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January 6, 2010

Marlene H. Dortch, Secretary
Office of the Secretary
Federal Communications Commission
445 12th Street, SW, Room TW-A325
Washington, DC 20554

Re: Petitions for Waiver to Deploy 700 MHz Public Safety Broadband Networks
Ex Parte Presentation - PS Docket No. 06-229
DA 09-1819

The North Dakota Rural Telecom Coalition ("RTC") and its nineteen (19) member companies shown in Attachment B provide the Commission and its staff with the following *ex parte* comments to address persistent errors and misstatements that have appeared in the record for the captioned proceeding. RTC's response to the November 16, 2009 comments of New EA d/b/a Flow Mobile (*Flow Reply*) will follow below. A separate document addressing technical issues raised by Flow Mobile's response to the PSST's criticisms (filed in conjunction with the *Flow Reply*), and related power point slides, are provided as Attachment A.

As an initial matter, RTC believes that the FCC must give great weight to comments and reply comments filed by the PSST and representatives of the public safety community. These are the entities that will be using the Public Safety Broadband Network – in conjunction with 700 MHz narrowband systems – to meet their mission-critical communications needs. As the Commission is aware, these entities have raised concerns *across the board* about technical and interoperability issues that would be created by introducing Flow Mobile's technology into the 700 MHz public safety band. The Commission should not dismiss the public safety

community's hard work in arriving at a consensus to use LTE as the uniform technology standard for the 700 MHz PSBN. The Commission should also give significant weight to reply comments filed by the State of Minnesota (Region 22). These reply comments rebut Flow Mobile's claim that "no… narrowband services are contemplated in the future in a neighboring jurisdiction" and raise concerns about the potential for interference to mission critical voice systems using the narrowband general use and state license frequencies from North Dakota and Flow Mobile's proposed operations. *Region 22 Reply Comments* at pp. 1-2.

"Delay and Uncertainty" in D-Block Licensing does Not Provide a Basis for Granting Flow Mobile's Request

Flow Mobile continues to argue that "delay and uncertainty" as to when spectrum licensed to the PSST and the D-Block will become available is justification for granting waiver requests. *Flow Reply* at p. 1. While the rapid deployment of a nationwide interoperable 700 MHz public safety network is a goal that RTC and its members support, any delay or potential uncertainty in resolving D-Block issues should not be viewed as a reason for granting Flow Mobile's waiver request. The PSST already holds its license to the public safety broadband channels, and it has made its technology selection. Even if the public safety community were to find Flow Mobile's "4G-like" technology to be an acceptable alternative to LTE (which it does not), Flow's own irrelevant demonstrations on three to four times the amount of spectrum per channel that it would have in practice – and with a 20%-25% dropped call rate at that – prove it is far from being ready for public safety deployment. Moreover, North Dakota is obligated to follow standard procurement and appropriations procedures before it may commit significant state resources – including payment of monthly service charges, and provision of space on state-owned towers and right-of-way access – to such a large scale undertaking and before it may commit state agencies to long-term service contracts. Governor John Hoeven has acknowledged that the State has these obligations.[1] Thereafter, North Dakota must complete the process of its Regional Public Safety planning process and coordination with neighboring jurisdictions, and Flow has informed North Dakota's consultant that the system would take two years to implement. This situation does not involve the sort of imminent deployment that justifies proceeding without the benefit of the D Block plan, and in the face of so many legitimate objections. And contrary to Flow's claims, RTC and its members are hardly "attempting to prevent the State of North Dakota from proceeding through a competitive procurement process," as Flow charges. *Flow Reply* at p. 20. To the contrary, RTC and its members have consistently

[1] *See, e.g.,* August 11, 2009 letter from Governor John Hoeven to New EA, Inc. ("When selecting commodities or services that will be used by state government, North Dakota state law requires executive agencies to use a competitive bidding process that provides equal opportunity to all qualified entities to submit a proposal for the service.")

urged the State to conduct an RFP and otherwise meet the requirements of state law, and it is Flow Mobile that has used its political ties to circumvent these processes.

Flow Mobile Has Never Adequately Addressed Major Interference and Interoperability Concerns Raised by Its Technology

Moreover, the record shows that Flow's TDD technology cannot be operated using public safety 700 MHz broadband channels without causing harmful interference to public safety LTE networks using FDD technology in adjacent markets. Thus, granting the State of North Dakota and Flow Mobile authority to proceed with deployment of a 700 MHz public safety broadband network that uses Flow's proposed technology will not only isolate North Dakota from participating in a seamless nationwide 700 MHz public safety broadband network, but it would likely create significant coverage gaps in border areas where neither Flow Mobile nor LTE networks would be capable of interference-free operation. This is of particular concern when the state's most populated city (Fargo – est. metro population of 195,685) and third most populated city (Grand Forks – est. metro population of 97,279) as well as a more than 200 mile stretch of Interstate highway (I-29) are situated along the Minnesota-North Dakota border.

Indeed, the one entity that is arguably in the best position to appreciate and assess the risks presented by the Flow Mobile proposal, the Public Safety Spectrum Trust, draws a sharp distinction between jurisdictions that seek authority to deploy 700 MHz public safety networks that are compatible with and have an established path for upgrading to LTE and the one jurisdiction that is seeking to blaze its own trail at the expense of others. In no uncertain terms the PSST urges the FCC to reject the State of North Dakota's and Flow Mobile's "attempt to deploy an incompatible system that would undermine nationwide interoperability and could cause harmful interference." *PSST Reply* at pp. 1-2. The PSST dedicates a substantial portion of its reply comments to explaining why allowing Flow Mobile and the State of North Dakota to deploy an incompatible broadband system or to use public safety narrowband channels is contrary to the public interest. *Id*. at pp. 5-8. RTC agrees with PSST that Flow's statements encouraging the FCC to "embrace an open access standard and technical flexibility" for the 700 MHz public safety band and to "avoid locking in" a uniform technology are contrary to the Commission's nationwide interoperability goals. *Id*. at p. 7. **All Petitioners should deploy a uniform technology to facilitate nationwide interoperability, and all of the major national public safety organizations, including the PSST, have endorsed LTE technology for the nationwide network**. *Id*.

With respect to Flow Mobile's proposed use of the 700 MHz narrowband channels, given the unanimous objection in the comments from the narrowband user community, RTC was not

surprised to see Flow's unsupported claim that "[t]en megahertz of spectrum is sufficient for Flow Mobile's technology to provide sufficient access and bandwidth for North Dakota public safety users." *Flow Reply at p. 17*. Flow evidently believes that "half a loaf" is better than none at all, but it provides no evidence to demonstrate that its technology would actually work using just 10 megahertz of spectrum. Indeed, Flow Mobile's only known trial at 700 MHz involved the use of 16 megahertz of spectrum in a single channel, and Flow provides no explanation as to how this significant change in technical parameters (*i.e.*, less than one third of the channel bandwidth) would impact the utility of its system, much less proof that the performance would be acceptable to the public safety community. Instead, Flow maintains that "access to the fallow narrowband spectrum would not be necessary should the Commission make the PSBL spectrum available to either Flow Mobile or the State of North Dakota." *Id*. In other words, Flow asks the FCC and the public safety community to simply take it on faith that the system will work as promised. With the public's health and safety and billions of dollars worth of public and private property at risk, neither the FCC nor the State of North Dakota can afford such a giant leap of faith. This risk is not justified since North Dakota's own consultant has noted the need for at least three 5 MHz channels for frequency re-use considerations; and the significant dropped call rate seen with a much wider channel will only worsen when the spectrum is constricted to two 5 MHz channels.

Finally, neither Flow nor the State of North Dakota has refuted RTC's showing that the State has an obligation to administer the 700 MHz narrowband spectrum through the regional planning framework created by the FCC and to minimize the potential for interference to narrowband operations in adjacent regions. Indeed, the first organizational meeting of the Region 32 (North Dakota) 700 MHz Public Safety Regional Planning Committee was not held until just two weeks ago (on Thursday, December 17th) and the Region 32 RPC has completed little or no substantive work toward preparing a 700 MHz regional plan. More importantly, the State of North Dakota has performed no coordination with operations using APCO Project 25 equipment in adjacent public safety regions (especially Region 22 – Minnesota).

Other Necessary Corrections and Clarifications for the Record

Flow Mobile argues that it is "meeting the needs of public safety by providing the only mobile broadband service in the markets where we serve." *Flow Reply* at p. 5. This statement is misleading and plainly wrong because the record shows that Verizon has mobile broadband services currently deployed throughout the state of North Dakota, and AT&T is actively implementing a similar capability. Indeed, Verizon submitted a proposal to North Dakota to

provide a statewide LTE capability specifically tailored to public safety. Unfortunately, Flow and its principals continue to ignore this fact.

Besides timing, Flow's other principal argument for its system is cost. Flow persists in misstating that "it would cost about $528 million to fill in the coverage gaps in North Dakota to create a statewide 3G network." *Flow Reply* at p. 19. This cost estimate is a gross exaggeration, and is based upon irrelevant and dated information taken out of context. RTC has outlined a 4G network for State of North Dakota that would provide 95% geographic coverage using fully mobile broadband technology (3GPP LTE), using actual RF engineering predictions. The highest estimated total CapEx requirements for the entire network, including a full 3GPP Enhanced Packet Core ("EPC"), all backhaul electronics and even the cost of mobile devices, are on the order of $65 Million. *ND Coalition Reply* at pp. 13-15. Thus, the cost of a statewide 4G network that could be seamlessly integrated into the nationwide 700 MHz public safety broadband network would likely be more than *eight times less* than what Flow Mobile claims it would cost *just to fill 3G coverage gaps.* Thus Flow's primary arguments in support of its technology - timing and cost - are without merit.

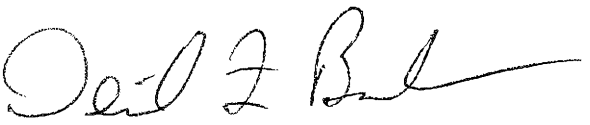
Flow Mobile responds to the PSST's observation that the ND/Flow proposal "appear[s] inconsistent with the Commission's nationwide interoperability goals" by arguing that the PSST "has not offered specifics to back up its claim." *Flow Reply* at p. 6. However, the burden of proof is not on the PSST to demonstrate why Flow's technology is *not* interoperable; rather it is on ND/Flow (as the waiver proponents) to demonstrate that Flow's technology can co-exist with LTE when both systems are deployed in the 700 MHz public safety broadband spectrum. This simply cannot be done. As shown in the attached technical analysis, Flow defines interoperability incorrectly for the situation at hand, focusing on "system interoperability". However, where radios are sharing the same spectrum, the Chief Engineer of the Commission's Public Safety & Homeland Security Bureau (William Lane) has confirmed that "physical layer interoperability" is needed, requiring common technical parameters. See Attachment A hereto.

Flow quotes Commissioner Copps as stating that "part of government's job is to implement policies so that multiple broadband platforms can develop—again, without picking winners and losers." Flow also quotes Chairman Julius Genachowski for stating that "removing obstacles to robust and ubiquitous 4G networks is one of the Commission's key priorities in mobile broadband." Reply at p. 12. However, these quotes are taken entirely out of context. Both speak to the Commission's goal for a competitive marketplace in <u>commercial</u> broadband services. Accordingly, they are completely misplaced in a discussion where the priority is to <u>meet the specialized communications and interoperability needs of the public safety community</u>.

RTC believes that early 700 MHz public safety network deployments must be consistent with statutory requirements and must comply with the recommendations of the NPSTC Broadband Task Force Report, which are predicated on the use of LTE technology from the outset. By adopting a nationwide licensing framework, and requiring waiver petitions to follow uniform technical standards, the Commission will ensure that rural public safety networks do not become "islands of incompatibility" and it will be able to fulfill its principal goal of creating a nationwide, interoperable public safety network.

Very truly yours,

NORTH DAKOTA RURAL TELECOM COALITION



Derrick Bulawa, General Manager
BEK Communications Cooperative, Member

cc: FCC Commissioners
Wireless Telecommunications Bureau
Public Safety & Homeland Security Bureau
Office of Engineering & Technology

Attachment A

Analysis of Flow Mobile Responses to PSST Criticisms

VantagePoint
Customer Focused. Technology Driven.

January 5, 2010

Federal Communications Commission
Washington, DC 20554

Re: PS Docket No. 06-229

Vantage Point Solutions, Inc. (VPS) has been asked to review the technical arguments contained in the November 16, 2009 "Comments of New EA dba Flow Mobile" and the related attachments, concerning the waiver requests filed by Flow Mobile and the State of South Dakota to allow use of the 700 MHz broadband and narrowband spectrum for a proposed statewide broadband system. VPS has performed its review, and provides the attached analysis of the Flow Mobile arguments. Our analysis is based on sound engineering principles and available technical and industry data.

VPS is a telecommunications engineering and consulting firm in Mitchell, South Dakota, with a full-time staff of over 100 employees. We will be glad to provide the Federal Communications Commission with additional information as may be helpful in reviewing this matter.

Respectfully Submitted,

John Michael De Witte
Vice President of Engineering

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Analysis of Flow Mobile Responses to PSST Criticisms

In an attachment to its November 16, 2009, Reply Comments, New EA dba Flow Mobile ("Flow") has provided its response to a number of "criticisms brought by Public Safety Spectrum Trust (PSST)[1]." However Flow's responses contain confusing or inaccurate materials, and do not fully address the core issues. RTC has therefore retained Vantage Point Solutions to review the Flow PSST responses and provide clarifying information to help the FCC in evaluating the pending Flow/North Dakota waiver requests. Flow's PSST responses (numbered 1-23) generally fall into four core issue categories: Technology, Costs, Incompatibility and Interference. Vantage Point addresses the relevant issues within each of these four categories below.

1. Technology

Flow repeatedly points to its demonstration in Dickinson as evidence of the viability of its proposed 700 MHz system. However, as will be discussed at the end of this section, the demonstration does not provide important information about the actual proposed deployment, and instead raises more issues (such as the serious dropped call rate under ideal test conditions). Further, the questionable suitability of Flow's technology for a fully mobile, secure, robust and survivable public safety broadband communications network must be weighed against its shortcomings in the other two categories – Incompatibility and Interference. Inaccurate and/or misleading statements about Flow Mobile's technology are identified and clarified herein.

a. Wi-Fi is Not Suitable for a Fully Mobile 700 MHz Public Safety Network

The PSST has raised numerous concerns about the suitability of Wi-Fi (a WLAN technology that is the basis for Flow's technology) for high-performance broadband in a fully mobile environment. Such questions understandably stem from the fact that Flow has never provided a complete and coherent explanation of its technology for the record, and its unsupported claims leave the public safety community only guessing as to its viability. Flow provides some glimpses into its technology in its PSST responses numbered 6 - 9, but these cursory explanations are insufficient.

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[1] Comments of New EA dba Flow Mobile, PS Docket No. 06-229 (*filed* November 16, 2009) at Attachment 1: "Flow Mobile Responds to Public Safety Spectrum Trust (PSST)" ("Flow Response to PSST Criticism").

First, concerning Wi-Fi's OFDM vs. LTE's OFDMA, Flow claims that "OFDM as a modulation scheme can cope with mobility by its inherent nature."[2] This is misleading. While OFDM can account for multipath distortion in fixed/pedestrian settings, as implemented in Wi-Fi, it is not inherently suited for mobility. This added dimension of distortion is why the near-real-time, subcarrier-by-subcarrier (narrow frequency) response methods employed in LTE's OFDMA were devised. Flow evidently claims to be doing something similar to this in its "unique and powerful beam-forming technology,"[3] thus acknowledging this requirement. Even so, this kind of processing is not a part of the Wi-Fi standard, and would have nothing to do with any "open standard" that Flow repeatedly cites as proof that its proposal will work. Even if this apparently critical part of Flow's technology did follow the Wi-Fi standard, the fact that it is not compatible and cannot co-exist in the 700 MHz public safety spectrum with the technology already chosen by the Public Safety Broadband Licensee renders it moot for the purpose at hand.

b. LTE is a Worldwide Standard with a Path to 4G, while Flow Mobile is a Proprietary Technology with No 4G Migration Path

Flow criticizes LTE as "a new standard which is still being worked on,"[4] "a new standard still in development,"[5] and "a technology still in development."[6] These statements are again misleading. Work on the current 3GPP standard for LTE (Rel-8) was completed nearly a year ago, and was ratified in March 2009. Subsequent releases for the LTE standard will address enhancements, such as, further facilitating Self-Organizing Networks, and, concatenating use of channels in multiple bands with even wider channel bandwidths, just as more advanced capabilities were added to the 802.11 standard over the years. However LTE's OFDMA, which, unlike Wi-Fi's OFDM, was purpose-built for the high-speed mobile broadband environment, is common to the three fully mobile broadband technology paths identified by the ITU as 4G, of which LTE is one. Thus LTE, along with the other two ITU-identified technologies (IEEE's Mobile-WiMAX, and the now generally abandoned 3GPP2 Ultra Mobile Broadband), are generally referred to in the industry as 4G. The ITU has not accepted IEEE's Wi-Fi (or any other OFDM-based technology) in any of its recognized migration paths to 4G. Nonetheless, with statements such as, "[p]resently, no international standard for 4G exists,"[7] Flow Mobile continually attempts to argue that LTE standardization and technology is not complete, and that it will not be for years. As evidenced above however, LTE technology and LTE standardization are complete for purposes of

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2 Flow Response to PSST Criticism, pp.8

3 Flow Response to PSST Criticism, pp.8: "…our unique and powerful beam forming technology, which is done per packet and per sub-carrier bin in both the uplink and the downlink, takes the mobility capabilities to a different level…" (emphasis added)

4 Ibid.

5 Flow Response to PSST Criticism, pp.10

6 Flow Response to PSST Criticism, pp.13

7 Flow Reply Comments, pp.8

allowing a deployment that will satisfy the needs of the public safety community; and the PSST and virtually the entire public safety community have chosen LTE as the standard for the 700 MHz public safety broadband deployment. As a standard, LTE is well in front of Flow Mobile in the legitimate testing, development and commercialization life-cycle that must attend any new technology – especially one that is intended for first responders in life-threatening situations. Moreover, LTE has been subject to rigorous field testing and peer review by teams of engineers and academics worldwide – far beyond just the closed-door research and limited beta testing that, to date, just a handful of Flow employees and owners have been privy to.

c. LTE is a Broadband Data Standard that Supports Voice and SMS Services

Flow further argues that LTE is not complete with a quotation from Verizon that "LTE-based voice and SMS services have yet to be finalized for commercial use."[8] However the same article from which the quote is taken reveals that Verizon and other major carriers and vendors "'have jointly developed a technical profile for LTE voice and SMS services' that will define 'an optimal set of existing 3GPP (3rd Generation Partnership Project)-specified functionalities that all industry stakeholders… can use to offer compatible voice solutions…'," so as to "…'avoid fragmentation' of LTE [voice] services and ensure 'the widest possible ecosystem for LTE.' To that end, the group has decided to work with the 3GPP's IP Multimedia Subsystem (IMS) [inherent to LTE's core network] that is designed to transfer wireless voice services over to IP."[9] IMS has long been specified in 3GPP releases prior to the current Rel-8, which specifies LTE among other things. The name of this effort has been dubbed "One Voice" by its participants.

Xchange magazine recently reported that "Nokia Siemens Networks has completed successful IMS-compliant voice calls and SMS messaging using 3GPP-standardized LTE equipment, it said [on December 10, 2009], and says it will also soon conduct VoLTE test calls with a fully implemented IMS system, all in support of the 'One Voice' initiative."[10] Thus any suggestion that LTE networks will not be capable of supporting voice and SMS service is incorrect. In any event, Voice and SMS are not germane to this discussion, as the intent for the Shared Wireless Broadband Network (SWBN) is exactly as its name implies – the Shared Wireless Broadband Network - which will serve as an adjunct to and not supplant the primary role for critical interoperable voice communications. Public safety voice has been the domain of the enormous standardization and interoperability efforts already achieved through APCO Project 25 (P25), which is universally accepted by the public safety community. LTE has the ability to support VoIP as well if not better than Wi-Fi due to the advanced, end-to-end QoS mechanisms provided

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[8] Flow Reply comments, pp.10

[9] Brad Reed, "AT&T, Verizon others boost 4G networks." Networld World. 11/4/2009; available at: http://www.thestandard.com/news/2009/11/04/t-verizon-others-boost-4gnetworks, emphasis added

[10] "Nokia Siemens, Alcatel-Lucent Complete VoIP Over LTE Calls", Xchange, 12/10/2009; available at: http://www.xchangemag.com/hotnews/nokia-siemens--alcatel-lucent-complete-voip-o.html

for by 3GPP's IMS. However, what is important is that no implementation of the SWBN should disrupt or displace P25 700 MHz voice communications on narrowband channels, thus removing voice interoperability for out-of-state first responders, as the Flow proposal would do.

d. Flow Mobile's Proprietary "Beam Forming" Technology is Not Comparable to MIMO

A third technology topic to be clarified is that of beam-forming vs. MIMO. Flow attempts to equate the two in its response to PSST's criticism numbered #7.[11] However beam-forming and MIMO are two different types of spatial diversity techniques, and they are used for different things. Beam-forming concentrates multiple, identical but phase-delayed signals to/from the client device. Flow's implementation of Wi-Fi attempts to ameliorate the inherent deficiencies of Wi-Fi's OFDM in the mobile environment. LTE addresses these deficiencies in the radio link by its use of OFDMA. LTE can use MIMO paths for parallel copies of a user's data to further improve a faded and/or non-line-of-site path, and will do so much better, with multiple antennas used at both ends for each path. But when the fully mobile multipath impairment largely handled by its use of OFDMA, LTE is then able to utilize MIMO to improve service still further, by multiplying the amount of data throughput to a single user. It does so by communicating different subsets of the user's data over different paths on the same channel. Beam-forming on the other hand has the effect of multiplying channel capacity only by making basic modulation-supported throughputs available to multiple users that are spatially (geographically) separated on the same channel – an option Flow claims in its response to PSST criticism #23 that it could make available in the future (i.e., Spatial Diversity Multiple Access, or "SDMA")[12], but which is not the same as MIMO. Indeed, LTE will be able to use both techniques together in the future. More germane to this discussion than the performance distinction however, is that the physical configuration required for beam-forming antennas (closely spaced, correlated antennas) does not lend itself to conversion to MIMO for LTE physical layer interoperability (requiring anti-correlated antennas typically separated by several wavelengths at the base station), and would require additional or replacement antennas. Flow attempts to dismiss this distinction; however the need for interoperability in the same band is discussed further in the Incompatibility section below.

e. 802.11r Cannot Turn Flow Mobile's Implementation of Wi-Fi Into a Suitable Mobile Technology

The fourth technology issue to be clarified relates to the IEEE 802.11r "Fast Basic Service Set Transition" amendment, and Flow's erroneous belief that this will provide its technology with mobile handoff capability. However, even Flow admits that 802.11r is "widely available but not fully implemented since Wi-Fi in high-speeds has not been implemented before."[13] There is a reason for this. The 802.11r

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11 Flow Response to PSST Criticism, pp.8

12 Ibid.

13 Flow Response to PSST Criticism, pp.9

amendment was primarily devised simply to reduce the period of time where bearer traffic is blanked while moving from one access point to another. As even Flow further acknowledges[14], 802.11r only targets an inaudible 50 millisecond (ms) gap, in particular for Voice over IP (VoIP) sessions, where the normal transition provided for in the 802.11-2007 base specification can be much longer and quite audible. It is accomplished by providing a means for the client Wi-Fi device to set up security and QoS with another access point it has associated with prior to transitioning, rather than afterwards. It does not improve handoff reliability in the physical layer at all. In order to accommodate the narrower blanking time, the client actually must communicate even more information with the source and target access points than is required for handoff under the base 802.11-2007 specification, making it even more of a challenge under fully-mobile channel impairments, not less. And this process is still not managed by the network (a paramount characteristic of truly mobile systems such as LTE) but solely by the client – another serious criticism rightfully raised by PSST. Again, one can only conclude that Flow must be relying on its "unique and powerful beam-forming technology" to make Wi-Fi suitable for full mobility, not any time-proven open standard. The 802.11r standard cannot turn Wi-Fi into a mobile technology, and for that matter, no design criteria for vehicular velocity even exists in the 802.11r amendment, as RTC pointed out in its Reply Comments.[15] Even Flow admits that the base 802.11-2007 standard only supports pedestrian speeds, but then, while subsequently touting 802.11r for fast handoff in the same sentence, carefully only mentions the 50ms handoff, not any reference to any higher, vehicular speed,[16] but thus creating an illusion that it somehow accommodates it. Flow only several paragraphs later attaches its supposed 100mph attribute only to its proprietary beam-forming implementation.[17] However, reports from a recent demonstration of Flow Mobile's technology in Dickinson, ND, shows that this proprietary beam forming technique apparently is not perfected either.

In particular, according to the *Elert Report*, Flow's demonstration evidenced handoff failures 20% to 25% of the time.[18] This significant failure rate occurred even in a standard 2.4 GHz Wi-Fi environment with many closely-spaced access points, each having full 20 MHz-wide channels (not 5 MHz-wide channels, as would be the case in their non-standard alteration into 700 MHz), and at relatively modest vehicular speeds within the town where the unlicensed multiple access point system is constructed, using 802.11r and Flow's beam-forming technique. In comparison, cellular carriers commonly target total abnormal call terminations for any reason, not just failed handoffs, to remain at less than 3%. Thus, in spite of Flow's claims of having devised a suitable mobile technology, and, with four times more channel bandwidth than would be available in practice, Flow's working system still did not come close to meeting one of the most basic network performance criteria expected of mobile systems today. This

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[14] Flow Response to PSST Criticism, pp.7

[15] RTC Reply Comments, pp.19

[16] "original Wi-Fi standard allows for 6 mph handoff" – Flow Response to PSST Criticism, pp.8

[17] "…our unique and powerful beam forming technology…takes the mobility capabilities to a different level and enables high throughput and stable connectivity at speeds of 100 mph." – Flow Response to PSST Criticism, pp.8.

[18] The Elert Report, commissioned by the State of North Dakota, was attached to Flow's October 15, 2009 Comments in PS Docket No. 06-229.

shortcoming is even more critical in the public safety context, where call reliability needs to be equal to or better than commercial quality, not worse.

The operating parameters of Flow's demonstration network in Dickinson are so dissimilar to those of a true 700 MHz public safety deployment as to render the results invalid as a proof of concept for the actual Flow system proposal – namely, its use of a total of between 10 MHz to 16 MHz of 700 MHz PSST spectrum, in 5 MHz-wide channels.[19] Because there was only one 700 MHz access point used in Flow's demonstration, handoff could not possibly have been tested in that band (a criticism raised in the Elert Report at p. 13). Further, session handoff was only demonstrated on 20 MHz-wide 2.4GHz channels, and it still failed egregiously under common industry standards. Still further, throughputs evidenced in the trial are not informative, as Flow has acknowledged that its demonstration was conducted on a single 16 MHz channel at 700MHz, and, on traditional 20 MHz-wide 2.4 GHz WiFi channels, not on one fourth or less of these channel bandwidths that would be required in practice.[20] There has been no demonstration whatsoever of the capacity to support live video and other highly packet-loss and latency-sensitive applications within the channel bandwidth constraints it would have in practice. Flow easily could have and should have demonstrated its network using such constraints, yet it did not. One can only surmise that a significant reduction in channel bandwidth will degrade performance to the point that the network may not support live video. The fact that Flow did not conduct its network demonstration using the appropriate channel bandwidth, and that it did not demonstrate ability to support a basic broadband capability, should lead any disinterested third party observer to question the relevance of the demonstration, and undercuts any network performance and technical validity claims made by Flow.

2. Costs

Flow consistently claims that the low cost of its overall network is the primary reason why the Commission should allow its technology to be deployed in rural areas, supporting its premise with claims that "building a 3G network in ND will cost upwards of $700 million,"[21] and that use of its technology could provide "high data speeds in a mobile environment for 1/10th the cost of the current networks."[22] Claims such as these appear throughout its Comments, Reply Comments, its Responses to PSST Criticisms numbered 3, 5, 9, 10, and even in its statement at number 23 that, "We would not be having this debate if states like North Dakota could afford to spend $700M for a public safety or even a dual use network."

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[19] Flow will have only 10 MHz of spectrum available if it foregoes use of the public safety narrowband 700 MHz spectrum.

[20] Flow states that its 700MHz system would occupy 4 MHz channels. Flow Response to PSST Criticism, pp.17

[21] Flow Response to PSST Criticism, pp.5

[22] Ibid.

This cost argument is not supported by available information. First, Flow overlooks the fact that Verizon Wireless today provides 3G coverage using CDMA2000 Evolution-Data Optimized (EV-DO) to roughly 80% of the geography of North Dakota, with an even larger percentage covered by cdma2000 1xRTT service.[23] Second, as addressed by RTC in its Reply Comments, Flow's claim that it would cost "approximately $528 million to complete the deployment of 3G in North Dakota" is grossly out of line with reality and appears to be based on an erroneous reading of a CTIA cost study. In this regard, RTC's own cost estimate – which was based on actual RF engineering predictions – determined that it would cost approximately $65 million to construct a statewide 700 MHz LTE network having 142 cell sites and providing 95% geographic coverage.[24]

The $528 million figure that Flow repeatedly cites was evidently taken from an April 2008 CostQuest report to CTIA that contains a chart entitled "Figure 8 – Estimated 3G Investment by State."[25] However, the North Dakota line item also indicates that 509 new tower sites plus 498 augmented existing sites would be needed to complete the 3G build. Anyone even casually glancing at this would be prudently compelled to look further into the study's assumptions and methodology, especially when RTC found that a 4G network for State of North Dakota that would provide 95% geographic coverage with genuine, fully mobile broadband technology (3GPP LTE), would utilize less than one-fifth the number of tower sites, as indicated from industry accepted RF engineering predictions, and supported by the fact that Verizon has fewer than 200 sites in the entire state providing its 80+% 3G coverage on an even higher frequency band (850 MHz).[26] Moreover, the term "ubiquitous broadband" for purposes of the study was defined in terms of the ability to receive <u>both predominant types of 3G service at all studied locations</u>. In other words, ubiquitous broadband service, per the CostQuest study from which Flow's hundreds of millions of dollars figure was taken, means the ability to receive 3G wireless broadband service in the technology evolution from <u>both</u> CDMA and GSM. If an area could only receive one class of broadband technology, it was categorized as "underserved" and the network was augmented from existing infrastructure to allow the support of both technologies. If the area had neither 3G technology service, the area was categorized as "unserved" by 3G and the network was augmented with both technologies (and possibly a tower) to support the defined level of service."[27] This two-technology capability is obviously irrelevant for public safety subscribers that would be using one service, and grossly overinflates any estimate to complete 3G coverage. Further, the study in question was dated April 2008, and used September 2007 site data.[28] Thus it was based on information that is over two years old, not on the current level of 3G coverage provided by Verizon or others. Even further, the study

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[23] RTC Reply Comments, pp.13

[24] Id.

[25] CostQuest Study, pp.21

[26] The actual figure is in Verizon's recent RFP for 4G backhaul facilities to several RTC members, which cannot be disclosed due to NDA constraints; however the figure is significantly fewer than 200 sites.

[27] CostQuest Study, pp.6, emphasis added

[28] "The geographic extent of non-3G coverage was based upon American Roamer's Coverage Right (9/2007) data product." – CostQuest Study, pp.8

assumed a 6 mile serving radius to represent the reach of a tower site in lower density areas[29] and equated this 6 mile serving radius to a 8.48 x 8.48 grid cell.[30] This is on the order of half or less of the radius that could be expected for traditional cell towers operating on 700 MHz frequencies in North Dakota, as demonstrated by RTC's RF modeling of LTE (although it may indeed apply to Flow Mobile's system per the 6.6-mile radius cited in its Testing document).[31] Finally, the costs assigned to each site, which might be applicable as an average for all locations in America, were significantly out of line for a rural state such as North Dakota. "Full site deployment, which includes the base station, tower, antenna, site acquisition, microwave backhaul, etc., are estimated to be $650,000 per site for either CDMA/EvDO or GSM/HSDPA based 3G deployments. For dual mode sites, the cost of the site was $865,000. For those areas where a tower exists but service has to be augmented to provide 3G level service, augmentation costs including all upgrade components required at the site are estimated to be $105,000 for GSM/HSDPA augmentation, $80,000 for CDMA/EvDO augmentation, and $185,000 for dual mode augmentation."[32] These figures are roughly twice what RTC budgeted in its most conservative, fully-loaded CapEx estimates, based on its consultant's firsthand experience with wireless network deployments in this part of the country.

To further illustrate the inaccuracy of Flow's claimed cost savings, one must consider the cost of non-radio access infrastructure, such as supporting structures, survivable power, backhaul costs, etc., that would apply to <u>any</u> mobile broadband service purporting to cover 95% of the state. If just the non-radio access CapEx requirement of the Flow-cited CostQuest methodology is applied even conservatively[33] to Flow's build-out, Flow's own infrastructure costs would be over $266 Million.[34] Even if one assumes an

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29 CostQuest Study, pp.11

30 CostQuest Study, pp.12

31 Flow Mobile 700 MHz Base Station Test Results for FCC, pp.4

32 CostQuest Study, pp.15

33 Flow has stated in its Responses to PSST at pp.3 that "Flow Mobile's approach, in the states we are planning to serve, is to build our own deployment locations. We will not need to collocate with other LTE oriented systems." An assumption of co-locating half of its sites on existing towers then, as discussed below, would be highly unlikely and extremely aggressive.

34 The CostQuest study assumes a 6-mile coverage radius, which is probably a realistic figure for Flow Mobile's sites, and is consistent with what Flow actually cites for its 700 MHz system in its Testing document (Flow Mobile 700 MHz Base Station Test Results for FCC, pp.4), The resulting 8.48 x 8.48 mile square grid cell cited in the CostQuest study would amount to 71.91 square miles per cell. Covering 95% of ND would require 95% x 70,704 miles / 71.91 miles per cell, or 934 cells, per the CostQuest study. If the assumed $80k for cdma electronics is subtracted from the $650k estimate used in the CostQuest Report for just a single technology site, and, if it is assumed that as many as half of the 934 towers were existing, by application of the same costing mechanism Flow has attempted to assign to 3G providers, Flow would still require (934 / 2) x ($650k - $80k) or $266.2 Million just to build its own infrastructure, before even adding the cost of any of their radio access electronics. Thus, Flow's claimed savings figures are unrealistic and unsupported. As described above, a traditional 3G/4G operation should not require anywhere near 934 cells, since the antennas will operate at levels higher than Flow's proposed antennas.

unrealistic 80% reduction of total infrastructure costs to account solely for any savings for the 80-foot[35] supporting structures contemplated by Flow instead of traditional towers, Flow's infrastructure costs alone would still be $53 Million before adding the cost of any of its radio access electronics. Because Flow Mobile's total CapEx estimations do not appear realistically to cover its necessary remaining network costs, the assumptions of Flow's business case are highly questionable and require closer scrutiny.[36]

Moreover, as pointed out in RTC's November 16, 2009 Reply Comments (at pp. 14-15), the cost of Flow's radios and infrastructure versus the cost of Verizon's radios and infrastructure is largely irrelevant, since the State of North Dakota is not buying the network. Instead, the commercial carrier partnering with the state will seek to recover its costs by charging North Dakota usage charges. In particular, as shown in the Elert report attached to Flow Mobile's Comments, "Flow Mobile does expect an ongoing revenue stream of roughly the cost of a commercial air card service today ($55-60/month/card)."[37] As Verizon Wireless charges for broadband service by monthly data volume regardless of access method today (2G or 3G), it is reasonable to expect that charges will not vary significantly for 4G service. If anything, they can be expected to become less per unit of data volume as broadband networks become more efficient, as has been the case across the industry to date. Thus, for comparable pricing, North Dakota can avoid having to abandon the incompatible Flow Mobile technology after a very short time of usage (and scrapping end user equipment that has become obsolete), and it can instead simply contract with an entity that can provide genuine 4G mobile broadband LTE in a comparable timeframe.

3. Incompatibility

The vast majority of Flow's Response to the PSST Criticisms, as well as its entire case in both its Comments and Reply Comments, revolves around its claimed compatibility and interoperability with LTE.[38] However, all of these are based solely on Flow's inappropriate use of a definition of Interoperability that is completely immaterial to the case at hand.

Flow's premise is that its network will interoperate with LTE at the *system* level (*i.e.,* two completely separate networks interfacing traffic from units of each), someday in the future. Flow even cites to an

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[35] Responses to PSST, pp.17: "Our BTS will be at an average height of 80 feet…" And even the notion of 80-foot utility poles is suspect, per the ND consultant's report cited by Flow Mobile in support of its proposal in its Waiver Comments, "The described system of using 80' poles and batteries would not generally be considered acceptable reliability for public safety communications. However, after asking about this it was discovered Flow Mobile has a more sophisticated plan to provide the necessary coverage and method of building base station sites." – The *Elert Report,* pp.16. Flow Mobile's CapEx estimations do not appear to have changed to reflect any such plan.

[36] RTC Reply Comments, pp.13

[37] *Elert Report* at page 19.

[38] These include PSST criticisms numbered 4, 5, 10, 11, 12, 13, 14, 15, 16, 18, 22 & 23 by Flow Mobile in its Response to PSST Attachment 1 to its Reply Comments.

example of GSM phones having Wi-Fi capability allowing devices to be utilized for office voice and data communications. However, this analogy is inapplicable when one considers that Wi-Fi and GSM must interface with each other through a system-level gateway. More importantly, Wi-Fi and GSM are two separate and distinct systems, operating on completely separate spectrum bands.

As the Commission is well aware, there is only one 700 MHz channel block allocated for public safety broadband use, and it is impossible for two networks using fundamentally different air interfaces and duplexing schemes (*i.e.*, FDD and TDD) to operate in the same spectrum in the same geographic area.

Flow has acknowledged that "Interoperability can be achieved in many ways."[39] Physical Layer Interoperability is the only definition that can apply in the case of the Public Safety Broadband Network, since there is only a single spectrum block available for this use. The FCC's Chief Engineer for the Public Safety and Homeland Security Bureau, Dr. Bill Lane, has provided a helpful discussion of the different types of interoperability in the context of public safety communications on an FCC website page entitled "Tech Topic 1 – Interoperability".[40] Dr. Lane explains as follows:

> **How It Is Achieved**
> To an engineer, the multiple definitions [earlier in his article] are interesting in that they describe interoperability for hardware, software, and systems [only the latter identified by Flow Mobile,] but frankly are of little import because the engineer's job is *to make things work.* Thus, the traditional radio engineer attempts to ensure interoperability, at least among various radio entities, by achieving three objectives:
> 1. Using compatible communications equipment operating on the same frequencies, with the same signaling characteristics, and the same operating procedures
> 2. Ensuring adequate signal coverage …, and
> 3. Scaling the size of the radio network with additional transmitter/receivers by sharing the mutually agreed upon procedures.
>
> **Same operating parameters.** The first objective is relatively easy to achieve by pre-ordaining the appropriate transmit/receive frequencies, modulation format, and other operating parameters with those entities wishing to share an interoperable radio network. … The point here is that the first principle of interoperability is for all entities to use the same operating parameters.[41]

"Operating on the same frequencies, with the same signaling characteristics, and the same operating procedures" would be characterized as "hardware" or "Physical Layer" Interoperability. Dr. Lane goes on to discuss this concept in greater detail in his subsequent "Tech Topic 3 – Physical Layer Interoperability,"[42] where he adds:

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39 Flow Waiver Comments, pp.7

40 Available at: www.fcc.gov/pshs/techtopics/tech-interop.html

41 Ibid., emphasis added

42 Available at: http://www.fcc.gov/pshs/techtopics/tech-pl-interop.html

> This is an example of providing interoperability at the physical layer (Layer #1) of the OSI model by making sure that the components of the network operate with the same communications characteristics at the transmission interface.
>
> The physical layer provides the mechanical, electrical, functional, and procedural characteristics necessary for the transmission of fundamental bits of information. As long as all of the users in the network operate on a common set of transmission parameters, security features, operational procedures, including agreement on any common messaging formats, etc., then interoperability may be attained and maintained.[43]

Rather than recognizing the need for "Physical Layer Interoperability" in public safety networks, Flow chooses an inapplicable definition of interoperability to argue its compliance with this very necessary requirement for public safety networks. But Flow's comments only claim Interoperability at higher (*i.e.,* "system") layers, which are completely irrelevant when Physical Layer Interoperability is called for. Flow acknowledges the incompatibility of its technology with the technology chosen by the PSST and public safety community when it says, "We don't believe that LTE and Wi-Fi can be deployed in the same frequency block. The thought of deploying two networks in the same frequency block is not a possibility and is absurd."[44] Flow's candid admission stands for itself.

4. Interference

In its responses to legitimate interference concerns raised by the PSST, Flow Mobile claims that it will not interfere with either narrow band or broadband 700 MHz public safety systems.[45] However Flow's support for these claims makes little technical sense.

First, Flow's claim that its TDD system will not interfere with LTE FDD systems cites a 2001 presentation to the FCC OET by the TDD Coalition, wherein the cited slide simply states that "Collocation of TDD & FDD systems are possible on the same tower with no performance degradation when an appropriate guard band is used."[46] Guard bands obviously are not even applicable when systems seeking to avoid interference with one another are operating on the same spectrum, as would be the case with Flow's operation in the 700 MHz public safety broadband channels. None of the defenses provided in response to PSST's interference concerns provides any explanation as to why Flow's network would not interfere when it would be operating co-channel with neighboring systems. In fact, Flow even admits the danger of such interference in its response to PSST's interference concern at Item 20, when Flow observes that,

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[43] Ibid., emphasis added

[44] Responses to PSST, pp.14, emphasis added.

[45] Flow Responses to PSST Criticism, at 2, 17, 19, 20, 21.

[46] Responses to PSST, pp.3, citing "Tutorial on TDD Systems", TDD Coalition, December 3, 2001, available at: www.fcc.gov/realaudio/mt120301.pdf, pp.48

"[t]he interference caused as discussed [by PSST] here is along the borders when two companies are using the same spectrum."[47] In that scenario, Flow confirms that, "Interference is caused, in those cases, if two different companies have license to use the [same] spectrum."[48] Indeed, while neighboring FDD-based LTE systems would be able to interleave subcarriers, taking advantage of a characteristic inherent to LTE's OFDMA design, TDD systems, especially those transmitting across the neighboring system's entire FDD uplink channel, would most definitely cause significant interference to neighboring co-channel FDD systems, as aptly described by PSST in its concern at Item 20. Guard bands here are completely immaterial.

The same holds true if Flow were to operate a broadband system on the narrowband channels, which would necessarily be co-channel with a neighboring P-25 system. When neighboring co-channel systems both utilize P-25, then they have the opportunity to coordinate and interleave narrowband channel usage/abstinence within the narrowband block, similar to "meshing two fine-toothed combs." However Flow reports that its system occupies at least a contiguous 4 MHz.[49] This would appear as a "brick" within the 6 MHz narrowband block assignment that must somehow mesh with the neighboring "fine-toothed comb." The resulting incompatibility would be obvious; nonetheless Flow inexplicably still offers that the problem is solved by application of the remaining 1MHz guard bands[50] on either side of its "brick."

The problem is a simple one, understood well by any in the industry that have had to mitigate interference in the past. The need to somehow stop RF from propagating over an arbitrary boundary such as a state line has long been a problem. At issue is the impossibility of a signal being of sufficient level (several dB, as much as 30dB for Wi-Fi 64QAM) over the thermal noise floor as required by the modulation being used for reliable reception on one side of the arbitrary boundary, and simultaneously being 6dB under the thermal noise floor on the other side of the arbitrary boundary – the generally accepted level at which the noise floor is raised by 1dB thus creating interference, which even Flow Mobile's supporting document acknowledges.[51] Beam-forming, while it may mitigate the problem to some extent, will not eliminate it – not even close.[52] A neighboring P-25 or LTE system should not have to suffer such a high likelihood of harmful interference.

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47 Responses to PSST, pp.18

48 Ibid.

49 Responses to PSST, pp.17

50 Ibid.

51 "Tutorial on TDD Systems", TDD Coalition, December 3, 2001, available at: www.fcc.gov/realaudio/mt120301.pdf, pp.45

52 For example, a mobile in a neighboring P-25 system on a 12.5 kHz-wide channel would have a thermal noise floor at 72°F of -126.9dBm. Even with an abundance of conservatism, assuming a very poor 10dB noise figure for the P-25 victim mobile receiver and no mobile antenna gain, the undesired signal arriving from Flow Mobile would need to be at or below (-126.9dBm + 10dB – 6dB), or -122.9dBm. Flow reports in its 700 MHz Base Station Test Results for the FCC document at pp.4 that its BTS EIRP is +48dBm. Again, out of an abundance of caution, even if one accepts a beam-forming horizontal + vertical pattern attenuation toward the victim mobile of

Even in the case where Flow might be operating its network adjacent-channel to an LTE system in the Upper D block, the very same document cited by Flow Mobile in its "guard band" defense provides two slides later that "a guard band of a 'single bandwidth channel' is required between an FDD and TDD

35dB – the equivalent of a grid parabolic dish aimed in the opposite direction, (even the FCC only accepts 27dB as maximum believable pattern attenuation for 850 MHz cellular systems per Rule Section 22.911(a)(4), for example), and, with the interfering Flow Mobile site a full 16 miles away, more than twice its apparently intended range but still well within RLOS of the victim receiver, the undesired signal at the victim mobile receiver antenna after the corresponding 118.5dB free space loss is still -105.5dBm – more than 17dB above the interference threshold for the victim mobile even in this extreme example. In practice, such a site, placed as far from the border as possible (12 miles) in an N=3 re-use pattern for sites with six mile coverage radii, necessarily would have to transmit toward the victim mobile for any of its own mobiles in line with the path to it. This of course is an arbitrary example, but assuming extremely conservatve operating parameters, it serves to demonstrate the dubious nature of Flow's non-interference claims.

Evidently responding to the objections of public safety narrowband users, Flow now surprisingly claims that it may not need the narrowband channels near the borders after all, as it now says it can get by with just 10 MHz. However this would necessitate a N=2 re-use pattern, which, instead of a traditional hexagonal grid, would have to take the shape of a two-color (two-5 MHz channel) checkerboard composed of 8.48 x 8.48 mile squares or diamonds. As cell coverages must overlap to enable handoff, (coverage circles are somewhat larger than the squares or diamonds), this necessarily will create co-channel interference among its own sites near the corners – which cannot be controlled automatically by beam-forming, at least in any standard Wi-Fi network where access points do not communicate among themselves to control such things, and access is controlled by the client devices, not the access points. This is confirmed by the Elert Report's observation (at p. 14) that "[d]ue to frequency re-use, the desire is to have three 5 MHz channels for reliable call hand off between base station sites."

Such a system, or even an N=3 system necessarily would create havoc for any neighboring LTE system, regardless of any beam-forming. Both of the grid cells, or in the case of N=3, two of three of them would necessarily be tangent to the border in any such pattern, making the interference potential particularly egregious. Flow Mobile would not be able to avoid transmitting on the LTE FDD uplink channel, plus numerous other interference scenarios exist. For example, a Flow border site would have to be within at least 6.6 miles of the border, best case. With calculation procedures similar to those used above, and assuming a victim LTE base station receiver was also 6.6 miles away from the border on the other side, the Flow transmitter, even with maximum pattern attenuation in the opposite direction assumed, would still interfere significantly with the LTE base station receiver, mounted high on a tower and easily in clear RLOS. The 5 MHz-wide LTE channel would have a thermal noise floor at 72°F of -101dBm. Assuming a typical 2dB noise figure for the LTE victim base station receiver and net LTE base station antenna gains and losses of +10dB, the undesired signal arriving from Flow Mobile would need to be at or below (-101dBm + 2dB – 10dB – 6dB), or -115dBm. With Flow's reported 700 MHz BTS EIRP at +48dBm,and again, out of an abundance of caution, even if one again accepts a beam-forming horizontal + vertical pattern attenuation toward the victim receiver of 35dB, and, with the sites separated by 13.2 miles, the undesired signal at the victim LTE base station receiver after the corresponding 117dB free space loss is still -103dBm, 11dB above the interference threshold for the victim LTE base station receiver even in this extreme, best case example. And again in practice, the interfering Flow transmitter would have to transmit toward the LTE station half the time to serve its mobiles between itself and the border, raising this potential interference by as much as the 35dB – a full 47dB of interference. Again, this is an arbitrary example, but employing enormous conservatism, it serves to demonstrate the dubious nature of any non-interference claims of Flow Mobile, even with beam-forming not resolving the interference even with the most extremely forgiving assumptions, and again, something that any neighboring P-25 or LTE system should not have to put up with.

Flow's only other subjective defense, as indicated at pp.3 and similarly elsewhere in its Responses to PSST – that it "understands FCC standards on interference and will adhere to them" – is unsatisfactory. This is because current FCC rules do not appear to contemplate protection of FDD systems from neighboring TDD system interference.

systems," and that "the guard band should be equal to the wider of the 2 channels."[53] With both the LTE and Wi-Fi channels being 5 MHz, such a guard band would not even be possible with the Upper D block being immediately adjacent.

Guard bands notwithstanding, however, even worse adjacent channel interference would be highly likely, as the LTE Upper D Block system will have no control of Flow TDD Wi-Fi mobiles on the adjacent (PSBL) channel transmitting significant adjacent channel interference to LTE mobiles all over its territory, all the while adjacent channel interference from Flow TDD base station transmitters on the adjacent FDD uplink channel will persist, all rendering the LTE Upper D block very difficult to use, if not essentially useless.[54] All base stations and all mobiles in both systems would require a dramatic amount of

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[53] "Tutorial on TDD Systems", TDD Coalition, December 3, 2001, available at: www.fcc.gov/realaudio/mt120301.pdf, pp.50

[54] For example, consider the case where both an LTE Upper D block mobile and a Flow mobile on the adjacent PSBL block are at a scene, in an area served by a Flow TTD base station on the PSBL FDD downlink channel (763-768 MHz). Interference necessarily will result to both mobiles from the mutually adjacent channel base stations' insufficient adjacent channel spectral masks that roll-off across each other's channels. This possibly could be improved with significant additional filtering on both base stations; however again, this is a situation the PSST-selected-LTE operation should not have to deal with, and which would not even be an issue if the both the PSBL and D block channels were LTE, where OFDMA inherently can selectively protect itself from partial channel impairments on a subcarrier by subcarrier basis, or even better, where the entire 10MHz can be used as one channel, and neighboring base stations in LTE's N=1 re-use pattern can coordinate use of subcarriers in the frequency domain.

Regardless, a worse and practically unavoidable condition exists: The Flow TDD mobile, also on the same frequency as the Flow TDD base station (which otherwise would be a PSBL FDD downlink channel), will also transmit on it! The nearby adjacent-channel LTE mobile's 5 MHz-wide receive (downlink) channel would have a thermal noise floor at 72°F of -101dBm. Assuming a modest 5dB noise figure for the LTE victim mobile receiver and net LTE mobile antenna gains & losses of +3dB, (consistent with what Flow Mobile reports for its mobile antenna in its 700 MHz Base Station Test Results for the FCC document at pp.4), any undesired signal would need to be at or below (-101dBm + 5dB – 3dB – 6dB) or -105dBm in order not to interfere. Being near to the LTE mobile at the scene, without benefit of any isolation due to vertical separation as when collocated on a tower, or of any "beam-forming" in the omni-directional mobile antenna patterns, the +31dBm EIRP Flow mobile transmitter (Ibid.), with the 802.11-2007 Wi-Fi spectral mask ranging only from -26dBc to -50dBc across the adjacent channel, (consistent also with the Flow-cited TDD Coalition Tutorial on TDD for the FCC at pp.51), will interfere significantly with the nearby LTE mobile receiver on the adjacent channel, with a transmitted signal level ranging from +5dBm to -19dBm across the adjacent LTE channel. A dramatic amount of filtering on all mobiles would be required to mitigate this situation. (LTE mobiles likewise will cause interference to Flow mobile receivers attempting to hear their access points on the adjacent FDD uplink channel, and likewise would require dramatic filtering.) The problem will not otherwise resolve completely until the mobiles are miles apart. (6 miles would be required for free space loss between the two to fall to the necessary 110dB isolation (+31dBm EIRP – 26dBc vs. -105dBm).) The LTE D Block system will have no control of Flow mobiles transmitting all over its territory on the adjacent (PSBL) channel, plus all LTE mobiles in ND – and nationwide – would be required to have dramatic filtering added to protect Flow Mobile's operation when in ND, all the while adjacent channel interference from the Flow TDD base station transmitters on the adjacent FDD uplink channel will persist, all rendering the LTE Upper D block channel very difficult to use, if not essentially useless. Contrary to the statement by Flow Mobile in its Response to PSST a pp.18 that "No engineer or business will stop buying spectrum if it is lucrative for their business because of fears like interference", no responsible consultant could recommend for anyone to bid much if anything on the Upper D block in a public-private arrangement with these withering potential interference conditions permitted.

additional filtering. LTE mobiles will likewise cause interference to Flow mobile receivers attempting to hear their access points on the adjacent FDD uplink channel – thus the unrealistic situation would be created where all the LTE mobiles in ND – and nationwide – would be required to have dramatic filtering added to protect Flow Mobile's operation when in ND. This is the reason there are TV whitespaces for instance, or why CB radio "trucker" channel 10 was moved to channel 19 to alleviate terrible adjacent channel interference to emergency channel 9 years ago, among a multitude of other obvious examples. Contrary to the aloof statement by Flow Mobile in its Response to PSST a pp.18 that "No engineer or business will stop buying spectrum if it is lucrative for their business because of fears like interference", in actual practice, no responsible consultant could recommend for anyone to bid much if anything on the Upper D block in a public-private arrangement, if these withering potential interference conditions that a Flow Mobile PSBL channel TDD Wi-Fi system would create are permitted. Even more importantly, if these conditions are permitted, first responder LTE Upper D block communications will be disrupted everywhere and every time a Flow TDD mobile using the adjacent downlink channel , (a one in two chance), shows up at a scene, as will visiting LTE mobiles interfere with Flow TDD mobiles using the PSBL uplink channel.

Flow opines essentially that public safety P-25 and LTE systems should be made to have to deal with Flow and its interference, to permit "innovation."[55] RTC disagrees. Public safety networks, where lives are at stake, are not the place for experimentation and underdeveloped technologies, nor especially should precious public safety funding and resources nationwide be unnecessarily sapped having to protect against otherwise avoidable interference in and from Flow Mobile's operation in North Dakota.

Unless with its "guard band" defense Flow somehow assumes that LTE can only be deployed on the 700 MHz Upper D block when its disposition is resolved and could not be deployed on the PSBL's spectrum in the meantime, for which RTC has already pointed out the invalidity of this assumption,[56] and even if this was the case, then from all of the above, Flow appears to lack even a high level grasp of (or refuses to acknowledge) the technical constraints of the case at hand. Flow's defenses for interference likewise completely lack relevance and/or feasibility, and are thus moot in their entirety for the practical application, and must be rejected.

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[55] In its Responses to PSST, Flow states a pp.17 and following that, "With respect to the [PSST] statement that 'it requires difficult frequency planning and isolation', difficulty in building something cannot be the reason for giving up on building it", and indicates that mutual mitigation should be made necessary per the statement, "The effort and the spirit to mitigate is the important factor to prevent harmful interference …. if we go by [PSST's] arguments, we have to deploy FDD systems only in the entire 700 MHz block! This makes innovation on a TDD system which is widely accepted as better use of spectrum almost impossible."

[56] From RTC Reply Comments, pp.6: "…it is a twist of the facts to imply that only the D Block will have LTE prescribed for it and that any and all other technologies might be freely deployed on the PSBL's broadband spectrum so long as they somehow coordinate with the eventual D Block licensee. In fact, the opposite is true - PSST is the PSBL, and it has designated LTE as the technology for the spectrum under its stewardship (and which Flow now seeks to use); and it is the disposition of the D Block that is unknown."

Conclusion

As demonstrated herein, Flow Mobile's arguments in support of the viability of its technology for robust mobile public safety broadband network are flawed, and any suggestion that Flow's technology would be compatible and/or interoperable with LTE networks deployed on the same 700 MHz public safety channels is incorrect. Moreover, Flow's proposed use of the 700 MHz narrowband spectrum would create interference for, and block the use of, the P25 channels by both neighboring jurisdictions and by North Dakota public safety. While Flow now indicates that it may be willing to consider foregoing use of the narrowband spectrum, this would reduce the spectrum available for Flow's operations to the point of creating frequency re-use issues and associated self-interference, which could significantly degrade the system's ability to deliver the needed broadband capabilities.

Attachment B

The North Dakota Rural Telecom Coalition

BEK Communications Cooperative	Steele, ND
Consolidated Telcom	Dickinson, ND
Dakota Central Telecommunications Cooperative	Carrington, ND
Dickey Rural Networks	Ellendale, ND
Griggs County Telephone Co.	Cooperstown, ND
Halstad Telephone Company	Halstad, MN
IdeaOne Telecom	Fargo, ND
Inter-Community Telephone Company	Nome, ND
Midstate Telephone Company	Stanley, ND
Moore & Liberty Telephone Company	Enderlin, ND
Nemont Telephone Cooperative	Scobey, MT
North Dakota Telephone Company	Devils Lake, ND
Northwest Communications Cooperative	Ray, ND
Polar Communications Cooperative	Park River, ND
Red River Rural Telephone Association	Abercrombie, ND
Reservation Telephone Cooperative	Parshall, ND
SRT Communications, Inc.	Minot, ND
United Telephone Mutual Aid Corporation	Langdon, ND
West River Telecommunications Cooperative	Hazen, ND

Issues re: Flow Mobile 700 MHz Waiver Proposal (PS Docket No. 06-229)

1) **The Public Safety community objects to the Flow Mobile proposal**
    a) PSST
    b) APCO
    c) NPSTC
    d) IACP
2) **Flow's network is not capable of physical layer interoperability with a public safety broadband network constructed using LTE**
    a) Flow's definition of interoperability applies when carriers are operating in separate spectrum bands.
    b) Per Dr. Bill Lane of the FCC, interoperability for public safety entities operating in the same band requires compatible communications equipment operating on the same frequencies, with the same signaling characteristics, and the same operating procedures. *See* http://www.fcc.gov/pshs/techtopics/tech-interop.html
3) **Flow's technology will cause harmful interference to 700 MHz public safety operations**
    a) TDD – FDD interference is unavoidable
    b) Co-channel Interference with broadband and narrowband operations in neighboring jurisdictions
    c) Adjacent-channel interference to public/private D-Block
    d) Insufficient spectrum for frequency re-use
4) **North Dakota will not be in a position to deploy a public safety broadband network until after the D-Block proceeding has been decided and concurrent with commercial deployment of LTE. Therefore, an interim waiver is not needed.**
    a) North Dakota is required to conduct an RFP
    b) Appropriations follow a two-year cycle in the State of North Dakota
    c) North Dakota has not completed its 700 MHz public safety regional planning
    d) North Dakota has not coordinated with neighboring jurisdictions
    e) Flow will need two years to deploy per *Elert Report*
5) **Wi-Fi is not suitable for a fully mobile 700 MHz public safety network**
    a) Wi-Fi is a fixed/nomadic WLAN technology that is not suited for high speed mobility.
    b) Wi-Fi can suffer from subscriber overload, with no way to control which users connect to which access point (per *Elert Report*)
6) **LTE is a worldwide standard with a path to 4G, while Flow Mobile is a proprietary technology with no 4G migration path**
7) **LTE is a broadband data standard that supports voice and SMS services**
8) **Flow's cost arguments are erroneous and unsupported by available information**
9) **Flow is not designated as an NGO and is not eligible under Section 337 of the Act**