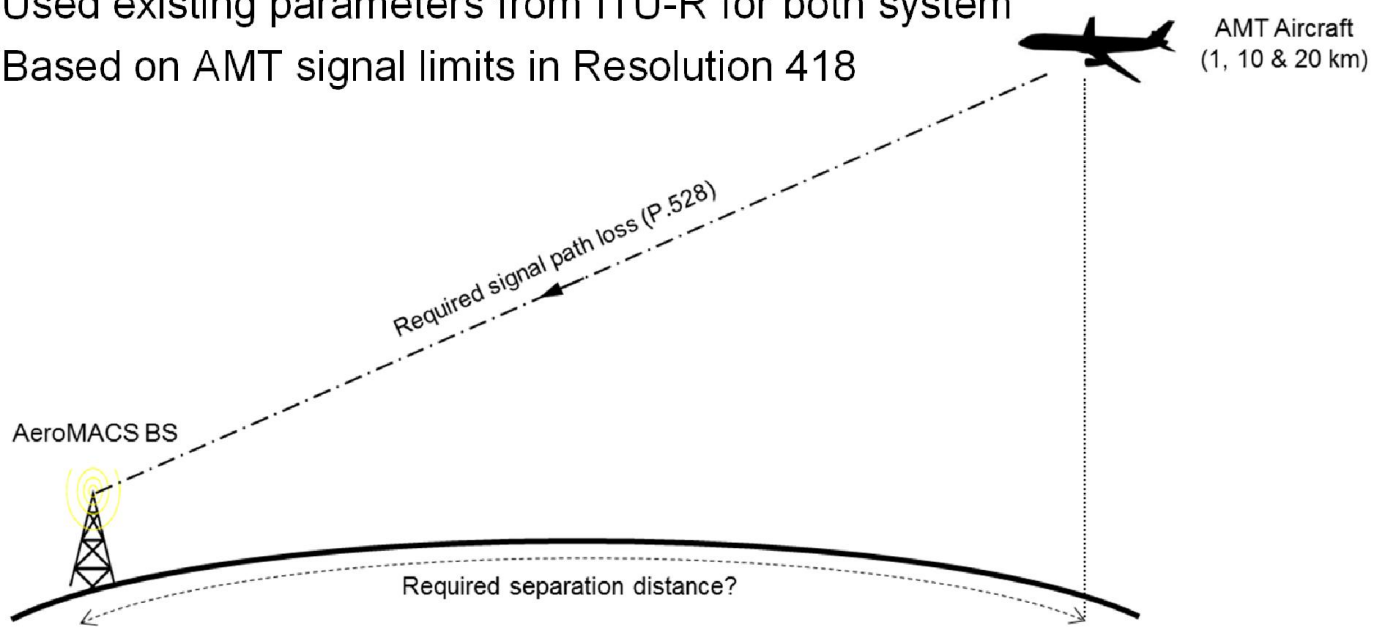
- Assigned a primary AM(R)S allocation for 5091-5150 MHz in WRC-07
  - Given the ‘unused’ MLS extension band
  - Limited to aviation surface safety applications at airports
  - AMT also given co-frequency allocation at same time
- Operational limitation
  - Limited to airport surface applications
  - Must be in accordance with international aeronautical standards
  - Must meet interference limits to co-frequency FSS

Aeronautical Mobile Telemetry

- Co-primary allocation (non-safety)
- Provides data to ground sites from test aircraft
  - One-way link from aircraft to ground receiver
  - Receiver tracks aircraft signal
- Combination of military and civilian use
  - Mostly operated in isolated areas at 52 sites across US
  - Several civilian airports have onsite/nearby operations
    - Seattle, St Louis, Dallas/Ft Worth, etc.
- Potential interference between systems
  - AMT signal into AeroMACS BSs
  - AeroMACS signal into AMT tracking receivers
- No coordination mechanisms considered at this time

AeroMACS and AMT Co-Frequency

- Preliminary study at last WG-F
  - Tested co-frequency separation distances
  - Used existing parameters from ITU-R for both system
  - Based on AMT signal limits in Resolution 418



ITU-R Resolution 418 (WRC-12)

For the protection of the aeronautical mobile (R) service (AM(R)S) in the frequency band 5 091-5 150 MHz, the maximum pfd produced at the surface of the Earth, **where AM(R)S may be deployed in accordance with No. 5.444B**, by emissions from an aircraft station of an aeronautical mobile service system, limited to transmissions of telemetry for flight testing, shall not exceed**: -89.4 dB(W/(m^2·20 MHz)) - Gr (θ).**

Gr (θ) represents the **mobile service receiver antenna gain** versus elevation angle and is defined as follows:

$$G_r(\theta) = \max[G_1(\theta), G_2(\theta)]$$

$$G_1(\theta) = 6 - 12\left(\frac{\theta}{27}\right)^2 \qquad G_2(\theta) = -6 + 10\log\left[\left(\max\left\{\frac{|\theta|}{27}, 1\right\}\right)^{-1.5} + 0.7\right]$$

where:

G(θ) : gain relative to an isotropic antenna (dBi)

(θ): absolute value of the elevation angle **relative to the angle of maximum gain (degrees).**

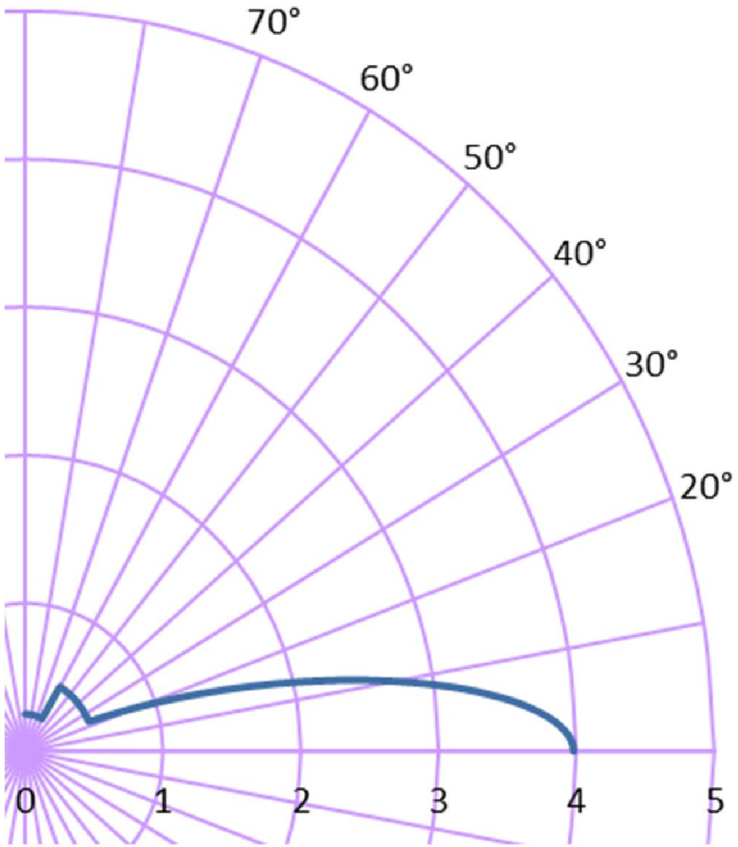
Study Results

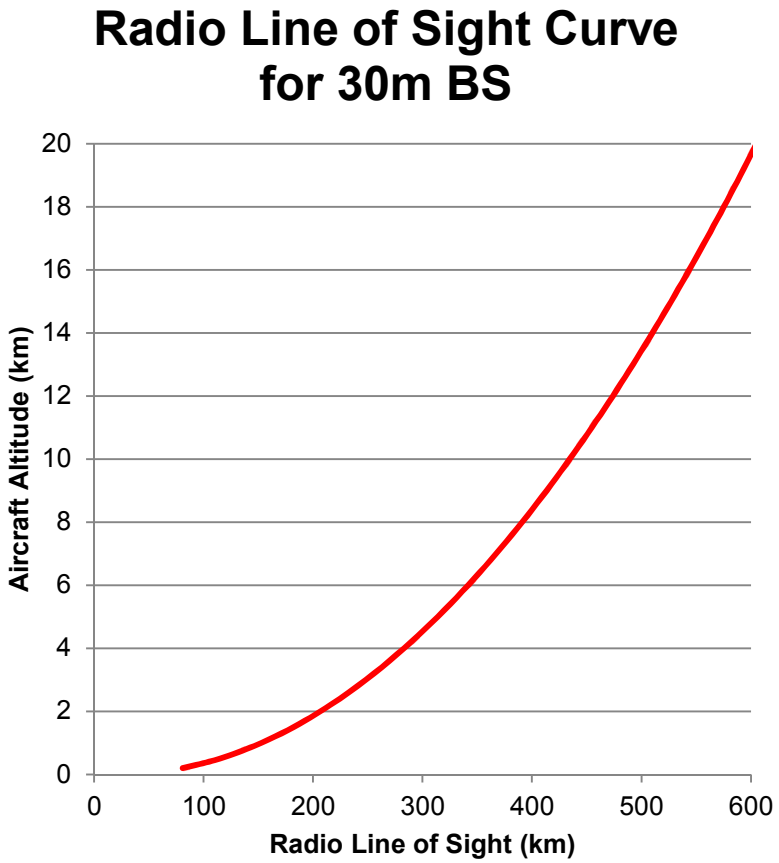
- Results specified a minimum range for several aircraft operating altitudes
  - Used the P.528 G/A propagation model
  - Range affected by radio line of sight
  - Receiver antenna pattern has +6 to -6 dB gain

Aircraft Operating Altitude (km)	Range (km) P.528 Model	Range (km) P.525 Model
20	285.9	66.2
10	311.7	136.1
1	154.9	163.1

- Would exclude AMT from large parts of the US and Europe if confirmed
  - Unclear if Res 418 has precedence

AeroMACS Specified Antenna Pattern





Other Co- and Adjacent-Band Services

- Japanese ANSP working on adjacent UAV and WiFi system interactions
  - Preliminary theoretical results show no compatibility issues
- GlobalStar feederlinks should not be degraded given current models
  - Thermal limit due to be raised (WRC-15 AI1.7)
  - Global coordination requirement still uncertain
- MLS' limited deployment shows no coordination requirements needed

FAA System Deployment

- Met with Brent Phillips, Mike Biggs, and Mike Richmond in early July
  - Discussed FAA deployment of system
  - Expressed views of the AFC
- FAA implementation still not fully planned out
  - Maximum of 13 sites by the end of 2015
  - Combination of fixed links and ground tracking (ADS-C) services
  - Looking for new FAA applications for the capability
- Frequency assignment process
  - No formal spectral planning process
  - Mixed internal opinions on single or multi-provider models
  - Awaiting security opinion on mixed AOC and ATS traffic on same network

US Regulatory Implementation

- FCC considering WRC-07 implementation as a whole
  - NPRM 12-338 issued in 2012
  - AeroMACS a small element
- FCC nearing final implementation ruling
  - Will only provide a suitable allocation
  - Does not consider service rules for operation
- FAA has already implemented federal systems in the band
  - NTIA authorization informed to FCC in 2013
  - Using fixed links for distribution network (AeroMACS system with directive antennas) and surface tracking
- Comments from FCC would welcome industry proposal on service rules

Filing requirements

- Description of the service proposed
- Explanation of the need for the service
  - What will it accomplish
- Draft technical specs for the operation
- Criteria for sharing with other services
- Spectrum management approach
  - Licensing approach for ground and aircraft
  - Suggests for CFR 47 Part 1 & 87 rule modifications
- Multi industry agreement crucial
  - Estimated minimum of $500k cumulative filing costs

AFC Recommended Principles

- Provide an economic benefit to the airline and cargo users.
  - Automated and timely reporting mechanisms to ensure data is available for analysis quickly.
  - Reduce human factors element in data process to minimize errors and associated costs.

- Minimize operational complexity for implementation.
  - System should not be mandated.
  - Deployment at core air-hubs by standardized providers.
  - Ability for airline owned networks at required airports.

- Appropriate management and control mechanisms.
  - A multi-provider environment to ensure competition (service and equipment).
  - Airlines and cargo carriers will be stakeholders in the management of the AOC spectrum.

- Regulatory compliance.
  - Provide a communications method for AOC communication applications.
  - Prevent access for services which would put into doubt the integrity of the AM(R)S.

Direction forward?

- Current options for AeroMACS management being considered by the FAA is as follows:
  - FAA owned and operated, ATS only
  - FAA owned and operated, ATS and AOC
  - FAA owned and contractor operated, ATS only
  - FAA owned and contractor operated, ATS and AOC
  - Contractor owned and operated, ATS only
  - Contractor owned and operated, ATS and AOC

AFC AeroMACS Concept?

- Separate federal and airline spectrum allocations
  - Segregation of spectrum at a national level
- Single licensee to coordinate amongst multiple providers
  - Non-discriminatory licensing to all eligible users
  - Manage aggregate interference to FSS
  - Coordinate location/time with AMS users
- Transmission of AOC and AAC messages
  - Will not provide DataComm functionality

Part 87 Modifications

- §87.131 Power and emissions
- §87.133 Frequency stability
- §87.137 Types of emission
- §87.139 Emission limitations
- §87.141 Modulation requirements
- §87.171 Class of station symbols
- §87.261 Scope of service
- §87.263 Aeronautical en-route frequencies
- §87.265 Administrative communications
- §87.267 New service provision?

Outstanding Institutional Issues

- FAA operation and spectrum requirements
  - What and how are they using the spectrum?
- AMT operational requirements
  - Confirmation of interference?
  - Operating parameters and areas?
  - Coordination options?
- Intent of DSPs and airlines for network deployment
  - Capacity of spectrum for multi-provider solution?
  - Timeline of implementation?
- Availability of equipment
  - Avionics and ground stations into service?
- Frequency coordination requirements
  - ICAO agreed process?
  - Coordination and assignment tools/resources required?

Questions?