PREDICTED IMPACT TO 2 GHZ BROADCAST AUXILIARY OPERATIONS FROM PROPOSED HANDSET TO SATELLITE EMISSIONS TERRESTAR NETWORKS

JANUARY 30, 2008

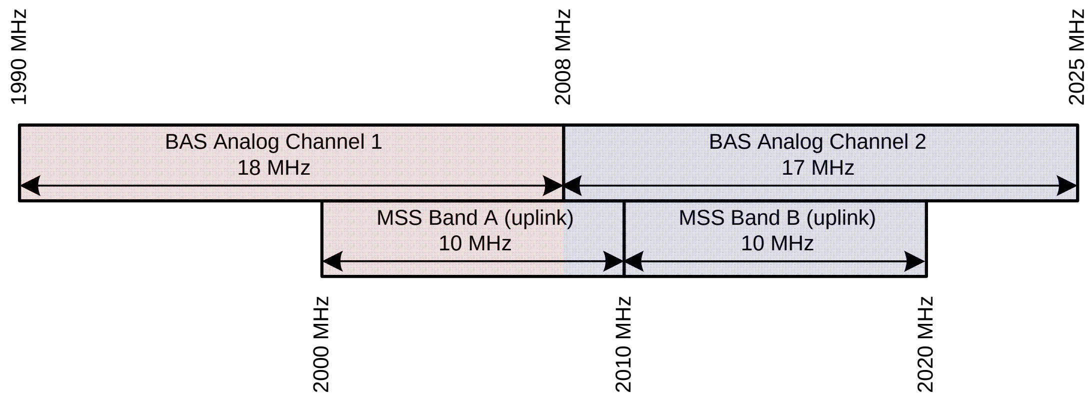
INTRODUCTION

TerreStar Networks (TSN) holds FCC authorization in the 2 GHz Mobile Satellite Service (MSS). To provide spectrum for the 2 GHz MSS, the FCC re-allocated spectrum from the Broadcast Auxiliary Services (BAS) and the Fixed-microwave Services (FS) for MSS use. Specifically, MSS operations have been authorized for the frequency bands 2000 MHz to 2020 MHz (to be re-allocated from portions of analog BAS channels 1 and 2) and 2180 MHz to 2200 MHz (to be re-allocated from the FS band). TSN's design calls for a system using frequency division duplexing (FDD), in which it will be assigned 10 MHz within the 2000 to 2020 MHz band for uplink transmissions from handsets and 10 MHz within the 2180 to 2200 MHz band for downlink transmissions from a combination of satellite and terrestrial base stations.

Commencement of TSN's operations was originally scheduled to coincide with the 2 GHz BAS transition to digital operations, originally scheduled for completion by September 2007. This transition process is considerably behind schedule, and a 29 month extension request is now pending with the FCC. Therefore, TSN hopes to begin operations prior to the completion of the 2 GHz BAS transition. In order to determine if a limited TSN operation is possible prior to the conclusion of the 2 GHz BAS transition, TSN has conducted a number of tests. Results of these tests indicate that it will be possible for TSN to operate the satellite portion of its system consistent with the findings of this report without causing interference to existing BAS operations.

TSN'S PROPOSED OPERATIONS

As mentioned previously, TSN will be assigned 10 MHz of uplink spectrum in the 2000 to 2020 MHz band; another MSS operator will be assigned the other 10 MHz of spectrum in this band. TSN's frequency assignment will be either MSS Band A (2000 to 2010 MHz) or MSS Band B (2010 to 2020 MHz). At this time, TSN does not know which frequency assignment it will receive. The relationship between the two MSS bands and the existing 2 GHZ BAS channels is shown in the following diagram.



In the long term, TSN intends to operate an integrated satellite/terrestrial communications service throughout North America. Prior to the likely completion of the 2 GHz BAS transition, however, terrestrial operations will be limited to a discrete number of test markets that either have been cleared or coordinated, and TerreStar principally will operate only the satellite component of the system. Since it is only the TSN handset transmissions (uplink to satellite) that will operate in the 2000 to 2020 MHz band, any potential impact to 2 GHz BAS operations will only come from TSN's handsets.

The satellite component of TSN's network will make use of a number of narrow-band signals, in a fashion similar to the GSM cellular system, using Time Division Multiple Access (TDMA) digital modulation. Handset power will be 1 watt peak, 0.25 watt average. The handset antenna will be enclosed within the handset, and its radiation pattern is characterized as omni-directional.

TEST METHODOLOGY

To better determine likely impact to BAS operations on Channels 1 and 2, TerreStar has completed a series of tests to analyze any harmful interference to Broadcast Auxiliary 2 GHz electronic news gathering (ENG) operations from a TerreStar handset operating in the satellite service mode. The tests involved simulated TSN handset transmissions on frequencies in the upper end of BAS Channel 1 and frequencies in the lower end of BAS Channel 2. Both bench and field tests were conducted.

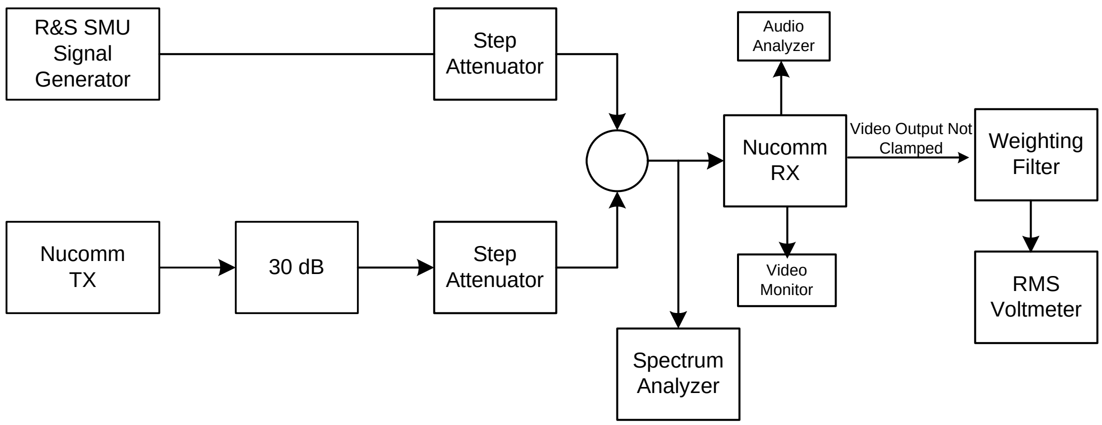
Bench Tests

Using the testing facilities of NuComm, at Hackettstown, New Jersey, TSN conducted a series of bench tests on two representative ENG receivers. The most recent tests were conducted on January 17-18, 2008. The receivers were a NuComm 22CR6 (analog) and a NuComm Newscaster CR6D (digital).[1] Both the analog and digital tests were conducted with the desired signal from the ENG transmitter centered in the channel (i.e. center frequency of 1999 MHz for BAS Channel 1; center frequency of 2016.5 MHz for BAS Channel 2). Thus, the digital tests are representative of the "narrow, in-place" configuration for temporary digital operations prior to a market's switch to the new BAS band plan.

The analog ENG tests considered both the (1) normal I.F. receiver bandwidth with an audio subcarrier of 6.2 MHz, simulating an ENG operation using two audio subcarriers and (2) the narrow I.F. receiver bandwidth with an audio subcarrier of 4.83 MHz, simulating an ENG operation using one audio subcarrier.

[1] The results reported herein supersede the results of earlier testing reported in the Interim Report of December 3, 2007. One notable inconsistency occurs in the digital radio desired-to-undesired ratio reported on December 3, 2007 . This inconsistency was in the digital data; the Interim report did not consider the reduced (by 6 dB) desired transmitter output power in digital mode. Therefore, the correct digital radio D/U ratio in the Interim report should have been –50 dB, which is comparable to the -48 dB reported herein. As for the analog data using the 15 MHz I.F. filter, it should be noted that the Interim Report contained results of testing using the 4.83 MHz audio subcarrier. For the 15 MHz I.F. tests reported herein, the 6.2 MHz audio subcarrier was used. Therefore, there is not a true comparison between the datasets for those analog measurements using the 15 MHz I.F. filter.

The analog testing procedure was based upon the TIA/EIA Standard, Electrical Performance for Television Transmission Systems, TIA/EIA-250-C. Specifically, the procedure is defined in Section 6.3, "Interference to the Video Signal-to-Noise Ratio"[2] and Section 7.2, "Performance Characteristics of the Audio Signal Channel, Total Harmonic Distortion." The analog test setup is illustrated in the following block diagram.



A NuComm "Channel Master" transmitter operating in the analog mode was used to provide the desired ENG signal. A simulated TSN handset, voice-channel, undesired signal was generated by a Rhode and Schwarz SMU signal generator, internally modulated with an NADC (North American Digital Cellular) signal with a modulation bandwidth similar to that of TSN's satellite mode and with all time slots occupied. The power output of both the transmitter and signal generator were set to provide a 0 dBm reference level as measured with a Hewlett Packard 435B Power Meter.

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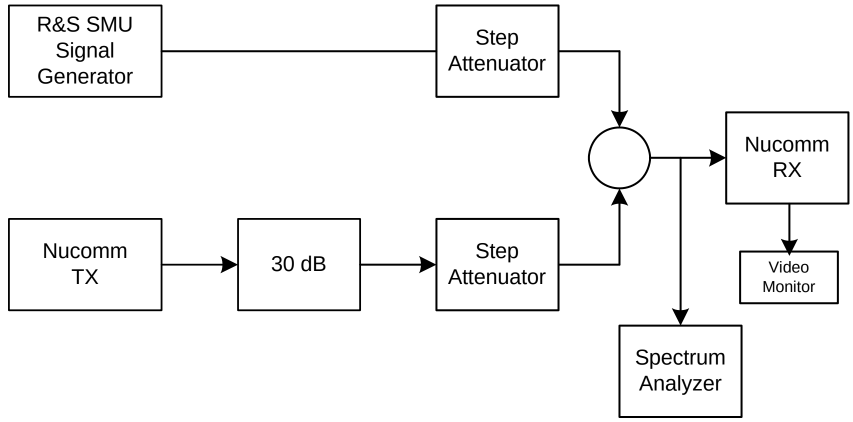
[2] The video signal-to-noise ratio is the ratio of the peak-to-peak luminance signal to the weighted rms noise voltage.

The analog test procedure was as follows:

1. The NuComm transmitter was set to the appropriate BAS channel (either Channel 1 or Channel 2 as required).
2. The received signal level from the Nucomm transmitter (desired signal) was adjusted by means of the step attenuator until the threshold of reception is achieved at the analog receiver (37 dB baseband quieting).
3. When testing the NuComm 22CR6 analog receiver in the narrow I.F. mode (10 MHz I.F. bandwidth), a single audio subcarrier on 4.83 MHz was modulated with a 1 kHz audio tone. In the normal I.F. mode (15 MHz I.F. bandwidth), a single audio subcarrier on 6.2 MHz was modulated with a 1 kHz audio tone.
4. The signal from the Nucomm transmitter was increased by 1 dB and the resulting improvement in receiver performance noted.
5. The interfering signal from the Rhode and Schwarz SMU signal generator was introduced at a low level, and gradually increased by means of the step attenuator until the receiver video performance was degraded back to the threshold of reception (37 dB baseband quieting).
6. An Audio Precision ATS-2 audio test system was employed to determine the Total Harmonic Distortion plus Noise (THD+N) in the audio baseband.
7. Steps 2 through 6 were repeated for 45 dB video base band quieting and 55 dB video base band quieting.
8. In each case the level of the interfering signal was noted and recorded, along with the ratio of the desired to undesired signal (D/U ratio). The visual quality of the demodulated video signal observed on the video monitor was noted, as well as the quality of the demodulated audio tone heard from the speaker in the audio test set.

The results from the bench testing on the Nucomm analog receiver is recorded in Table 1, which is attached to the end of this report.

The test procedure used for the digital receiver was similar to that used for the analog receivers. The NuComm “Channel Master” transmitter operating in digital mode was used to provide the desired ENG signal. A simulated TSN handset, voice-channel, undesired signal was generated by a Rhode and Schwarz SMU signal generator, internally modulated with an NADC (North American Digital Cellular) signal with a modulation bandwidth similar to that of TSN’s satellite mode and with all time slots occupied. The power output of both the transmitter and signal generator were set to provide a 0 dBm reference level as measured with a Hewlett Packard 435B Power Meter. The Nucomm digital mode was its “default” mode with 1/32 guard interval, ½ code rate, QPSK, OFDM and an 8 MHz receive bandwidth. The test setup for the digital receiver is illustrated in the following block diagram.

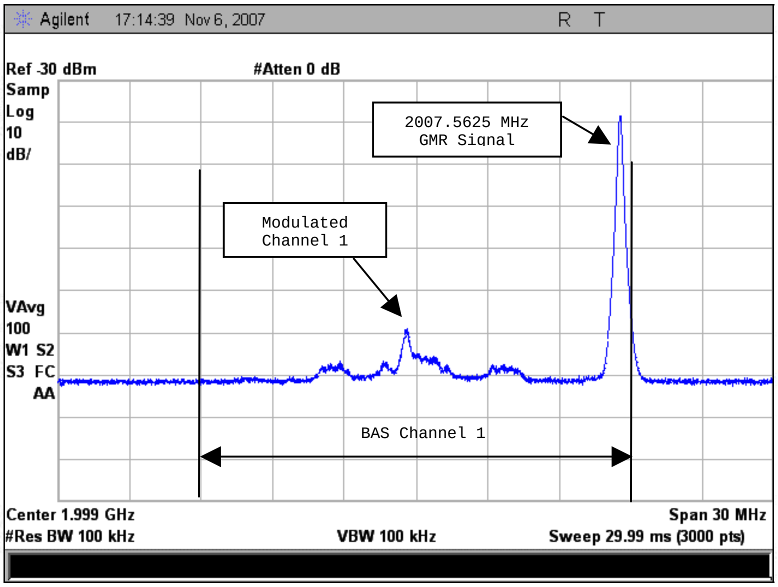


The digital test procedure was as follows:

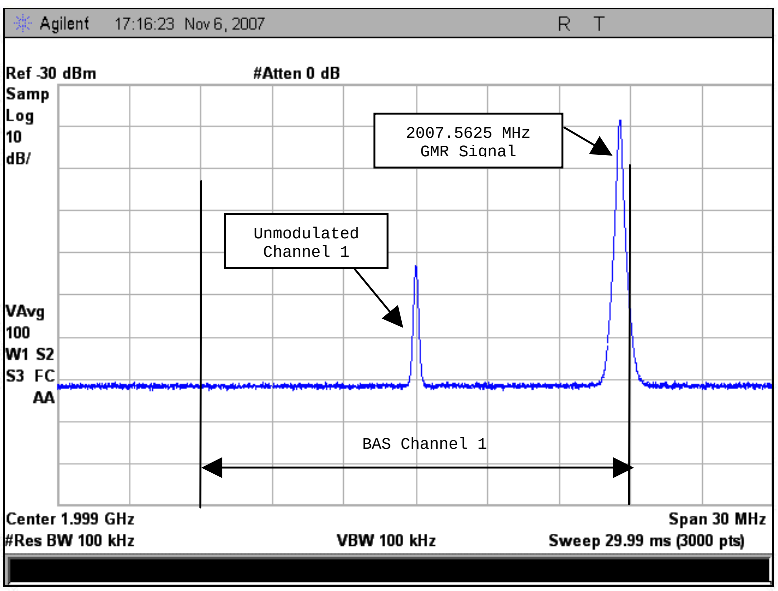
1. The NuComm transmitter was set to the appropriate BAS channel (either Channel 1 or Channel 2 as required).
2. The received signal level from the Nucomm transmitter (desired signal) was adjusted by means of the step attenuator until the threshold of reception was achieved at the digital receiver (the lowest received signal at which the post error correction bit error rate was equal to or less than 10^{-6} as read from the receiver front panel display).
3. The interfering signal from the Rhode and Schwarz SMU signal generator was introduced at a low level, and gradually increased by means of the step attenuator until the BER just exceeded 10^{-6}. The undesired signal was then decreased by 1 dB (the BER reduced to at or below 10^{-6}).
4. Steps 2 and 3 were repeated at a desired signal level of threshold plus 10 dB and threshold plus 30 dB.
5. In each case the level of the desired and interfering signals were noted and recorded, along with the ratio of the desired to undesired signal. The visual quality of the demodulated video signal observed on the video monitor was noted.

The results from the testing on the digital receiver are recorded in Table 2, which is attached to the end of this report.

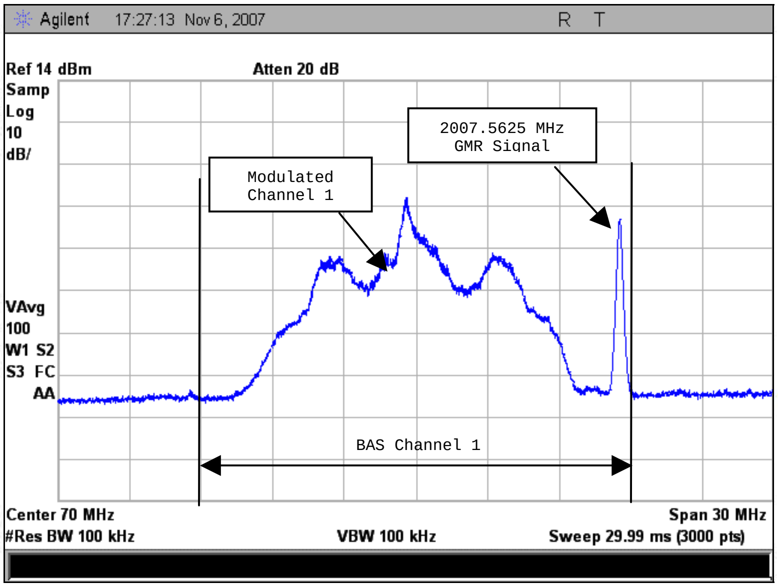
Below are representative spectrum analyzer displays showing the desired and undesired signals based upon previous bench tests from the NuComm CR6D receiver and the 12 MHz I.F. filter.



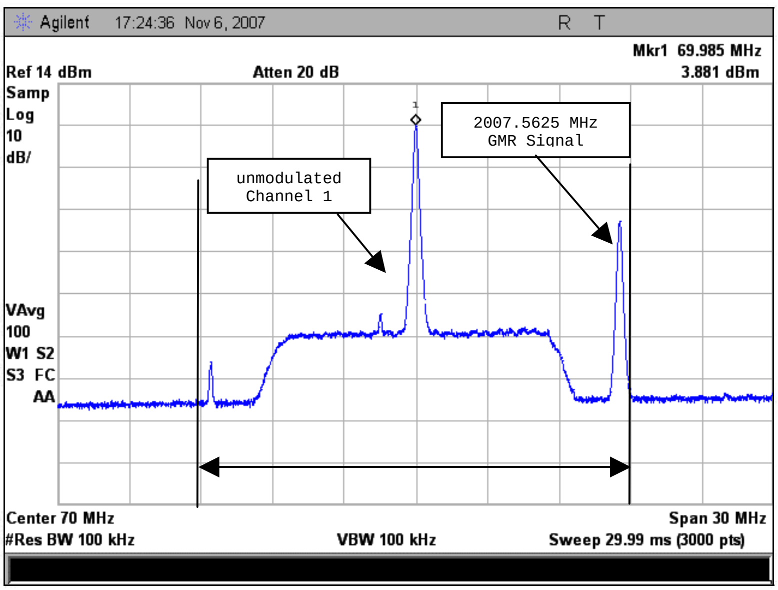
Graph 1. TSN GMR 2007.5625 MHz signal compared to analog modulated BAS with 12 MHz I.F. filter and a D/U ratio of –35 dB.



Graph 2. TSN GMR 2007.5625 MHz signal compared to analog unmodulated BAS with 12 MHz I.F. filter and a D/U ratio of –35 dB.

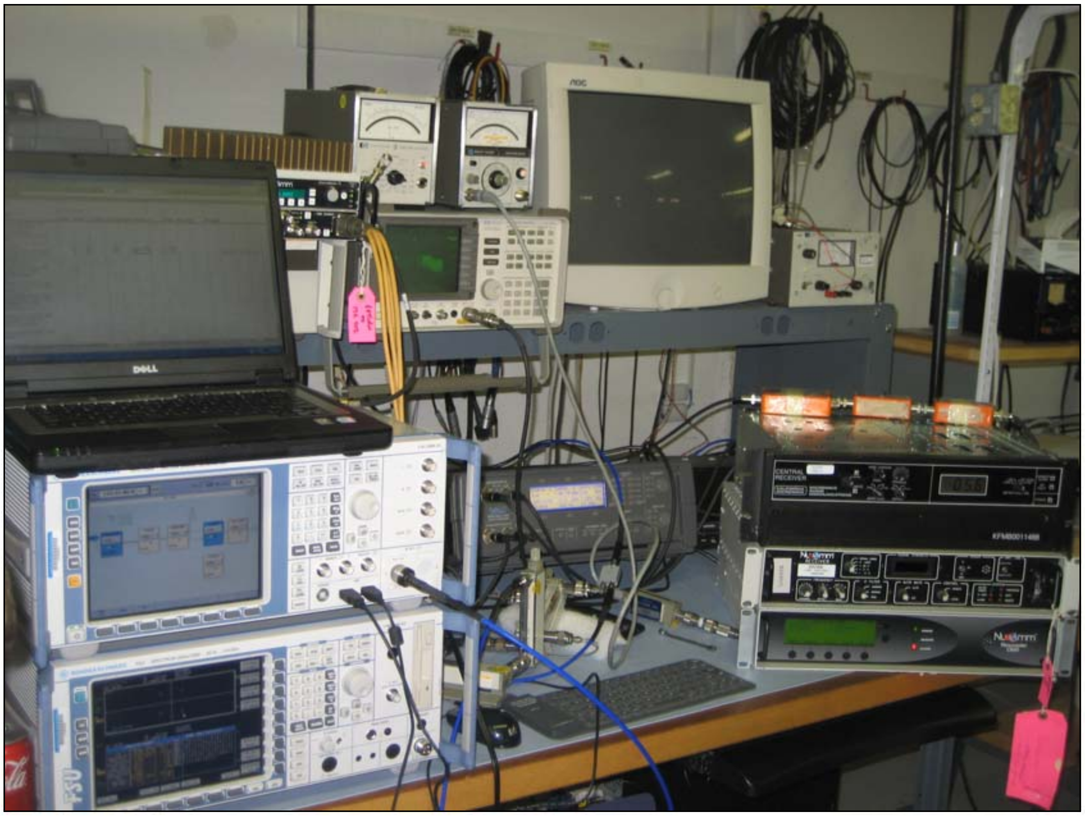


Graph 3. Receiver I.F. Output with TSN GMR 2007.5625 MHz signal compared to analog modulated BAS with 12 MHz I.F. filter and a D/U ratio of –35 dB.



Graph 4. Receiver I.F. Output with TSN GMR 2007.5625 MHz signal compared to analog unmodulated BAS with 12 MHz I.F. filter and a D/U ratio of –35 dB.

The photograph below shows the actual test setup.



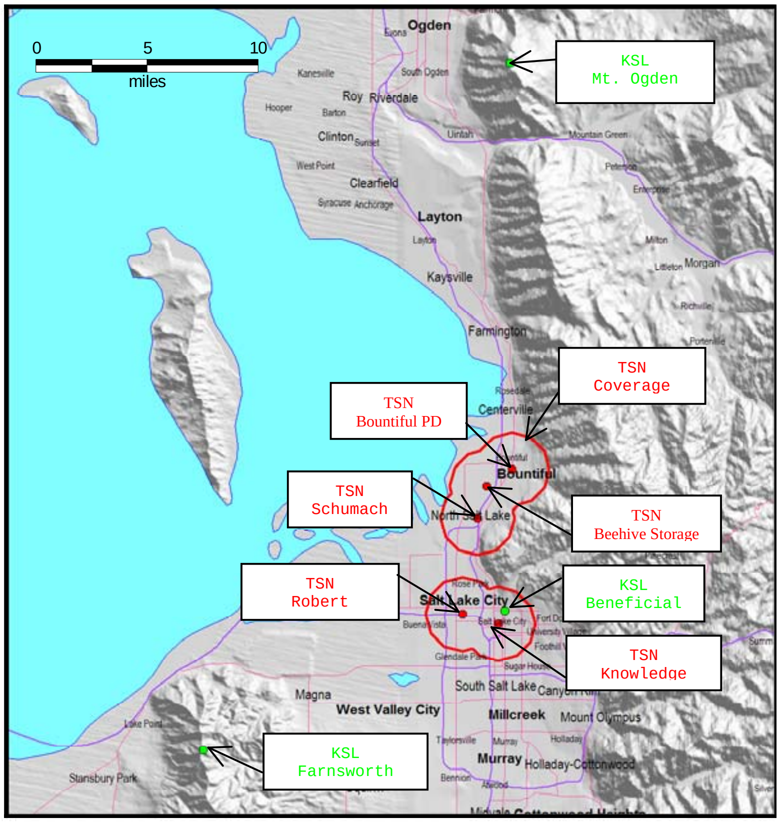
Photograph 1. Equipment Setup for Bench Tests

Table 3, attached to the end of this report, provides a list of the test equipment employed in conducting the bench tests.

Field Test

A field test was conducted in the Salt Lake City to determine the impact to television station KSL BAS Channel 1 operation from proposed TSN operations. The tests performed were for a simulated TSN handset operating in *satellite* mode and KSL's BAS receiver operating in both the analog *normal* and *narrow* I.F. bandwidth modes and digital mode. The field test subjectively analyzed the video and audio impairments.

Two KSL BAS receive sites were tested, a downtown site located at the *Beneficial Life* building and the main site located atop *Farnsworth Peak*. Map 1 shows the locations of the BAS receive sites and the proposed locations of future TerreStar base stations.



Map 1. KSL BAS Receive Site & TSN Base Station Locations

The testing procedure, for both KSL BAS receive sites, was as follows:

1. The KSL ENG MRC transmitter was set to BAS channel 1 in analog mode using a single 4.83 MHz audio subcarrier modulated with a 1 kHz tone. A standard ENG truck with a pneumatic mast and +20 dBi antenna was employed.
2. The simulated TSN interfering signal, generated with a Rhode and Schwarz SMU signal generator, was set at 2008 MHz and for a maximum effective isotropic radiated power of 1 watt (+30 dBm). The TSN transmitting antenna was a non-directional vertical whip antenna mounted atop a vehicle.
3. At each KSL BAS receive location, an MRC CodeRunner 4 BAS receiver was employed and set to either the normal (15 MHz) or narrow (10 MHz) I.F. filter bandwidth.
4. The TSN interfering signal was moved radially outward from the BAS receive site to determine the location where the maximum interfering signal could be received, while on boresight into the BAS receive antenna. The BAS receive antenna polarization was selected to maximize the interfering signal level.
5. The KSL ENG truck was moved outward along the same bearing as the TSN device, to a location where a threshold ENG path could be obtained.
6. Upon establishment of the threshold BAS path, the TSN interfering signal was turned on to determine if there was any subjective impact from the TSN signal.
7. This procedure was repeated for the ENG in digital mode.

At the KSL BAS test frequency of 2008 MHz, interference was observed in the recovered video and audio in the *normal* I.F. bandwidth mode. The scenario occurred when the KSL link was at threshold condition and the TSN device was positioned for maximum received power level. Further testing of that same scenario indicated that by increasing the BAS transmitter output power approximately 6 dB above threshold eliminated the observed audio and video interference.

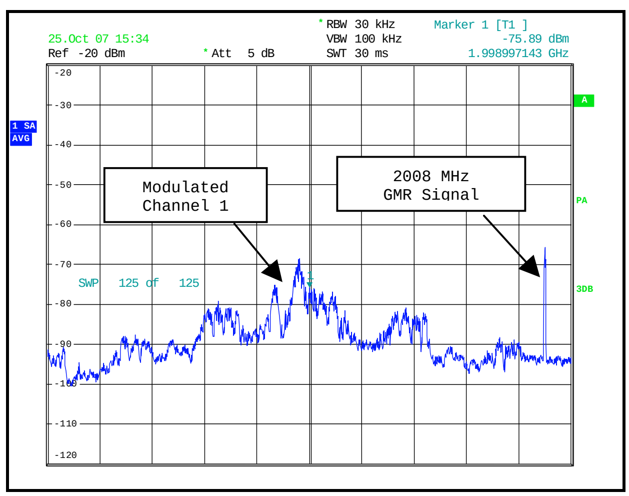
No interference to either KSL BAS receivers was observed in the recovered video and audio in the *narrow* I.F. bandwidth mode with the TSN device operating at 2008 MHz. No interference to either KSL BAS receiver was observed while operating in the digital mode and the TSN device operating at 2008 MHz.

The following two photographs show one of the two BAS receive antennas and the TSN test transmitter.

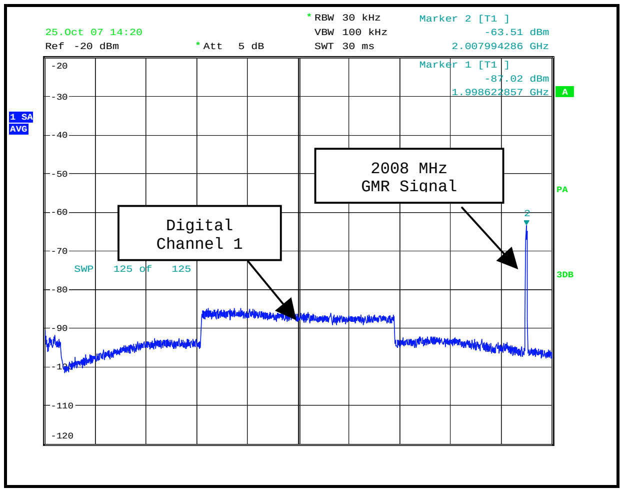
Photograph 2. KSL Downtown Beneficial Life Receive Antenna (south sector)

Photograph 3. <u>TerreStar Emitter with Vertical Whip Antenna.</u>

Below are spectrum plots from the KSL *Farnsworth Peak* transmitter site.



Graph 5. <u>TSN GMR 2008 MHz signal compared to analog modulated BAS with 10 MHz I.F. filter from Farnsworth Peak. BAS analog was at threshold and TSN was at maximum signal level (with receiver preamplifier on).</u>



Graph 6. <u>TSN GMR 2008 MHz signal compared to digital BAS signal with 8 MHz Occupied Spectrum from Farnsworth Peak. BAS digital is at threshold and TSN signal is at maximum level (with receiver preamplifier on).</u>

<u>Summary of Findings</u>

Digital BAS Operations

1. Based on the field test in Salt Lake City, no impact to Channel 1 BAS operations was observed with the TSN undesired signal operating at 2008 MHz and the ENG transmissions in digital mode.
2. With BAS operations in digital, "narrow, in-place" mode, minimum D/U ratios vary from -56 dB to -30 dB. These low ratios apply to both BAS Channel 1 and BAS Channel 2, no matter whether the undesired TSN signal is in the upper end of BAS channel 1 (2007 to 2008 MHz, MSS Band A) or the lower end of BAS Channel 2 (2010 to 2011 MHz, MSS Band B).

Analog BAS Operations – Narrow I.F. Mode (10 MHz I.F. Bandwidth)
-using 4.83 MHz audio subcarrier

1. Based on the field test in Salt Lake City, no impact to Channel 1 BAS operations was observed with the TSN undesired signal operating at 2008 MHz and the ENG transmissions set for analog, narrow I.F. mode.
2. The greatest TSN signal level received in the Salt Lake City field tests using the downtown BAS receive site was approximately –65 dBm with the receiver preamplifier off. This TSN device was located at 0.8 mile from the KSL Downtown BAS receive site.

3. For TSN handset operations near the upper edge of BAS channel 1 (between 2007 and 2008 MHz, MSS Band A), the Bench tests revealed the following:
    a. With the Nucomm 22CR6 receiver operating on Channel 1, the minimum D/U ratios vary from –46.5 dB to –33.5 dB, depending on the desired signal strength and frequency of the simulated, undesired TSN transmitter. The D/U ratios remain low no matter which TSN frequency is used.
    b. With the Nucomm 22CR6 receiver operating on Channel 2 and the TSN signal at the very upper end of BAS Channel 1 (2007.75 MHz), the minimum D/U ratios vary from –46.5 dB to –40.5 dB, depending on the desired signal strength.
4. For TSN handset operations in the lower portion of BAS channel 2 (between 2010 and 2011 MHz, MSS Band B) and the NuComm 22CR6 receiver operating on Channel 2, the minimum D/U ratios vary from –10.5 dB to +2.5 dB. The D/U ratios trend higher as the TSN frequency is increased (moved further up into BAS Channel 2).
5. Improvements in the minimum D/U ratios for narrow IF mode compared to normal IF mode varied from 11 dB to 55 dB depending on undesired frequency and BAS channel.
6. For the NuComm 22CR6 receiver operating at video threshold, there was a discernable visual degradation of video quality on the monitor when the TSN undesired signal was added at the minimum D/U ratio. At video levels above threshold, the visual degradation at the minimum D/U ratio was characterized as slight to no change.
7. In all cases for the NuComm 22CR6 receiver operating at video threshold, the recovered audio was very noisy and no further impairment was discernable to the ear when the TSN undesired signal was added.
8. In all cases for the NuComm 22CR6 receiver operating above video threshold, no change in the audio tone was discernable to the human ear when the TSN undesired signal was added up to the 1 dB degradation point. Beyond the 1 dB degradation point, the onset of audio impairments occurred.

Analog BAS Operations – Normal I.F. Mode (15 MHz I.F. Bandwidth)
-using 6.2 MHz audio subcarrier

1. At the KSL Salt Lake City BAS test frequency of 2008 MHz, interference was observed in the recovered video and audio in the *normal* I.F. bandwidth mode. The scenario occurred when the KSL link was at threshold condition and the TSN device was positioned for maximum received power level. Further testing of that

same scenario indicated that by increasing the BAS transmitter output power approximately 6 dB above threshold value eliminated the observed audio and video interference.

2. For TSN handset operations near the upper edge of BAS channel 1 (between 2007 and 2008 MHz, MSS Band A), the Bench tests reveled the following:
    c. With the Nucomm 22CR6 receiver operating on Channel 1, the minimum D/U ratios vary from -1.5 dB to +8.5 dB, depending on the desired signal strength and frequency of the simulated, undesired TSN transmitter. The D/U ratios are lowest when the TSN frequency is highest (at the very upper end of BAS Channel 1), and the D/U ratios trend higher as the TSN frequency is decreased (is moved further down into BAS Channel 1).
    d. With the Nucomm 22CR6 receiver operating on Channel 2 and the TSN signal at the very upper end of BAS Channel 1 (2007.75 MHz), the minimum D/U ratios vary from -3.5 dB to +4.5 dB, depending on the desired signal strength.
3. For TSN handset operations in the lower portion of BAS channel 2 (between 2010 and 2011 MHz, MSS Band B) and the NuComm 22CR6 receiver operating on Channel 2, the minimum D/U ratios vary from +5.5 dB to +14.5 dB. The D/U ratios trend higher as the TSN frequency is increased (moved further up into BAS Channel 2).
4. For the NuComm 22CR6 receiver operating at video threshold, there was a discernable visual degradation of video quality on the monitor when the TSN undesired signal was added at the minimum D/U ratio. At video levels above threshold, the visual degradation at the minimum D/U ratio was characterized as slight to no change.
5. In all cases for the NuComm 22CR6 receiver operating at video threshold, the recovered audio was very noisy and no further impairment was discernable to the ear when the TSN undesired signal was added.
6. In all cases for the NuComm 22CR6 receiver operating above video threshold, no change in the audio tone was discernable to the human ear when the TSN undesired signal was added up to the 1 dB degradation point. Beyond the 1 dB degradation point, the onset of audio impairments occurred.

Conclusions

In the Salt Lake City field tests, the maximum undesired signal at the BAS receiver input was found to be –65 dBm, when the TSN test vehicle was located south of the Beneficial Life Building looking into the south sector of the BAS receive antenna. This was based on use of a test signal generated at 1 Watt out of the transmitter amplifier and employing a roof mounted antenna on a vehicle. Looking at the photograph showing the view to the south from the Beneficial Life Building (see page 10), it is seen that there are relatively unobstructed views from a number locations to the BAS south sector antenna. Furthermore, the BAS receive antenna polarization was selected to maximize the undesired signal. We believe, therefore, that it is appropriate to consider this -65 dBm as a representative worst-case undesired signal.

Digital BAS Operations

Based on the results of the digital receiver bench tests, even the worst case –65 dBm field test signal is below the minimum undesired signal level necessary to cause interference at any of the frequencies and at all desired signal levels that were tested. Therefore, we may conclude that in the real world, a BAS receiver operating in digital, “narrow, in-place” configuration will be immune to TSN handset interference with the TSN handset operating on any of the tested frequencies in MSS Bands A or B.

Analog BAS Operations – Narrow I.F. Mode (10 MHz I.F. Bandwidth)
-using 4.83 MHz audio subcarrier

Based on the results of the analog receiver bench tests, even the worst case –65 dBm undesired field test signal is well below the minimum undesired signal level necessary to cause interference at TSN frequencies between 2007 MHz and 2008 MHz when the analog receiver was operating in the narrow I.F. mode. We may conclude, therefore, that a BAS receiver operating in analog, narrow I.F. mode (no matter whether on Channel 1 or Channel 2) will be immune to TSN handset interference when the handset operates on the frequencies that were tested and which were between 2007 MHz and 2008 MHz (MSS Band A). This conclusion is supported by the field tests, where no impact to KSL’s Channel 1 BAS operations was observed with the TSN test signal at 2008 MHz and the BAS receiver in narrow I.F. mode.

What is the potential for interference to a BAS receiver operating on Channel 2 in the analog, narrow I.F. mode, from a TSN handset operating on frequencies between

2010 and 2011 MHz (MSS Band B)? In this situation, we conclude that in the majority of real world cases there will be no interference to BAS reception if the TSN signal is at the very low end of MSS Band B. Considering the worst-case field test signal, we see that interference is predicted with the undesired transmitter operating at 2010.016 MHz (extreme lower end of MSS Band B) and when the ENG received signal is at low and moderate S/N levels; at a high S/N level the worst-case field test signal is just at the threshold of interference. In a real world situation (handset antenna vs. roof mount, impact of signal absorption by the user's head, typical local path obstructions between a handset at ground level and a BAS receiver, BAS receiver polarization not optimized for maximum undesired signal) we believe that the actual received undesired signal levels will almost always be below the interference levels shown in the bench tests. For interference to occur, we believe that the TSN handset will have to be in the main beam of the BAS receive antenna, the TSN handset will have to be operating relatively close to the BAS receive antenna, the TSN handset will have to have a nearly unobstructed path to the BAS receive antenna, and the desired ENG signal will have to be marginal.

For undesired signals on 2010.4223 MHz, the bench tests indicate about a 10 dB degradation in performance compared to 2010.016 MHz. Even on 2010.4223 MHz, we believe that in many situations the actual undesired signals will be below the levels necessary to cause interference, however the minimum D/U ratios for low and moderate S/N levels are high enough that when a TSN handset is operated in the main beam of the BAS receive antenna, even with real-world losses considered we predict that interference would occur. Our conclusion, therefore, is that it does appear possible for TSN to operate its handsets at the very low end of MSS Band B when an ENG receiver is operating in the analog, narrow I.F. mode on Channel 2, and cause almost no interference to typical ENG operations. However, we note that as the TSN frequency is increased, it appears that the likelihood of interference increases.

Analog BAS Operations – Normal I.F. Mode (15 MHz I.F. Bandwidth)
-using 6.2 MHz audio subcarrier

For a BAS receiver on Channel 1 or Channel 2 operating in the analog, normal I.F. mode, there will be an increased potential for interference from TSN handsets compared to either of the other modes tested, particularly if the ENG link is at threshold or near threshold conditions. This is particularly noticeable for BAS Channel 2 with the TSN signal operating between 2010 MHz and 2011 MHz, where the minimum D/U ratios are in the +10 dB to +20 dB range in many cases.

If we compare the –65 dBm worst-case field test signal to the minimum undesired signal levels shown for normal I.F. mode operation in Table 1, we see that the –65 dBm field test signal exceeds the minimum D/U ratios in every case. In a real world situation (actual handset antenna vs. roof mount antenna for field test, impact of signal absorption by the user's head, typical local path obstructions between a handset at ground level and a BAS receiver, BAS receiver polarization not optimized for maximum undesired signal) the undesired signals will typically be much lower than –65 dBm. Still, with a TSN handset in the main beam of the BAS receive antenna and with a relatively unobstructed view to the BAS receive antenna, we would predict that the minimum D/U ratios will be exceeded in some cases with the BAS link at or near margin. This conclusion is backed up by the field test observations where interference to BAS operations was observed in some cases with the KSL BAS receiver operating in normal I.F. mode.

In summary, we make the following conclusions:

- In the digital, "narrow, in-place" mode, BAS reception on Channels 1 and 2 will be immune to interference from TSN handsets for all desired signal levels and all tested TSN frequencies.
- For analog ENG operation with one audio subcarrier and employing the narrow I.F. filter mode, BAS reception on Channels 1 and 2 will be immune to interference from TSN handsets for all desired signal levels and for all tested TSN frequencies between 2007 MHz and 2008 MHz (MSS Band A).
- For analog ENG operation with one audio subcarrier and employing the narrow I.F. filter mode, TSN interference to BAS reception on Channel 2 will be limited to cases where the TSN handset operates in the beam of the BAS receive antenna at locations relatively near the BAS receive antenna and with near line-of-sight conditions if the TSN frequency is just above the bottom edge of MSS Band A (2010 MHz). As the TSN frequency is increased in MSS Band B, the amount of predicted interference to BAS Channel 2 operations will increase.
- For analog ENG operation on Channels 1 and 2 with two audio subcarriers and employing the normal I.F. filter mode, a TSN handset may cause interference in some situations no matter on which frequency it operates, usually when the BAS link is at or close to its threshold level and the TSN handset is in the beam of the BAS receive antenna.
- Based on the bench and field testing, the recovered audio quality from an analog BAS receiver in the normal I.F. bandwidth mode was observed to be more sensitive to a TSN interfering signal than recovered video quality. As an

undesired TSN signal is increased, video picture impairment would usually occur only at undesired signal levels greater than those for which the onset of any audio impairment occurs.

PREDICTED IMPACT TO 2 GHZ
BROADCAST AUXILIARY OPERATIONS
FROM PROPOSED HANDSET TO SATELLITE EMISSIONS
TERRESTAR NETWORKS
JANUARY 2008

TABLE 1
RESULTS OF TESTS PERFORMED ON NuComm 22CR6 (ANALOG) RECEIVER

GMR Center Frequency (MHz)	BAS Mode	BAS Channel	I..F. Receiver Filter BW (MHz)	ENG Receiver (desired) Power (dBm)	VSG (undesired) Power (dBm)	Target Video S/N Ratio	Desired-to-Undesired Ratio (db) to Target SNR	Subcarrier THD+N*	
								No U Signal	With U Signal
2007.75	Analog	1	10	-89.5	-45	37	-44.5	75%	75%
				-82.5	-45	45	-37.5	2.2%	2.7%
				-71.5	-38	55	-33.5	0.20%	0.20%
			15	-90.5	-92	37	1.5	35%	45%
				-83.5	-82	45	-1.5	1.5%	1.8%
				-72.5	-76	55	3.5	0.18%	0.18%
		2	10	-89.5	-44	37	-45.5	82%	82%
				-82.5	-36	45	-46.5	2.0%	3.0%
				-71.5	-31	55	-40.5	0.20%	0.20%
			15	-89.5	-94	37	4.5	66%	66%
				-83.5	-80	45	-3.5	1.4%	1.6%
				-72.5	-74	55	1.5	0.18%	0.18%
2007.3438	Analog	1	15	-90.5	-93	37	2.5	48%	48%
				-83.5	-84	45	0.5	1.7%	2.0%
				-72.5	-78	55	5.5	0.18%	0.18%
2007.0313	Analog	1	10	-89.5	-43	37	-46.5	80%	80%
				-82.5	-38	45	-44.5	2.3%	3.7%
				-71.5	-38	55	-33.5	0.22%	0.22%
			15	-90.5	-99	37	8.5	50%	50%
				-83.5	-87	45	3.5	1.7%	2.0%
				-72.5	-81	55	8.5	0.20%	0.20%
2010.016	Analog	2	10	-89.5	-82	37	-7.5	68%	68%
				-82.5	-72	45	-10.5	2.1%	2.3%
				-71.5	-65	55	-6.5	0.23%	0.23%
			15	-90.5	-99	37	8.5	79%	82%
				-83.5	-89	45	5.5	3.6%	3.9%
				-72.5	-82	55	9.5	0.23%	0.23%
2010.4223	Analog	2	10	-89.5	-92	37	2.5	68%	72%
				-82.5	-81	45	-1.5	2.0%	2.3%
				-71.5	-71	55	-0.5	0.23%	0.23%
			15	-89.5	-104	37	14.5	50%	70%
				-83.5	-94	45	10.5	3.6%	3.8%
				-72.5	-83	55	10.5	0.22%	0.22%

*In narrow IF mode, the 4.83 MHz subcarrier was modulated with a 1000 Hz tone and the total harmonic distortion plus noise was measured.
In wide IF mode, the 6.2 MHz subcarrier was modulated with a 1000 Hz tone and the total harmonic distortion plus noise was measured.

PREDICTED IMPACT TO 2 GHZ
BROADCAST AUXILIARY OPERATIONS
FROM PROPOSED HANDSET TO SATELLITE EMISSIONS
TERRESTAR NETWORKS
JANUARY 2008

TABLE 2
RESULTS OF TESTS PERFORMED ON NuComm CR6D (DIGITAL) RECEIVER

GMR Center Frequency (MHz)	BAS Mode	BAS Channel	I.F. Receiver Filter BW (MHz)	ENG Receiver Desired Signal		VSG (undesired) Power (dBm)**	Desired-to-Undesired Ratio (db) to Target BER (10^{-6})
				Condition*	Power (dBm)		
2007.75	Digital	1	8	Threshold	-95	-47	-48
				Threshold + 10 dB	-85	-40	-45
				Threshold + 30 dB	-65	-35	-30
		2	8	Threshold	-95	-39	-56
				Threshold + 10 dB	-85	-33	-52
				Threshold + 30 dB	-65	-30	-35
2007.5625	Digital	1	8	Threshold	-95	-47	-48
				Threshold + 10 dB	-85	-40	-45
				Threshold + 30 dB	-65	-35	-30
2007.3438	Digital	1	8	Threshold	-95	-46	-49
				Threshold + 10 dB	-85	-39	-46
				Threshold + 30 dB	-65	-35	-30
2007.0313	Digital	1	8	Threshold	-95	-43	-52
				Threshold + 10 dB	-85	-37	-48
				Threshold + 30 dB	-65	-35	-30
2010.016	Digital	2	8	Threshold	-95	-42	-53
				Threshold + 10 dB	-85	-35	-50
				Threshold + 30 dB	-65	-21	-44
2010.204	Digital	2	8	Threshold	-95	-47	-48
				Threshold + 10 dB	-85	-39	-46
				Threshold + 30 dB	-65	-25	-40
2010.4223	Digital	2	8	Threshold	-95	-53	-42
				Threshold + 10 dB	-85	-45	-40
				Threshold + 30 dB	-65	-31	-34
2010.7348	Digital	2	8	Threshold	-95	-63	-32
				Threshold + 10 dB	-85	-53	-32
				Threshold + 30 dB	-65	-35	-30

*Threshold level was measured in the absence of an undesired signal and is defined to be the lowest desired signal at the receiver input at which the post correction bit error rate (BER) was at or below 10^{-6} as read from the receiver front panel display.
**The undesired power level shown in this table is the maximum power from the vector signal generator (VSG), measured at the receiver input, at which the desired signal post correction BER remained at or below 10^{-6} as read from the receiver front panel display.

Table 3 – Bench Test Equipment List

BAS Receivers:

NuComm 22CR6 Receiver -	Serial Number 9324-005
NuComm CR6D Receiver -	Serial Number 100260-015
MRC Central Receiver -	Serial Number Not Available

BAS Transmitter:

NuComm Channel Master Tx -	2/7 CMTX1-E1.5B1-336

Test Equipment:

HP RMS Voltmeter -	Serial Number 2225A28660
HP 435B Power Meter -	Serial Number 2238A04734
Audio Precision Audio Analyzer	Portable One Dual Domain Audio Measurement System Serial Number P1P – 53488
HP 8562A Spectrum Analyzer	Serial Number 2913A03696
R&S SMU 200A Vector Signal Generator	Serial Number 102566
R&S FSU Spectrum Analyzer (used to monitor modulation of Vector Signal Generator)	Serial Number 200257

Base Band Filters (analog tests)

Matthey	CMTT Junction Filter JFK-10B, Serial Number 1429
Matthey	CMTT Unified Weighting Filter 451-2B, Serial Number 1428
Matthey	CMTT Low Pass Filter LPM 5B, Serial Number 1427