Radio Frequency Spectrum Management

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DOT/FAA Spectrum

Presented at the USTTI Course 19-311
Radio Frequency Spectrum Management
September 19, 2019
Aviation is Very Dependent on Radio Waves
So 99.9% Rate – What Does it Mean

• In Educational Terms – A Wonderful Grade in School, but ...
• 99.9% Rate In Other Perspectives Equates To for Example:
  – 16,000 lost pieces of postal mail per hour.
  – 22,000 checks deducted from the wrong account each hour.
  – 2 Unsafe Landings at O’Hare International Airport each day.

• Requirements for Aeronautical Navigation Systems is in the Order of 99.99999%
  – That is “Seven-9’s” of Integrity.
  – In the US National Airspace System (NAS) selecting one scheduled flight at random each day a passenger can expect, on average, go for 21,000 years before the probability of being in a fatal crash.

• How are these extraordinary levels achieved?
High Levels of Safety are Achieved by ...

- Redundancy, Safety Margins
- Remove, or Mitigate, all Possible Sources of Risk
- Freedom from Radio Frequency Interference (RFI)
  - from authorized users of the aeronautical bands.
  - from authorized users of any other bands.
  - from any unauthorized user of any bands.
- ITU Article 4.10 recognizes the need for protection of Safety Services
- Exclusive allocation for Aeronautical Radionavigation Systems
- Exceptions to exclusive allocations:
  - In band 960-1215 MHz ARNS shares spectrum with RNSS
  - In bands 1555-1559 MHz and 1656.5-1660.5 MHz, SATCOM shares spectrum with Mobile Satellite Service
  - ITU footnotes (e.g., 5.362A) provide priority and preemption for satellite safety communications over non-safety communications
Regulatory Authority

- **Communications Act of 1934 as Amended**
  - Established Radio Spectrum usage in the USA
- **Federal Aviation Act of 1953 as Amended**
  - Authority for FAA use of Radio Spectrum
- **Office of Management and Budget Circular A-11**
  - Spectrum Authorization Before Expenditure of Funds
- **ITU Radio Regulations**
  - Including International Civil Aviation Organization (ICAO)
- **FCC Rules and Regulations, Part 87**
National Airspace System (NAS) Facilities
(numbers are approximate)

- **Communication**: 9000 VHF and 5000 UHF facilities
- **Navigation**: 1000 VOR, 1300 localizers, 1100 glideslopes, 1100 DME, 2500 other
- **Surveillance**: 700 SSR, 900 primary, 1600 other

![COMM](image1)
![NAV](image2)
![SURV](image3)
## Frequency Assignments by Agency

<table>
<thead>
<tr>
<th>Agency</th>
<th>Number of Assignments</th>
</tr>
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<tbody>
<tr>
<td>Air Force</td>
<td>35000</td>
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<td>FAA</td>
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<td>Army</td>
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<td>Justice</td>
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<td>Homeland Security</td>
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<td>Interior</td>
<td>14000</td>
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<tr>
<td>Coast Guard</td>
<td>13000</td>
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<tr>
<td>Other Agencies (combined)</td>
<td>37000</td>
</tr>
</tbody>
</table>
FAA Spectrum Organization

Spectrum Engineering Services Group
Michael Weiler (A)
202-267-7531

Spectrum Military Team
John J. Cabala
202-267-8584

Business Management
Bianca Prado (A)
202-267-9718

Spectrum Assignment and Engineering Team
Timothy J. Pawlowitz
202-267-9739

Spectrum Planning and International Team
Michael L. Richmond
202-267-3700

Radio Frequency Interference
James S. Aviles
540-422-4436

Spectrum Testing and Engineering Analysis
John A. Petro
609-485-5436

Spectrum Engineering Services Team – Eastern Region
Stephanie L. Thomas
404-305-6674

Spectrum Engineering Services Team – Central Region
Mark R. Gallant
817-222-4761

Spectrum Engineering Services Team – Western Region
James H. Motley
310-725-3474

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Spectrum Assignment and Engineering Team

• Implement Spectrum Engineering Criteria and Policy for the FAA
  – Support the operational radio frequency spectrum requirements of the National Airspace System (NAS)
  – Support the Research and Development of Technologies and Equipment that are intended to be implemented into the NAS
  – Engineer Frequencies that meet ICAO protection requirements to provide Interference Free Communications, Navigation, and Surveillance (CNS) services for every Air Traffic Control facility used throughout the NAS
  – Acquire and maintain NTIA frequency authorizations for all NAS CNS facilities
  – Conduct Coverage Analysis studies to ensure that the minimum received signal power meets ICAO requirements throughout the frequency protected service volume
Spectrum Assignment and Engineering Team

• Analyze the impact of and coordinate risk mitigations to support military operational/training/exercise requirements that might impact NAS operations
  – This includes support for Interrogation Friend or Foe (IFF) exercises, Electronic Attack, Global Positioning System (GPS) jamming, Counter-Improvised Explosive Devices (C-IED’s), Counter-Unmanned Aircraft System (C-UAS), and the Joint Tactical Distribution System (JTIDS)

• Provide FAA representation on the Frequency Assignment Subcommittee (FAS) of the IRAC

• Chair the IRAC Aeronautical Assignment Group (AAG)

• Execute the FAA’s Interference Resolution Program
  – Maintain the Radio Frequency Interference Tracking (RFIT) System.
  – Assist Field Personnel in the resolution of RFI Events.
  – Provide Spectrum Services at the FAA’s Operations Command Center
Spectrum Planning and International Team

• Develops spectrum specifications for NAS
  – Both technical and operational
• Ensures FAA systems meet both domestic and International Spectrum Standards
• Conduct Studies necessary to help ensure RFI free spectrum
• Represent FAA at the IRAC and it’s Subcommittees
• Engage in RTCA Inc. Special Committees
• Represent aviation needs on US delegations to international fora
  – ICAO, ITU-R, CITEL, WRC
• Chair ICAO Frequency Spectrum Management Panel
Spectrum Testing and Analysis Team

- Located at William J. Hughes Technical Center, Atlantic City New Jersey
  - Performs spectrum measurements on aeronautical communication and navigation equipment.
  - Validates technical characteristics of FAA and commercial equipment.
  - Tests vulnerabilities of communication, navigation, and surveillance equipment to various modulations and technologies.
  - Develops advanced software and electronics components for compatibility assessment measurements and for field RFI detection and location.
Spectrum Service Area Teams

- **Eastern, Central, Western (including Alaska, Hawaii, Guam)**
  - Conduct Day-to-Day Frequency Assignments to meet ATC Requirements

- **Resolve RFI Events Disrupting NAS CNS Services**
  - Coordinate with FCC, NTIA, DHS, DOD and Local State Government Agencies as needed

- **Coordinate Department of Defense Radio Frequency Tests**
  - Those which require use of NAS frequencies in the local areas

- **Engineer NAS frequency requirements**
  - New aeronautical frequencies,
  - Temporary Frequencies for air shows, Fire Fighting and Hurricanes
  - Conduct frequency coverage analysis
  - Perform Obstruction Evaluation Airspace Analysis

- **Coordinate Frequencies with Mexico and Canada**
RTCA Incorporated

- Employs a consensus-driven process on issues affecting air traffic management operations
- Generates minimum performance standards (MOPS) for CNS/ATM systems and equipment
- MOPS generally are the basis for FAA regulatory requirements
- The Spectrum Engineering Service participates in the Special Committees dealing with spectrum related issues:
  - GPS (SC-159)
  - ADS-B (SC-186)
  - Unmanned aircraft systems (SC-228)
  - AMS(R)S (SC-222)
  - ATCRBS & Mode S (SC-209)

https://www.rtca.org/content/about-us-overview
NAS NextGen

- NextGen is a wide ranging transformation of the entire national air transportation system to meet future demands both in the air and at airports
- Incorporates satellite based technologies to the mix of legacy ground based technologies
- Purpose is to reduce congestion, and improve the passenger experience
- New capabilities are based on RNSS
  - Include GPS (L1 & L5), GALILEO, GLONASS
  - Additional planned global RNSS systems
  - Augmentations - GBAS, SBAS, Regional
  - Automatic Dependent Surveillance-Broadcast
  - VHF Data Link Mode 2
FCC

- Title 47 CFR Part 87
  - Rules under which civil aviation uses spectrum

- FAA comments on draft FCC rule makings via the IRAC process
  - Primarily those which have potential impacts to aviation

- FAA works with FCC Enforcement Bureau
  - Solve RFI to aviation services

- Works with FCC on PPSG
  - PPSG tasked to look at Federal spectrum for repurposing for civil wireless, etc.
DoD Coordination

- FAA has the responsibility to manage the spectrum associated with the National Airspace System (NAS) as per Section 8.3.16 of the NTIA Manual.
- DoD Spectrum Management Office (SMO) sends frequency assignment request to FAA for pre-coordination.
  - Issues, e.g., DoD use of civil frequencies (e.g., GPS) for testing, are worked out between FAA and DoD,
  - FAA coordinates with DoD over large scale exercises, e.g., RIMPAC, Bold Quest, Red Flag
- DoD SMO submits frequency assignment to NTIA to be voted
- NTIA grants permission to radiate
- FAA works with AFTRCC to coordinate Joint use of spectrum by civil and military for aircraft flight testing
DoD (continued)

- **DoD use of 1030/1090 MHz frequencies**
  - FAA and DoD share the 1030/1090 MHz band - Military Mode 1, 2, 3/A, C, 4 and 5 & Civil Modes 3/A, C and S
  - DoD primary IFF uses: Interrogators, Transponders, and Test Sets
  - DoD uses civilian equipment such as TCAS and Transponders with Civil Modes
  - FAA use 1030/1090 MHz to support surveillance and collision avoidance systems, such as ADS-B, SSR, TCAS, and MLAT

- **WG-8 Subcommittee of SPS for 1030/1090 MHz Systems**
  - Collaboration between FAA and DoD to develop certification language for DoD operational characteristics
    - locations, IFF modes, recommendations on operational parameters and conditions and any features/modes not being certified
    - Recommendations on discrepancies from AIMS letter that affects civil modes
    - NTIA is the final signature authority for SPS certification
DoD (continued)

- **International AIMS PO**
  - Conduct box, platform, interoperability and performance testing
  - FAA interest is to ensure conformance with agreed EMC standards necessary to protect civil systems
  - FAA participates in the DoD AIMS PO Configuration Control Board (CCB) held quarterly discussing AIMS Manual update
  - Technical discussion on change proposals (CPs) of 1030/1090 MHz system characteristics and requirements
  - FAA is also a voting member on those CP at CCB
International Civil Aviation Organization (ICAO)

- A specialized agency of the United Nations with 190 Member States
- Created in 1944 to promote the safe and orderly development of international civil aviation throughout the world
- Sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection
- Panels on which the FAA participates
  - Aeronautical Communications Panel
  - Navigation Systems Panel
  - Aeronautical Surveillance Panel
  - Frequency Spectrum Management Panel
    - Chaired by FAA/Spectrum Engineering Service engineer
International Telecommunications Union-Radiocommunication (ITU-R)

- Produces Recommendations which address
  - Spectrum sharing between systems
  - Cross-border electromagnetic compatibilities
  - Most countries adhere to Recommendations as if they were law

- Produces Reports
  - Provide technical and operational background on specific issues
  - Provide system characteristics and RFI susceptibilities
    - for use in radio frequency compatibility studies and
    - sometimes referenced in Recommendations

- Drafts Conference Preparatory Meeting (CPM) Report
  - ITU-R technical and operational guidance for WRC delegates

https://www.gsma.com/spectrum/wrc-series/
ITU-R Study Groups in which FAA Participates

• Study Group 4 Satellite Services
  – GPS, SATCOM and compatibility with non-aviation systems

• Study Group 5 Terrestrial Services
  – Aviation systems and services including radar and avionics

• Study Group 7 Science Services
  – Compatibility with earth-exploration-satellite service operating in spectrum allocated to aviation services
World Radiocommunication Conference (WRC)

- Meets every three to four years, or so
  - Establishes radio frequency allocations, globally
  - FAA participates on the U.S. delegation
  - Critical for civil aviation due to aviation’s global nature

- WRC-19 Agenda Items (AIs) of interest for FAA/aviation
  - 1.7, protection of voice and data links
  - 1.10, implement GADSS
  - 9.1 issue 4, integrate suborbital vehicles into NAS
Any Questions?

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