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CORF Meeting

October 15, 2006

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Spectrum Management for Radio Astronomy
A Historical Perspective

- **Prehistory – K. Jansky to ~ 1958**

  Radio Astronomy Born Out of Interference Concerns

  ✓ **No Consistent Spectrum Management for Radio Astronomy**

- **In-band Protection (~ 1958 to ~ 1979)**

  Dominant Concern: Fixed Transmitters

  ➢ **Beginnings of International Spectrum Management for Radio Astronomy**

  - ✓ **Radio astronomers begin attending ITU meetings (WARCs and CCIR)**
  - ✓ **Radio astronomy recognized as a radio service (albeit not a radiocommunication service)**
  - ✓ **First allocations to the Radio Astronomy Service**
  - ✓ **Rec. 769 (Report 224) and other ITU Recommendations**

  ➢ **Beginnings of US Spectrum Management**

  - ✓ **NRAO established within the NRQZ**
  - ✓ **NSF Spectrum management office set up**

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Spectrum Management for Radio Astronomy
A Historical Perspective (2)

- **Satellites – Mostly NGSO (~ 1979 to ~ 2003)**

Dominant Concern: Unwanted Emissions From Satellites

International

- ✓ Radio astronomers seek to limit unwanted emissions from satellites spilling over into radio astronomy bands
- ✓ Series of ITU-R Task Groups (TG 1/3,1/5,1/7, 1/9)
- ✓ First regulatory limits on space system unwanted emissions (RR App. 3 on Spurious Ems – Far from satisfying RA requirements
- ✓ Mandatory Limits in a Few Bands; Voluntary Consultation in Others (Res. 739)
- ✓ Typical Systems of Concern: Iridium, GLONASS
- ✓ RA receivers increasingly wide-band
- ✓ Upward creep in frequency in radio astronomy, followed by commercial applications

US

- ✓ MoUs with various satellite entities limit access to spectrum/provide access at required noise floor level for limited period of time

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Spectrum Management for Radio Astronomy
A Historical Perspective (3)

- **Ubiquitous Unlicensed, Low-Power, Broad-band Devices (~ 2000 to present, and beyond)**

  Dominant concern: Rising noise floor

  - **International and Domestic**
    - ✓ Cell phones show the way to mass marketing of wireless devices
    - ✓ UWB developed for commercial applications
    - ✓ Limits between national and International regulations blurred, as controlling the transport of mass market devices is difficult
    - ✓ US leads the charge in adoption of mass market devices
    - ✓ Typical systems: BPL, IMT-2000 (under may names)
    - ✓ Radio astronomers, driven by science, increasingly interested in the entire spectrum
    - ✓ Development of large, multinational radio astronomy observatories

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Issues

New Concerns Added to Older Ones – not Substituted (Issues from Previous Period don't Become Obsolete e.g. NRQZ)

- **Regulatory Problem:**
  - Coexistence of Band Allocations for Authorized Radio Services (Radio Astronomy?) with Unlicensed Devices
- **Bandwidth Issue:**
  - Are Radio Astronomy Allocations Needed in an Era of Broad Band Receivers?
- **Dynamic Scheduling Issue:**
  - Full Exploitation of Expensive Radio Astronomy Facilities (Coupled with Technological Progress) Requires (Allows) Dynamic Scheduling of Telescopes
- **Development of Mitigation Techniques and their Limitations?**
- **Will/Can Radio Astronomers (and other passive services) Benefit or (Suffer) from Adaptive/Smart Radio?**

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1.6 GHz Satellite Coordination
Iridium Issues

- **June, 2006 - Agreement signed on aeronautical uplinks operating in the 1616 - 1626.5 MHz band, on terms similar to those of the NSF-Globalstar agreement**
  - **When an airborne mobile Earth station is within 4.1(√ h) km (where h is the aircraft altitude in meters) of a radio astronomy site that is making observations, the average unwanted emission levels at the input port to the transmit antenna for any 1 MHz segment in the band 1610.6 - 1613.8 MHz from the airborne mobile Earth station shall not exceed –82 dBW/MHz, with a corresponding aircraft underside antenna gain of nominally -10 dBi or lower gain.**
  - **No restrictions apply during times when no 1612 MHz observations have been notified.**
- **NRAO and NAIC should send their scheduled observing periods at 1612 MHz to Iridium and Globalstar.**
- **FCC authorized Iridium operations down to 1618.25 MHz some time ago. Any increase in interference?**
- **Indications are that Iridium may wish to operate down to 1616 MHz.**

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1.6 GHz Satellite Coordination GLONASS Issues

- **GLONASS unwanted emissions measured by Leeheim monitoring station**
  - > **Individual GLONASS satellites comply with Rec. ITU-R RA.769 level for the band, but exceed by about 20 dBs the *epfd* (aggregate) level.**
  - > **Other RNSS systems operating in the 1559-1610 MHz band comply or plan to comply with the level**
- **GLONASS argues that it has complied with the IUCAF-GLONAS agreement and is unwilling to take further measures. Arguments based on:**
  - ✓ **RNSS being a safety service**
  - ✓ **Equitable access to RNSS band (GLONASS separated only 0.6 MHz from radio astronomy band edge!)**