Test Plan for Measurement of Interference Susceptibility Ratio to C-Band Receive Terminals to Potential IMT Signals

John Kean, Senior Technologist

23 May 2013

Procedure to Measure Interference Susceptibility Ratio of C-Band Satellite Receive Terminals with Signals from Potential IMT Services

The World Radiocommunication Conference (WRC-2007), among other organizations representing wireless communications, has proposed additional globally-harmonized spectrum to support the expansion of International Mobile Telecommunications-Advanced (IMT-Advanced) services.[1] These initiatives involve frequencies that may impact the operation of fixed satellite earth stations receiving in the 3400-4200 MHz range (known as C-Band). This test plan set forth a simplified procedure to test interference susceptibility margins with a standard earth station used by National Public Radio. It is believed that these margins are generally applicable to other C-Band earth stations having the same EIRP and antenna configuration.

This study focuses on frequencies that are not shared with fixed satellite services (FSS), potentially operating on frequencies immediately below the C-Band downlink used in Region 2, which spans from 3700 to 4200 MHz. The exact nature of IMT-Advanced services are not yet known, but it is assumed that they will operate as either fixed or mobile transceivers on a blanket authorization for a given frequency band and geographic area. Even if an IMT operation avoids operation on the 36 MHz-wide transponder channels used by C-Band downlinks, it is possible for one or more IMT devices to operate in close proximity to C-Band downlink facilities with no prior coordination, which poses a risk for interference and desensitization effects.

In the United States, 3.65 GHz is currently used for point-to-point and point-to-multipoint fixed services under Part 90 of the FCC rules. These stations operate with WiMAX protocols in accordance with the IEEE 802.16 standard with bandwidth of up to 7 MHz.

The procedure in Appendix A is an initial draft plan that uses one or more standard downlinks employed by National Public Radio (NPR). The test would radiate a relatively-narrowband (no more than 10 MHz) signal near the downlink with known EIRP, and interference susceptibility ratios would be determined from the ratio of the received satellite signal to the interfering test signal, taking into account the EIRP and distance. The E_b/N_0 of the satellite receiver would be observed; interference would be determined at the point at which the E_b/N_0 is reduced. These ratios are intended to provide an indication of the maximum allowable powers of IMT-type emitters as a function of distance and azimuth from the earth terminal. No more radiated power will be emitted than is necessary to affect the E_b/N_0 of the satellite receiver which is within a small distance (less than 50 meters) of the test transmitter. None of the proposed sites have other C-Band earth stations nearby, and the proposed sites are surrounded by trees or buildings that are taller than the test antenna (2m AGL), which will prevent the radiated signal from extending outside the local test area.

---

[1] "ITU-R Radiocommunications Assembly Expands IMT-2000 3G Radio Interface Family with OFDMA technology"; http://www.itu.int/newsroom/wrc/2007/itur_web_flash/20071019.html, 19 October 2007.

Appendix A – Procedure for susceptibility tests

Test Procedure	Step #	Description	Objective
FCC Experimental Authorization	1	It is expected that emissions will require authority from the FCC	File experimental request
Select satellite earth terminal	2	The NPR earth terminal shall employ one of the standard R/O antennas	The terminal should be distant from other C-Band services and in a location that will minimize the radiation of the signal beyond the immediate vicinity.
Collect test instrumentation	3	A test antenna with known gain is used to illuminate the R/O antenna. The antenna beam is oriented horizontally toward the earth terminal under test and may be oriented at various azimuths around the earth station. The test should include the types of RF signals used for mobile wireless communication for stimulus. It is believed that this may be IS-95 CDMA, DECT or GSM/EDGE signals, for IMT, and 3.5 or 7 MHz wide OFDM for Part 90 WiMAX.. The test system must produce clean, stable signals at an ERP of up to 1000 milliwatts, requiring a TPO of 26 mW (+14 dBm).	NPR has secured an antenna (Seavey SGA-40) having a gain of 18 dBi and half-power beamwidth of 23 degrees. We have identified an Agilent E4433B RF signal generator with H97 software options that can generate the appropriate personalities in the target IMT and Part 90 bands. We have identified a MiniCircuits linear amplifier with a power output of +20dBm (1 dB compression). With the selected antenna, target EIRP will be 5 dB below this rating.
Measure R/O receiver susceptibility threshold	4	Operate with normal receive conditions. Set RF level of signal generator to zero output Place interference test antenna at a known distance from the R/O antenna in a direct line with the R/O antenna's main beam. Observe E_b/N_0 of the satellite receiver and raise RF level of RF generator in small steps until and reduction is noted (if any). Choose a distance and height to avoid reradiation of the signal from metallic objects within the beam width of the horn antenna	Note the level of signal in dBm into test antenna and distance from R/O antenna Tests may be repeated at the same bearing with different distance to verify the directivity of the R/O antenna. Tests may be repeated at the same bearing with different elevation
	5	Repeat Step 4 with different bearing at the same radial distance	Note the level of signal in dBm into test antenna and distance from R/O antenna
Compile the data	6	Using the EIRP of the test transmission and the expected downlink EIRP of the R/O terminal, calculate the signal ratio for E_b/N_0 degradation.	
Project to IMT operation	7	Using data available about IMT emissions, relate signal ratios to IMT transmissions	Determine clearance distances necessary for IMT emissions to protect R/O terminals from interference as a function of downlink EIRP and distance from the R/O terminal