Before the

Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Service Rules for the 698-746, 747-762 and 777-792 MHz Bands	)	WT Docket No. 06-150
Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band	)	PS Docket No. 06-229
Amendment of Part 90 of the Commission's Rules	)	WP Docket No. 07-100

REPLY COMMENTS OF LAYER 2 CONNECTIONS, LLC
IN RESPONSE TO COMMENTS ON THE THIRD REPORT AND ORDER
AND FOURTH FURTHER NOTICE OF PROPOSED RULEMAKING

Layer 2 Connections, LLC ("Layer 2 Connections") hereby submits the following reply comments in response to the comments received on the Third Report and Order and Fourth Further Notice of Proposed Rulemaking (FCC 11-6) in the above matter ("Fourth Notice") on the implementation of a nationwide, broadband interoperable "public safety" network in the 700 MHz band.

In Layer 2 Connections' comments ("L2C Comments") in response to the Commission's Third Report and Order and Fourth Further Notice of Proposed Rulemaking[1] we advocated important needs that the FCC should consider in its rulemaking:

1. *The need for extending the concept of "network of networks" to encompass networks of all types regardless of mode or bands.* We reasoned that this would address the likely-protracted transition from commercial and private networks

[1] Layer 2 Connections, LLC Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237551

used by public safety agencies today to emerging 700 MHz Public Safety Broadband network(s) ("700 PSBN"). We also believe that in emergency situations public safety agencies will often need to extend the coverage, capacity and resilience of their 700 PSBN network(s) by using alternative network types.

2. *The need to ensure that roaming handoff between any network (legacy commercial, private or 700 PSBN) used by public safety agencies is a "make-before-break" seamless transfer.* We reasoned that anything less than a "make-before-break" transfer (i.e., a "break-before-make" transfer) risked the safety and productivity of the first responder, as situational awareness and communications would be broken. We also reasoned that public safety agencies will need to use non-700 PSBN networks to provide additional coverage, enhanced capacity and greater resilience and they should have a reasonable expectation that these networks will behave seamlessly as one "network of networks" ensuring the manual intervention is not required by the user.

3. *The need for the extended "network of networks" concept to supplement the capacity and enhance the resilience of the 700 PSBN.* With this capability public safety agencies can handle surges in capacity during an incident and benefit from network diversity that provides backup in case of failure. We reasoned that being able to bond multiple similar or dissimilar networks together simultaneously with user-definable QoS will make it much more likely that public safety users can transfer their ever-increasing data traffic in the most demanding of circumstances.

We further reasoned that QoS must function regardless of whether the operator(s) of the network(s) being used are cooperative or non-cooperative in assisting the end user.

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OBSERVATIONS

Based on our reading of the comments on the Commission's Report, Order and Notice filed by others we make the following observations:

1. THE "NETWORK OF NETWORKS" CONCEPT SHOULD BE EXTENDED TO INCLUDE NON-LTE NETWORKS.

The following comments suggest to us that being able to extend the "network of networks" concept to all legacy public and private systems will benefit public safety agencies during their transition to 700 PSBN and afterwards:

Motorola Solutions, Inc. states in their comments[2]:

> *"It is clear that, at least for the foreseeable future, public safety has a need for both narrowband and broadband 700 MHz band operations."*

and separately:

> *"Most entities deploying public safety LTE will have existing narrowband or enterprise systems they already plan, install, operate and optimize. These entities have existing processes and workflows for narrowband and enterprise operations. The operating costs associated with adding public safety LTE operations will be minimized if public safety LTE fits into the existing operations models and workflows utilized by these entities."*

We agree with Motorola that public safety will have a need for more than broadband 700 MHz for the foreseeable future. We also agree with Motorola that minimizing the operating costs and the impact on legacy operations models and workflows will speed adoption of the 700 PSBN while at the same time reducing migration costs for public safety agencies. We further agree that roaming across public safety and commercial partners' networks will improve public safety

[2] Motorola Solutions, Inc. Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237732, Pages 19, Technical Appendix 32.

communications.

Harris references the Fourth FNRMP in their comments[3]:

> *"The ability to interconnect users of the public safety broadband network to users of legacy narrowband networks will be critical to the adaption of broadband networks."*

and separately states:

> *"In order to ensure public safety operators can interoperate with commercial networks, the public safety operator would have to engage in a roaming agreement and perform roaming tests with the commercial operator."*

We agree with Harris that narrowband interconnect will be critical and believe that where legacy networks are also capable of data transmission then enabling these legacy networks to participate as part of the expanded "network of networks" will be equally as critical to the adoption of the 700 PSBN.

In our L2C Comments we briefly describe how wide area network virtualization provides a simpler way of achieving interoperability with commercial networks -- one that does not require roaming agreements and that leaves each public safety agency in control of how the "network of networks" is available to its users.

APCO states in their comments[4]:

> *"APCO further suggests that backwards compatibility of subscriber equipment to existing commercial technologies (e.g. HSPA+, EVDO) can, in most cases, address non-mission critical performance and coverage requirements along with satellite services until such time as the public safety broadband wireless network can be built out in a given area."*

We agree with APCO and believe that public safety will benefit when a user can communicate over any type of network when it is necessary and when it is authorized. This will

[3] Harris Corporation Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237780, Pages 16, 13
[4] APCO Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237730, Page 8

ease transition and provide additional coverage, capacity and resilience for mission-critical communications.

Alcatel-Lucent states in their comments[5]:

> *"The Federal Communications Commission's ("FCC/Commission") adoption of Long Term Evolution ("LTE") as the common standard technology for the 700 MHz public safety broadband block was a major step towards creating the interoperable broadband network that Congress and the 9/11 Commission envisioned. No less important is the need for this nation's first responders to roam across public safety and commercial partners' networks."*

We agree with Alcatel-Lucent and believe that this roaming should be over any type of network as necessary and authorized by public safety agencies.

San Francisco Bay Area states in their comments[6]:

> *"The Commission seeks comment on how the public safety broadband network handles mobility and handoff across a network-of-networks. The Bay Area believes that such handoff functionality is a critical aspect.*

and separately:

> *"In terms of functionality, the Bay Area requirement is to have seamless handover between radio sites, so end users experience no lapse in coverage, dropped sessions, etc. The functionality offered, at a minimum, must be similar to what is offered by cellular systems."*

We agree with this requirement that handover between radio sites must not drop sessions, etc. We believe that this feature should not be restricted to the 700 PSBN but extended to and between any other legacy or future commercial or private systems that are necessary and authorized for use by public safety agencies.

[5] Alcatel-Lucent Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237664, Page 2
[6] San Francisco Bay Area Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237740, Pages 8, 9

2. HANDOFF WITHIN AND BETWEEN THE 700 PSBN AND OTHER COMMERICAL AND PRIVATE NETWORKS MUST BE TRULY SEAMLESS.

In addition to San Francisco Bay Area comments above, the following comments suggest to us that public safety users need to move seamlessly within the expanded "network of networks" concept we suggest in Point 1.

Minnesota Public Safety states in their comments[7]:

> *"Mutual aid agreements and subsequent response across jurisdictional boundaries are common, and it is also common for each involved jurisdiction to have its own discrete communications systems. Seamless handoff is essential for those responders who routinely operate across the borders of networks in such arrangements."*

We agree with Minnesota Public Safety.

Telcordia states in their comments[8]:

> *"Telcordia agrees with the FCC's conclusion that the LTE based public safety broadband network must support seamless handover within and across coverage regions. However, definition of smooth and seamless handover needs further clarification."*

We agree with Telcordia and would like the requirement to support seamless handover to encompass more than just X2-based and S-1 based LTE handoffs; we advocate for seamless handovers between *any type* of network. We also believe that a better definition of "seamless handoff" is needed that is based on a "make-before-break" transition, as anything less can endanger the safety and productivity of the first responder . Our detailed rationale for this can be found in our L2C Comments.

[7] Minnesota Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237605, Page 6.
[8] Telcordia Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237587, Page 13 and 14

Alcatel-Lucent states in their comments[9]:

> *"Inter-RAT ("Radio Access Technologies") handoff to technologies such as GSM, UMTS, HSPA, and CDMA is considerably more complicated and will benefit from performance enhancements techniques that are part of 3GPP Rel. 9 specifications. Hence, Alcatel-Lucent recommends that Inter-RAT roaming not be mandated for the initial early deployments."*

We respectfully disagree with Alcatel-Lucent's position. We advocate for seamless handovers between any types of network as part of the expanded "network of networks" concept. We feel that this best meets the public safety user's needs and expectations especially ***during*** their transition to 700 PSBN from these and other legacy networks. As such, Inter-RAT roaming would be ***needed*** as part of early 700 PSBN deployments. We support an FCC mandate for Inter-RAT roaming immediately to mitigate the difficulties of integrating legacy and 700 PSBN networks during migration and afterwards; the mandate should be specific in requiring a "make-before-break" handoff.

3. THE EXTENDED NETWORK OF NETWORKS WILL ENHANCE CAPACITY AND RESILIENCE.

The following comments suggest to us that the extended "network of networks" concept must encompass any type of legacy or future network in order to extend the capacity and enhance the resilience of the 700 PSBN. Public safety agencies must be able to handle jumps in capacity during an incident and to benefit from backup in case when the 700 PSBN fails or is congested.

Motorola states in their comments[10]:

> *"The difference between average loading and busy hour could be 2x or 3x. A jump in incident capacity could be greater than 10x on a given cell. That is, a lot*

[9] Alcatel-Lucent Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237664, Pages 20, 21.
[10] Motorola Solutions, Inc. Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237732, Technical Appendix Page 21.

> *of extra capacity to carry in every backhaul link throughout the system. A larger system with a large subscriber base could easily fully load a cell under incident. Although additional responders can be brought in from adjacent systems, there is no expectation that all cells can be loaded at the same time."*

We agree with Motorola that RF and backhaul capacity both limit the availability of bandwidth in situations where an incident causes a significant spike in user-density and usage. We advocate for an expanded "network of networks" to provide increased RF and backhaul capacity that is diverse from the 700 PSBN.

ERIC TAC states in their prior comments posted 10/28/2010[11]:

> *"Interoperable Roaming - Definition - Always on, automatic user transfer from a Public Safety users' home network onto all major radio authorized frequency bands and participating providers in order to access any network resources."*
>
> *"Need – Public Safety needs priority access to network resources at all times up to the maximum capacity as is possible"*

We agree with ERIC TAC's that transfers should be always-on and automatic (we call this "make-before-break") and that public safety needs access to the maximum capacity possible. In our L2C Comments, we describe a requirement that meets the ERIC TAC need for "maximum capacity" by allowing multiple similar and/or dissimilar networks to be bonded together. When bonded a user is able to address the aggregated bandwidth of all the available networks as if they were one network.

ERIC TAC also states:

> *" Known Issues – The ability of a public safety official to move from their home wireless data network to a remote, visiting network and still have access to all of their available applications, without the need for manual intervention by either the home system administrator or the visiting system administrator is very important to the Public Safety community. Such a scenario could assume pre-authentication of the visiting and home networks on a network to network basis. Any alternative should include manual intervention so not to limit functionality in*

[11] ERIC TAC Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7020919093

> *an emergency scenario. Case example, out of region resources converging in to the NYC metropolitan region to help after 9/11 or New Orleans Katrina disasters would require shared use of all available commercial frequency bands as the resources of the public safety radio spectrum may not be readily available."*

and separately:

> *"Recommendation: We feel that the elements that make up the national public safety broadband architecture may be much more than just LTE system architecture and may include a home LTE network, adjacent or nearby private or commercial LTE networks nearby 2/3G networks and interfaces to existing public safety LMR systems. We feel the answers to these questions will come over time. There is no doubt that the system architecture of a public safety national broadband network will be more redundant than any commercial wireless system previously offered and the network may end up as the aggregation of elements from multiple systems to ensure viability and resilient public safety operation."*

We agree with ERIC TAC's comments that when public safety radio spectrum is not readily available then shared use of all available commercial frequency bands should be enabled in keeping with our proposed enhancements to the "network of networks" concept. We further advocate that the mechanisms used to make use of all available radio spectrum must be automatic (i.e. not require user-intervention) and must manage QoS over links whose availability and quality may fluctuate rapidly.

Andrew Seybold stated in his prior comments posted 6/23/1010[12]:

> *"The FCC believes that roaming onto commercial networks will occur on a sporadic basis. My research shows that having only 10 MHz of spectrum available will result in having to roam on commercial networks in at least the top 100 metropolitan areas on a daily basis, and for long periods of time for each occurrence."*

and separately:

> *"The FCC based its usage models only on major scenarios spread out over large geographic areas of a city or jurisdiction. There are no assumptions that look at capacity requirements for smaller incidents that occur on a daily basis and are fairly local in nature and, therefore, will have broadband coverage from only one or perhaps two cell sectors."*

[12] Andrew Seybold Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7020512618 – page 3

We agree with Andrew Seybold that there is likely to be significant reliance on commercial networks by public safety users due to capacity constraints. These capacity constraints will be difficult to plan for and will require public safety users to leverage alternative network capacity.

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CONCLUSIONS

Layer 2 Connections LLC believes that, regardless if a single PSBN network or a network of LTE networks is agreed upon to serve public safety, the sample extracts we have highlighted above indicate that there is a very real need to extend the "network of networks" concept beyond its current LTE-only scope to encompass any type of legacy or future commercial and private network as necessary and authorized for public safety use. We feel that there is no more important time to adopt this concept than now, as public safety users migrate from their patchwork of public and private systems to the common 700 PSBN.

We recommend that the Commission ensures that all available networks, including 700 PSBN, can be made to work as one network for public safety communications thus increasing coverage through "make-before-break" seamless roaming, capacity through network bonding, resilience and spectrum utilization through network diversity.

In the public interest of serving first responders' safety and productivity, we also encourage the Commission to specifically mandate that inter- and intra-RAT handoffs be defined as "make-before-break" handoffs, and that the Commission mandate the capability of network-bearer bonding.

We refer the Commission to our previous comments[13] and ex-parte filings[14] for more details on our recommendations. Layer 2 Connections is a small, woman-owned business based

[13] Layer 2 Connections' Comments: http://fjallfoss.fcc.gov/ecfs/document/view?id=7021237551

[14] Layer 2 Connections' Ex Parte Filings:

http://fjallfoss.fcc.gov/ecfs/document/view?id=7021134859

http://fjallfoss.fcc.gov/ecfs/comment/view?id=6016166898

http://fjallfoss.fcc.gov/ecfs/comment/view?z=zcm1x&id=6016062996

in North Carolina with experience serving the public safety community with mission-critical voice and data communications.

If you have any questions or comments regarding these comments, please do not hesitate to contact any of the Layer 2 Connections principals below at 919.300.7733 or via email as listed. Thank you for this opportunity to continue to serve the public safety community.

Sincerely,

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