Before the
DEPARTMENT OF COMMERCE
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
Washington, D.C. 20230

In the Matter of	)
	)
Development of the Nationwide Interoperable	) Docket No: 120928505-2505-01
Public Safety Broadband Network	)

COMMENTS OF ALCATEL-LUCENT

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November 9, 2012

TABLE OF CONTENTS

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	)	
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Alcatel-Lucent submits these comments to the National Telecommunications and Information Administration ("NTIA") in response to the above-captioned Notice of Inquiry seeking comment on the First Responder Network Authority's ("FirstNet") conceptual network architecture, which was released during FirstNet's first board meeting on September 25, 2012.[1]

I. INTRODUCTION AND SUMMARY

Alcatel-Lucent is the trusted transformation partner of service providers, enterprises, and governments worldwide, providing standards-based solutions to deliver voice, data and video communications services to end-users. A leader in fixed, mobile and converged broadband networking, IP and optics technologies, applications and services, Alcatel-Lucent leverages the unrivaled technical and scientific expertise of Bell Labs, a leading innovator in the communications industry.

Alcatel-Lucent has been a steadfast supporter of the public-private partnership framework to implement an interoperable, nationwide public safety broadband network ("PSBN"). Alcatel-Lucent supports the use of interoperable, open-standards-based, commercial

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[1] First Responders Network Authority Presentation to the Board, FirstNet Nationwide Network (FNN) Proposal, Sept. 25, 2012 ("FNN Proposal"), available at http://www.ntia.doc.gov/files/ntia/publications/firstnet_fnn_presentation_09-25-2012_final.pdf.

broadband technologies in the PSBN to protect the life, health and safety of our Nation's First

Responders and citizens. Our company's proposal to dedicate the data portion of the U.S. Public

Safety 700 MHz spectrum to a broadband-only block, submitted to the Federal Communications

Commission ("FCC") in 2005, helped pave the way for the nationwide PSBN, which FirstNet

was created to implement in the Middle Class Tax Relief and Job Creation Act of 2012

("MCTRJCA Act" or "Act").[2]

   Alcatel-Lucent commends the FirstNet Board of Directors for issuing the FirstNet

Nationwide Network ("FNN") conceptual architecture for public feedback in its very first board

meeting. Moving forward expeditiously, made possible by the experience and knowledge of the

board members themselves, sets an appropriate tone for the work yet to be done to promote the

successful deployment of a nationwide PSBN.

   With respect to the proposed FNN conceptual architecture itself, Alcatel-Lucent

supports it as an appropriate starting point requiring further refinement. Pursuant to the Act,

FirstNet is authorized to employ a wide range of infrastructure and spectrum sharing

mechanisms through public-public and public-private partnerships to achieve its goals of an

interoperable nationwide PSBN.[3] Among those potential infrastructure and spectrum-sharing

partners are existing commercial mobile operators. Nationwide, Long Term Evolution ("LTE")

networks are currently being deployed by national, regional, and rural commercial mobile

operators. Wherever feasible, partnering with them to facilitate deployment of the FNN is a

necessary and *vital* first step toward FirstNet's success. 3GPP-based LTE already contains the

tools necessary to meet public safety requirements, as they are finalized, with respect to

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[2] *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156 (2012) ("MCTRJC Act"). In particular, the flexibility for leasing spectrum to non-public safety users can be interpreted as spectrum sharing on a secondary basis.

[3] *See* MCTRJC Act § 6208.

priority/preemption, quality of service, reliability, resiliency, and security. Carriers already

deploying LTE, or preparing to do so, could hypothetically serve as a FirstNet rapid entry point

into service.

This is feasible *technologically*. However, it remains unclear the extent to which

commercial mobile operators will agree to various forms of Radio Access Network ("RAN")

sharing, or other types of network equipment sharing, that are suggested by the conceptual

architecture. It also remains unclear the extent to which commercial mobile operators and

FirstNet will be able to enter into service level agreements ("SLAs") that meet the expectations

of FirstNet's primary user base – First Responders – as well as the needs of commercial mobile

operators serving their commercial customers. These uncertainties cannot be overstated, since

First Responders must recognize FirstNet's service as distinct and valuable to their mission when

compared to existing commercial services to which they already subscribe, and the Act does not

require First Responders to subscribe to the FirstNet service. In light of public safety service

requirements yet to be fully defined, and business negotiations with commercial mobile

operators yet to take place, Alcatel-Lucent recommends certain clarifications to the conceptual

architecture and its business model, which in turn will ensure FirstNet can leverage a broad

public-public and public-private partnership ecosystem for a "day one" service launch.

Alcatel-Lucent recommends that the initial FNN conceptual architecture be

expanded to incorporate RAN utilizing only the public safety spectrum, otherwise referred to as

Band 14, which suggests a broader "day one" business model than an operator-only approach.[4]

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[4] It is admittedly not entirely clear what the FirstNet Board envisions in terms of the business
model underlying the conceptual architecture slides. The slides alone suggest a commercial
operator-only approach to FirstNet deployment and partnerships. Discussion amongst the board
members demonstrates a clear understanding of the need for a far more diverse public-public and
public-private partnership ecosystem.

In preparing to deploy Band 14 RAN independent of commercial mobile operators, FirstNet must pursue partnerships with a wide variety of entities that will be open to sharing infrastructure and spectrum with FirstNet. In addition to commercial mobile operators, utilities, rural local exchange carriers, State and local governments, and even the Federal Government - any entity with financial resources, property, existing communications infrastructure, as well as resources to pay for user fees and/or to lease spectrum from FirstNet (with appropriate protections for First Responder traffic) - is a potentially meaningful partner for FirstNet. A holistic approach to FirstNet's conceptual network architecture, and pursuit of a broad partnership base, may reveal far more resources available for FirstNet's initial deployment plans than the $2 Billion available through the Act.[5] This includes the possibility of creating a much larger Band 14 device ecosystem, potentially lowering the cost for devices substantially.

Finally, with respect to the conceptual architecture's Distributed Core Network, Alcatel-Lucent commends the Board for its inclusion of a Service Delivery Platform and recognition of the value of a modern day applications ecosystem and its potential benefits for the public safety community. Alcatel-Lucent has long recognized that communications networks are made more powerful and valuable to users when they are complemented by a robust and active development ecosystem. Enabling applications development by as many stakeholders as possible, in a secure and reliable manner, promises to empower the public safety communications marketplace in the same way the mobile broadband applications ecosystem has empowered consumers today.

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[5] MCTRJC Act § 6208 (discussing public-private partnerships); § 6207 (providing for $2 Billion in initial network funding).

II. ALCATEL-LUCENT'S PROPOSED ENHANCEMENTS TO THE FNN CONCEPTUAL ARCHITECTURE

The FNN conceptual architecture model appears to demonstrate a form of RAN-sharing between FirstNet and commercial service providers.[6] Alcatel-Lucent recognizes the importance of FirstNet attempting to leverage 3G and 4G commercial networks to allow for a rapid initial deployment of services for public safety using a roaming approach, together with associated SLAs, to ensure public safety users get the services they need. Such a RAN-sharing partnership could minimize the initial investment required of FirstNet to launch service, while providing FirstNet with wide geographic service availability based on existing 3G/4G commercial footprints.

To ensure FirstNet is leveraging the full range of infrastructure-sharing opportunities with existing commercial entities, and robust demand by a broad base of potential secondary users, Alcatel-Lucent recommends some granular clarifications to RAN-sharing as originally proposed in the FNN conceptual architecture. In particular, Alcatel-Lucent recommends the incorporation of RAN utilizing only Band 14 and non-carrier-owned infrastructure (e.g. towers, backhaul, and other passive infrastructure that may be owned by State and local governments, utilities, etc). These clarifications and additions will ensure, for purposes of communicating intent and clarifying to FirstNet's customer base and potential partners, that the FNN architecture matches the sentiments expressed by the Board at the September 25th meeting: FirstNet must work with a wide range of entities to achieve success, not solely commercial mobile operators. The clarifications and additions Alcatel-Lucent recommends to the FNN conceptual network architecture appear in Figure 1 below:

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[6] FNN Proposal at 15-19.

Figure 1
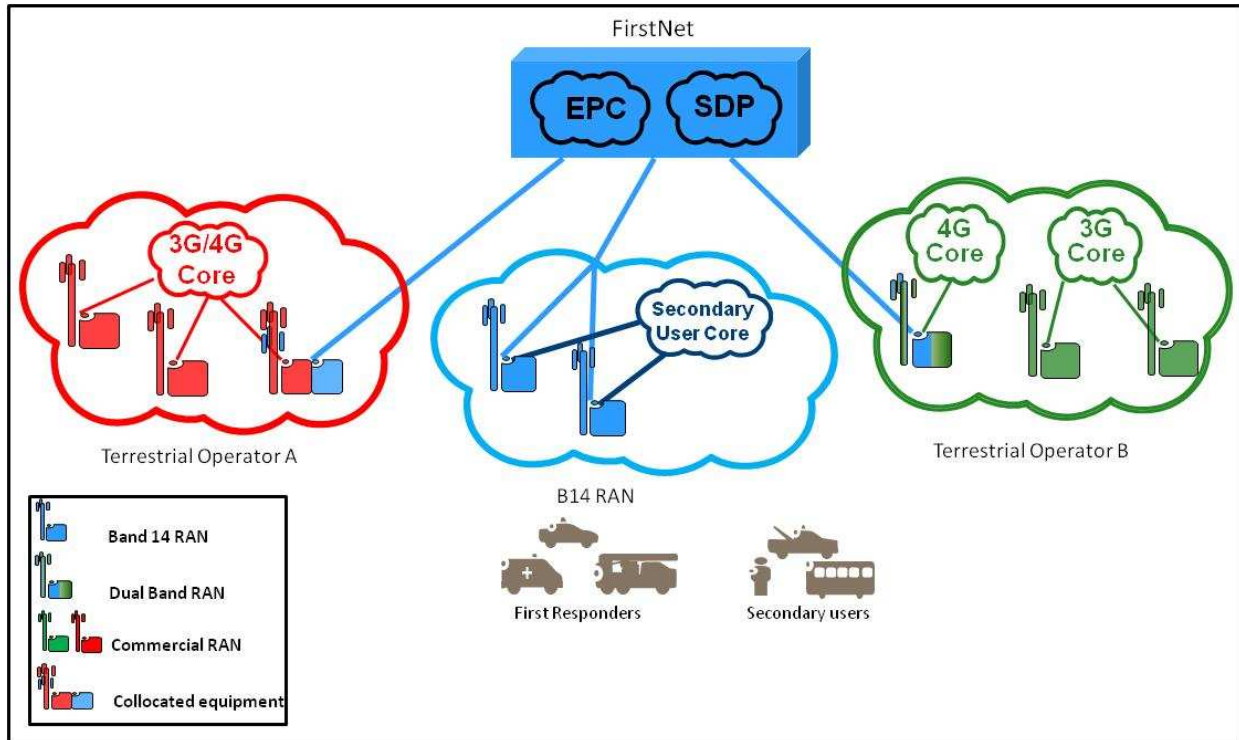
A. RAN-Sharing with Commercial Operators

Existing LTE 3GPP-compliant technology makes all potential FirstNet-commercial mobile operator RAN-sharing options technologically possible today. Critically, FirstNet must remain steadfast in its adoption of only 3GPP-compliant technologies, as directed by the Act.[7] While some may argue that the *addition* of non-standardized features and functionalities to otherwise 3GPP-compliant technology does not render their offerings non-compliant to standards, such "differentiation" will turn FirstNet's technology into a one-of-a-kind solution, increasing the very costs FirstNet's leveraging of commercial LTE deployment is

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[7] MCTRJC Act §§ 6203(c)(2), 6206(b)(1)(B) (ensuring minimum technical standards are based on commercial standards for LTE).

supposed to minimize, and risk a lack of interoperability with the LTE technology being deployed by the private sector today and into the future.

Figure 1 includes clarifications to the operator RAN included in the FNN conceptual architecture. These clarifications are intended to capture the full range of RAN-sharing options for FirstNet and commercial operator partners. Alcatel-Lucent does not endorse any one specific form of RAN-sharing as the best, most reasonable, or even realistic RAN-sharing solution, but offers each formulation for FirstNet's consideration as it holds discussions with potential commercial mobile operator partners. The options include:

1. Greenfield RAN-Sharing

A greenfield RAN-sharing partnership utilizing a Multi-Operator Core Network ("MOCN") strategy maximizes the sharing opportunity, allowing sharing of spectrum and RAN equipment (dual band eNodeBs supporting Band 14 and commercial spectrum as well as antenna infrastructure, backhaul, and towers). This type of sharing allows seamless roaming between Band 14 and adjacent commercial LTE sites, and is particularly appropriate for rural deployments where commercial networks are generally designed for coverage, similar to needs of a public safety network Band 14. This form of greenfield RAN sharing is depicted by "Terrestrial Operator B" in Figure 1.

As depicted by "Band 14 RAN" in Figure 1, greenfield RAN sharing can also rely exclusively on Band 14 for the RAN, whereby a commercial mobile operator partner exclusively utilizes Band 14 spectrum on a secondary basis for its entire LTE service need.

2. Adding Band 14 eNodeB to Existing LTE RAN

Demonstrated by Operator A in Figure 1, this option adds Band 14 to an existing carrier deployment by including Band-14-specific equipment alongside the existing commercial

mobile operator eNodeB. This scenario would leverage some or all existing infrastructure already deployed by the carrier (antenna, tower, shelters, cabinets, backhaul, etc). Although adding Band 14 to existing mobile operator sites is technically possible, there are a variety of technical and service-related issues that must be addressed for it to be a meaningful option for FirstNet and commercial partners.

For example, commercial operators generally design RAN for capacity in some areas, leading to much higher cell counts than might otherwise be required to provide service to First Responders. This leaves FirstNet with two options: deploy a Band 14 eNodeB at each commercial site (called a 1:1 overlay), or deploy fewer sites to satisfy specific Public Safety coverage and capacity needs. When deploying a 1:1 overlay the addition of Band 14 requires the insertion of additional radio components (diplexers) between a commercial operator's existing radio equipment and the antenna, a disruptive approach which may not be attractive to commercial mobile operators. A site would have to be taken offline in order for this sharing scenario to be implemented. Further, the risk of interference due to passive inter-modulation (cross-mixing of signals) created by the insertion of new shared components needs evaluation at each affected site.

If a 1:1 overlay is not used to reduce RAN costs, existing commercial antennas likely cannot be shared due to the different vertical and horizontal adjustments required for the Band 14 cell sites compared to commercial sites, which will have already been adjusted to provide optimal coverage for the operator's commercial service area.

It remains to be seen whether existing radio cabinets can be shared, given potential space and power constraints. There may be situations where there is enough rack space in mobile operator-owned equipment cabinets for the addition of FirstNet-specific equipment,

such as alarm panels, controllers or other radio boards. It seems likely, however, that this form of RAN sharing will require additional Band 14 radio cabinets to be installed alongside already-installed commercial cabinets.

3. Non-RAN Infrastructure Sharing

LTE RAN deployment where FirstNet leverages a commercial operator's physical infrastructure, such as towers and backhaul, but not the operator's RAN. In practical terms, for the reasons cited in scenario 2 above, the leveraging of existing commercial assets by FirstNet for Band 14 RAN deployment could limit itself to sharing transport links, cell site routers and/or backup systems, and towers themselves if space is available to accommodate FirstNet-owned equipment.

B. RAN-Sharing with Commercial Mobile Operators & Service Level Agreements: Business Model Considerations

In all sharing models outlined in Figure 1, FirstNet would presumably need to enter into a SLA and/or Roaming Agreement with a commercial partner. That business negotiation is critical to the success of any potential RAN-sharing solution. Among the range of issues that must be resolved in the context of business negotiations are:

- Priority and/or Preemption: How will FirstNet traffic be treated on a commercial network; for that matter, how might a commercial lessee of FirstNet spectrum have its own traffic treated?
- Quality of Service: Will a commercial provider guarantee latency and throughput meeting public safety's perceived needs?
- Reliability: Will a commercial operator agree to provide FirstNet with the network reliability expected by First Responders?
- Resiliency (Hardening): Will a commercial operator agree to whatever amount of hardening FirstNet determines is necessary to meet the needs of First Responders?
- Security (Cyber and Physical): What are FirstNet's appropriate cyber and physical security needs. Are they matched by commercial operator needs, and if not, can distinctions be addressed?
- Spectrum Sharing: Consistent with the range of issues outlined above, what terms and conditions might be mutually agreeable for commercial mobile operators to use excess

FirstNet spectrum capacity for their commercial operations? This is critical; access to additional spectrum capacity is perhaps the most important tool FirstNet possesses to encourage partnerships with commercial entities.

An additional consideration is the management of a RAN-sharing solution. When RAN is deployed by commercial providers, FirstNet will need to have a view of the operational state of that RAN infrastructure. Public Safety jurisdictions have expressed a need to view the state of the RAN network in their jurisdiction. The network must also provide individual agencies, tribes, and/or states with the ability to manage their subscribers (e.g. add or remove them from service), and set priorities for them within an overall framework provided by FirstNet. Similar functionality is required for device management, whereby a jurisdiction can control applications associated with "managed" devices as well as lock or wipe any lost or stolen devices.

For device management, Alcatel-Lucent believes FirstNet should embrace an open, standards-based solution that leverages the Open Mobile Alliance–Device Management (OMA-DM) standards, widely adopted in commercial networks. Doing so will allow a single management system for any type of device, optimizing the overall cost associated with device management.

Ultimately, FirstNet's primary customer, public safety First Responders, have a variety of service needs that differ from those of commercial customers, as reflected in each of the issues outlined above. It may be the case that through negotiation, FirstNet is able to identify a pathway forward where a subset of First Responder needs can be met initially, with an evolution of First Responder service characteristics over time and in such a manner that facilitates various forms of infrastructure sharing with commercial mobile operators absent inefficiencies for the existing commercial customer base. These are critical and primary challenges for the FirstNet business model in that one of the tools the Act provides to FirstNet is

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the ability to charge user fees in order to create resources for capital and operating expenses as a

financially self-sufficient entity above and beyond the maximum $7 Billion provided by the Act.

Unless public safety First Responders recognize a clear benefit to subscribing to FirstNet's

service when it becomes available, FirstNet will run the risk of losing important revenue.

C. A Note on the Importance of FirstNet's Subscriber Base.

One observation Alcatel-Lucent makes with respect to partnerships with commercial

operators is in relation to the targeted, and anticipated, subscriber base. Although a subscription

to FirstNet is not mandatory it is imperative that First-Responders be FirstNet subscribers first to

assist FirstNet in becoming financially viable. As with every wireless service provider the ability

for FirstNet to manage deployment and operational expenses will be impacted by its subscriber

base. Therefore, FirstNet must make every effort to encourage as many First Responders as

possible to directly subscribe to its service. The process whereby commercial First Responder

subscribers roam onto FirstNet, or bi-directional roaming, was debated extensively in the work

of the FCC's Technical Advisory Board for First Responder Interoperability.[8] If the FNN

conceptual architecture was to facilitate bi-directional roaming, it could have negative

consequences on FirstNet's operating business model. Such form of roaming threatens to

prohibit FirstNet from leveraging such user fees, as First Responders simply stay "home" with an

existing commercial mobile operator. It also raises issues with respect to security of the FirstNet

network, because it may be difficult for FirstNet to know whether a commercial operator device

roaming onto the FirstNet network is actually being used by a First Responder.

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[8] See *Recommendations of the Technical Advisory Board for First Responder Interoperability*,
Order of Transmittal, FCC 12-68, PS Docket No. 12-74, rel. June 21, 2012 (the Recommended
Minimum Technical Requirements to Ensure Nationwide Interoperability for the Nationwide
Public Safety Broadband Network, Final Report, is attached thereto as Appendix A) at § 4.8.5

D. RAN-Sharing With Secondary Users

It remains to be seen which, if any, RAN sharing partnership scenarios between FirstNet and commercial mobile operators will be successfully employed. The presentation of the FNN conceptual architecture at the Board's meeting on September 25th, and points of discussion amongst Board members, seemed to suggest that "Operator RAN"[9] is not intended to solely stand for commercial mobile operators, but also for utilities, State and local government, etc. As such, the architecture slides should be amended to match the discussion amongst the board: a separate graphic showing Band 14-only RAN should be added. In Alcatel-Lucent's proposed modification to the FNN architecture in Figure 1 above, a blue "Band 14 RAN" depiction has been added to account for a broad ecosystem of potential infrastructure partners and secondary users that may rely exclusively on Band 14 RAN.

The Act initially allocates $2 Billion to FirstNet, with a promise of $5 Billion more depending on the outcome of spectrum auctions.[10] In addition to explicit government funding, the Act also provides tools for FirstNet's use to create additional resources for capital and operating expenses, including generating income through user fees, as well as through spectrum and infrastructure-sharing partnerships.[11] To that end, and to the extent partners are willing to devote their own capital to the deployment of infrastructure – LTE RAN solely utilizing Band 14 – there is no reason to assume Band 14-only investments will not be feasible at the inception of the network.

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[9] FNN Proposal at 15-19.

[10] MCTRJC Act §§ 6207, 6413.

[11] MCTRJC Act § 6208.

1. Rural Commercial Mobile Operators

Rural commercial mobile operators may serve as partners in RAN-sharing models, such as those depicted in "Terrestrial Operator A" or "Terrestrial Operator B" in Figure 1. Rural operators may also present FirstNet with unique opportunities to deploy Band 14-only infrastructure where needed as outlined in "Band 14 RAN" in Figure 1. FirstNet, with dedicated access to a 20 MHz block of national spectrum, represents an opportunity for rural operators to pool resources with a national partner. FirstNet has ample legal authority[12] to permit such carriers to lease spectrum from FirstNet, and jointly deploy RAN utilizing only Band 14 in a greenfield deployment. First Responder needs and those of rural commercial operators can be addressed through the aforementioned business negotiations and resulting SLAs. In rural communities in particular, public safety-specific capacity needs may rarely, if ever, even come into play.

An example of this strategy is already at play in the U.S. rural market today, where Verizon is employing a similar strategy to expand its footprint in rural markets.[13] Seventeen rural operators have agreed to lease 700 MHz C-block spectrum from Verizon, deploy their own RAN, and obtain Verizon's core services.[14] The Act provides FirstNet with the legal tools to attempt a similar business model: engage with rural operators, leasing them spectrum with appropriate SLAs in exchange for their deployment of Band 14 RAN. Consistent with existing 3GPP standards specifications for a MOCN approach, rural operators would be free to

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[12] MCTRJC Act § 6208.

[13] Verizon Wireless, LTE in Rural America, available at http://aboutus.verizonwireless.com/rural/Overview.html (visited Oct. 24, 2012).

[14] Robin Nicol, 4G LTE Goes Live in Rural America, May 11, 2012, available at http://news.verizonwireless.com/news/2012/05/4g-lte-goes-live-in-rural-america.html (visited Oct. 24, 2012).

deploy their own Core, purchase hosted Core services from a third party, or share Core services amongst themselves. Rural carriers are already pursuing these network Core strategies today.[15] Alternatively, FirstNet might pursue a partnership with a spectrum wholesaler, who serves as a broker residing in between FirstNet and the rural operator marketplace.

2. Utilities

This same business model also works with utilities, perhaps even more than with traditional rural commercial mobile operators. Utilities do not currently have spectrum dedicated to their broadband needs, whereas FirstNet has more spectrum than it likely needs throughout much of the country. Alcatel-Lucent believes that if FirstNet and the utility sector can come to a meeting of the minds over the same set of SLA-driven issues as with commercial mobile operators, a strong services, infrastructure, and financial partnership would be in the making.

Utilities continue to pursue mission critical broadband communications for Supervisory Control and Data Acquisition ("SCADA") to empower the smart grid, as well as for emergency crew response communications. These utility communications are critical, since a utility's ability to quickly restore power in an emergency is often a precursor to other critical public safety First Response activities.[16] Presumably, FirstNet and the utility sector could find common cause in a network that meets their mutual need for specific levels of reliability, resiliency, and security. Because of the role these applications play in controlling the electric

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[15] See, e.g., Alcatel-Lucent brings high-speed mobile broadband to rural Texas through 4G LTE agreement with West Central Wireless, June 5, 2012, available at http://www.alcatel-lucent.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLd4w3MfQFSYG YRq6m-pEoYgbxjgiRIH1vfV-P_NxU_QD9gtzQiHJHR0UAAD_zXg!!/delta/base64xml/L0lJayEvUUd3QndJQSEvNElVRkN BISEvNl9BX0U4QS9lbl93dw!!?LMSG_CABINET=Docs_and_Resource_Ctr&LMSG_CONT ENT_FILE=News_Releases_2012/News_Article_002650.xml (visited Oct. 24, 2012).

[16] See, e.g., comments of Dick Mirgon: http://urgentcomm.com/networks_and_systems/news/critical-infrastructure-lte-partner-20120224.

grid, SCADA traffic is delay-sensitive. SCADA applications, however, generate relatively small

amounts of traffic. Based on modeling studies conducted by Alcatel-Lucent, we estimate that

roughly 2%-5% of sector capacity would be needed to support these critical SCADA functions.

As a general matter, these loads can be accommodated by FirstNet in a shared network

environment absent a negative impact on public safety First Responder communications.

Utilities have a wide variety of resources that, in partnership with FirstNet, could substantially

reduce infrastructure deployment costs, such as rights of way, towers and real estate for base

station placement, and communications networks already being used for utility and smart grid

communications that may double as LTE backhaul. Providing utilities with service level

agreements that protect the small amount of air interface bandwidth required by SCADA

applications could create a win-win opportunity for First Responders and utilities.

3. Federal Partnership

Inclusion of public-public partnership models in FirstNet's architecture and initial

business model may also facilitate FirstNet partnership with the Federal government itself. First,

Federal law enforcement agencies have the same day-to-day mission critical communications

needs as State and local First Responders. As a consequence, FirstNet must pursue Federal law

enforcement as a target user group with the ability to pay subscription fees to use the FirstNet

network. Second, whether utilizing FirstNet's Core, or a separate Federal Core, Alcatel-Lucent

believes infrastructure sharing between FirstNet and the Federal Government should not be

discounted as a potential opportunity.[17] The concept of a collaborative relationship between

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[17] Alcatel-Lucent notes that, as directed by the Act, President Obama has issued an Executive
Order forming a "Broadband Deployment on Federal Property Working Group" to study
ways in which access to Federal Government-owned property can be streamlined to facilitate
broadband deployment. FirstNet engagement with the Working Group is advised as part of a
broader partnership pursuit. *See, e.g.* Executive Order, Accelerating Broadband Infrastructure

FirstNet and the Federal Government is consistent with both the Federal Government's Digital

Strategy[18] and Shared Services Strategy.[19] Notwithstanding up to $7 Billion in Federal funds

made available to FirstNet in the Act, Federal government agencies invest considerable resources

in communications infrastructure, and the Federal Government owns a substantial amount of real

estate, all of which could be leveraged to achieve FirstNet's success.

III. ENABLING VOICE SERVICES WITHIN THE FIRSTNET NETWORK AND TO/FROM COMMERCIAL NETWORKS

Interoperability between commercial networks and the FirstNet network is a

major factor for the provision of services across multiple networks. Adopting 3GPP Voice over

LTE (VoLTE) standards for cellular telephony will maximize interoperability of this service on

different networks, and will allow communication not only within the FNN, but between

FirstNet users and users on other wireless or wireline networks. Note, calls will drop when a

user moves from one service provider network to another, or to/from the FirstNet network. Also,

while transparent to end-users, different networks will require different voice clients on the

device, impacting the device. For example, an LTE device would need a voice client which

differs from that used on CDMA and HSPA networks.

Push-to-talk ("PTT") interoperability for public safety users can be achieved by

using a standardized PTT client and server. Such a solution could provide full interoperability

whether the user is on the FirstNet network or a commercial LTE network, and proof of concept

solutions for non-mission critical PTT are already available. On any of these networks, a PTT server will be located in the FirstNet network, and the QoS interfaces exist to make this work well. Ultimately, any PTT solution will likely be required to interoperate with LMR-based users, as well as non-PTT users, whether wireless or wireline. The methodology of using a standardized PTT client and server does not extend to non-LTE commercial networks. There are some PTT solutions that leverage buffering because of the lack of QoS in legacy commercial networks. However, more investigation will be required to understand whether these approaches really meet the needs of First Responders, e.g. in terms of latency and voice quality.

Given the persistence of, and continued investment in, Land Mobile Radio (LMR) networks across the U.S., and the misperception and continued misinformation circulating within the public safety community that mission critical voice is "decades" away, there is a corresponding lack of interest within the private sector to expend precious research and development (R&D) resources to develop mission critical voice. The Act allocates up to $300 Million to the National Institute of Standards and Technology ("NIST") to conduct research and development on public safety communications, including mission critical voice communications.[20] While funding for the R&D program may not be available for some time, formalizing a NIST R&D program, which can be performed independent of commercial R&D considerations, outlining exactly how NIST plans to promote the creation and standardization of mission critical voice, and the timeframe in which it intends to declare success, would be valuable for setting expectations within the public safety market.

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[20] MCTRJC Act § 6303(b)(4).

IV.   FIRSTNET DISTRIBUTED CORE NETWORK

A. FirstNet EPC

Alcatel-Lucent supports the FirstNet concept of having a FirstNet distributed core network. We believe that most of the EPC components should be located in a few secure, hardened locations strategically distributed in the U.S., while at the same time managing signaling delay between the end-user and the network. Alcatel-Lucent believes that it is important for S-Gateways ("SGWs") and P-Gateways ("PGWs") to be distributed regionally to permit optimization of backhaul infrastructure and minimize the distance user traffic needs to travel. This is similar to the cost effective and efficient network core strategy employed in national commercial networks today.

As long as FirstNet "owns" the national core, there are additional options that FirstNet might pursue, and which would be appropriate for additional consideration, such as the "hosted core" model selected by the City of Charlotte for its BTOP-funded public safety LTE demonstration project.[21] The City of Charlotte has contracted with Alcatel-Lucent to provide core services to Charlotte, reducing capital and operating expenses associated with core services generally. Alcatel-Lucent's hosted core solution includes hosted EPC equipment, an applications platform, and a network operations center that manages these and the end-to-end network. Given FirstNet's need to manage scarce resources and to deploy a service in a timely manner, as well as a wide variety of potential partnership relationships between FirstNet and third party

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[21] City of Charlotte Selects Alcatel-Lucent to Deploy Public Safety LTE Mobile Broadband Network, Oct. 11, 2011, available at http://www.alcatel-lucent.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLd4w3MfQFSYGYRq6m-pEoYgbxjgiRIH1vfV-P_NxU_QD9gtzQiHJHR0UAAD_zXg!!/delta/base64xml/L0lJayEvUUd3QndJQSEvNElVRkNBBISEvNl9BX0U4QS9lbl93dw!!?LMSG_CABINET=Docs_and_Resource_Ctr&LMSG_CONTENT_FILE=News_Releases_2011/News_Article_002529.xml (visited Oct. 24, 2012).

infrastructure partners, FirstNet adoption of a similar "hosted core" model may prove to be efficient and economical. For example, FirstNet may elect to rely on third party hosting of its own Core to reduce operational expenses. Alternatively, FirstNet might elect to provide its own "hosted core" service to others, such as States deploying Band 14 RAN on FirstNet's behalf, or States that may "opt-out" of FirstNet. Similarly, and consistent with the discussion amongst the Board at its September 25th meeting, should FirstNet decide to pursue demonstration projects, third-party hosted core services, or those provided to demonstrators directly by FirstNet, may provide significant value to FirstNet.

With respect to the specific conceptual architecture provided by the FirstNet Board, however, it is not apparent if anything other than a FirstNet "owned" core is being suggested. Alcatel-Lucent observes that depictions of Terrestrial Mobile Operator RAN in the architecture slides include "core network" within the RAN cloud. Do these pictures merely show RAN partners "passing through" public safety traffic to the FirstNet core? Will partners be hosting some element of core services on behalf of FirstNet? In sum, additional information is required for Alcatel-Lucent to comment specifically on the EPC portion of the conceptual architecture.

B. FirstNet Service Delivery Platform

Alcatel-Lucent strongly supports the inclusion of a service delivery platform (SDP) in the FirstNet conceptual architecture's depiction of the FirstNet distributed core. Promoting the creation of a broad, innovative, and distributed ecosystem supporting First Responder application needs is consistent with the direction the commercial sector has taken with respect to the modern day mobile broadband environment.

In the mobile broadband marketplace, where consumer demand and the advent of a burgeoning mobile applications ecosystem is driving unprecedented growth in data consumption, Alcatel-Lucent has long recognized that network operators must drive maximum value from their networks by playing a proactive and constructive role in the broader communications landscape. The concept of *Applications Enablement* addresses the mobile web's disruptive changes by helping service providers' partner with developers, media and content players in new ways, so they can open and enrich their networks and, ultimately, grow their own value proposition. Combining network *enablers*, or Application Programming Interfaces (APIs), with application developers' capabilities, ensures maximization of network resources, and a superior user experience and quality of service for consumers and applications developers alike.

Alcatel-Lucent interprets FirstNet's conceptual SDP as consistent with these commercial practices, and an invaluable change from the current closed, proprietary public safety applications marketplace. *Openness*, with appropriate security protections and protocols in place, promises to revolutionize the public safety applications marketplace and deliver unprecedented innovation and tools for public safety's use.

The ng Connect Program[22], conceived and founded by Alcatel-Lucent, is an example of a business model that may be helpful in facilitating a robust SDP benefitting First Responders. ng Connect brings together infrastructure, device, application and content companies to create an end-to-end ecosystem with all the resources and expertise required to rapidly deliver next generation services and applications to service providers, enterprises and consumers. In addition, the Alcatel-Lucent University Innovations Program[23], a participating member of ng Connect Program, connects Bell Labs' extensive research and development capability with their counterparts at universities across the country to bring great new ideas to market at an accelerated pace.

Today, Public Safety is limited by its legacy infrastructure, including limited bandwidth and applications capabilities, provided by a limited set of "public safety" vendors. In contrast, consumers have been exposed to a robust infrastructure, device, and applications ecosystem, including commercial applications platforms such as Apple's App Store and Google Play, which make virtually unlimited types of applications at competitive price points available to them. Implementation of an ecosystem development initiative, exemplified by ng Connect, offers FirstNet the opportunity to leverage previously unimagined innovation that will help to

[22] http://www.ngconnect.org/

[23] http://www.alcatel-lucent.com/innovation/university/alu_university.html

shape tomorrow's public safety application ecosystem. This is achieved by: bringing together

innovative companies not generally linked to this market; fostering innovative application and

device concepts, and integrating and validating them; delivering new services, applications and

revenue models to service the First Responder community; enabling the deployment of simple,

innovative solutions and applications for the connected First Responder; improving time to

market; and addressing key issues in the early adoption stage of LTE technologies.

V.   CONCLUSION

For the foregoing reasons, Alcatel-Lucent commends FirstNet for releasing its FNN

conceptual architecture to the public, and recommends that FirstNet modify the FNN conceptual

architecture to ensure the inclusion of a robust ecosystem of public-public and public-private

infrastructure and spectrum sharing partners.

Respectfully submitted,

_____/s/_____
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November 9, 2012