In the Matter of	**)**	
	)	
Promoting Interoperability in the 700 MHz	**)**	WT Docket No. 12-69
Commercial Spectrum	**)**	
	)	
Interoperability of Mobile User Equipment	**)**	RM-11592 (Terminated)
Across Paired Commercial Spectrum Blocks	**)**	
in the 700 MHz Band	**)**	

V-COMM, L.L.C'S EX PARTE REPLY COMMENTS
OCTOBER 26, 2012

Dominic Villecco
President
Jim Shelton
Director of RF Engineering
V-COMM, L.L.C.
2540 US Highway 130
Suite 101
Cranbury, NJ 08512
(609) 655-1200

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

In the Matter of	**)**	
	)	
Promoting Interoperability in the 700 MHz	**)**	WT Docket No. 12-69
Commercial Spectrum	**)**	
	)	
Interoperability of Mobile User Equipment	**)**	RM-11592 (Terminated)
Across Paired Commercial Spectrum Blocks	**)**	
in the 700 MHz Band	**)**	

V-COMM, L.L.C.'S EX PARTE REPLY COMMENTS

I. EXECUTIVE SUMMARY

1. This document is submitted for the record in response to the AT&T Ex Parte from October 3rd 2012, which includes a document, dated October 1st, 2012 written by Professor Reed and Dr. Tripathi ("R&T"). In that document, R&T make several incorrect assertions regarding V-COMM's test methods. In addition, they claim that information was omitted, which did not allow them to validate the results. In our response below, we dedicate the first section to providing clarifications of the misperceptions that AT&T identifies. We then dedicate the remaining sections to provide additional details regarding various aspects of our findings, in order to address the flawed conclusions of AT&T. Furthermore, we provide additional details regarding our tests and test results for the record.

2. Our response demonstrates:

- AT&T makes several outright inaccurate statements about our Channel 51 and E-Block testing.

- AT&T misleads its audience in their interpretation of the V-COMM data provided.

- AT&T uses misleading language to further bolster its claims, while questioning the integrity of opposing parties.

- The very question R&T asks regarding inappropriate filtering used in our test configuration is actually the basis of AT&T's incorrect setup and subsequently skewed lab results.

3. V-COMM continues to stand behind its findings, based on the testing of multiple Band 12 and multiple Band 17 devices, of various form factors and vendors. The quantity and quality of our device testing is well beyond any other Band 12 testing submitted for the record. Further, our testing is the only testing which included laboratory testing, field testing, and analysis utilizing multiple practices favored by the FCC's OET.

4. In view of the above, there is no question but that there is no technical reason not to reinstate interoperability.

1

II. CORRECTIONS OF INCORRECT AT&T ASSUMPTIONS

A. LTE Signal Levels

5. Messrs. Reed and Tripathi (R&T) state <u>incorrectly</u> that we "appear to use relatively high LTE signal levels that are experienced away from the cell-edge and closer to cell towers" for our Channel 51 and E-Block laboratory tests[1]. What we performed was quite different to what AT&T assumed. In order to collect a full set of test data for each device, we tested each device at signal levels 1 dB above device sensitivity (DEVSENS), 3 dB above DEVSENS, 10 dB above DEVSENS, and 30 dB above DEVSENS. We collected these signals levels above device sensitivity for purposes of providing the FCC with the data requested pursuant to the NPRM. Commercial wireless networks are <u>not</u> designed for operation at DEVSENS. The DEVSENS results we measured reflect the levels at which a device would be operating across the coverage area of a network. However, for purposes of this NPRM, all conclusions were developed using the worst case 1 dB above DEVSENS operations to assess the maximum potential for interference.

6. Using worst-case measurements at very low desired signal levels is in-line with suggestions by R&T, as devices may not always operate at high LTE signal levels throughout a coverage area. We state this throughout[2] the report and are uncertain how R&T reached their conclusion that V-COMM used "relatively high LTE signal levels[3]". Further, R&T state that V-COMM "does not disclose LTE signal levels used in lab tests". This too is <u>incorrect</u>. Our testing methodology, like others submitted in the record – such as tests submitted by PCTEST and 7Layers and analysis submitted by Qualcomm – utilized similar methodology for desired signal levels operating above the device's actual sensitivity levels. The rise in the noise floor of the device is quantified and used as the interference assessment to the system. The rise in the noise floor of the device (in dB) is also equal to the rise of the desired signal level performed in the desensitization testing as referenced to the actual device sensitivity without interference. For example, a 1 dB rise in noise floor for a device with DEVSENS of -100.8 dBm is equivalent to an LTE signal of -99.8 dBm. This is the same methodology outlined by AT&T in their Reply Comments[4].

7. Below is a table (Table 1), showing each device's sensitivity measurement, as well as each LTE desired signal level (i.e. "rise in noise floor") used in the laboratory testing[5]. This table does not represent new information because our Reply Comments stated

---

[1] AT&T Ex Parte from Oct. 3rd, 2012, Reed and Tripathi Report, Executive Summary, page 2.

[2] See V-COMM Reply Comments Executive Summary, Para 24, Para 63, et. al.

[3] AT&T Ex Parte from Oct. 3rd, 2012, Reed and Tripathi Report, Executive Summary, page 2.

[4] See Reply Comments of AT&T Services, Inc., Exhibit A "Test Methodology to Assess Interference to Band Class 12 and Band Class 17 from Channel 51 Broadcasting", page 7 Table 1.2.2 and Para 1.2.3.4.

[5] As provided in V-COMM's Reply Comments, the Channel 51 IM and E-Block IM interference tests were performed with the UE transmitting at maximum power (labeled as Full Power +23dBm). E-Block "receiver blocking" interference tests were performed with the UE transmitting at the minimum uplink power level (labeled as No Power) in order to maintain the reverse link in receiver blocking tests. These DEVSENS power levels, as referenced in the table as Full Power +23dBm and No Power, represent the baseline cases without interference, and are used in the respective desensitization interference tests (i.e. +23dBm for IM desense tests, No Power for Receiver Blocking desense tests). The desired signal levels are increased above these DEVSENS values for the respective desense tests by the corresponding desense level (i.e. 1dB, 3dB, etc.).

the tests were desensitization tests and we provided the desense levels for each test case performed (i.e. 1dB, 3dB, etc. desense above sensitivity) and the sensitivity results for all devices tested. Therefore, the desired signal level for each test is simply 1dB, 3dB, etc. above the device sensitivity. The relationship of the desired signal level (Desired) to the desense level (Desense) tested and measured device sensitivity (DEVSENS) is equal to Desired = Desense + DEVSENS. Accordingly, a table of these values is provided below to address this "concern" and demonstrate that our testing and case study analysis is correct and accurate as submitted.

LTE Downlink Signal Strength (dBm)		Device A Band 17			Device B Band 17			Device C Band 17			Device D Band 12		
		QPSK	16QAM	64QAM	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
5 MHz (B Band LTE DL Signal Strength)													
No Power	DevSENS	-100.8	-91.4	-76.0	-99.9	-90.6	-75.9	-100.3	-91.1	-74.6	-101.0	-91.7	-77.0
	1dB Rise in Noise Floor	-99.8	-90.4	-75.0	-98.9	-89.6	-74.9	-99.3	-90.1	-73.6	-100.0	-90.7	-76.0
	3dB Rise in Noise Floor	-97.8	-88.4	-73.0	-96.9	-87.6	-72.9	-97.3	-88.1	-71.6	-98.0	-88.7	-74.0
	10dB Rise in Noise Floor	-90.8	-81.4	-66.0	-89.9	-80.6	-65.9	-90.3	-81.1	-64.6	-91.0	-81.7	-67.0
	30dB Rise in Noise Floor	-70.8	-61.4	-46.0	-69.9	-60.6	-45.9	-70.3	-61.1	-44.6	-71.0	-61.7	-47.0
Full Power (+23 dBm)	DevSENS	-100.8	-91.4	-76.0	-98.1	-88.9	-74.1	-100.2	-90.9	-74.2	-100.1	-90.8	-76.9
	1dB Rise in Noise Floor	-99.8	-90.4	-75.0	-97.1	-87.9	-73.1	-99.2	-89.9	-73.2	-99.1	-89.8	-75.9
	3dB Rise in Noise Floor	-97.8	-88.4	-73.0	-95.1	-85.9	-71.1	-97.2	-87.9	-71.2	-97.1	-87.8	-73.9
	10dB Rise in Noise Floor	-90.8	-81.4	-66.0	-88.1	-78.9	-64.1	-90.2	-80.9	-64.2	-90.1	-80.8	-66.9
	30dB Rise in Noise Floor	-70.8	-61.4	-46.0	-68.1	-58.9	-44.1	-70.2	-60.9	-44.2	-70.1	-60.8	-46.9
5 MHz (C Band LTE DL Signal Strength)													
No Power	DevSENS	-100.7	-90.6	-76.0	-100.1	-90.8	-76.0	-100.6	-91.2	-74.8	-100.5	-91.2	-77.0
	1dB Rise in Noise Floor	-99.7	-89.6	-75.0	-99.1	-89.8	-75.0	-99.6	-90.2	-73.8	-99.5	-90.2	-76.0
	3dB Rise in Noise Floor	-97.7	-87.6	-73.0	-97.1	-87.8	-73.0	-97.6	-88.2	-71.8	-97.5	-88.2	-74.0
	10dB Rise in Noise Floor	-90.7	-80.6	-66.0	-90.1	-80.8	-66.0	-90.6	-81.2	-64.8	-90.5	-81.2	-67.0
	30dB Rise in Noise Floor	-70.7	-60.6	-46.0	-70.1	-60.8	-46.0	-70.6	-61.2	-44.8	-70.5	-61.2	-47.0
Full Power (+23 dBm)	DevSENS	-100.6	-91.2	-75.7	-97.8	-88.5	-73.7	-100.3	-91.0	-74.4	-100.1	-90.8	-76.5
	1dB Rise in Noise Floor	-99.6	-90.2	-74.7	-96.8	-87.5	-72.7	-99.3	-90.0	-73.4	-99.1	-89.8	-75.5
	3dB Rise in Noise Floor	-97.6	-88.2	-72.7	-94.8	-85.5	-70.7	-97.3	-88.0	-71.4	-97.1	-87.8	-73.5
	10dB Rise in Noise Floor	-90.6	-81.2	-65.7	-87.8	-78.5	-63.7	-90.3	-81.0	-64.4	-90.1	-80.8	-66.5
	30dB Rise in Noise Floor	-70.6	-61.2	-45.7	-67.8	-58.5	-43.7	-70.3	-61.0	-44.4	-70.1	-60.8	-46.5
10 MHz (B&C Band LTE DL Signal Strength)													
No Power	DevSENS	-98.4	-89.9	-79.6	-97.7	-89.3	-79.0	-98.1	-89.7	-79.4	-98.8	-90.3	-80.3
	1dB Rise in Noise Floor	-97.4	-88.9	-78.6	-96.7	-88.3	-78.0	-97.1	-88.7	-78.4	-97.8	-89.3	-79.3
	3dB Rise in Noise Floor	-95.4	-86.9	-76.6	-94.7	-86.3	-76.0	-95.1	-86.7	-76.4	-95.8	-87.3	-77.3
	10dB Rise in Noise Floor	-88.4	-79.9	-69.6	-87.7	-79.3	-69.0	-88.1	-79.7	-69.4	-88.8	-80.3	-70.3
	30dB Rise in Noise Floor	-68.4	-59.9	-49.6	-67.7	-59.3	-49.0	-68.1	-59.7	-49.4	-68.8	-60.3	-50.3
Full Power (+23 dBm)	DevSENS	-98.1	-89.7	-79.4	-96.0	-87.6	-77.4	-98.1	-89.6	-79.3	-98.3	-90.0	-79.9
	1dB Rise in Noise Floor	-97.1	-88.7	-78.4	-95.0	-86.6	-76.4	-97.1	-88.6	-78.3	-97.3	-89.0	-78.9
	3dB Rise in Noise Floor	-95.1	-86.7	-76.4	-93.0	-84.6	-74.4	-95.1	-86.6	-76.3	-95.3	-87.0	-76.9
	10dB Rise in Noise Floor	-88.1	-79.7	-69.4	-86.0	-77.6	-67.4	-88.1	-79.6	-69.3	-88.3	-80.0	-69.9
	30dB Rise in Noise Floor	-68.1	-59.7	-49.4	-66.0	-57.6	-47.4	-68.1	-59.6	-49.3	-68.3	-60.0	-49.9

LTE Downlink Signal Strength (dBm)		Device E Band 12			Device F Band 12			Device G Band 17		
		QPSK	16QAM	64QAM	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
5 MHz (B Band LTE DL Signal Strength)										
No Power	DevSENS	-101.9	-92.6	-77.9	-100.4	-91.1	-75.7	-101.5	-92.0	-80.9
	1dB Rise in Noise Floor	-100.9	-91.6	-76.9	-99.4	-90.1	-74.7	-100.5	-91.0	-79.9
	3dB Rise in Noise Floor	-98.9	-89.6	-74.9	-97.4	-88.1	-72.7	-98.5	-89.0	-77.9
	10dB Rise in Noise Floor	-91.9	-82.6	-67.9	-90.4	-81.1	-65.7	-91.5	-82.0	-70.9
	30dB Rise in Noise Floor	-71.9	-62.6	-47.9	-70.4	-61.1	-45.7	-71.5	-62.0	-50.9
Full Power (+23 dBm)	DevSENS	-100.9	-91.5	-76.9	-100.2	-90.9	-75.5	-101.4	-91.9	-80.8
	1dB Rise in Noise Floor	-99.9	-90.5	-75.9	-99.2	-89.9	-74.5	-100.4	-90.9	-79.8
	3dB Rise in Noise Floor	-97.9	-88.5	-73.9	-97.2	-87.9	-72.5	-98.4	-88.9	-77.8
	10dB Rise in Noise Floor	-90.9	-81.5	-66.9	-90.2	-80.9	-65.5	-91.4	-81.9	-70.8
	30dB Rise in Noise Floor	-70.9	-61.5	-46.9	-70.2	-60.9	-45.5	-71.4	-61.9	-50.8
5 MHz (C Band LTE DL Signal Strength)										
No Power	DevSENS	-101.1	-91.8	-77.2	-99.9	-90.6	-75.9	-101.6	-92.1	-80.9
	1dB Rise in Noise Floor	-100.1	-90.8	-76.2	-98.9	-89.6	-74.9	-100.6	-91.1	-79.9
	3dB Rise in Noise Floor	-98.1	-88.8	-74.2	-96.9	-87.6	-72.9	-98.6	-89.1	-77.9
	10dB Rise in Noise Floor	-91.1	-81.8	-67.2	-89.9	-80.6	-65.9	-91.6	-82.1	-70.9
	30dB Rise in Noise Floor	-71.1	-61.8	-47.2	-69.9	-60.6	-45.9	-71.6	-62.1	-50.9
Full Power (+23 dBm)	DevSENS	-101.0	-91.7	-77.0	-99.3	-90.0	-75.5	-101.4	-92.0	-80.8
	1dB Rise in Noise Floor	-100.0	-90.7	-76.0	-98.3	-89.0	-74.5	-100.4	-91.0	-79.8
	3dB Rise in Noise Floor	-98.0	-88.7	-74.0	-96.3	-87.0	-72.5	-98.4	-89.0	-77.8
	10dB Rise in Noise Floor	-91.0	-81.7	-67.0	-89.3	-80.0	-65.5	-91.4	-82.0	-70.8
	30dB Rise in Noise Floor	-71.0	-61.7	-47.0	-69.3	-60.0	-45.5	-71.4	-62.0	-50.8
10 MHz (B&C Band LTE DL Signal Strength)										
No Power	DevSENS	-99.0	-90.5	-80.2	-97.5	-89.1	-78.8	-99.1	-90.6	-80.2
	1dB Rise in Noise Floor	-98.0	-89.5	-79.2	-96.5	-88.1	-77.8	-98.1	-89.6	-79.2
	3dB Rise in Noise Floor	-96.0	-87.5	-77.2	-94.5	-86.1	-75.8	-96.1	-87.6	-77.2
	10dB Rise in Noise Floor	-89.0	-80.5	-70.2	-87.5	-79.1	-68.8	-89.1	-80.6	-70.2
	30dB Rise in Noise Floor	-69.0	-60.5	-50.2	-67.5	-59.1	-48.8	-69.1	-60.6	-50.2
Full Power (+23 dBm)	DevSENS	-98.9	-90.4	-80.1	-97.4	-88.9	-78.5	-99.0	-90.6	-80.1
	1dB Rise in Noise Floor	-97.9	-89.4	-79.1	-96.4	-87.9	-77.5	-98.0	-89.6	-79.1
	3dB Rise in Noise Floor	-95.9	-87.4	-77.1	-94.4	-85.9	-75.5	-96.0	-87.6	-77.1
	10dB Rise in Noise Floor	-88.9	-80.4	-70.1	-87.4	-78.9	-68.5	-89.0	-80.6	-70.1
	30dB Rise in Noise Floor	-68.9	-60.4	-50.1	-67.4	-58.9	-48.5	-69.0	-60.6	-50.1

Table 1 - LTE Downlink Signal Strengths for LTE Device Testing

8.   As can be seen, the testing presented in our Reply Comments provides a much broader sampling of device performance results than the testing that AT&T commissioned, and they only tested at DEVSENS +3 dB and DEVSENS + 6 dB[6].

B.   Test Filters

9.   R&T also incorrectly assert that the test filters used "…quite possible…reduced the amount of interference that actually reached the test device[7]". This is categorically incorrect. The filters we used did <u>not</u> reduce the amount of interference.

10. First, the E-Block and Channel 51 filter were used to filter out any extraneous out-of-band emissions and noise from the SFE-100 signal generator OUTSIDE of each respective passband. Curiously, R&T only cite a concern with the E-Block filter and omit any reference to the Channel 51 filter, despite the fact the Channel 51 filter is used for the same purpose as the E-Block filter. Any filter insertion loss was accounted for in the link budget of the test set-up to obtain the correct interfering power at the UE. These filters were designed to conform to 3GPP OOBE specifications. Shown below are the filter traces for both the E-Block and Channel 51 filter[8].

11. Second, the UE receive filter was specifically used to view the interference and signals on a spectrum analyzer. This in no way affected the test results, which were obtained by the BLER program within the CMW-500. This is documented in Appendix A of the V-COMM Reply Comments.[9]

12. Therefore, our test equipment configuration is correct and valid, and well documented. None of the filters used had <u>any</u> potential to reduce the impact of interference to the UE devices. The use of the filters is <u>absolutely</u> necessary in order to ensure unwanted emissions are not included in the measurements (Channel 51 and E-Block filter), and to accurately view spectrum analyzer signals (UE receive filter).

13. Interestingly, use of similar filters to control unwanted signals in the AT&T test environment were not specified (or included) in any of the AT&T commissioned testing. In addition, the AT&T specification of Channel 51 emulator wideband noise[10] does not sufficiently filter the noise generated by the Channel 51 emulator, thus impacting the results of interference measured that is contributed by noisy emissions from its test generator reaching the device under test. Our observation is in complete agreement with the Cellular South Ex Parte filing[11], which concludes that the AT&T Channel 51 test results are invalid.

---

[6] AT&T Ex Parte from Oct. 3rd, 2012, 7Layers report entitled "Test Configuration for Evaluation of the Impact of Varying LTE Signal Levels on the Band 12 Device Performance in the Presence of Channel 51 Interference", page 6. AT&T refers to the device reference sensitivity as REFSENS, whereas we refer to it as DEVSENS.

[7] AT&T Ex Parte from Oct. 3rd, 2012, Reed and Tripathi Report, Executive Summary, page 5.

[8] DTV OOBE emissions are attenuated according to FCC Rule 73.622, part (h) (1).

[9] Also see paragraphs 101 and 102 of the V-COMM Reply Comments for explanations.

[10] AT&T Reply Comments, AT&T Test Plan, p. 3. The noise power level is specified as -90 dBm/10 MHz (-160 dBm/Hz) when generating a -20 dBm/6 MHz downlink signal at the lower edge of the B+C DL channels, thereby allowing an effective "passband" of extraneous noise across the A,B, & C UL channels.

[11] Ex Parte of Cellular South, Inc. d/b/a C Spire Wireless, 8/03/12, Presentation (dated 8/1/12), page 10.
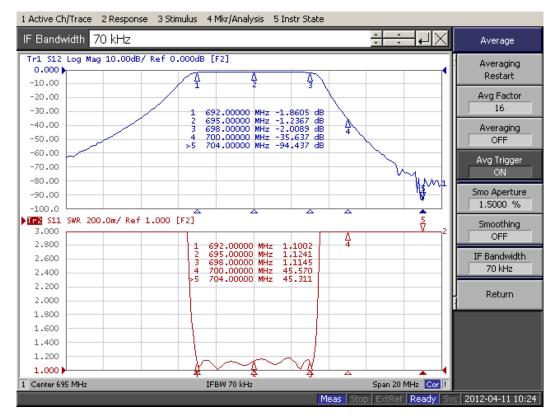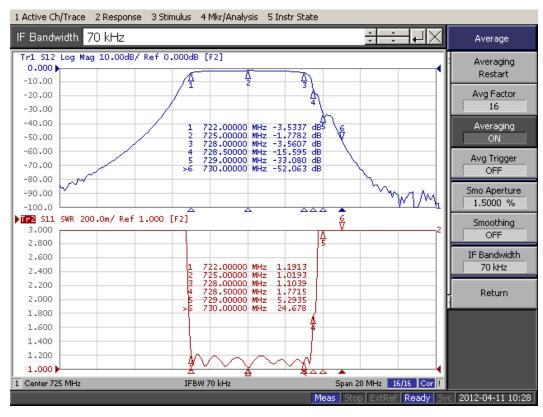
Figure 1- Channel 51 Filter Trace

Figure 2 - E-Block Filter Trace

## C.	TM 91-1 Model

14. In addition to asserting numerous fallacies about our laboratory methodology, R&T also incorrectly assert that TM 91-1 model would "substantially understate the areas where Band 12, but not Band 17 devices, will experience degraded performance from E-Block transmissions". They mistakenly claim that TM 91-1 is a simplistic and outdated model; however, as is described below, all of their reasons are not accurate and show their general misunderstanding of the TM 91-1 model.

15. R&T mistakenly claim that the FCC TM 91-1 model was used incorrectly for transmitter heights above 300 feet, AGL. However, had they fully read and understood our report, they would have known that for antenna heights above 300 feet AGL, a conservative LOS calculation was applied as per TM 91-1 recommendations and is further described below. This is consistent with the FCC's TM 91-1 model, which uses the model's formula for antenna heights below 300 feet, and uses the higher signal strength predicted for antenna heights above 300 feet as compared to the model's formula and LOS calculations. We correctly applied the TM91-1 model for those antenna heights below 300', and conservatively applied the LOS model for antenna heights above 300 feet. Therefore, our E-block signal strength modeling is very conservative particularly for antenna heights above 300 feet.

16. R&T also mistakenly claim that the model does not account for differences in path loss between urban, suburban, and rural areas. As is stated in the TM 91-1 documentation available through the FCC, the model is a Suburban path loss model. Within urban areas, where there is more clutter and subsequently more path loss, the suburban model creates a more conservative estimate of propagation. The application of an urban model would serve only to shrink (not increase) the already miniscule areas of impact derived in our Case Study. Moreover, as explained above, the TM 91-1 calculation was compared to a LOS calculation for higher antenna heights, and we utilized the more conservative prediction of LOS modeling for those cases. The LOS model would be more representative of open and quiet rural areas without a lot of ground clutter, where a UE would have a direct line of sight to the transmitter. Rural areas with more land clutter and densities of trees would more closely represent the RF propagation environment of suburban areas, as compared to the LOS propagation of open range rural areas. Thus, many rural areas would also be representative of the TM 91-1 modeling as well.

17. In addition, it should be noted that the addition or lack of ground clutter (one way or another) would similarly impact both the desired and the interfering signal. For example, if there is lack of clutter in one environment it can be expected to have higher interference levels, but it would also have higher desired signal levels to overcome such interference. Similarly, if the desired levels were lower due to higher clutter environments, the same clutter would be expected to also lower the interference levels. So, the impacts of local ground clutter affect both the desired and interference levels and should be taken into account in the interference assessments.

18. Next, R&T falsely claim that the TM 91-1 model does not take into account frequency dependent path loss. This fallacy is a misunderstanding by R&T and is discussed in V-COMM's Reply Comments. The actual TM 91-1 calculation is a Field Strength calculation (in dBu), and as such does not have a frequency dependent path loss component until it is converted into a Received Signal Strength (in dBm) at the remote device. Thus, the

frequency dependent component is added at that point in the modeling, thereby demonstrating that R&T's claim is erroneous and reflects a general lack of understanding of the TM91-1 model and the FCC's intention for applying the model.

19. R&T also mention that there is no random fading applied to our model. Simply put, this is because any additional random fading on the path loss model would create a more realistic and lower interference level (and therefore not a worst case) scenario. Adding a random fading factor into the calculation would only add lower interference levels during fading, thereby shrinking or even effectively eliminating the already miniscule areas of impact around E-Block transmitters.

20. Finally, R&T propose that a "more sophisticated and accurate model for measuring path loss over shorter distances" such as the Okumura-Hata or COST-231 model should have been applied. From afar, this seems like a logical claim. However, however, R&T fail to observe the basic radio propagation characteristics of these models, which are not accurate and are NOT intended for use with distances less than 1 km. Therefore, neither the Okumura-Hata nor the COST-231 model could have accurately been applied in our Case Study that was showing interference impacts at distances less than 1 km. Because these propagation models are invalid at such close distances to the tower, the TM 91-1 model was implemented as an extremely conservative propagation model. Okumura and COST models are utilized on an industry wide basis for a variety of propagation analyses; however these are for distances over 1 km in range. In fact, V-COMM's RF modeling software packages include these models, and we appropriately applied the Okumura-Hata model in our E-Block to A-Block Interference[12] filing, which is for interference occurring at distances over 1 km. However, again, we used the TM 91-1 approach per the FCC guidelines for short distance propagation and as a worst case interference assessment for antenna heights over 300 feet using LOS modeling. In fact, V-COMM would welcome the opportunity to perform field measurements of such cases as they would likely show that the interference is overstated.

21. The above explanation regarding the model choice and implementation, coupled with the fact that all of the criticisms that R&T have can easily be dismissed upon closer examination of the V-COMM Reply Comments, reaffirms that the TM 91-1 model was properly used to implement a conservative, worst-case scenario. Further, the suggestion to use other modeling techniques would either result in erroneous and unreliable analyses, or show that the potential interference is actually <u>much less</u> than the calculations using the conservative TM91-1 model approach.

22. Contrary to R&T implication that this model is outdated, it should also be mentioned that the TM 91-1 model was recently referenced in the White Space proceeding[13], which is a recent FCC proceeding that used the TM91-1 model to assess the potential interference over short distances in adjacent UHF frequency bands.

D.   E-Block Transmitter Assumptions

23. In conjunction with being improperly informed on how the TM 91-1 model was implemented, R&T assume incorrectly that our E-Block transmitter parameters were skewed

---

[12] Engineering Statement Regarding Lower 700 MHz E-Block to A-Block Interference, FCC File No. 5448551

[13] White Space 3rd MO&O, Part 15 Docket 87-389, Interactive Video & data services RM-6196

to show a favorable scenario. In reality, these parameters were derived from FCC rules and worst-case propagation analyses. Specifically, R&T assume that our antenna heights, powers, and elevation patterns are either incorrect, or inherently wrong. In addition, they misrepresent our <u>entire</u> collocation argument, wildly stating that we assume that 98%[14] of the time E-Block towers are collocated based on an "extrapolation"[15]. This appears to be a figure ("98%"), as well as an "extrapolation" assertion, conjured from thin-air. We expand on the parameters applied and the 98% assertion in more detail below.

24. The first argument that R&T make is that we fail to accurately represent the number of E-Block transmitters placed at heights greater than 300 ft. AGL. As was described above, this is blatantly inaccurate. We show multiple graphs of E-Block propagation, with transmitter heights varying from 200 ft. AGL to 1000 ft. AGL. In fact, the majority of transmitter heights provided in these analyses are <u>greater</u> than 300 ft AGL. The incorrect assumption stems from the fact that they did not understand the TM 91-1 model and its implementation. Specifically, at heights above 300 ft. AGL, the LOS model was implemented (as is described in the FCC OET TM 91-1, entitled "Propagation in Suburban Areas at Distances less than Ten Miles").

25. R&T then assume that the ERPs used for each E-Block tower height "often transmit at levels below the maximum allowable 50 kW". This is another errant assumption. Nowhere <u>in our</u> Reply Comments do we state that E-Block sites will often transmit at levels below 50 kW. What we do state, is that the FCC PFD requirement will necessarily limit the ERPs on <u>some</u> towers[16]. From theoretical analysis as well as real-world implementation, V-COMM understands at tower heights below 220-240 feet AGL the ERP will have to be reduced below 50 kW in order to comply with FCC PFD requirements[17]. Therefore, for every transmitter height above 220 ft. AGL, the maximum ERP of 50 kW was used and PFD limits were still obeyed. For sites under 220 ft. AGL, the ERP was reduced until no signal strengths higher than -17 dBm on the ground (e.g. FCC PFD limits) were calculated. There is absolutely nothing erroneous or nefarious in applying these conditions in simulating the E-Block transmitters.

26. R&T also complain that, since we did not provide the Antenna Elevation pattern that was used in our analyses, our results can not be validated. V-COMM analyzed 15 different antenna patterns from multiple manufacturers and selected a Dielectric antenna (7P-C1-7-H-L), specifically designed for an E-Block mobile broadcast deployment. It was not realistic to analyze ALL possible mobile broadcast antenna patterns; therefore V-COMM chose a pattern based on our experience in designing and deploying Mobile Broadcast systems, that can achieve 50 kW ERP with reasonable and achievable transmitter power out (TPO), using typically deployed transmission lines.

27. Lastly, R&T wildly assert that we claim "that Qualcomm's MediaFLO system transmitters were collocated with E-Block transmitters 98% of the time." Nowhere in our

---

[14] There is not a single instance of "98%" in the V-COMM Reply Comments.

[15] V-COMM could not find any means by which the data we provided would extrapolate to the 98% figure cited

[16] The only alternative to a power reduction is an antenna selection that keeps the energy at the horizon; however, such an antenna choice then eliminates the potential interference concerns being addressed in this Case Study.

[17] *Id.*

Reply Comments is this stated, and nowhere in R&T's paper is any reference presented. Instead, V-COMM was executing a collocation analysis based on prior Qualcomm arguments[18], while referencing markets in different areas of the U.S., and including the areas for which Qualcomm had provided drive test data. The V-COMM collocation analysis demonstrates that a statistically significant majority of E-Block towers that are located in areas where interference could potentially affect the population are collocated. Further, the analysis revealed that for non-collocated E-Block sites, they are often remote and/or high enough that the potential for interference is not realized.

E.   Consistency with Other Laboratory Testing

28. R&T state that V-COMM conclusions and data do not support "multiple other tests", which show "significant degradation of performance for Band 12 devices, but not Band 17 devices." Vague wording aside, R&T are making conclusions based on their data results which consists of tests of a single device. The "multiple other tests" R&T refer to must be the two AT&T commissioned tests by 7Layers and PCTest, because no other tests were conducted with actual Band 12 devices. Therefore, the use of the word "multiple", when describing these two tests, each using the same device, and specifically designed and commissioned by AT&T, misleads the reader that AT&T's testing somehow represents an industry consensus. Additionally, all of these "other tests" use the same inappropriate filter setup which produces invalid results, as described above.

29. In another location, R&T state that "V-COMM's test results are contrary to all of the other testing of Band 12 devices that we have seen." The use of the term "contrary" with the phrase "all of the other testing of Band 12 devices" is also an extremely misleading statement, as the only other Band 12 device tests were designed and commissioned by AT&T and consist of a single Band 12 Tablet. In contrast, we can affirmatively state that AT&T's commissioned testing is contrary to all other Band 12 device testing, because our testing includes multiple band 12 devices, as used and representative of the band 12 devices in the market. In fact, our testing consisted of 3 Band 12 devices, of all different form factors, while their testing consisted of 1 device, in a tablet form factor, which is a limited subset of a carrier's device profile. Conveniently, R&T seem to phrase this statement to purposefully omit the testing done and submitted to the record by Wireless Strategy and Paul Kolodzy, which coincide with, and reinforce, our findings.

F.   Computation of Desensitization

30. R&T are again misleading when they mention "V-COMM fails to explain how it measured the impact of E-Block interference (and Channel 51 interference) on Band 12 and Band 17 devices." In fact, our test methodology is discussed in depth in Appendix A.

31. They also question how we "compute" desensitization, which is not so much a computation as it is a measurement. V-COMM performed a standard desensitization test, and our test set-up and methodology are similar to the ones performed by 7Layers and PCTest, commissioned by AT&T. In fact, R&T state this earlier in their paper, noting "The tests conducted by V-COMM, PCTest, and 7Layers all appear to have used similar testing equipment.[19]" As noted by R&T, there are "different ways to compute desensitization",

---

[18] V-COMM Reply Comments at Para 75.

[19] AT&T Ex Parte, Reed and Tripathi Report, Section at 1.1, page 7.

however it should be noted our testing measured it and it was not computed in theoretical analyses or otherwise. In any case, we provided further explanations of the desensitization testing performed in an above section of this report.

G. Channel 51 Signal Level Measurements

32. In order to resolve R&T's "curiosity"[20] regarding the use of the Cedar Rapids propagation model (as opposed to field test measurements), V-COMM explains that: 1) the propagation model was selected and utilized in accordance with FCC procedures on estimating DTV coverage. 2) To be clear, we did **not** conduct Channel 51 signal measurements in the Waterloo market, notwithstanding R&T's confusion to the contrary. 3) The test equipment, and the test teams that collected the LTE signal data throughout the Waterloo market, were different from those that collected the DTV signal level measurements. 4) **All** of our Channel 51 DTV signal level measurements (Cedar Rapids, Chicago, and Montclair) were done in close proximity to the stations themselves, since our focus was on those areas of high DTV signal strength where Reverse PA IM could potentially occur.

---

[20] Id., page 14.

III.   EXPLANATIONS OF V-COMM'S TEST METHODOLOGIES

A.   Waterloo Testing

33. R&T misconstrue the execution and purpose of the Waterloo, Iowa testing. V-COMM, through its clientele, went beyond the laboratory device testing and coverage analysis efforts in an effort to provide the FCC with as much empirical data <u>as possible</u>. The report used the **<u>only</u>** US (King Street/USCC) market (Waterloo, IA) capable of a B+C deployment configuration within proximity to a Channel 51 transmitter using a Band 12 configured system and devices. Testing was executed in areas up to the market boundary as close to the Channel 51 transmitter as possible. There were no efforts to purposely skew the test data collection area, and none were skewed. In fact, the Channel 51 RF propagation modeling results, generated in accordance with FCC DTV coverage prediction methods, were included with the DT route overlaid to provide the FCC the true picture of the data collection and coverage prediction. This was the only market in which this scenario could be applied.

34. R&T claim; "*There appear to be a limited number of measurements in locations with Channel 51 signals levels likely to be above -40 dBm*"[21]. They make this obscure "limited" observation based on the V-COMM Ch. 51 coverage prediction map with the drive test route overlaid and include in their report. We did not share their observation. Therefore, we calculated the data points and found that 50% of the drive test route points are in areas where predicted Channel 51 signal strength is greater than -37 dBm. With respect to their "-40 dBm" figure provided (but with no real relevance based on test data to support a -40 dBm assertion); 56% of the drive test route are in areas greater than -40 dBm. These are the facts, as evidenced by the map, rather than what R&T "appear" to observe.

35. We did not expect there to be any performance issues in the Waterloo market based on our analysis of the Channel 51 PA IM issues through device testing, propagation analysis, and Ch 51 field strength testing. Our device testing resulted in a DTV signal strength of -13 dBm providing the potential to create IM interference and therefore device performance impact. AT&T argues the levels of Channel 51 signal strength that create the PA IM conditions is considerably lower (into the -30 dBm range) which is based on the testing results of a <u>single</u> device. It is also based on a non-standard resource block (RB) assignment scenario for uplink device transmissions. In the standard LTE base station configuration, the PUCCH is configured to use the standard assignment[22] of RB0 and RB49 for UE uplink control channel transmissions, and the eNodeB assigns PUSCH user traffic

---

[21] Id., page 12.

[22] An exception to the standard LTE base station configuration is the special, non-standard operating mode called PUCCH Over-dimensioning. In this mode of operation, the LTE base station can designate non-standard RB assignments for UE uplink control channel transmissions (PUCCH) that are further inside the LTE channel block and not at the upper and lower edges (i.e. assign other RBs, and not RB0 & RB49 for PUCCH). This non-standard LTE base station operating mode for PUCCH RB assignment is strictly reserved for special circumstances (i.e. potentially to mitigate special interference scenarios) and not recommended for use as it results in performance degradations on the LTE uplink channel and reduction in spectrum efficiency. We are not aware of any LTE systems in any market utilizing this special PUCCH Over-dimensioning assignment operating mode. LTE systems in practice utilize the standard configuration that reserves RB0 and RB49 for PUCCH control channel transmissions and RB1 through RB48 for PUSCH user data transmissions.

data transmissions to RBs 1 through 48. Thus, under normal conditions, RB49 is used for PUCCH rather than PUSCH transmissions; however AT&T's testing and results relies upon a non-standard utilization of PUSCH on RB49.[23] Thus, a LTE UE would not experience the CH51 interference results as provided by the AT&T test plan and as executed by 7Layers and PCTest.

36.   However, regardless of the various Channel 51 signal strengths that R&T have claimed as reflective of true Band 12 performance (using flawed test techniques or theoretical analysis), with respect to Waterloo, that only makes the V-COMM case stronger since half of the drive test area is reflective of predicted signal strength of -37 dBm or stronger. The purpose of executing these tests was to show that, regardless of the configuration applied by King Street/USCC, the performance of the network is not impacted by LTE eNodeB received signals and the signal of the DTV station. As stated in our initial filing; King Street/USCC are "so convinced of non-interference that they are continuing to run their Waterloo-Cedar Falls, IA market as a 10 MHz B+C Band 12 network." Regarding the field tests results of the Channel 51 transmitters themselves; we show that high signals from Channel 51 transmitters are few and far between and "Potential for Harmful Interference" is deminimus. There is no "apparently"[24] about this fact; USCC and King Street are now operating a Band 12 configured B+C market in Waterloo, IA.

37. The collection of device performance over several devices, in combination with the measurements of field signal strengths of Channel 51 transmitters, and the worst case propagation modeling using FCC TM91-1 we executed, should convey that the likelihood for interference is deminimus. In fact, these analyses result in potential interference impacts to a minuscule amount of area across the entire United States!

38. Similarly, as discussed above, they confuse the issues related to modeling of the Channel 51 received signals V-COMM executed using the FCC TM91-1 modeling techniques. Clearly the techniques applied were worst case analysis that maximizes the potential interference impacts from a Channel 51 transmitter.

---

[23] AT&T's test plans specify uplink PUSCH user data transmissions of 5RBs with an offset of 45, which is using RB 45 through RB 49 for PUSCH user data transmissions. Normally, in standard LTE eNodeB configurations, RB49 is reserved for UE PUCCH control channel transmissions, which would not be transmitted at the same time as PUSCH transmissions from the same UE. Thus, the interference measured would not be representative of standard operating conditions for uplink UE transmissions.

[24] AT&T attorney cover letter at page 2.

B.   RB Allocations

39. R&T provided Channel 51 Reverse PA IM test data based on the use of 5 resource blocks (RBs). The RBs utilized are identified by R&T as "5 RBs offset 45". Figure 3 (a) shows all available RBs for an FDD 10 MHz B+C LTE Carrier with a center frequency of 710 MHz (the center of the B and C Block). AT&T originally uses a center frequency of 711 MHz, which effectively puts their 5 RBs at the very top edge of the B and C Block[25]. In addition, the use of a center frequency of 711 MHz is not depictive of real world deployments. ENodeB vendors use the last 1 MHz (715-716) to transition their receive filters to avoid interference from D-Block operations.

40. As noted above, these 5 RBs included the RB49, which is reserved for PUCCH rather than PUSCH transmissions in a standard configuration. Therefore, the configuration used in the 7Layers and PCTest test would not be representative of a standard deployment scenario, and is not representative of a true potential interference condition. The last 5 PUSCH RBs are shown in Figure 3 (b) below.

41. What is worthy of noting is that less than half of the RBs in a 10 MHz B+C LTE carrier can even potentially result in Reverse PA IM products. Further, the quantity and location in frequency of the RBs assigned to any one UE is dynamically allocated on a frame-by-frame (10 ms) basis. This allocation is controlled by the eNodeB (eNB) scheduler. The eNB scheduler has the ability allocate RBs based on its assessment of the UE's channel conditions. The fluctuations in UE channel conditions are not specific to Reverse PA IM; on the contrary, these are more likely to be a result of frequency selective fading, inter-cell interference, and other common RF propagation issues inherent to mobile wireless systems. Therefore, any Reverse PA IM issue that could arise would be statistically rare, short-lived, and can be automatically compensated for by the eNB through LTE- specific interference mitigation techniques.
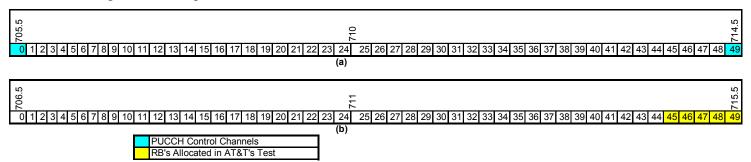

Figure 3 - Resource Block Allocation Figures

IV.   IDENTIFICATION OF DEVICES AND CHIPSETS

42. Table 2 below contains the Band 12 device and chipset information used in testing. This includes devices from 2 different manufacturers and with Qualcomm chipsets. During our testing timeframe, USCC had 5 available devices, 3 of which were commercially available at the time. The three devices tested were the Samsung Galaxy III, the Huawei UML 397 Wireless Modem, and the Samsung SCH-LC11 MiFi device. All are now

---

[25] They also tested a second time at 710 MHz, and got a 50% reduction in interfering power level.

14

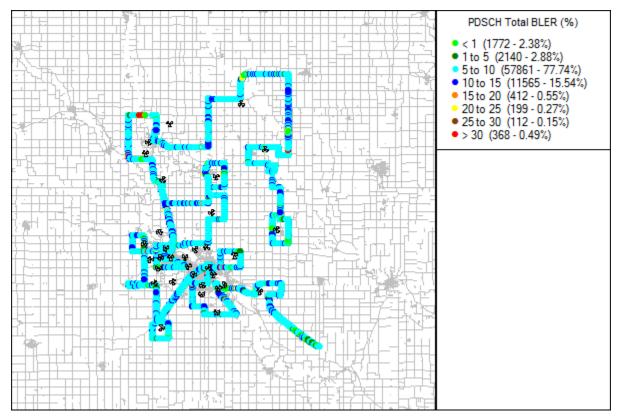commercially available and can be seen on USCC's website.

Manufacturer	Model	Device Type	Chipset
Samsung	Galaxy S III	Smartphone	Qualcomm MSM8960
Samsung	SCH-LC11	MiFi	Qualcomm MDM9600
Huawei	UML397	Wireless Modem	Qualcomm MDM9600

Table 2 - Band 12 Devices and LTE Chipset Information

43. As for Band 17 devices, we chose 4 of the 12 available at the time across multiple manufacturers and product types. We also noted at the time that Verizon had over 10 Band 13 LTE devices commercially available.

V. ADDITIONAL DETAILS REGARDING WATERLOO 10 MHZ B+C DRIVE TEST RESULTS

44. Included below, in Figure 4 through Figure 7, are maps with drive test results from the Waterloo testing for the 10 MHz B+C configuration. Each map depicts a different KPI for the Band 12 UE device. As can be seen from the figures, the performance of the UE device is consistent even in the areas closest to the Channel 51 transmitter, where DTV signal levels are in the ranges that AT&T claims interference from Channel 51 should have detrimental impacts on performance. This is clearly not the case, and once again, we reiterate that King Street/USCC has left this market operating in this 10 MHz B+C configuration.
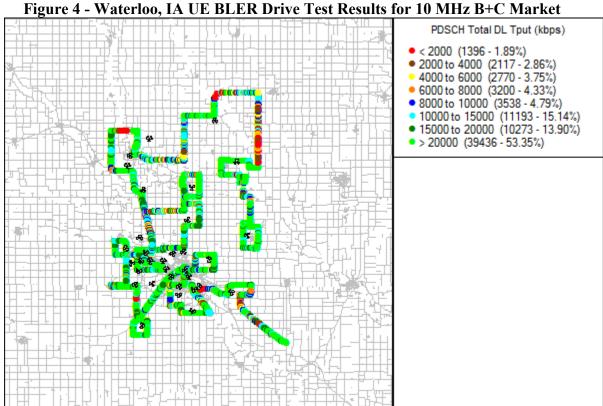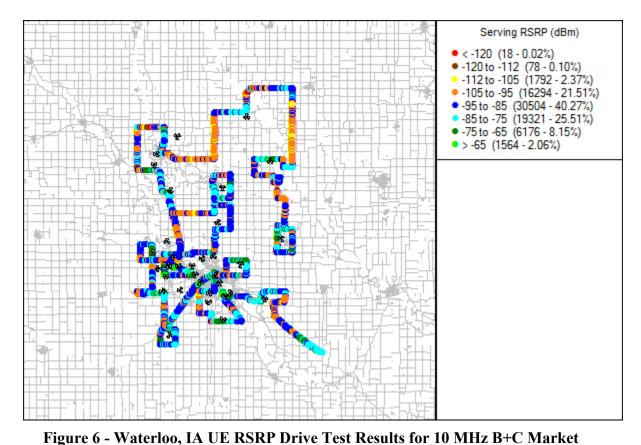
Figure 4 - Waterloo, IA UE BLER Drive Test Results for 10 MHz B+C Market

Figure 5 - Waterloo, IA UE DL Throughput Drive Test Results for 10 MHz B+C Market

16

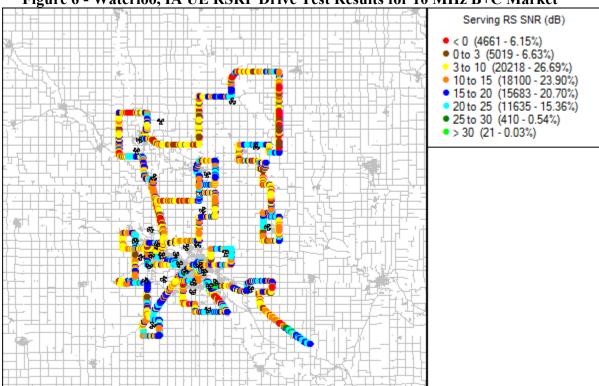**Figure 6 - Waterloo, IA UE RSRP Drive Test Results for 10 MHz B+C Market**

Figure 7 - Waterloo, IA UE SNR Drive Test Results for 10 MHz B+C Market

17