

# Global Positioning Systems Directorate

## USE OF A 1-dB DECREASE IN $C/N_0$ AS THE GPS INTERFERENCE PROTECTION CRITERION



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# Overview

G P S   D I R E C T O R A T E

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- Impracticality of Alternative Metrics
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# Key Parameters

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- A 1 dB decrease in the carrier-to-noise (C/N) ratio is equivalent to a -6 dB interference-to-noise (I/N) ratio and a 1 dB increase in the noise floor  $((I+N)/N)$ .
- Regulations alternate between referencing the 1 dB decrease in C/N, -6 dB I/N ratio, and 1 dB increase in the noise floor.



# International Precedence

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ITU-R Recommendation	Band	Protection Criteria
M.1490-1 (2006)	Radar (2900-3100 MHz)	-6 dB I/N ratio
M.1462-0 (2000)	Radar (1215-1400 MHz)	-6 dB I/N ratio
M.1463-3 (2013)	Radar (1215-1400 MHz)	-6 dB I/N ratio
M.1465-1 (2007)	Radar (3100-3700 MHz)	-6 dB I/N ratio
M.1739 (2006)	WAS/RLAN (5 GHz)	-6 dB I/N ratio
M.1800 (2007)	MSS (1390-1392 and 1430-1432 MHz)	-6 dB I/N ratio
M.1903 (2012)	RNSS (1559-1610 MHz)	1 dB (I+N)/N ratio
M.1904 (2012)	RNSS (1164-1215, 1215-1300, 1559-1610 MHz)	-6 dB I/N ratio
M.2059 (2014)	Radio altimeters (4200-4400 MHz)	-6 dB I/N ratio



# Domestic Precedence

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Year	Decision	Protection Criteria
2002	NTIA comments to FCC on MSS ATC proceeding	1 dB (I+N)/N ratio
2003	IPC for GPS receivers in FCC's Rulemaking on Ultra-Wideband (UWB) devices	1 dB (I+N)/N ratio
2004	FCC's rules for limiting emissions of Low Power Television (LPTV) stations into GPS band	1 dB (I+N)/N ratio
2012	NTIA letter to FCC on Space-Based PNT EXCOM testing	1 dB C/N ratio degradation



# Impracticality of Alternative Metrics

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- “Break-lock” and other receiver-dependent metrics would require impractical amounts of testing on each receiver type in multiple operating modes.
- Metric must also protect receivers that output parameters such as velocity, acceleration, time, frequency, attitude, and heading.
- New metric must satisfy 2010 National Space Policy to “sustain the radiofrequency environment in which critical U.S. space systems operate.”



# Harmful Interference Versus IPC

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- The concept of harmful interference serves as a regulatory method to raise a concern with respect to a new service signal having a severe impact on an existing service.
- An interference protection criterion (IPC) ensures that systems operating in the same or adjacent bands do not interfere with one another.
- For service level compatibility questions, U.S. spectrum management does not assign specific values for harmful interference but instead uses IPC to keep harmful interference levels from being reached.



# Conclusion

G P S D I R E C T O R A T E

- The IPC of a 1 dB decrease in the  $C/N_0$  ratio is:
  - Consistent with the 2010 National Space Policy and IPC for other services,
  - Supported by domestic and international precedent,
  - Practical to apply to compatibility analysis
  - An appropriate protection criterion for all GPS receiver types in all operating modes.