GPS Spectrum and Interference Risks

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There are fundamental differences between Radio Communications and Radio Navigation

- Digital Radio Communications:
  - Incoming message is not known
  - Must determine whether each signal “bit” is a one or a zero
  - Use sophisticated methods to correct errors

- Digital Radio Navigation
  - Incoming signal sequence (ones and zeros) is totally known by user
  - The goal of the user is to precisely time the transition from one to zero (and zero to one)

GPS can be Harmed Several Ways

The ARNS/RNSS spectrum is a unique resource

- Sharing with higher power services jams weaker signals
- Out-of-band and ultra-wideband emissions raise the noise floor
- Segmentation prevents future evolution

Spread spectrum GPS signals are unlike communication signals
- 10^-6 W received power, one-way
- Any filter can be overwhelmed if exposed to enough power

GPS can be Harmed Several Ways

- Challenged by global growth of all types of wireless devices
  - Excess power in adjacent bands can overload RNSS receivers (or any other receiver)
  - In the past, incompatible mobile satellite services and low-powered devices have unsuccessfully sought to operate across restricted RNSS bands
  - Industry-level agreements (e.g., low-power digital TV, MSS ATC) can and have restrained unwanted emissions

- Protection of GNSS spectrum by just one country is inadequate if commercial devices that cause harmful emissions proliferate
  - Pressure for L-band spectrum to support mobile broadband and other applications, e.g., unmanned devices, cloud computing, software radios, etc.
  - International use of unlicensed repeaters and licensed in-band pseudolites, intentional and unintentional spoofers
  - Intergovernmental coordination of space-based L-band radars for EESS applications
  - Industry-level negotiations, interagency agreements, and international regulatory cooperation will be needed to sustain the RNSS bands
Approved ITU Recommendations on Protection Criteria Exist

Commercial GPS Jammers are Illegal

Receiver Overload and UWB Emissions Impacts are not just a GPS Concern

On-going Issues

Spectrum – In-band
- Coordinate with other GNSS providers to limit the noise floor in the L-band
- Understand the operational performance of Beidou and Galileo to see if multi-GNSS receivers are actually useful to customers worldwide
- Prevent increases in the noise floor due to EESS space-based L-band radars, future UWB devices
- Improve efforts to track down and eliminate intentional, small, commercial jamming devices – Plus in-band pseudolites

Spectrum – Out-of-Band
- Protect RNSS spectrum from out-of-band emissions in adjacent bands
- Avoid “one-size-fits-all” solutions
- Burden of evidence on proving safety, not showing harm
- Reflect industry best practices in improving OOBE
- Protect RNSS applications from receiver overload resulting from excessive transmitted power in adjacent bands
- Any application can suffer overload if the power differential is large enough

Backup

GPS Modernization Program

Increasing Space System Capabilities - Increasing Military/Civil User Benefits