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July 24, 2009

VIA EMAIL

James S. Blitz, Esq.
Vice President, Regulatory Counsel
Sirius XM Radio Inc.
1500 Eckington Place, N.E.
Washington, D.C. 20002

Re: Ashburn, VA Demonstrations

Dear Jim:

The WCS Coalition is in receipt of your letter requesting additional information regarding the demonstrations to be performed in Ashburn, VA of the potential for interference from mobile WCS operations to the satellite digital audio radio service. Please see the answers to your questions and the additional information you requested below.

1. iPerf tool scripts -

The following iPerf scripts will be used for the demonstration:

High Bandwidth UDP Upload
The application server located within the IP Core network will be configured as an iPerf server using the following script:
bin\iperf.exe –s –u –P 0 –i 1 –p 5001 -f k

The laptop enabled with the WCS end user device will be configured as an iPerf client using the following script which will generate a continuous 2 MB/s data stream for the duration of the test:

bin\iperf.exe –c <IP address of application server> –u –P 1 –i 1 –p 5001 -f k –b 2M –t 100000 –T 1

High Bandwidth UDP Download
The laptop enabled with the WCS end user device will be configured as an iPerf server using the following script:
bin\iperf.exe –s –u –P 0 –i 1 –p 5001 -f k

The application server located within the IP Core network will be configured as an iPerf client using the following script and will generate a continuous 2 MB/s data stream for the duration of the test:
bin\iperf.exe –c <IP address of laptop with WCS end user device> –u –P 1 –i 1 –p 5001 -f k –b 2M –t 100000 –T 1

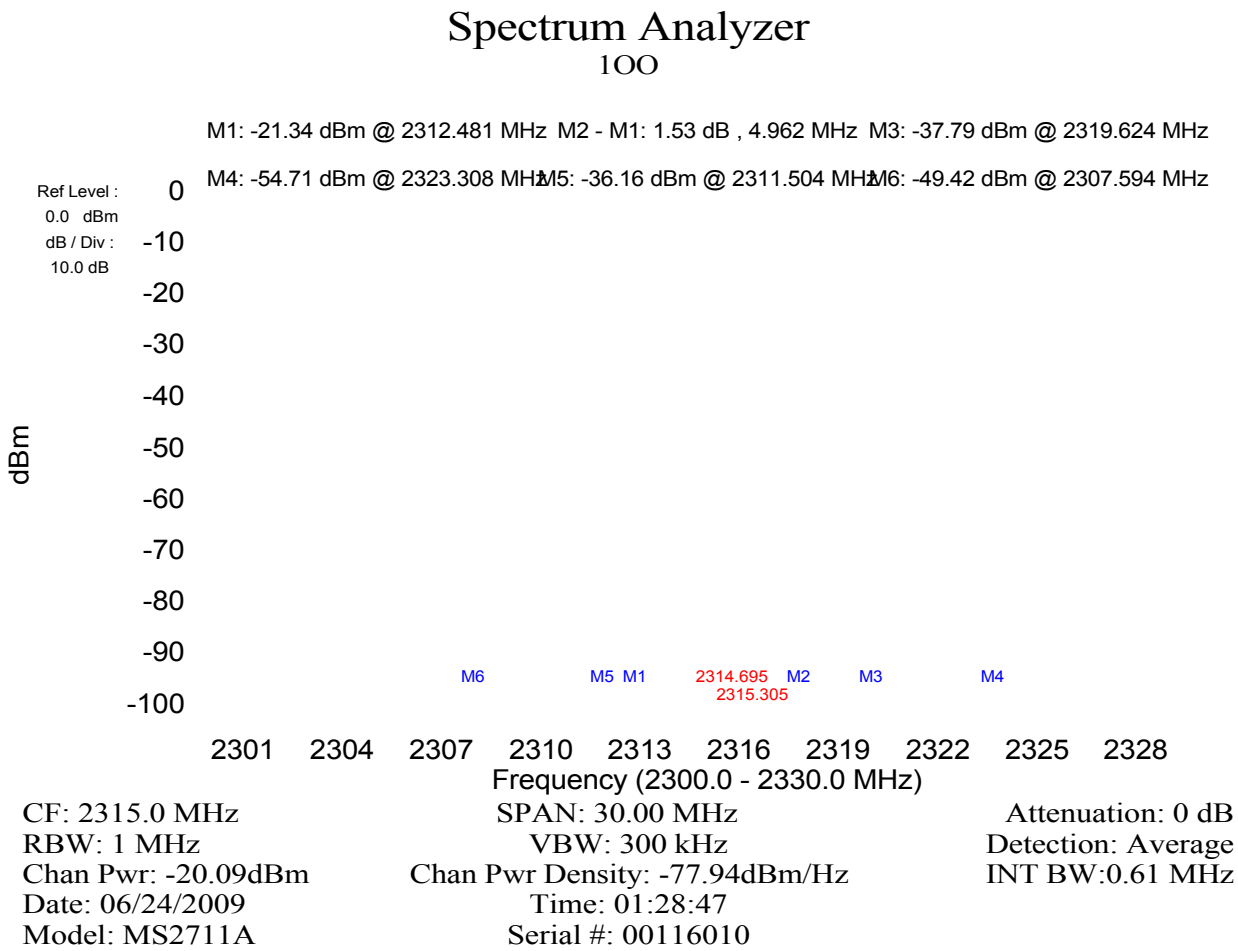
VoIP Test
To emulate a VoIP traffic flow from the WCS end user device, the laptop enabled with the WCS end user device will be configured as an iPerf client using the following script which will generate a 88 KB/sec data stream with a 2 KB packet size for the duration of the test:
bin\iperf.exe –c <IP address of application server> –u –P 1 –i 1 –p 5001 -I 2K -f k –b 88K –t 100000 –T 1

The application server located within the IP Core network will be configured as an iPerf server using the following script: *bin\iperf.exe –s –u –P 0 –i 1 –p 5001 -f k*

2. Antenna RF input port spec on WCS user terminal

When we last met with Sirius XM at the FCC, the WCS Coalition offered to conduct testing of an Alvarion WCS modem connected to a Sirius XM-supplied external antenna. The WCS Coalition agreed to provide specifications on the RF input port of the Alvarion device. Upon further inspection, it was discovered that the Alvarion WCS device, also known as the AWB PC200, does not have an actual RF input port that an external antenna could plug into. There is an external port on the outside of the device, but it is a "dummy" port that is not connected to the modem board itself. Accordingly, the WCS demonstration in Ashburn will be conducted using the Alvarion device's integrated antenna. The OOBE characteristics of this device, including the integrated antenna, are attached to this letter.

3. WCS user terminal in- and out-of-band emission spectral plots showing the mapping of WiMax waveforms that will be used during the test in each WCS band



Over the Air Emissions Plot of WCS End User Device

The figure above illustrates the emissions characteristics of the WCS end user device to be used in the demonstration. The spectral emissions plot was measured with a spectrum analyzer connected to a wide band, low gain omnidirectional antenna. Note that the resolution bandwidth of the spectrum analyzer was set to 1 MHz.
For the measurement, the center frequency of the WiMAX carrier was set to 2315.0 MHz. As illustrated, the nominal bandwidth of the WiMAX carrier is 5 MHz (M1 – M2 = 4.962 MHz).

4. Details on data capture capability (sampling speed and captured parameters, such as transmit power levels

A data collection tool will be used to decode and log end user device statistics during the tests. Information to be recorded will include received signal strength (in dBm), device transmit power (in dBm), downlink and uplink modulation and coding scheme selection, and the number of packet data units sent and/or received. The data collection tool is a software application that operates on the laptop connected to the WCS end user device and records device statistics at one second intervals. The statistics along with a time stamp derived from the laptops internal clock are stored in a delimited text file.

A GPS receiver can be connected to the laptop enabled with the WCS end user device through its USB port. The internal clock on the laptop can be synchronized to GPS time and the position stamps recorded by the GPS device can be stored in a separate delimited text file.

5. A WCS base station coverage map for the Ashburn site

Please see Attachment A which represents coverage of \the mobile system transmit power when operating at 24 dbm.

6. Will the base station operate with a maximum 2 kw as the proposed rules would allow

The base station will not be operating the maximum 2kw as the proposed rules would allow because the base station is very low and operating at 2kw would not permit us to comply with OET circular #65. It is anticipated that base stations that are constructed at greater heights will have the ability to operate at 2kw while still complying with all necessary FCC rules and regulations.

7. Alvarion representative availability

The WCS Coalition will attempt to make an Alvarion representative available, of course subject to his or her schedule.

8. Office space to facilitate lab testing

Due to space limitations at Digital Bridge, they are unable to make office space available to either party. However, the closest hotel to the Digital Bridge headquarters is the Embassy Suites (44610 Waxpool Road, Ashburn, VA), and we have leased a conference room to accommodate any necessary discussions during the demonstration dates.

9. Other

We have attached hereto as Attachment B the matrix of demonstrations we anticipate running on the 28th and 29th, and as Attachment C a revised Test Plan. The WCS Coalition does not have any information we require from you prior to the start of the demonstrations, we will no doubt have questions and requests for additional information during the demonstration process.

I trust that this provides the information Sirius XM requested. Feel free to let me know if there is additional information that would assist Sirius XM in better understanding how the demonstration will be conducted.

Very truly yours,

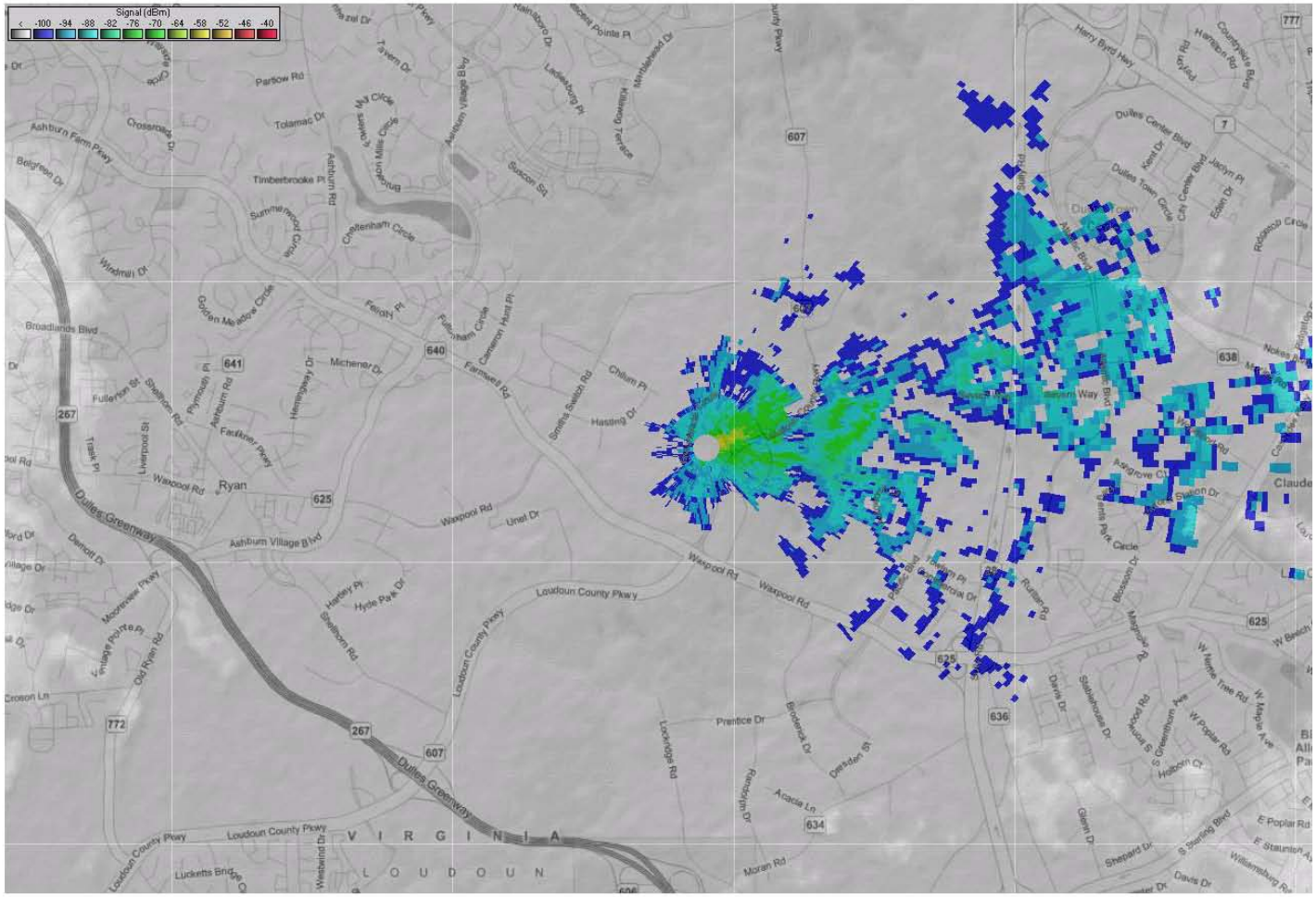
Mary N. O'Connor

Mary N. O'Connor

Attachments

cc: Office of the Secretary Docket 07-293
Julius Knapp

Attachment A
Ashburn, VA Coverage Map



Attachment B
Demonstration Matrix

		SDARS Service		SDARS Device		Application Type			Positioning of WCS Device			WCS Device Tx Power	
Test #	WCS Frequency Block	Sirius	XM	OEM	After-Market	High Bandwidth Upload	High Bandwidth Download	VoIP	Lap Height	Ear Height	Dashboard Height	Fixed EIRP +23 dBm	Variable EIRP with TPC
1	A-Block (Upper)	X		X		X			X			X	
2		X			X			X		X		X	
3			X		X	X			X			X	
4			X		X			X		X			X
5			X		X		X				X	X	
6			X	X			X				X	X	
7			X	X		X			X				X
8			X	X				X		X		X	
9	B-Block (Lower)		X	X				X		X		X	
10			X		X		X				X	X	
11		X			X	X			X			X	
12		X			X			X		X			X
13		X			X		X				X	X	
14		X		X		X			X				X
15		X		X			X				X	X	
16		X		X				X		X		X	
17	D/A-Block	X			X		X				X	X	
18		X		X				X		X		X	
19			X		X		X				X	X	
20			X		X	X			X				X
21			X		X			X		X		X	
22			X	X		X			X				X
23			X	X			X				X	X	
24			X	X				X		X			X
25	B/C-Block		X		X		X				X	X	
26			X	X				X		X		X	
27		X			X			X		X		X	
28		X			X		X				X	X	
29		X			X	X			X				X
30		X		X				X		X			X
31		X		X		X			X			X	
32		X		X			X				X		X

Attachment C

WCS-SDARS COEXISTENCE FIELD DEMONSTRATION PLAN

JULY 24, 2009

Preliminary

The equipment configurations, test conditions, and data collection procedures described in this document are preliminary and may be modified by the WCS Coalition once the field demonstration equipment is operational.

1. Introduction

The WCS Coalition, Sirius XM, and the FCC's Office of Engineering and Technology (OET) will jointly witness a demonstration in the Washington, DC metropolitan area of the performance of Satellite Digital Audio Radio Services (SDARS) receivers in close proximity to Wireless Communication Service (WCS) mobile subscriber terminals operating at or near the performance characteristics proposed by the WCS Coalition.

A recent video supplied to the FCC by Sirius XM attempted to represent the interplay between WCS and SDARS end user devices in moving vehicles. The WCS Coalition has criticized this video on the grounds that Sirius XM used signal generators, noise generators, power amplifiers, and other test instruments to emulate WCS-band signals in a manner that did not accurately reflect the characteristics of a WCS device operating in accordance with the WCS Coalition's technical proposal.[1]

The goal of the field demonstration detailed in this document will be to produce a similar video, but to use operational WCS base station equipment and end user devices to show the potential impact of mobile WCS end user device operation on SDARS receivers under real world conditions. Specifically, the field testing proposed herein intends to evaluate:

- The effectiveness of low maximum transmit power, transmit power control, adaptive modulation and restrictive spectral masks on reducing the potential for interference from mobile WCS devices to nearby SDARS receivers.

- Whether WCS user activity, user proximity, relative motion, and coupling loss further reduce the occurrences of interference to SDARS receivers.

1.1. Background

There are several key factors that impact the likelihood of a WCS device to cause interference to an SDARS receiver, including:

- Whether the two devices are in close proximity
- Whether the WCS device is transmitting
- On what frequency the WCS device is transmitting
- At what power level is the WCS device transmitting

The testing conducted by Sirius XM did not account for at least two of these key factors,

[1] *See* Letter from Paul J. Sinderbrand, Counsel for WCS Coalition, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 95-91, et al (filed March 9, 2009).

namely the impact of transmit power control and transmission variability based on WCS user activity.

The variable nature of the transmit power of a mobile unit in an operational cellular network employing transmit power control, as proposed by the WCS Coalition, is an important factor in evaluating any potential for interference. "Worst case," static phenomena, such as the maximum allowable transmit power of the user device, do not accurately portray the interference condition. In real world conditions, the mobile transmit power varies dynamically over time and location, which has a direct impact on its interference potential to victim receivers. For a cellular technology, such as WiMAX, the end user device's transmit power level is a function of multiple algorithms and parameters, primarily designed to ensure that a mobile transmits at the lowest possible level to minimize intra-system interference and maximize battery life. The result is that the mobile in a typical cellular deployment is almost always operating at power levels well below its allowable maximum.

In addition, a mobile station in an operational TDD system transmits only during the uplink portion of a frame and only when it has packets to transmit. The length of these packets (bursts) is a function of the application model (traffic pattern), which is commonly biased towards the downlink. As such, even in instances where it is necessary for the end user device to operate at or near its allowable maximum power, the duration and frequency of the transmissions are small.

1.2. Objectives

The objective of this field test is to demonstrate the combined effects of WCS mobile end user device transmit power levels, out of band noise levels, and user activity factor on the potential for audible muting of SDARS subscriber units under typical in-vehicle operation.

1.3. Scope

A demonstration environment has been developed in Ashburn, VA near Dulles International Airport. The area consists largely of modern commercial and office park developments with buildings ranging in height from one to five stories and is characterized as an open area with rolling terrain, wide streets, and moderate foliage. A survey of SDARS network coverage suggests that both Sirius and XM have suitable satellite coverage in the area. XM also appears to have some weak, intermittent terrestrial repeater coverage.

The WCS test network will consist of a WiMAX base station and a commercial WiMAX end user device. The base station and commercial mobile device are provided by Alvarion Ltd. and are certified to comply with ETSI specifications.

SDARS subscriber equipment will be comprised of newly purchased "after market" units and commercially-installed units in rental cars. The WCS end user device will be comprised of the WCS modem connected to a laptop and will be situated in a separate rental car.

Video/audio recording will document the performance of the SDARS receivers while the SDARS and WCS test vehicles drive along a prescribed route. Software applications will be used to generate traffic to send over the WCS airlink connection and to record the real time operating characteristics – output power, position, etc. – of the WCS subscriber terminal. The traffic profiles and drive route will be selected to ensure that the WCS end user device operates over a full range of possible transmit power levels and activity profiles.

A total of 32 different test cases, which include the various permutations described in Section 5 will be performed.

2. Methodology

This field test will be conducted using two test vehicles: one outfitted with SDARS subscriber equipment and one with the WCS end user device. Data will be collected while these test vehicles drive along a prescribed route.

Software applications will be used to generate traffic to send over the WCS airlink connection and to record the real time operating characteristics – output power, position, etc. – of the WCS subscriber terminal.

As discussed in Section 5.1, a total of 32 different test cases, which include various permutations of the WCS device, WCS bands of operation, SDARS service, SDARS coverage condition, and traffic application will be performed. The collected data will be analyzed to determine the effectiveness of reduced maximum power levels, restrictive OOBE limits, transmit power control and other "real world" parameters on coexistence.

The overall test program will consist of the following stages:

(1) WCS equipment delivery, integration and optimization
(2) Interoperability Test of the prototype WCS end user device
(3) Configuration of test vehicles and stage test cases
(4) Execution of test plan by WCS Coalition, witnessed by OET and SDARS
(5) Submission of demonstration results

2.1. Data collection

Video/audio recording of the SDARS receiver and a video recording of the proximity of the WCS test vehicle to the SDARS test vehicle will be obtained for each test case in a

manner similar to that of the Sirius XM recording. The recorded video/audio log files are the relevant data resulting from the demonstration.

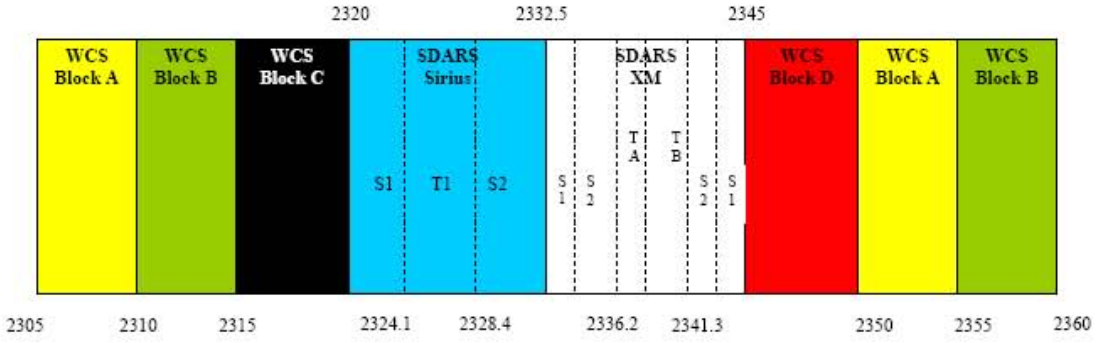
Real time statistics of the WCS end user device operation will be logged. This data will be used to verify that the WCS device utilized a full range of possible transmit power and modulation coding schemes during the tests.

If possible, the video/audio and WCS end user device log files will be time and position stamped with GPS.

2.2. WCS frequency bands

SDARS and WCS services operate in adjacent frequency bands as shown in the tables below per Federal Communication Commission (FCC) spectrum allocation. Tests will be conducted in the following WCS bands: B-Block (lower), C-Block, D-Block, and A-Block (upper).

Service	Frequency (MHz)
WCS A Lower	2305 to 2310
WCS B Lower	2310 to 2315
WCS C	2315 to 2320
SDARS Sirius	2320 to 2332.5
SDARS XM	2332.5 to 2345
WCS D	2345 to 2350
WCS A Upper	2350 to 2355
WCS B Upper	2355 to 2360



For the C-Block and D-Block tests, as it is not technically feasible for a 5 MHz WiMAX carrier to occupy the entire channel allocation and meet the proposed OOBE limits, the

carrier will overlap a portion of the adjacent B-Block or C-Block spectrum leaving the 2.5 MHz closest the band edge unoccupied.[2]

2.3. Estimated Test Time

It is estimated that 2 days will be required to complete the test cases described.

2.4. Entrance Criteria

The following criteria will be met by the WCS Coalition before commencing the demonstration:

- Acquisition of STA to operate WCS equipment in test location
- Installation, integration, and optimization of the WCS equipment and end user devices
- Assembly and configuration of additional equipment required for testing, such as test cars, data collection software and instruments, etc.

[2] While the WiMAX standard supports flexible bandwidths from 1.75 MHz – 15 MHz, the test equipment currently supports only the 5 MHz and 10 MHz WiMAX profiles. Conducting C-Block or D-Block tests while occupying the entire 5 MHz channel is not relevant to the coexistence scenarios to be demonstrated. Given current technology limitations, the 2 MHz within the C-Block or D-Block closest to the SDARS band are not readily usable by a WCS mobile device due to the stringent emissions mask requirement that needs to be met at band edge (*See* Letter from Jennifer M. McCarthy, Vice President Regulatory Affairs, to Ms. Marlene Dortch, Secretary, Federal Communications Commission, November 26, 2008).

3. Test Equipment

3.1. WCS Test Network Architecture

The overall architecture for the trial WCS network is depicted in Figure 1 below.

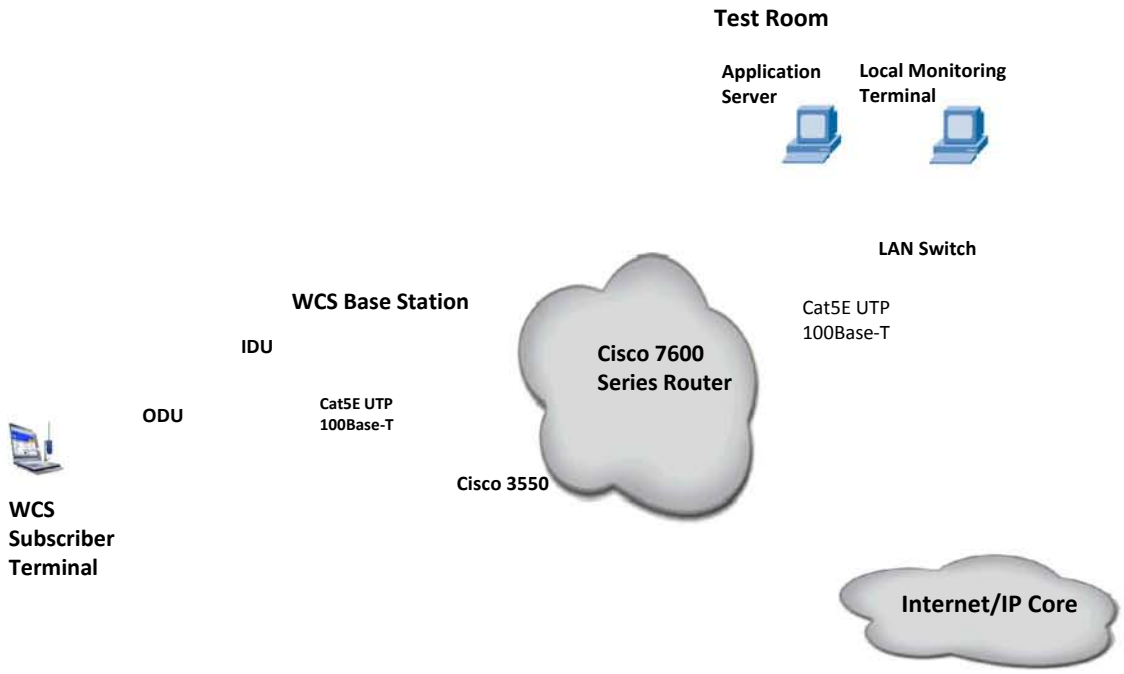


Figure 1. WCS Test Network Architecture.

The components of the test network include an access layer consisting of a WCS radio base station and WCS end user device based on the WiMAX 16e standard; a Cisco 7600 series router, which serves as the IP gateway for the access layer; an IP Core network, which performs authentication, security, IP address management, and Internet traffic management. A Test Room, which consists of an application server and local monitoring terminal, which interface with the Cisco router, will be used to manage the network during the tests, to host applications used for traffic generation, and to collect statistics related to access network performance.

3.2. WCS Radio Base Station Equipment

A WCS radio base station developed by Alvarion Ltd. will be used for the testing. Alvarion's BreezeMAX radio base station is a WiMAX 802.16e certified platform for fixed, nomadic and mobile wireless access.

The modular base station consists of an Indoor Unit and an Outdoor Access Unit. The Indoor Unit (IDU) is the main chassis of the BreezeMAX base station, which establishes wireless network connections and manages bandwidth in compliance with the IEEE 802.16e-2005 wireless standard. The IDU is comprised of two main units in addition to power and management components: the Access Unit, a programmable WiMAX modem card that performs radio resource management and the Network Processing Unit that manages the base station components and all connected subscriber units. The Outdoor Access Unit (ODU) is a remote radio unit that connects to an external antenna. The ODU supports 5 MHz and 10 MHz WiMAX channel bandwidths. Specifications for the BreezeMAX radio base station are provided in Attachment 1.

The BreezeMAX base station is certified to comply with ETSI specifications and is intended for operation outside of the United States. The base station emissions exceed the OOBE limit currently authorized under Part 27.53(a)(1), however the additional OOBE are not anticipated to impact the drive test results.[3] The ETSI certification test report for the base station is provided in Attachment 2.

The WCS base station operates over the entire 2300 – 2400 MHz band and has a tuning resolution of 125 kHz, providing flexibility for WCS C-Block and D-Block testing, which will require partial use of the allocated 5 MHz frequency blocks.

3.3. WCS End User Device Equipment

The following WCS end user device will be used for testing:

<u>Commercial End User Device</u>
The Alvarion BreezeMAX WCS end user device is a PC Card with a PCMCIA adaptor for operation with a laptop. The BreezeMAX modem is a WiMAX 802.16e certified device for fixed, nomadic and mobile wireless access. The device supports Windows XP and Windows Vista operating systems.

The Alvarion end user device is a fully self-contained device with an integrated baseband section, RF section, and antenna. The end user device has an average EIRP of +24 dBm and is configured with transmit power control. Specifications for the BreezeMAX device are provided in Attachment 3.

The BreezeMAX end user device is certified to comply with ETSI specifications and due to its OOBE performance is intended for operation outside of the United States only.

[3] The WCS base station emissions do, however, comply with the 55+10 log (p) OOBE limit contained in WCS Coalition's proposal.

3.4. WCS Trial Network Configuration and Parameter Settings

The initial configuration and parameters settings for the WCS trial network are provided in Table 1 below. During the equipment integration phase it may be necessary to modify these parameters to optimize airlink performance. Changes to these settings will be documented prior to the start of testing.

Table 1. Initial WCS Trial Network Configuration

WiMAX OFDM Parameter	Value
Channel Bandwidth	5.0 MHz
FFT Size	512
Guard Time	1/8 symbols
DL/UL Ratio	27/17
Computed DL Data Symbol rate	5400 bps
Computed UL Data Symbol rate	3400 bps
DL OFDMA Mode	DL PUSC
DL Frequency Reuse	1
DL Cell Edge Modulation Scheme	QPSK-1/2
UL OFDMA Mode	UL PUSC
UL Frequency Reuse	1
UL Cell Edge Modulation Scheme	QPSK-1/2

3.5. SDARS Receivers

Both standard after market and Original Equipment Manufacturer (OEM) installed SDARS receivers will be used for the testing. The make, model, and serial numbers for the receivers shall be recorded.

<u>Sirius</u>

- OEM (original equipment manufacturer) installed in rental car
- Newly purchased commercial product directly out of box

<u>XM</u>

- OEM (original equipment manufacturer) installed in rental car
- Newly purchased commercial product directly out of box

3.6. Application and Traffic Generation Tool

For the tests, Iperf (http://iperf.sourceforge.net/) will be used to measure maximum TCP and UDP bandwidth performance. Iperf allows the tuning of various parameters and UDP characteristics. Iperf reports bandwidth, delay jitter, and datagram loss. Iperf

output contains a timestamped report of the amount of data transferred and the throughput measured.

Iperf is a commonly used network testing tool that can create TCP and UDP data streams and measure the throughput of a network that is carrying them. Iperf has a client and server functionality, and can measure the throughput between the two ends, either unidirectonally or bi-directionally.

To test the effects of different application types, the following applications will be used in the testing:

- Voice Over IP
- High Bandwidth (2 Mbps) UDP Download
- High Bandwidth (2 Mbps) UDP Upload

3.7. Data Collection Tools

For the tests it is desirable to log the statistics for the WCS end user device so the operating characteristics can be known. A real time device-based data collection tool will be used to decode and log PHY/MAC parameters and messages. Information to be recorded will include received signal strength, device transmit power, ranging messages, and MCS selection. Additional information may be logged depending on the specific test conditions.

For the SDARS receivers, audio recording of the radio output and video recording of the relative position of the WCS device will be conducted. An XM upper-ensemble channel (Channel 58), and a Sirius channel (Channel 10) will be monitored for audible mutes. Video/Audio recording of radio output and visual of WCS interference vehicle will be collected, and if possible, time-stamped to permit synchronization with device log files and further analysis of interference events.

If possible, the video/audio recording and WCS end user device log files will be time and position stamped to permit further investigation of interference events that may be observed.

3.8. Test Vehicles

Two four door sedan test vehicles will be used. The WCS Test Vehicle will be outfitted with the WCS mobile subscriber terminals and a laptop PC. The SDARS Test Vehicle will be outfitted with the representative Sirius and XM satellite radio receivers. The

Sirius and XM receiver antennas will be mounted on the vehicle roof using typical installation.

3.9. Ancillary Equipment

The following ancillary equipment may be used during testing:

- Video camera
- Agilent 4438C
- WCS Block Filters
- WCS Power Amplifier
- Omni antenna (PCB/WCS antenna)
- Spectrum analyzer
- Bias tee
- Power supply
- Antenna cables and adapters
- Directional coupler
- Battery powered speakers and audio extension cable
- DC/AC inverters
- Wheeled Cart
- Tape measure
- Power strips and extension cords

3.10. Calibration/Certification

Where applicable, equipment will demonstrate current calibration, required FCC certification, and standards compliance.

4. Test Environment

4.1. Test Location

Tests will be conducted in the vicinity of Ashburn, VA near Dulles International Airport. The test area is a modern commercial and office park development with buildings ranging in height from one to five stories. The test area is characterized as an open area with rolling terrain, wide streets, and moderate foliage. Both line-of-site and non-line-of-site propagation paths are expected to exist in proximity to the WCS radio base station.

Figure 4. Satellite image of test environment near Dulles Airport.

Figure 5. Photograph of test environment.

4.2. WCS Base Station Installation

The WCS radio base station will be installed at 44675 Cape Ct., Ashburn, VA. The antennas are situated at latitude 39.01759°N and longitude 77.45573°W and have a radiation centerline of 28 feet above ground level.

Two Telsa T01281605 panel antennas are installed on pipe mounts on top of the rooftop of the two story office building. The pipe mounts are attached to a steel frame that provides visual screening for the HVAC condensers and other items installed on the rooftop. With this configuration, the orientation of the sector can be adjusted to optimize signal coverage and drive route selection. The antenna installation is depicted in Figure 6 and 7 below.

The Telsa panel antennas are cross-polarized (±45°) panel antennas covering the 2300 – 2700 MHz band. The panel antennas have a nominal gain of 15.5 dBi with a half power beamwidth of 85° in the horizontal plane and 7° in the vertical plan. A specification sheet for the antenna is provided in Attachment 4.

The Alvarion radio heads are affixed to the pipe mounts and connected to the antennas through short coax jumper cables. The IF cables from the radio heads extend across the rooftop and enter the equipment room, where the baseband portion of the base station is installed, through a roof penetration, as shown in Figure 8.

Figure 6. Base station location.

Figure 7. WCS Base station antenna installation.

Figure 8. WCS Radio head IF cable run and roof penetration to equipment room.

4.3. WCS Base Station Coverage

Performing a link budget analysis with the parameters specified in Section 3.4 combined with the transmit power and receive sensitivity characteristics of the WCS base station and end user devices yields a maximum allowable path loss metric of 142 dB for in-vehicle operation. Applying an adjusted SUI propagation model suggests that the maximum coverage range of the WCS base station should be approximately 1.0 miles.

4.4. Sirius and XM Network Coverage

A preliminary investigation of the Sirius and XM network coverage was completed by the WCS Coalition to ensure the suitability of the test environment. While it is necessary to complete a full characterization of the Sirius and XM network coverage prior to testing, the initial evaluation suggests that:

- The Sirius network provides sufficient satellite-only coverage for testing.

- The XM network provides sufficient satellite coverage for the testing. Very low levels of terrestrial repeater coverage were also detected at select locations within the test environment.[4]

Measurements obtained with Sirius and XM satellite radio receivers in the test environment are depicted in Figures 9-13 below.

Figure 9. Sirius network coverage at a location within test environment.

[4] The terrestrial repeater coverage appears to be too weak and intermittent to contribute to receiver performance, so for test purposes the XM receiver is assumed to be served by satellite signal only.

Figure 10. Sirius network coverage at a location within test environment.

Figure 11. XM network coverage at a location within test environment, showing no reception of terrestrial repeater coverage.

Figure 12. XM network coverage at a location within test environment, showing reception of repeater coverage

Figure 13. XM network coverage at a location within test environment, showing reception of repeater coverage.

4.5. Drive Route Selection

The drive route for data collection will be selected after the WCS base station equipment is installed and integrated and a full characterization of the radio coverage can be performed.

Considering the initial analysis related to link budget coverage in Section 4.3 above, it is anticipated that the coverage will extend approximately 1.0 miles from the test site.

The following criteria will be applied in selecting the drive test route:

- Full range of WCS RF coverage, from weak, “cell edge” conditions to strong “cell interior” conditions so that the full range of power control and modulation coding scheme effects can be characterized.
- Received power from the base station of no more than -55 dBm to ensure that the WCS base station does not contribute to the SDARS receiver overload or noise floor rise effects to be tested.
- Roadways which have variable terrain, shadowing, foliage, traffic density, and vehicle speed limits.
- Suitable SDARS satellite coverage levels.

The WCS base station location with a 1.0 mile boundary is depicted in Figure 14 below. It appears that there will be sufficient WCS coverage of nearby roads and commuter routes to achieve the drive route selection criteria listed above.

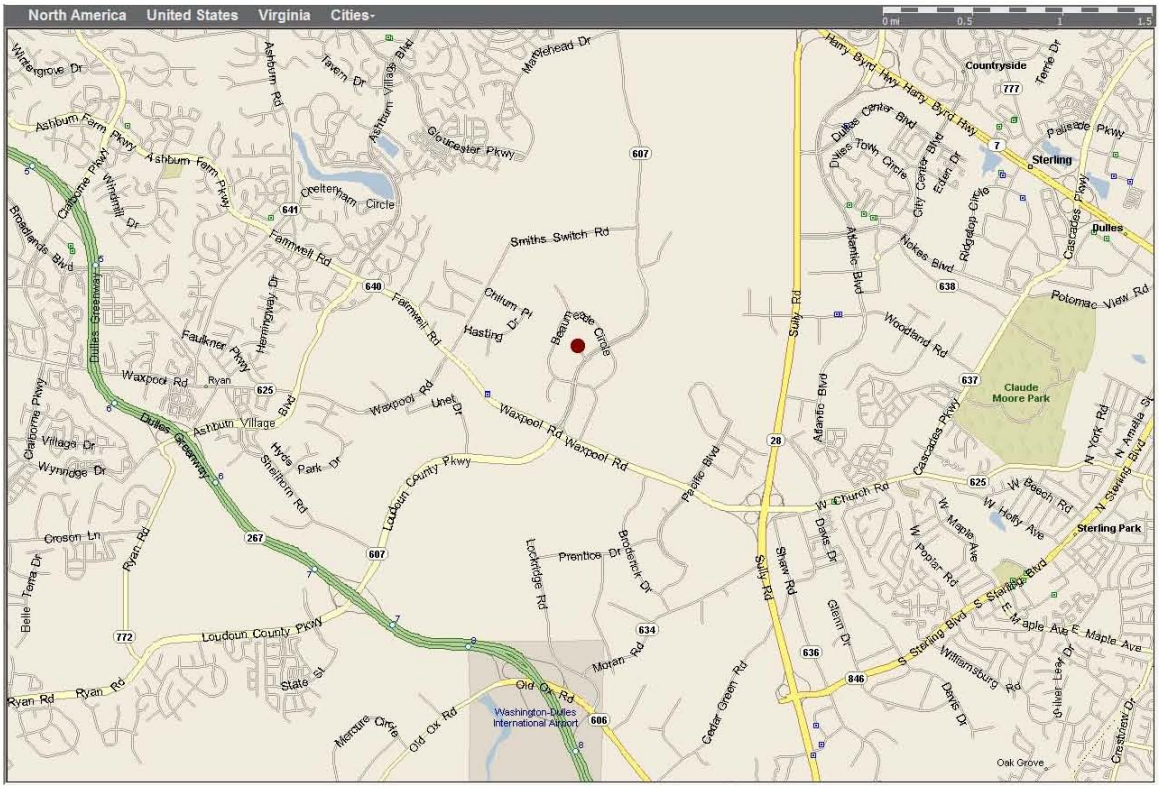


Figure 14. WCS base station location with estimated 1.0 mile coverage boundary.

5. Test Program

The field test program will consist of the following phases:

(1) Coverage verification of the Sirius and XM networks
(2) Coverage and throughput verification of the WCS test network
(3) Drive tests using the SDARS and WCS test vehicles

For the drive tests, a total of 32 different test cases will be performed. These test cases include various permutations of WCS devices, WCS bands of operation, SDARS service, SDARS coverage condition, and end user traffic application. When possible, the tests will be performed during normal business hours with traffic present along the test route.

5.1. List of Tests

A matrix describing the test conditions and equipment parameters for the 32 drive test cases is contained in Attachment 5.

5.2. Test Procedures

The test procedures are as follows:

SDARS Network Coverage Verification
Purpose: To verify the coverage conditions of the Sirius and XM networks to establish a baseline of the quality and consistency of the audio service over the drive test route. Two coverage conditions will be verified: A. Sirius "satellite only" network coverage B. XM "satellite only" network coverage
Prerequisite: 1. The drive test route has been selected. 2. The Sirius and XM receivers and video/audio recording equipment are installed in the test vehicle.
Configuration: 1. The WCS base station should be powered down during the tests.
Procedure: 1. Proceed to the start of the drive test route. 2. Using the appropriate displays or diagnostic capabilities with the SDARS receiver under test, determine the initial signal coverage condition. 3. Tune to the selected test channel. Channel 10 for Sirius or Channel 58 for XM. 4. Turn on the video/audio recording device. 5. Drive along the drive test route, making notes of any audio mutes observed along the drive route on the log sheet. 6. Repeat test procedure for conditions B. and C. above.

WCS Test Network Coverage Verification
Purpose: To verify the range and sensitivity of the WCS base station over the drive test route
Prerequisite: 1. The drive test route has been selected. 2. The base station, end user device, and application server are properly configured. 3. The end user device can successfully complete network entry and register on the network.

4. The end user device can successfully negotiate basic capabilities once registered on the network.

Configuration:

1. The base station and end user device are operational for the test.

Procedure:

For initial coverage verification:

1. Proceed to the start of the drive test route.
2. Connect the end user device to the laptop.
3. Activate the end user device and device monitoring application (with GPS connected).
4. Using the appropriate displays or diagnostic capabilities, determine the initial signal coverage (RSSI and CINR) condition.
5. Start a data logging session recording the measured RSSI and CINR of the user device.
6. Drive along the drive test route, making notes of any areas of strong or weak coverage or CINR. Also note instances where the RSSI exceeds -55 dBm as these locations should be excluded for the drive test route.

To verify the range and sensitivity of the base station and end user device:

1. Proceed to the start of the drive test route.
2. Connect the end user device to the laptop.
3. Activate the end user device and device monitoring application (with GPS connected).
4. Activate a “ping” application from laptop.
5. Start a data logging session recording the measured RSSI and CINR of the user device.
6. Drive along the drive test route, monitoring an active ping session for the duration of the drive test.

WCS-SDARS Drive Test

Purpose:
To demonstrate the effect of WCS mobile end user device transmit power levels, out of band noise levels, and user activity factor on audible muting of SDARS subscriber units under typical in-vehicle operation.

32 different test case permutations will be executed. The basic procedure fort each test is essentially the same.

Prerequisite:
1. The base station, end user device, and application server are properly configured.
2. The end user device can successfully complete network entry and register on the network
3. The end user device can successfully negotiate basic capabilities once registered on the network.
4. SDARS network coverage has been verified
5. WCS network coverage, range, and sensitivity have been verified and drive route has been adjusted accordingly.

Configuration:
1. The SDARS receivers are operational for the test.
2. The base station and end user device are operational for the test.
3. To test the effects of different application types, four different WiMAX service flows will be used in the testing.
4. iPerf and the application server are configured to emulate the appropriate applications for the following service flows:
   - Best-effort service (BE): Web browsing, data transfer
   - Non-real-time Polling service (nrtPS): File Transfer Protocol (FTP)
   - Real-time Polling service (rtPS): Streaming audio and video, MPEG encoded
   - Unsolicited grant services (UGS): Voice over IP (VoIP) without silence suppression

Procedure:
1. Configure the SDARS and WCS test vehicles according to the parameters established in the test matrix for the given test.
2. Proceed to the start of the drive test route.
3. Tune to the selected SDARS test channel. Channel 10 for Sirius or Channel 58 for XM.
4. Turn on the video/audio recording device.
5. Connect the end user device to the laptop.
6. Activate the end user device and device monitoring application (with GPS connected).
7. Start a data logging session recording the measured RSSI and CINR of the user

device.

8. Initiate the iPerf session to emulate the service flow defined in the test matrix.
9. Drive along the drive test route monitoring the SDARS reception and iPerf session for the duration of the test.
10. Vary the relative speed, proximity, and orientation of the SDARS and WCS test vehicles throughout the test.

Attachment 1: Alvarion BreezeMAX Radio Base Station Specifications

Attachment 2: Alvarion BreezeMAX ETSI Certification Report

Attachment 3: Alvarion WiMAX Device Specifications

Attachment 4: WCS Base Station Antenna Specifications

Attachment 5: Matrix of Drive Test Cases