National Institute of Standards and Technology
Docket No. 110727437–1433–01

Soliciting Input on Research and Development Priorities for Desirable Features of a Nationwide Public Safety Broadband Network

COMMENTS OF ALCATEL-LUCENT

Alcatel-Lucent submits these comments in response to the National Institute of Standards and Technology's (NIST's) request for input on various possible features of a new nationwide interoperable public safety broadband network, with a focus on determining research and development priorities.

Over the past decade, Alcatel-Lucent has been a steadfast and vocal champion of the use of commercial broadband wireless technologies to transform the way our Nation's first responders communicate. Our commitment to development of an interoperable, nationwide public safety broadband network based on open standards, supported by a broad base of manufacturers and a competitive marketplace remains absolute. We are encouraged to see public safety communications in the U.S. beginning to move in this direction.

Public safety research supported by NIST has played an essential role in the development of a nationwide interoperable public safety broadband network.

Alcatel-Lucent is pleased to continue its on-going collaboration with NIST's Public Safety Communications Research (PSCR) Laboratory Public Safety Broadband Demonstration Network in Boulder, Colorado. Recognizing the potential of such a research program to help transform public safety communications, Alcatel-Lucent became an early and ardent supporter of this effort. We are proud to be the first public safety broadband vendor to install a Long Term Evolution (LTE) network in PSCR's labs, to support the Lab's first public safety 700 MHz LTE call, and to be the first LTE public safety solution provider to complete NIST test plans through Phase 2 Part 1.

The interactions with PSCR staff and public safety practitioners in the PSCR broadband demonstration network have been invaluable. In particular, we have seen the power of the knowledge and experience NIST and public safety practitioners have gained through this effort. This experience has helped inform and sharpen the technical advocacy NIST has been pursuing on behalf of the Nation's public safety practitioners to ensure development of an interoperable nationwide public safety broadband network based on open standards supported by a broad base of manufacturers and a competitive marketplace. It is important that this valuable work continue to be a priority in NIST's public safety research program.

In order for public safety to take advantage of the features and cost advantages provided by LTE and ensure these benefits continue as LTE technology evolves, it is essential that the design and architecture of public safety LTE networks closely follow the designs and architectures used by

commercial service provider networks. Any architectural or feature choices that deviate from this norm must be minimized. Design of features to fill gaps must be carefully aligned with the mechanisms already supported by the LTE standard. For this reason, we believe that R&D directed at customizing LTE network functions be kept at a minimum, helping ensure a proper balance is struck between alignment with commercial deployment and the needs of public safety practitioners. Further, this customization must come in a manner that promotes competition and support among a broad base of manufacturers. In our opinion, to be effective, these features are best standardized through industry consensus, with NIST playing a key role in translating first responders' needs in standardization bodies. In that regard, as major stakeholders in any system implementation, vendors involved in broadband deployments are expected to contribute significantly to the development of new features as has been the case with the implementation of the priority access service in commercial networks.

In order to properly take advantage of the benefits of LTE, we urge NIST to ensure its public safety research projects are closely aligned with the LTE standards roadmap and commercial trends.[1] We note, for example, that direct mode features for LTE are just beginning to be studied in 3GPP. Significant R&D spending on the development of "Meshing (ad-hoc device-to-device communication)" should be avoided until these features have been incorporated into the 3GPP standards. Instead, we encourage NIST to direct research funds at the development of deployable broadband infrastructure and relays that can provide service in the absence of connectivity to wide area infrastructure using LTE to provide connectivity to the deployable units, and adaptive wireless networking techniques (such as meshing, using whitespace or other communications means) to provide interconnectivity between the deployable units, rather than the user devices themselves, thereby allowing users and applications to exchange data.

In addition to funding the PSCR broadband demonstration network on an on-going basis, we believe some of the most beneficial areas of public safety broadband research in the short, medium and long term lie in efforts to ensure public safety practitioners can fully take advantage of the rich functionality provided by LTE through the development of a robust, public safety LTE ecosystem.

Open Application Programming Interfaces (APIs)

The use of open Application Programming Interfaces (APIs) and Service Oriented Architecture (SOA) frameworks are accepted industry practices for exposing network features to new and existing applications. Using such APIs, for example, it will be possible for applications:

- to inform an LTE network of the Quality of Service (QoS) requirements of a media stream (e.g., the desired data rate and priority) and other parameters in a common way.

[1] We note a key recommendation of the FCC PSAC Network Evolution Working Group's report: "To maximize the stability of the technology, the timing of rollout of each increment (e.g., 3GPP Releases) of technology [in the public safety broadband network] should lag that of the commercial markets, allowing public safety to take advantage of the vast amount of testing performed by commercial carriers." (*See* http://transition.fcc.gov/bureaus/pshs/advisory/eric/PSAC%20Network%20Evolution%20WG%20Report%20May%2024%20FINAL.pdf).

- to retrieve pertinent information from the LTE network such as location information of a particular device.

Use of open APIs makes new network features available to the widest community of developers possible, encouraging innovation and leveraging commercial research and development. Furthermore, open APIs provide a stable interface between the applications and the underlying LTE network, shielding applications from low level changes and enhancements of the LTE network as public safety LTE networks continue to evolve.

NIST can help play an important role in the development of open public safety broadband APIs by ensuring public safety user needs are represented in existing Open API initiatives such as the GSM Association's (GSMA) OneAPI.[2] Such an effort will help:

- Ensure that public safety applications will be available that take advantage of LTE's features and which will provide the greatest benefit to the public safety community;

- Ensure that devices are available which support public safety applications and required LTE network functionality;

- Ensure that LTE solution providers will expose these network services in a common way, promoting interoperability and market competition;

- Leverage commercial investment in Open API development; and

- Encourage, through experimentation, the development of new applications and network features which use LTE networks, public safety information bases and other assets.

Through such research, NIST can help ensure Computer Aided Dispatch, visitor portal, incident response and other public safety applications provided by multiple vendors can take advantage of the features provided by public safety LTE networks. Furthermore, such a collaborative research program would encourage the development of innovative public safety devices to take advantage of LTE network functionality.

Evolved Multimedia Broadcast Multicast Services (eMBMS) for Public Safety
Delivery of streaming media (e.g., video, voice) to a large number of public safety officials is a valuable tool in public safety response. eMBMS is a LTE feature that is a critical building block of such applications. We believe research directed at exploiting this feature for public safety response is an important area for investment.

Mission-Critical Public Safety Voice Services
With the introduction of eMBMS, it will be possible to support network-centric mission-critical voice services over LTE, relying on dual mode devices supporting LTE and Project 25 interfaces for the support of talkaround. In addition to providing interoperability with legacy Land Mobile

[2] We note that GSMA's OpenAPI v3.0 supports mechanisms for applications to request specific quality of service treatment for data streams and other features of interest to public safety.

Radio systems, support of mission-critical voice services over LTE will enable new, valuable functionality for first responders, including:

- The use of high-fidelity codecs with performance far superior to the narrowband codecs used by public safety today; and

- The dissemination of images and other multi-media content to groups of first responders.

As direct mode features as incorporated into future releases of LTE, these features can also be leveraged for support of mission critical public safety voice services. R&D funding administered by NIST can serve as a catalyst for this important area of public safety research.

Inter-Jurisdiction Interference Mitigation
While standardized mechanisms to improve intra-system performance at the edge of a radio cell footprint exist, the complexity introduced by independent public safety deployments requires a sound approach to minimize inter-system interference and to allow for seamless roaming. A use case study sponsored by NIST focusing on the problem of interference mitigation along, for example, the US-Canada border, would be a fruitful area of research.

Next-Generation Public Safety Broadband Network Architecture
A number of innovations are emerging in the development of commercial broadband technology which promise to have significant benefits when applied to public safety broadband networks and should be a focus of NIST's public safety broadband research program.

- **Active Antenna Array Technology**
  The use of Active Antenna Arrays offers a range of benefits when applied to public safety networks. Using vertical beam-forming, active antenna arrays can significantly improve the capacity and coverage of a public safety broadband network.

- **System on a Chip Technology**
  System on a chip technology used in conjunction with AAA technology can be used to create technology-agnostic base stations that are remotely programmable. This flexibility has a wide range of benefits when applied to public safety broadband networks. The technology allows changes in existing radio technologies to be incorporated gracefully. Furthermore, it allows multiple radio technologies to be supported simultaneously on the same infrastructure. This feature significantly reduces total cost of ownership, and allows public safety to share infrastructure with commercial service providers.

- **Cloud-based Core Network Infrastructure and Applications**
  Commercial service provider networks will begin to migrate to cloud-based core network architectures and applications where appropriate. These architectures promise benefits to public safety, including enhanced reliability, lower costs through pooling of infrastructure and common applications like Short Message Service (SMS) and Voice over LTE (VoLTE).

- **Heterogeneous Networks**
  Due to the potential high concentration of traffic loads at critical infrastructure, public gathering places and other locations in a public safety service area, next-generation broadband networks will rely on use of small cells. Relays will be used to fill coverage gaps. This mix of large cells, small cells and relays are referred to as heterogeneous networks, an active area of research in the LTE community. One of Public safety's biggest dilemmas in the buildout of a nationwide network remains the lack of sufficient antenna structures. This dilemma is further compounded by the desire to cover 95% or more of a particular service area. Small cells and relays could represent a cost-effective method of providing capacity where needed and filling coverage gaps.

Research on next-generation public safety broadband network architecture funded by the Public Safety Innovation Fund (PSIF) incorporating these elements will help spur the development of cutting edge wireless technologies for public safety, helping establish a roadmap that will capture and address public safety's needs beyond what can be provided by the current generation of broadband technology and driving technological progress in that direction.

NIST has played an important role in helping prepare the way for the introduction of a nationwide public safety broadband network. Through the additional areas of research described in this response, we believe NIST can further deepen its impact on the transformation of public safety communications in the U.S. and world.

Respectfully Submitted,

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