MSTV

MAXIMUM SERVICE TELEVISION

October 15, 2007

Julius Knapp
Chief
Office of Engineering and Technology
445 12th Street, SW
Washington, DC 20554

Re: OET Testing of Unlicensed Devices; ET Docket No. 04-186

Dear Mr. Knapp:

MSTV expresses its appreciation to you for convening a meeting regarding further testing of unlicensed devices. OET did the right thing in hosting the October 5, 2007 meeting with MSTV and other interested parties in an effort to promote transparency, obtain input on how to conduct the testing and explain how testing fits into the decision-making process for this issue.

As you know, MSTV has a significant number of questions about the test program that, unfortunately, remain unanswered. The purpose of this letter is to not only highlight these concerns, but to also offer proposals that will improve the testing process.

Prior to the meeting, MSTV submitted a list of questions that need to be answered before OET's further testing begins, and as to which public comment should be sought. MSTV asked that OET provide answers to these questions at the meeting, but answers to the vast majority of these questions were not provided at the meeting or otherwise. After the meeting, OET issued a Public Notice announcing the further testing and seeking device submissions for that testing. That Notice provided no further insight and no opportunity for public comment on these important issues.

This omission is inconsistent with OET's laudable commitment to making this testing process open and transparent, because it has not furnished a test plan detailing how these tests will be conducted. Providing a testing plan would allow parties the opportunity to comment and offer suggestions. Without this step, the testing process will not be open and the Commission will not have the benefit of input from expert parties and the public.

Questions, which are integral to the testing process, still remain unanswered. For example, OET has not specified how many locations will be tested, how these locations will be selected, and whether they will be representative of the various areas where television viewers are located. Further, during the meeting, you stated that failure will not be defined in advance of the testing; this means that parties observing the testing will be unable to see a device achieve an effective sensing threshold to protect viewers. Relatedly, there has been no determination as to

what constitutes the appropriate testing threshold. The Commission has stated that it believes devices need to sense at -116 dBm[1] in order to prevent interference to television services, yet the manufacturers' of the devices submitted thus far suggest sensing only to a level of -114 dBm. If devices sense effectively at -114 dBm or at -116 dBm or at some other level, what will this mean? These are all key prerequisites to any testing that must be established and disclosed prior to the start of testing. Moreover, little if anything was disclosed regarding the type of interference testing that OET plans to conduct and whether this testing will be conducted in the laboratory, in the field or both.

The little that was made clear during OET's meeting is that OET has determined that it is not necessary to test a complete device, nor is it necessary to test the types of devices which will operate in the band. Therefore, most of the "devices" submitted for testing will not contain a transmitter to accompany the sensing functions, and none of the "devices" submitted are devices that would actually operate in the band (nor would these devices meet the FCC's requirements for equipment authorization or approval). There was no discussion of how or why this determination was made.

You have made clear that (1) OET and the Commission as a whole will examine many issues in deciding whether to authorize unlicensed services and, if so, crafting appropriate rules for these TV band devices, and (2) these additional tests are only one piece in a large technical and analytical record. This statement is consistent with broadcasters' long-held view that even a few limited "successful" tests would not be a sufficient basis for determining that personal/portable devices should be allowed to operate in the band nor could such limited testing be the basis of determining the proper operating requirements for such devices needed to protect TV viewers throughout the United States and the diverse conditions that can apply to those viewers. Therefore, MSTV is very concerned that any rules written in response to these limited tests will not be adequate. OET must not rely on the certification process and limited and incomplete testing to protect television viewers and services. Certification does not determine interference and it is not, lawfully, a substitute for proper rulemaking.

Unlike prior unlicensed device regimes, where items like microwave ovens might have been interfered with if the Commission got it wrong, the stakes here are far higher. Never before has authorization of unlicensed operation threatened America's free, universal and local television service. Thus, it is essential that additional testing be performed to provide OET the information required to determine whether to authorize unlicensed personal/portable TV band devices, not merely to determine if the sensing functions in certain boxes are able to sense at -114 dBm. This will not be sufficient.

During the meeting you asked that parties submit any testing requests or suggestions to OET for its consideration. MSTV is committed to providing OET with any assistance necessary to aid in further testing in order to protect against harmful interference to the public's television

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[1] The Commission stated that this value was chosen based on the work of IEEE 802.22. However, IEEE 802.22 has indicated that this value includes other factors, such as geolocation, outdoor reception and receive antenna height requirements. IEEE has indicated that the -116 dBm value alone will not protect TV viewers. Further, MSTV and others have submitted detailed technical analysis showing that -116 dBm is not sufficient to not protect TV reception. Recent data submitted by Microsoft also confirms this position.

services. To this end, and in light of the issues discussed above, MSTV recommends that OET undertake the specified further testing in the Appendix attached hereto.

Respectfully submitted,

Jonathan D. Blake
Counsel to MSTV

Proposed Modifications/Additions to the Tests Conducted by the FCC to Evaluate the Performance of Prototype TV-Band White Space Devices

This document proposes modifications and/or additions to tests conducted by the FCC during their initial evaluation of the performance of the prototype TV-band White Space devices. The proposed modifications focus on the three areas tested by the FCC: Spectrum sensing capability testing, transmitter characterization and interference testing, and field testing.

1. Spectrum Sensing Capability Tests

In the initial evaluation of the performance of prototype TV-band devices, two "bench" or laboratory tests were performed. The first test "determined the baseline minimum discernable signal that could be successfully detected by the scanner/sensor component of the prototype" and the second test determined "the impact to the baseline from signals present on nearby channels."[2] The original tests were done using laboratory-grade unimpaired DTV signals. OET indicated that it intends to conduct similar tests on the "new" prototypes using a subset of twelve ATSC signal captures. While we agree that the use of the captures is an improvement from the previous tests, the spectrum sensing tests are still deficient in that they fail to test two key components essential to spectrum sensing – the antenna system used for sensing and the environment in which the device will operate and sense. The following laboratory tests #1 and #2 should be used to account for these two factors and allow the spectrum sensing performance of the actual device with its antenna to be measured in a controlled and repeatable manner. Moreover, it is worth noting the previous field measurements were conducted using the device and antenna system. Using a different configuration in the lab than in the field will make it difficult, if not impossible, to compare and assess the two sets of measurements.

The second test in the initial evaluation testing was intended to determine the impact of sensing from TV signals present on nearby channels. While the results of these "multiple-signal detection threshold tests" did indicate that "sensing" was impacted by the presence of signals on nearby channels, the initial tests were limited to only the impact of a signal on one additional channel.[3] The tests were also not performed under either medium (-53 dBm) or strong (-28 dBm) signal conditions. Rather a single signal level of -60 dBm was used.[4] Laboratory test #3 presents some revisions to this previously conducted test to more accurately reflect RF conditions encountered in the field and to assess whether there is an impact on performance of the sensing device from signals on nearby channels.

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[2] See OET Report, *Initial Evaluation of the Performance of Prototype TV-band White Spaces Devices*, FCC/OET 07-TR-1006, dated July 3, 2007 at p. 5 and Section 3.

[3] The following text was included in the OET Report: "Although receivers used for sensing the presence of DTV signals might also be subject to similar performance degradations, such an intricate test as was performed in the previous FCC effort was deemed outside the scope of this project. Rather, within this project, tests were performed with only one additional signal placed first on an immediately adjacent channel (N-1) and then on a second channel (N+2)." See OET Report at p 15.

[4] See OET Report at p 17.

In addition, the original bench tests did not include any testing to evaluate the acquisition time and its effect on sensing. The previous tests merely observed the length of time the device took to "sense" including the time devoted to signal processing.[5] However, sensing must be accomplished within time periods necessary to permit practical communications. Laboratory test #4 is a new proposed test, intended to measures the performance of sensor and sensing time.

The Coalition has also proposed the use of transmitter power control based on the ability to accurately sense signal levels on the three channels above and below the channel being used for transmission. Laboratory test #5 was also added to measure the ability to effectively implement such an algorithm.

Laboratory Test #1

The performance of the antenna system used for sensing must be included in laboratory tests. Previous laboratory tests failed to test one of the most important components of the device – the device's antenna system. Under the previous lab test, the antenna was disconnected and signals were conducted through a cable connected directly into the antenna port. This test determines the "sensing threshold level" capability of the device's algorithms and internal circuitry.[6] It does not, however, evaluate the complete sensing system of the device. In practice, the signal "sensed" by the device is received through an antenna that has certain characteristics and gain patterns that will affect the actual signal being received and therefore sensed. Testing should include transmission tests of the device including its antenna system rather than the direct cable connected tests that do not include the contributions of the antenna system and the operating environment.

Such testing can readily be accomplished in a controlled environment such as the FCC's anechoic chamber. The device would be placed in the anechoic chamber and a transmitter source would be placed a short distance away (e.g., 3 meters). The propagation loss would be calculated or measured to determine the actual signal at the device and a baseline detection threshold test such as specified in 3.2.1 of the OET report would be run using a laboratory generated signal, and the ATSC recommended captures. This testing would allow the FCC to better determine the actual sensing capabilities of device. In addition, the device should be rotated in both the horizontal and vertical planes to measure the impact of different orientations on the antenna pattern and sensing threshold. It is recommended that at least three positions (45 degrees apart) be tested in both planes to fully characterize the performance of the device. If more than one antenna is supplied with the device, all supplied antennas should be tested. Recent data submitted by Microsoft included measurements with two different antennas, a

[5] See OET Report at p 12.

[6] The OET report mentioned that this technique was proposed in the IEEE 802.22 sensing group. The IEEE 802.22 sensing tests were intended to validate the performance of the sensing algorithm and not the device itself. Complete testing of the device is not part of the standard, but will developed separately, as an informative annex and as part of the Recommended Practice for using the standard.

"monopole" and "discone."[7] The Microsoft data showed numerous measurements where the variability between the two antennas at the same location was 20 dB or more.[8]

Laboratory Test #2

The impact of close-in obstructions such as the body must be taken into account in any sensing threshold tests. Previous laboratory tests failed to take into account the way these devices will actually be used and required to "sense." For example, some of the applications called out for personal/portable devices by the Coalition include laptops, PDAs, MP3 players, digital cameras, etc. All of these applications require that the device be held or located close to the user's body and will cause the signal received to be attenuated or will change the antenna pattern and gain of the device's antenna system. Studies conducted previously at the FCC laboratory on mobile telephones showed that these effects can be significant. Tests should be conducted to determine the impact on the sensing level that could be caused by body attenuation and distortions in antenna pattern that would occur in normal use for the various applications identified above. This test would involve repeating Laboratory Test #1 above with the addition of a person in close proximity to the device simulating how the device would be actually used in practice.

Laboratory Test #3

The multiple-signal detection threshold tests should be revised at a minimum to include the presence of two nearby DTV or unlicensed device signals on the following combination of channels: N±1, N±2 and at least one pairing that would be assumed to generate third-order intermodulation distortion on the channel being sensed. Tests should be conducted with the signal level of the signals at the strong (-28 dBm) and medium (-53 dBm) levels called out by ATSC and used by the FCC in their March 2007 receivers tests in this proceeding, rather than the -60 dBm level previously used.

Laboratory Test #4

Sensing acquisition time must be tested. Previous laboratory tests measured the device's ideal sensing detection threshold without regard to acquisition time required for sensing. In the FCC report, its was noted that one device took 27 seconds per channel and a total scan time of approximately 14 minutes. The second device scanned a single channel in approximately 8 seconds and all channel in about 4 minutes. The Coalition has indicated that the majority of time is devoted to processing the signal and the sensing times are much shorter. For practical communications systems sensing must be in milliseconds and not seconds. The FCC should conduct laboratory tests to determine the sensing acquisition time and the performance for

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[7] See Microsoft *ex parte* filing dated September 20, 2007.

[8] See, for example, Family Room data for channel 25 at site D; Living Room and Master Bedroom data for channel 30 at site E; and, Living Room data for channel 25 at site H. Microsoft *ex parte* filing dated September 20, 2007.

various acquisition times. This can be accomplished even with prototype devices by sending TV or wireless microphone signals of various durations starting for example with 100 ms and increasing to some higher value depending on the device's ability to detect those signals. This data can be compared to sensing tests with a continuous signal to compare sensing acquisition times.

Laboratory Test #5

TPC-related "sensing" needs to be tested. The Coalition has proposed an algorithm for transmitter power control (TPC) related to power in the three channels above and below the channel on which the device will operate. Laboratory testing of the capability to accurately detect signal levels on these channels needs to be conducted. Testing should determine whether signals levels across all six channels can be accurately determined under a variety of multiple signal conditions. In addition, testing should include sensing when transmissions are present on the channel being used for transmission to simulate transmissions between devices. The effects of various device orientations and nearby obstructions such as the body of the user should also be included in such testing.

2. Transmitter Characterization and Interference Tests

The initial prototype testing attempted to characterize the White Space device transmitter and to demonstrate the potential for the prototype device "to cause interference to the OTA reception of DTV broadcasts under real-world conditions". In this new round of testing, we urge that The Commission repeat all the transmitter characterization tests previously conducted and, as proposed below, modify their laboratory interference tests to more accurately represent real-world conditions.

In the previous FCC interference tests, the Commission stated that "a simple interaction scenario was chosen for examination under the premise that the results can serve as a baseline for modeling more complex scenarios."[9] The test process consisted of moving the transmitter towards and/or away from a test antenna receiving a DTV signal in small increments while turning the transmitter on and off and observing the effect. The tests were conducted with both the device's transmitting antenna and antenna used for DTV reception at about 3 to 5 feet. Such low antenna heights are not representative of "real-world" conditions that were intended to be modeled. In addition, at such heights it is unlikely that transmitting signal cleared the first Fresnel zone making the use of such data for modeling more complex scenarios difficult or impossible.[10] Laboratory test #6 recommends revisions to the previous test procedure contained in section 5.3 of the OET report.

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[9] See OET Report at p. 49.

[10] See, for example, NTIA Report TR-07-449, *Propagation Loss Prediction Considerations for Close-in Distances and Low-Antenna Height Applications.*

Laboratory Test #6

Typical co-channel and adjacent interference ranges need to be determined. The transmission characteristics should be determined in a laboratory controlled open field environment. As the FCC stated with regard to 5 GHz, the co-channel interference distance is important factor in determining the required sensing threshold of the device. These distances determine how far away the device needs to be from a television receiver in order to avoid interference and over which sensing must remain accurate. Previous interference testing of the device raised unexplained anomalies in the co-channel interference distance measured and the testing was not done in a way that was representative of a typical consumer outdoor rooftop antenna installation. These basic transmission tests must be done with the unlicensed device at 2 meters and the TV antenna at a height of 10 meters. To the extent possible, more than one over-the-air frequency and signal level should be used. At the very least, the results should be used to calculate or extrapolate the interference distances from the measured D/U ratios from the FCC previous receiver testing to provide interference distances at TOV.

3. **Field Tests** –

In the previous FCC tests, the Commission unfortunately did not articulate the purpose and rational for conducting field tests. It is, therefore, difficult to make recommendations regarding the type, scope and size of the field tests required to provide the information the Commission is seeking in this proceeding. Given the lack of this type of information, we are only limited to offering general guidance. We believe that it is essential that regardless of the purpose and scope of the FCC field testing, the Commission should collect enough data to scientifically and statistically support its findings. To accomplish that it is imperative to define the goal of testing prior to going in the field so to adequately determine the number of data points needed to statistically and scientifically conduct the proper analysis.

Field Test # 7 offers some of the factors that should be considered when developing a field test program for this proceeding.

Field Test #7

Field testing should include enough different locations to be representative of both TV reception and unlicensed operation throughout the United States. Urban, suburban and rural areas should be represented in any testing. Testing should also include variations in terrain, vegetation and other features that affect propagation. Testing should also include areas where there are significant TV stations in operation and areas where there are relatively few.[11] In addition to the Baltimore-Washington area, testing should be carried out in highly urban areas and areas with rugged terrain, such as Seattle, Pittsburgh, etc. testing should also include sensing of TV signals as well as transmission of the White Space device.

[11] Sensing must work correctly in all areas to prevent interference. In areas with many TV stations out-of-band energy from TV transmitters may increase the signal level being "sensed" while in areas with few stations this may not occur.

MSTV

MAXIMUM SERVICE TELEVISION

January 23, 2007

Julius Knapp
Chief
Office of Engineering and Technology
445 12th Street, SW
Washington, DC 20554

Re: OET Testing of Unlicensed Devices; ET Docket No. 04-186

Dear Mr. Knapp:

Ensuring an open and transparent testing process in this proceeding, of such great importance to the American public, is imperative. Accordingly, the release of the OET Test Plan is a necessary step towards achieving this goal.[1]

Unfortunately, however, the current OET Test Plan will be insufficient to provide OET and the Commission with the information that is necessary to determine whether unlicensed devices will cause harmful interference to television operations and other licensed services in the band. During the October 5, 2007 meeting, OET asked that parties submit testing requests and suggestions to OET for its consideration. MSTV complied with that request and on October 15, 2007 submitted a number of questions as well as proposed testing recommendations to ensure that OET's second round of testing would be representative of the performance of the devices under real world conditions.[2]

Despite the fact that no parties submitted objections to MSTV's proposals, OET with little explanation or comment failed to address MSTV's questions or implement most of its testing recommendations. Instead, the OET Test Plan simply states that suggestions in the public record "were considered and included where appropriate and practicable."[3] MSTV appreciates the importance of a practical testing plan and drafted its recommendations with this concern in mind. However, if these tests are truly to be used "to provide additional information for the record that will be considered in assessing the interference potential of such devices and appropriate requirements," as suggested in

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[1] *See* Public Notice, *Office Of Engineering and Technology Announces Plans for Conducting Measurements of Additional Prototype TV White Space Devices & Plan for Tests of Prototype Personal/Portable TV White Space Devices*, FCC/OET DA 08-118 (released Jan. 17, 2007) (OET Public Notice & Test Plan).

[2] *See* Letter from MSTV to Julie Knapp, ET Docket No. 04-186 (filed Oct. 15, 2007)

[3] OET Test Plan at 2.

In light of these issues, MSTV asks that OET either amend its current testing plan or undertake further testing to evaluate the issues discussed in the Appendix attached hereto.

Respectfully submitted,

Jodi M Steiger

Jonathan D. Blake
Jodi M. Steiger
Counsel to MSTV

Deficiencies in the OET Test Plan to Evaluate the Performance of Prototype TV-Band White Space Devices

1. The OET Test Plan fails to test or quantify the impact of the key component of any white spaces devices -- the receive antenna. All of the devices rely on the use of an external antenna to capture and sense the presence or lack of a TV signal. Yet the OET bench and laboratory tests completely ignore the impact of the receive antenna on the devices' performance.

Under the OET Test Plan, laboratory and bench testing of the devices is limited to conducted testing only and does not include any radiated testing to determine the actual performance of these devices under controlled conditions. MSTV provided detailed suggestions on how this testing could be conducted. There were no opposing comments to the use of these tests.

2. The OET Test Plan fails to properly test or quantify how personal/portable devices will actually be used and the impact that the operator of the device will have on its ability to sense TV signals. Personal/portable devices are likely to be hand-held devices that will be used close to the body. Microsoft and others have suggested for example such devices could include game controllers, digital cameras, MP3 players, etc. Body absorption and attenuation of radio signals can have dramatic impact on the signal levels received by a portable device. In fact, this is an area that should be well known to the FCC in the mobile telephone area where testing by the OET Laboratory has shown that the antenna pattern of a mobile phone can change by tens of decibels when the impact of the user's body or head is taken into account. Testing devices as proposed under the pristine case where the RF signal is feed by a cable directly into the device will bear little relevance to the device's actual performance. Again, MSTV provided detailed proposals on how to test the impact of the user on the device and there were no opposing comments to the use of these tests. These test proposals also recognized that not all impacts could be quantified and were deliberately restricted recognizing the OET testing would be time limited. To do no testing in this area, however, is negligent and irresponsible.

3. The OET Test Plan fails to adequately test the effect of multiple DTV signals, such as third order intermodulation (IM) products. Bench Test 3 indicates that the multiple DTV signal tests will be limited to two signals only. This includes the desired signal and one additional "strong" adjacent channel signal. However, this ignores the real world where more than two TV signals are present in most markets and where such signals may combine to produce intermodulation products on a third channel. To simulate real world conditions, multiple DTV signal tests must include at a minimum three channels to simulate the presence of two nearby DTV signals with at least one pairing that would be assumed to generate third-order IM distortion on the channel being sensed, as suggested in MSTV's earlier test proposals.

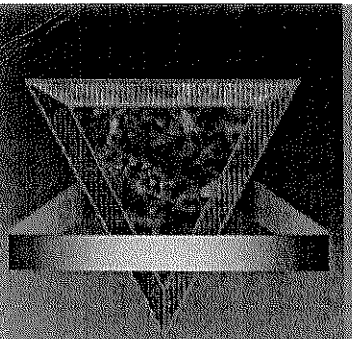
4. The OET Test Plan fails to test or quantify the impact on new mobile TV operations. One of the Commission's goals for digital television was the promise of new services to the public. Broadcasters and electronics manufacturers are currently spending tens of millions of dollars to meet that promise and are developing the ability to provide new mobile digital TV operations and services. Receivers used for this new mobile television reception will operate at significantly lower signal thresholds and will have different interference characteristics than the DTV receivers previously tested by the FCC. Furthermore, TV mobile devices and portable unlicensed may operate in much closer proximity and this fact must be taken into account to ensure that these primary mobile broadcast operations are fully protected as required under Part 15 of the rules.

At OET's open meeting on October 5, MSTV was assured that the OET would account for mobile TV in its testing plan. The current OET Test Plan, however, does not provide for any testing of mobile TV. Members of the broadcast industry have offered to make equipment available to OET and to cooperate in testing of mobile devices. OET's test plan should be amended to include testing of the interference characteristics of new mobile receivers and other mobile testing.

5. The OET Test Plan fails to provide any scientific methodology or test procedure to determine whether an appropriate sensing level can be set that will protect TV viewers. MSTV has already presented data that signals at -125 dBm and below can be present well within a TV station's service area. No one has provided any analysis or measurements to refute this data. Microsoft has submitted its own data that, as MSTV has pointed out, has shown that its device with a sensing level of -114 to -116 dBm capability fails to properly detect TV signals. Google, in its recent filing, claims that its device has the capability to sense at -120 dBm level. Google has provided data to the FCC that shows that it measured signals at this threshold level or very close to this level of -120 dBm at its headquarters which is only thirty miles away from and well within the protected contour of TV stations serving the San Francisco area. Clearly, lower TV signal levels undetectable by the Google device would be present slightly further from the stations or in indoor locations where building attenuation would be greater. However, the -120 dBm level is the lowest sensing level claimed by these concept devices or "not finished consumer products," a level already clearly shown in the record of this proceeding to be inadequate. MSTV is therefore concerned that the field testing proposed in the OET Test Plan makes no attempt to determine an appropriate sensing level. Further despite its claim to the contrary, the OET Test Plan does not suggest that these devices would be tested under "real world" conditions using practical antennas, taking into account the body attenuation of the user, the impact and overload of device transmissions on the device's receiver, etc.

MSTV has suggested that field testing must include enough different locations to be representative of both TV reception and unlicensed operation throughout the United States. However, the Public Notice announcing the OET Test Plan suggests that field testing would be conducted over a limited time period of four to six weeks. This field testing is also to include both TV and cordless microphone testing. Given the scanning time of many of these devices is on the order 30 minutes and more and that different

rooms will be tested at each location, it is unlikely that more than one location can be tested per day. If testing is limited to the work week, this means that a maximum of 30 locations can be tested in a six week period. The OET Test Plan suggests that these locations will include "a sample of personal residences (single family and multiple unit dwellings) and business structures located in urban, suburban and rural environs." Clearly, a 30 location sample is inadequate to even be representative of one of these environs within a single TV market let alone all TV over-the-air viewers across the United States. Without such an adequate and statistically valid sample, it is impossible to determine what an appropriate sensing level would be to protect those viewers as required under Part 15 of the FCC rules.



MSTV

MAXIMUM SERVICE TELEVISION

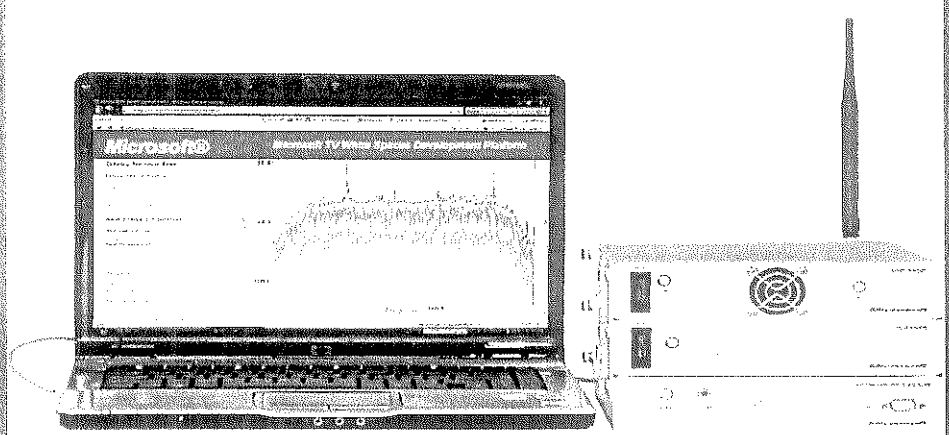
White Spaces Update
February 5, 2008

Unlicensed Device Testing

- Phase II tests have begun
  - Lab tests (4-6 weeks) Began January 24th
  - Field tests (In DC only) (4-6 weeks)
- "Concept" devices submitted by
  - Microsoft
  - Philips
  - Adaptrum
  - Motorola
  - Institute for InfoComm Research
  - Google
    - Not submitted for testing (demonstration only)
    - Antenna submitted
- No "consumer grade" devices were submitted

Microsoft Device

Microsoft TV White Spaces Development Platform Version 2



- Two devices were submitted same as previous devices
- Different antenna
  - Center loaded whip
- Sensing Capability
- Transmit capability
  - Includes separate outboard "brick" filter

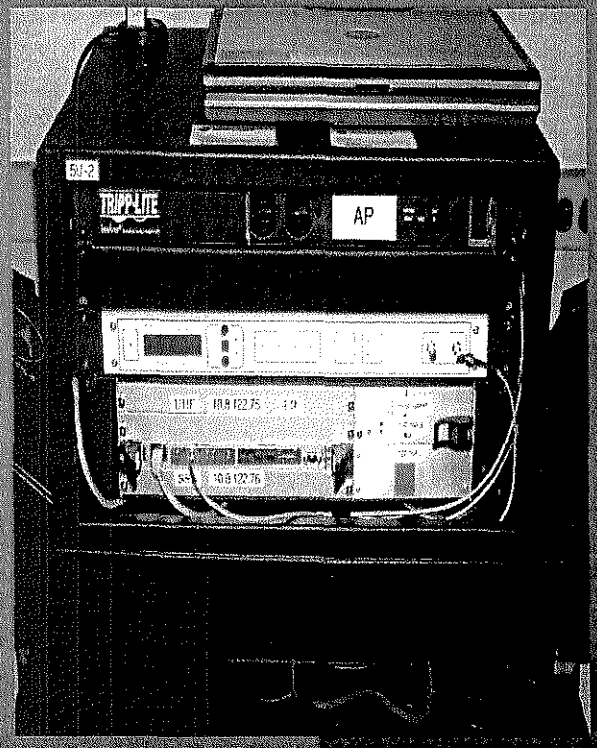
Philips Device

- Device is a sensor only
- No transmitter
- Physically different from earlier submission
- Uses center loaded whip (same as Microsoft)

Adaptrum Device

- User interface being reworked at FCC request
- New devices may be able to communicate
- Device included two biconical printed circuit antennas about 6” to 8” square
- Default sensing time is 37 seconds per TV channel

Motorola Device



- Introduces the concept of geo-location database enabled WSDs.
- Hybrid devices uses:
  - GPS/Geo-location database
  - Spectral sensing for mobile
- Transmitter disabled
- Device operates on adjacent channel
- Additional "sensing only" mobile component not pictured or submitted for testing

I²R White Space Device

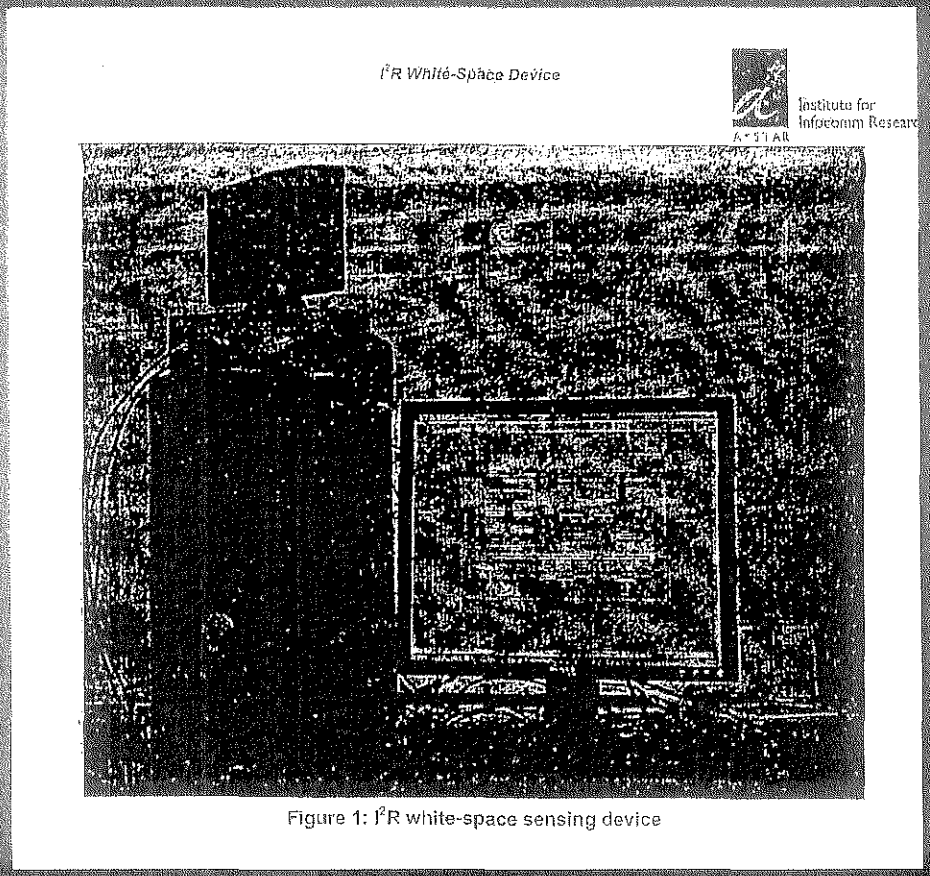


Figure 1: I²R white-space sensing device

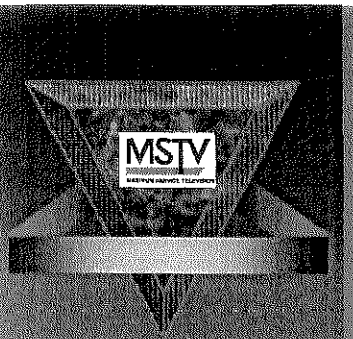
- Institute for Infocomm Research (I²R) of Singapore
- Will submit 2 identical devices
- Key Components
  - Omni antenna
  - Commercial TV tuner from Freescale
  - Mixed signal and digital processing boards
  - Computer

Antenna Performance and Sensing Level

- How do you take the antenna performance into account for sensing level
- Moore's law holds for electronics not antenna performance
- Not a particularly practical personal portable antenna design

Unlicensed Devices: Phase II Testing

- MSTV testing proposals
  - Submitted testing recommendations October 15, 2007: to ensure complete and thorough testing
  - Outlined specific test procedures
  - No parties objected
  - Most testing suggestions not included in FCC test procedure



FCC White Space Device General Testing Observations

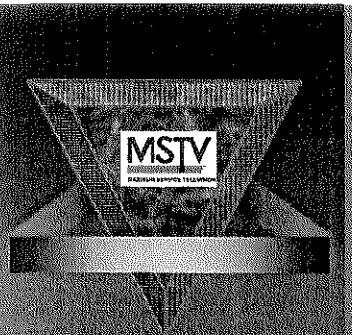
- Concept testing vs. actual devices
  - "Concept devices" not designed for consumer use but will be used as the basis for rules
  - Imperative that "concept devices" include realistic testing that considers how these devices will be used by consumers.
- Certification process does not test for interference
  - It merely certifies that consumer grade devices were manufactured consistent with the rules.
  - If the underlying rules are flawed due to inadequate tests, then certification will not protect against interference.

Unlicensed Devices: Phase II Testing

- Devices tested do not reflect consumer devices
  - Antennas must be considered in lab tests
    - Lab tests are being conducted without considering the affect of an antenna.
    - Sending the signal to a device by "wire" does not accurately measure a device's sensing capability.
    - Typical antenna will significantly reduce a device's sensing capability.
  - Must test based on consumer use of personal and portable devices
    - Consumers will use these devices "close to the body"
    - Body absorption and attenuation of signals are key issues in any mobile device.
    - No tests being conducted to measure impact of "body absorption" on the sensing ability to these devices

Unlicensed Devices: Phase II Testing

- FCC has conducted no independent analysis to determine the correct sensing level necessary to prevent interference
  - MSTV analysis demonstrates that signal levels below -125 dBm can be found well within a TV station's service area. Do not need a "sensing device" to prove this fact.
  - Phase two tests focus on levels at approximately -114 dBm to -120 dBm, because that is the level of sensing claimed by the proposed "concept devices." It is the best they can do.
  - There is no evidence that -114 dBm or -120 dBm is the correct sensing level or that this will be sufficient to avoid devices from turning on to co-channels.



Unlicensed Devices: Phase II Testing

- Must have realistic acquisition times
  - Concept devices may take up to a minute to sense each channel.
  - A device may take up to up to 35 minutes to "sense" 30 channels.
  - Such sensing times are unrealistic as a consumer device.
- Must have all components, i.e., sensing and transmit functions
  - Most of the devices are not complete and do not have both sensing and transmit functions.
  - There are likely to be interactive affects between the transmit and sensing components of the device.

Unlicensed Devices: Phase II Testing

- Must test with multiple DTV signals
  - FCC lab tests will be limited to the consideration of two signals
  - In real world there will be multiple DTV signals which may combine with the unlicensed devices to produce inter-modulation distortion on a third channel.
- Must test interference to broadcast mobile devices
  - Broadcast industry is developing new mobile reception capabilities
  - FCC does not consider interference to be harmful if the device causes interference to TV receivers up to 10 meters from the unlicensed device.
  - These mobile devices may operate in closer proximity to unlicensed devices.
  - Test plan should be amended to consider the impact on mobile operations.

Unlicensed Devices: Phase II Testing

- Field tests must be expanded
  - Need to test multiple sites in multiple markets to ensure there are not "holes" or "hidden nodes."
  - Tests should not be limited to Washington, DC area
    - It is not a typical "urban" area due to height restrictions on buildings
    - Topography of Washington DC is not predictive of terrain found in most areas of the country.