FCC Workshop on GPS Protection and Receiver Performance

June 20, 2014

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Receiver Design - GPS Signals are Very Weak and Very Complex

GPS is a **navigation** system, not a communication system

– The issue is not the correct reception of a 1 or a 0

– The issue is timing the edge of a 1 or 0 to sub-ns accuracy

GPS signals are very weak, below thermal noise floor

– Receivers must be extremely sensitive
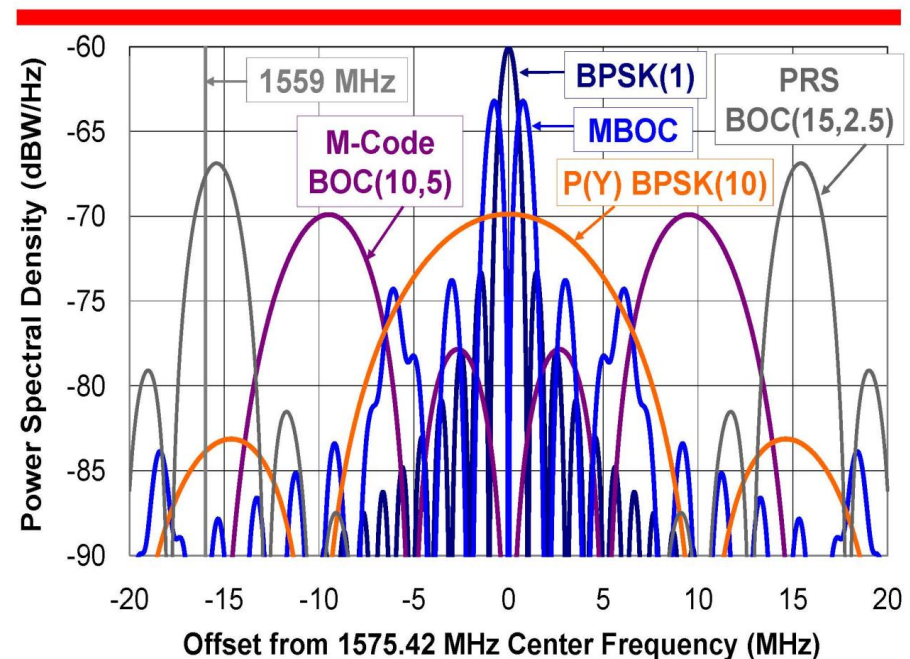
– Difficult to exclude nearby strong signals

Precision GPS requires:

– Wideband signals

– Multiple frequencies

– Continuous carrier tracking

Additional GNSS are important

– Add reliability and integrity

Many existing and future GNSS signals are wideband

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Receiver Design - GPS Signal Wideband Evolution

– GNSS wideband signals by design stretch to the edge or beyond the GNSS spectrum (1559-1610 MHz)

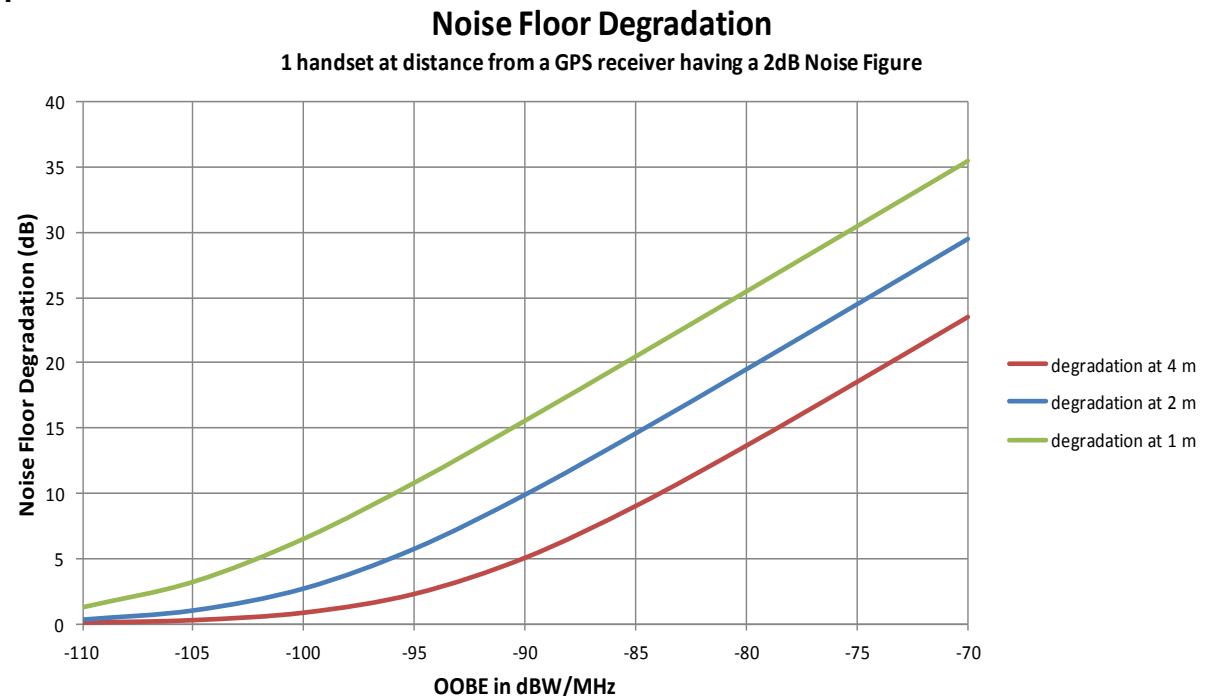– Government designed signal structure

GPS and Galileo L1 Signals

Many existing and future GNSS signals are wideband

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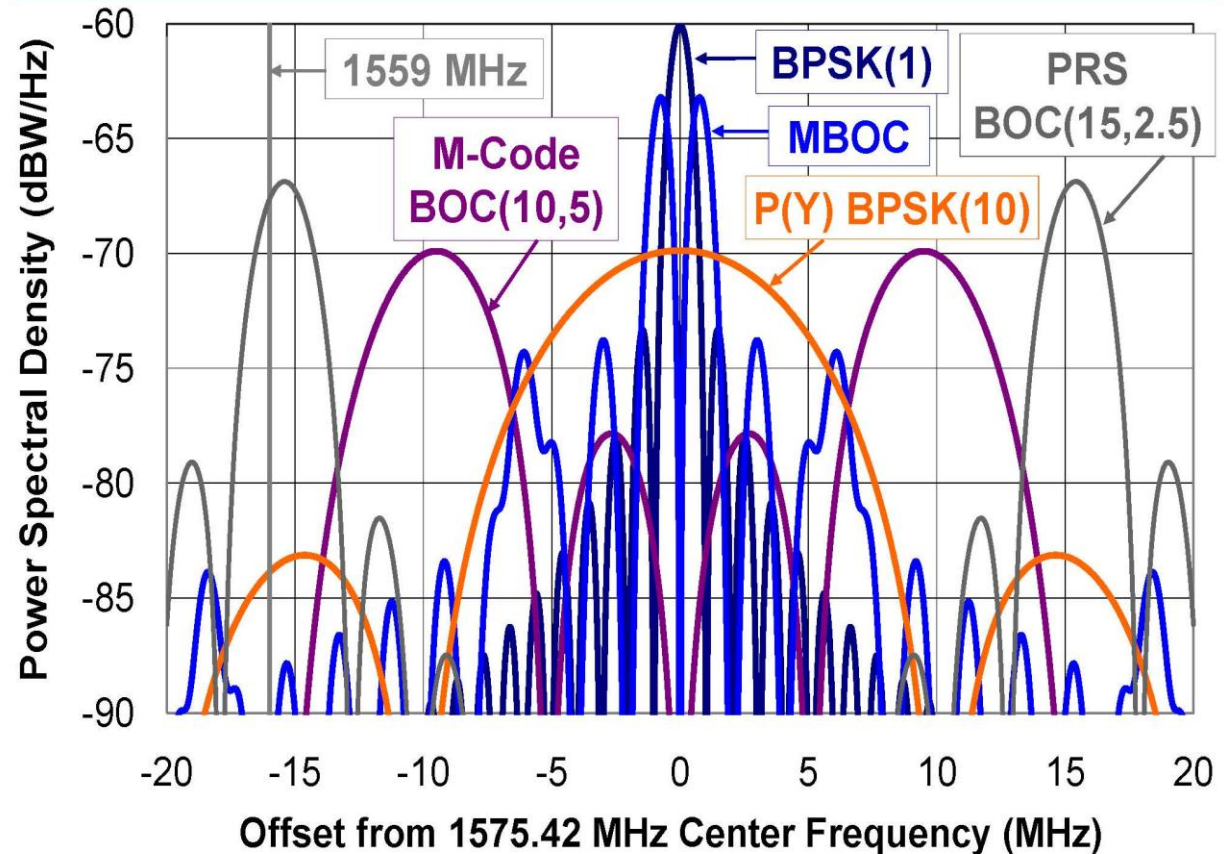
Receiver Design - Noise Floor Must Remain Low

In GPS processing, interfering signals are spread over the entire bandwidth, potentially increasing the noise floor

- Multiple wireless base stations, handsets and other systems could cumulatively add noise until GPS is degraded

- General OOBE limits of -43 or -70 dBW/MHz OOBE limits too high

- OOBE Interference at -95 dBW/MHz degrades GPS performance

Noise Floor Degradation
1 handset at distance from a GPS receiver having a 2dB Noise Figure

Chart: Noise Floor Degradation (dB) vs OOBE in dBW/MHz

- degradation at 4 m
- degradation at 2 m
- degradation at 1 m

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Receiver Design – Future Possibilities Depend on Application and Other Factors

Certainty on the spectrum environment is needed

– Difficult to design for the future without it

GPS receiver designs vary enormously

– Timing design is very different from high precision design

– Multi-frequency, multi-GNSS design adds challenges

– Additional interference protection is more feasible for some receivers than others

Filtering cellular signals

– Might impact sensitivity, involve excessive size or cost

– Might cause distortion of GPS measurements

– Effects depend on the spectrum environment and user requirements

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