

Spectrum Issues and WRC-07 Preparation

Presented to: ICNS Session J: Aviation Spectrum

By: Mike Biggs, ATO-W, Sr. Engineer

Date: 3 May, 2007



Federal Aviation
Administration



Aeronautical Communications

- **Two categories**
 - Those provided for safety and regularity of flight
 - Allocations designated as “(route)” or “(R)”
 - Air Traffic Control (ATC) and Aeronautical Operational Control (AOC)
 - Others
 - Aeronautical Administrative Communications (AAC), Aeronautical Passenger Communications (APC), etc
- **Almost all FAA-provided services occur in “(R)” spectrum.**
 - AM(R)S for terrestrial (a/g, a/a) communications
 - AMS(R)S for satellite communications
- **Remainder of this presentation deals with AM(R)S**



Existing AM(R)S Bands

Frequency Band	Comments
2.85-3.025 MHz	High Frequency (HF) Communications
3.4-3.5 MHz	HF Communications
4.65-4.7 MHz	HF Communications
5.45-5.48 MHz (Region 2)	HF Communications
5.48-5.68 MHz	HF Communications
6.525-6.685 MHz	HF Communications
8.815-8.965 MHz	HF Communications
10.005-10.1 MHz	HF Communications
11.275-11.4 MHz	HF Communications
13.26-13.36 MHz	HF Communications
17.9-17.97 MHz	HF Communications
21.924-22 MHz	HF Communications
108-117.975 MHz	Added at WRC-03, limited to ICAO standard navigation and surveillance systems
117.975-137 MHz	VHF Air-ground communications



AM(R)S Spectrum Issues

- **AM(R)S spectrum is at or near saturation in high traffic areas.**
- **AM(R)S spectrum is required to support future navigation and surveillance systems**
 - Those future systems are designed to provide maximum situational awareness to the pilot, and may not meet the “property of waves” definition required to operate in aeronautical radionavigation service (ARNS) spectrum.
 - There are no “surveillance” services/allocations
 - Future navigation/surveillance systems may incorporate additional data functions to foster voluntary user equipage (e.g., providing FIS-B as part of new ADS-B system)
- **AM(R)S spectrum is required to support planned introduction of unmanned aircraft systems (UAS) into air traffic services airspace**
 - Lack of information on requirements limited work on this topic
 - Possible future WRC agenda item?



WRC-07 Agenda Item 1.6

- ***To consider additional allocations for the aeronautical mobile (R) service in parts of the bands between 108 MHz and 6 GHz, in accordance with Resolution 414 (WRC-03) ...***
 - *Initial focus should be on bands currently available to aviation*
 - *If requirements cannot be met in those bands, then look elsewhere*



Other Existing Aviation Bands

Existing ARNS Bands below 6 GHz*

74.8-75.2 MHz	Marker Beacons
108-117.975 MHz	VOR, ILS Localizer, GBAS
328.6-335.4 MHz	ILS Glide Slope
960-1215 MHz	DME, TACAN, SSR
1300-1350 MHz	Footnote 5.337 limits to ground-based radars and associated airborne transponders
1559-1610 MHz	Shared with GNSS
1610-1626.5 MHz	Shared with AMS(R)S and MSS
2700-2900 MHz	Footnote 5.337 limits to ground-based radars and associated airborne transponders
4200-4400 MHz	Footnote 5.438 limits to use by radio altimeters installed on aircraft and associated ground transponders
5000-5150 MHz	Priority to MLS (5.444), portions shared with FSS, RNSS and/or AMS(R)S
5150-5250 MHz	MLS shared with FSS and Mobile (RLANs)

*Small bands exist below 1 MHz. Due to limited bandwidth available, these are not considered candidates for future AM(R)S systems



Why ARNS bands for AM(R)S?

- **Regulatory considerations**
 - Safety services require a higher degree of protection of the spectrum in use
 - International scope of aviation requires global allocations
 - Internationally attention was to start with existing aviation bands
- **Technical considerations**
 - Systems operating in the safety services are internationally standardized, offering relatively consistent characteristics
- **Experience**
 - Recent development of Universal Access Transceiver (UAT)



Results of studies

- **Reviewed use and characteristics of all civil aviation bands & developed spectrum requirements**
- **Current focus internationally (ICAO, ITU):**
 - Possible extension of current AM(R)S band into parts of VHF aeronautical radionavigation band (i.e., portion of 108-117.975 MHz) to provide short-term relief
 - Portion of 960-1215 MHz band (portions of “L-Band”) for line-of-sight system
 - Low-moderate data throughput
 - Portions of 5000-5150 MHz band (“C-Band”) for airport surface network system
 - Short range, high data throughput



Why portions of VHF Band for AM(R)S?

- **Primarily European initiative**
 - Expansion of current DSB-AM system
 - Possibly just a software change to existing avionics
 - Conflicting reports regarding “simplicity”
- **Band limited due to concerns from FM broadcast community**
 - Larger protection volumes
 - Introducing airborne AM(R)S transmitters
- **WRC CPM Methods*: 117.975 MHz down to 116 or 112 MHz**
 - *Allocation in this band is not part of US WRC Proposals*
 - *Current US proposal is no change*
 - *Not part of current FAA plans (supports limited capabilities)*
 - *Opposition by Broadcasters*

****No change to the current allocation is always a (usually unstated) CPM Method***



Why portions of L-Band for AM(R)S?

- **Good propagation characteristics**
 - Line-of-sight transmission with moderate transmit power
- **Internationally standardized current use offers opportunities**
 - 960-977 MHz used globally for national allotments
 - DME/TACAN in 978-1024 MHz limited to ground transmitters
- **Need a large amount of available spectrum**
 - Studies point to need for up to 60 MHz
 - Requirement for a number of distinct channels
 - Cosite (on-aircraft) compatibility may be “long pole”
 - Provides options for designed compatibility with incumbent users
 - Frequency hopping/diversity and/or time/bandwidth trade-offs
 - Design-in future growth (need positive cost/benefit to foster equipage)
- **Possible technologies under investigation**
 - See Session A of this ICNS Conference
- **WRC CPM Methods*: 960-1024 or 960-1164 MHz**
 - *Current US WRC proposal supports 960-1024 MHz with regulatory protections for existing uses.*
 - *Considerable difference in operational environment above 1024 MHz (SSR, RNSS, etc)*

****No change to the current allocation is always a (usually unstated) CPM Method***



Why portions of C-Band for AM(R)S?

- **Spectrum requirements studies indicate need for 60-100 MHz**
- **Good short-range characteristics**
 - High path loss maximizes frequency re-use
 - Ideal for airport surface network
- **Internationally lightly used**
 - Planned for MLS
 - RNSS plans for 5000-5010 and/or 5010-5030 MHz
 - Mobile satellite feeder uplinks in 5091-5150 MHz
- **Large amount of available spectrum**
- **User equipment/technology readily available**
 - IEEE LAN standards may be extensible
 - New 802.16e offers required mobility – good AM(R)S candidate
- **WRC CPM Methods: All or portions of 5000-5010, 5010-5030 and/or 5091-5150 MHz**
 - *Current US WRC Proposal supports all 3 bands with regulatory protections for existing/planned use by incumbent services*
 - *Further studies for 5000-5010 and 5010-5030 MHz bands as RNSS and AM(R)S systems mature*



Conclusions

- **Evolving applications in civil aviation necessitate additional spectrum for safety communications**
 - Portions of the spectrum already allocated to the Aeronautical Radionavigation Service (ARNS) offer a partial solution to those AM(R)S needs
 - Further study of UAS required (future WRC agenda item?)
- **Two types of operations envisaged**
 - Short-range/high-throughput
 - Longer-range/moderate-throughput
- **US WRC-07 proposals will address spectrum for both**