Comments in response to NTIA's Notice of Inquiry (NOI) issued October 4, 2012 on behalf of the First Responders Network Authority (FirstNet)

Document version: 1.1

Document date: October 30, 2012

MAVENIR SYSTEMS

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Every reasonable effort has been made to ensure the information and procedures detailed in this document are complete and accurate at the time of printing. However, information contained in this document is subject to change without notice.

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Introduction

This document provides comments from Mavenir Systems Inc. to the Notice of Inquiry (NOI) issued on October 4, 2012 by the National Telecommunications and Information Administration (NTIA) on behalf of the First Responders Network Authority (FirstNet). Our comments address the architecture and solutions to deliver robust communication solutions for first responders on commercial mobile wireless networks, on the public safety broadband network as that becomes operational, and on municipal or public Wi-Fi networks where available as a supplement to the primary broadband networks. Our comments are focused on the Services Delivery Platform. The delivery of integrated voice, video and messaging capabilities is discussed, as well as incremental levels of security that may be applied to ensure appropriate access to the network and services.

About Mavenir Systems, Inc.

These comments are filed on behalf of Mavenir Systems Inc. by Madan Jagernauth, VP Marketing & Strategy. Mavenir Systems Inc. is a venture-backed US-based company headquartered in Richardson, Texas. Mavenir delivers Converged Voice, Video and Messaging solutions, based on our mOne® Convergence Platform, to wireless operators globally. Mavenir's value-added IMS and cloud-based solutions enable the transformation of legacy core networks by offering compelling new services such as VoLTE and RCS, and by providing innovative solutions to address the challenge of migrating subscribers and services to 4G. These solutions are deployed by customers in the North American and European markets. Our customers include three of the five largest mobile network operators in the United States, including MetroPCS; Mavenir provided the IP Multimedia Subsystem (IMS) core and telephony application server (TAS) for MetroPCS VoLTE service, the first such service launched globally.

Assumptions

Our assumptions are:

- The FirstNet Nationwide Network implementation will be based on interoperable industry standards to gain the broadest leverage of commercial off-the-shelf solutions.

- FirstNet builds, deploys and operates an EPC that integrates not only the access deployed in dedicated public safety spectrum but also the commercial networks to enable the seamless delivery of services from the FirstNet SDP.

General Comments: FirstNet Nationwide Network (FNN) Concept

Our understanding of the concept proposed is that FirstNet would build, deploy and operate a Distributed Core Network of Evolved Packet Core (EPC) and Service Delivery Platform (SDP) that would not only connect to a dedicated FirstNet public safety network but also connect to and utilize commercially available Radio Access Networks (RAN). Implicit in this concept is the use of a RAN feature called Multi Operator Core Network (MOCN), which permits a single cell site to broadcast multiple network identifiers and connect to multiple RPCs thus enabling seamless network sharing; we believe that this is a fundamental requirement to achieve the multiple goals of meeting public safety requirements, utilizing existing radio access networks, becoming operational as quickly as possible while minimizing capital expenditures.

The SDP is defined in the FNN concept as "voice, PTT, messaging, location and video application servers and data warehouses plus the FirstNet App Store". Mavenir expects that the FirstNet implementation of communication services on the extended network will be implemented using industry standards for voice, video and enhanced messaging. Further, we expect that new capabilities implemented through the FNN will be introduced over time rather

than all at once, and that these new capabilities will be required to be interoperable with existing capabilities to ensure seamless communications for all first responders.

Service Delivery Platform

Mavenir believes that the FirstNet SDP should be based on the well-defined IP Multimedia Subsystem (IMS) Core and Application Server approach being implemented for communication services on LTE. IMS-based real-time voice and video services as well as near real-time enhanced messaging services are being implemented in commercial networks today. Figure 1 below shows a generalized architecture of the system, with the areas in which Mavenir provides solutions that are relevant to FirstNet Nationwide Network highlighted in blue.
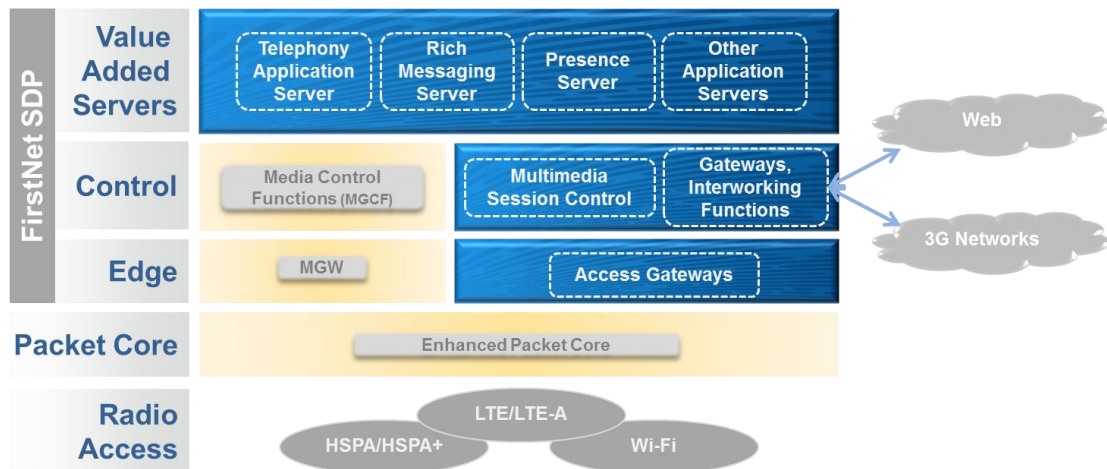
Figure 1: Generalized System Architecture Highlighting FirstNet SDP

Telephony Application Server

The Telephony Application Server (TAS) provides real-time voice and video services, including one to one calling and ad hoc conferencing, over IP networks. These networks include LTE and Wi-Fi today, and may include HSPA in the future as the standards and ecosystem mature. Both

voice over LTE (VoLTE) and voice over Wi-Fi (VoWi-Fi) services are being provided commercially by mobile network operators today in the USA with Mavenir's solution.

Mavenir's Convergence TAS (CTAS) is a standards-based highly scalable product that provides voice, video, and supplementary services to IMS/VoIP clients over any IMS-enabled IP access network. Based on its unique convergence capabilities and flexible software packaging, CTAS is designed to enable service parity and consistency with the legacy Circuit-Switched (CS) mobile network, as well as simplify and accelerate IMS deployments. CTAS supports a rich suite of advanced IP services, such as HD audio, video conferencing, and multi-device and multi-access. Two key functions can be integrated with the CTAS to simplify deployments: enabling direct interworking to existing Intelligent Networks (IN) equipment, and enabling seamless mobility and service continuity as mobile subscribers move between different access networks; the significance of direct IN interworking is that there is no need to upgrade the IN network to achieve delivery of a consistent service experience to the end user.

Push-to-talk over cellular (PoC) can be supported on the TAS. While a standard exists for the implementation of PoC on IMS, this capability has so far not been implemented in commercial networks. We expect that adding such capability to our CTAS can be done through a software upgrade.

Rich Messaging Server (RMS)

Our RMS is a flexible IP messaging application server with intelligent routing, policy-driven services and multiple domain delivery capabilities that provides a complete suite of text, picture and instant messaging services on a single consolidated platform. RMS allows mobile service providers to migrate seamlessly from legacy messaging services such as SMS and MMS to LTE, as well as offer new conversational multimedia messaging services. The RMS offers the

following functions: Instant Messaging Application Server, supporting a wide variety of IP messaging bearers in accordance with 3GPP, Open Mobile Alliance (OMA) CPM and OMA SIMPLE IM specifications; GSM Association (GSMA) OneAPI support for web-based SMS, GSMA Rich Communication Suite (RCS); multimedia messaging and third party development; short message interworking between SIP/IMS endpoints and the legacy SMS network; multimedia message interworking between legacy or SIP/IMS endpoints and the legacy MMS network; group messaging functionality for all messaging bearers; content sharing and file transfer; multi-device delivery; and, interfaces to persistent message store and message synchronization.

Presence and Resource List Server (PRS)

Our PRS supports a rich suite of presence features that are optimized for deployment in mobile service provider networks. PRS is designed with all the requisite features and functionality to support RCS, providing both social presence and device capabilities discovery, and thus ensuring an optimal user experience for mobile subscribers.

PRS accepts, stores and distributes presence information, manages buddy and group lists, performs subscription authorization and enforces privacy rules. More importantly, PRS is scalable to cost-effectively support presence service for the mobile mass market based on features such as notification filtering, and aggregation and rate control mechanisms.

Multimedia Session Control

Multimedia session control is provided by the IMS Call Session Control Function (CSCF). CSCF is a SIP registrar and router that conform to 3GPP specifications. They provide standard functionalities including HSS Selection, Serving-CSCF assignment, IMS user equipment registration, authentication, and application service interworking. They support standards for

open interoperability with Mavenir or any 3rd party applications. Mavenir's CSCF is standards-compliant and implemented on a widely used, highly scalable Advanced Telecommunications Computing Architecture (ATCA).

Gateways and Interworking Functions

Interoperability between FNN and communications networks at large is essential to ensure that first responders are positioned to make appropriate communications at will, on-network and off-network. Industry standards are well defined to ensure such interoperability can occur. As FirstNet intends to work with multiple commercial networks, which may have differing capabilities, it becomes essential that the solutions for interoperability reside in FirstNet's Core Network to avoid the cost, complexity and time to deploy.

Our VoLTE IWF product is deployed as a simple, cost-effective overlay to existing legacy circuit-switched (CS) networks, enabling delivery of voice and SMS services across LTE networks. VoLTE IWF is an application that removes CS dependencies and alleviates costly CS upgrades. The VoLTE IWF connects the Evolved Packet Core (EPC) to the legacy CS network using existing legacy interface and, supports two applications, Circuit Switched Fall Back (CSFB) and Single Radio Voice Call Continuity (SR-VCC). CSFB enables the introduction of Single Radio LTE devices before IMS-based VoLTE is available by reusing existing CS infrastructure. SR-VCC enables handover of active voice calls from LTE to 3G in the event a subscriber roams out of LTE coverage. Operators can implement CSFB as an interim solution to start offering LTE smartphones right away, and later perform a software upgrade to enable SR-VCC functionality as a subsequent solution for VoLTE, again avoiding any costly MSC upgrades.

We believe the ability to interwork with SMS and MMS will be needed for seamless communications. Our portfolio of messaging routers and gateways is based on a mature set of

SMS and MMS messaging products that can be deployed easily and rapidly, and provide mobile service providers a comprehensive messaging solution for all their messaging needs. Capabilities include a multimedia messaging gateway that controls access to the network from 3rd party content providers for delivery of high-value SMS and MMS messaging services and content.

Equipment Identity Register for Device Security

Device and network security are of paramount importance to ensure that the requisite services are available when needed, and to avoid unauthorized access the network. Earlier this year, the FCC announced a major effort, in conjunction with CTIA and major wireless network operators, to address mobile device theft. Stolen, or otherwise misplaced, devices could pose a public safety network access risk. One way to minimize this risk is by implementing an Equipment Identity Register (EIR).

Mavenir's Equipment Identity Register allows network access control based on the unique device identity, deterring device theft and fraud, and enables provisioning of optimized services based on device type. This EIR has advanced administrative and subscriber management capabilities allowing network operators to use the EIR to perform checks and block any blacklisted mobile handset or equipment. It is also possible to detect and block cloned devices to eliminate unauthorized network access.

Mavenir's EIR also provides a range of extended services to improve user experience. For instance, operators may use the EIR to lock handsets/equipment to specific SIM cards to align user access to specific services. Device Tracker, a value-added application within the EIR allows operators to provide services optimized for the device, such as transcoding or ringtones, by

detecting equipment make and model. The EIR may also be used to trigger external service applications, based on subscriber, SIM and equipment information.

Potential Use of Wi-Fi

The FNN conceptual network design model did not mention the potential use of Wi-Fi. It should be noted that over the past two years the wireless industry has had an increasing interest in the use of Wi-Fi for offload of traffic, and that the use of Wi-Fi is integral to the discourse of heterogeneous networks (HetNets). While Mavenir is not advocating that Wi-Fi be considered a primary means of access, Mavenir recommends that FirstNet does not preclude the use of Wi-Fi as one additional means of access to desired communication services and, indeed, that FirstNet ensures that its communication services can be delivered seamlessly across licensed and unlicensed wireless access networks.

Proposal

Mavenir proposes:

- To demonstrate the current state-of-the-art capabilities for voice services on LTE and Wi-Fi in commercial networks. We can demonstrate these services running on commercial networks using commercially-available smartphones at our headquarters in Richardson, Texas. This demonstration is dependent on the availability of the appropriate LTE access network, hence the proposal to demonstrate in Texas.

- New services we anticipate will be launched into commercial service in the coming months. We can demonstrate enhanced messaging capabilities, including the group messaging, media sharing and file sharing, either at our Richardson, Texas facility or at a facility of FirstNet's choosing. This demonstration is dependent on access to one of

the following access networks: Wi-Fi, T-Mobile's 4G network or MetroPCS's LTE network.

- Work with FirstNet, NTIA and NIST to have our solutions certified for use by FirstNet. This is dependent on the scope of work and schedule being defined and mutually agreed.