Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	
Wireless E911 Location Accuracy Requirements	PS Docket No. 07-114
Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems	CC Docket No. 94-102
Association of Public-Safety Communications Officials-International, Inc. Request for Declaratory Ruling	
911 Requirements for IP-Enabled Service Providers	WC Docket No. 05-196

COMMENTS OF VONAGE AMERICA, INC.

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TABLE OF CONTENTS

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Vonage America, Inc. ("Vonage") today provides its customers with safe and reliable 911 service. As the FCC required in its *VoIP E911 Order*,[1] Vonage provides PSAPs with automatic number identification (ANI) and subscriber-reported registered location information in the form of a validated street address. The record before the FCC in this docket and Vonage's own extensive testing efforts demonstrate that there is no autolocation technology available today that can provide more accurate and reliable location information to public safety. Because the FCC's existing standards provide public safety with the best possible location information available for interconnected

[1] *IP-Enabled Services; E911 Requirements for IP-Enabled Service Providers*, First Report and Order and Notice of Proposed Rulemaking, 20 FCC Rcd 10245 (rel. June 3, 2005) ("*VoIP E911 Order*").

VoIP subscribers, the Commission should not subject interconnected VoIP service providers (IVSPs) to autolocation requirements until it is technologically feasible to provide autolocation information that is more reliable than the location information IVSPs provide today.

I. INTRODUCTION AND SUMMARY

Vonage is the leading United States provider of interconnected voice over Internet protocol service, currently serving more than 2.3 million subscriber lines. By combining Vonage service and a Vonage analog terminal adapter (ATA[2]) or other CPE and broadband Internet access service, consumers can use Vonage service to make calls to and receive calls from the PSTN over any broadband connection anywhere in the world. In large part because Vonage subscribers have the freedom to make calls from any location where they have broadband access,[3] Vonage has no way of automatically determining the location of its subscribers when they initiate a Vonage call.

Vonage supports the Commission's efforts to adopt E911 requirements that satisfy the expectations of public safety and the public,[4] and ensure that Vonage's subscribers receive the most reliable and accurate emergency service possible. Even

[2] Vonage offers its customers many choices of ATA; in this document, the term ATA is meant to encompass the wide range of such devices available to consumers generally and to Vonage subscribers in particular.

[3] Vonage enables subscribers to adopt phone numbers that are not associated with the subscriber's actual or primary location. For this reason, Vonage cannot rely on phone numbers as a proxy for subscriber location. *Vonage Holdings Corporation Petition for Declaratory Ruling Concerning an Order of the Minnesota Public Utilities Commission*, Memorandum Opinion and Order, 19 FCC Rcd 22404, 24419-20 (¶¶ 25-26) (2004) ("*Vonage Order")*

[4] *Wireless E911 Location Accuracy Requirements; Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; Association of Public-Safety Communications Officials-International, Inc. Request for Declaratory Ruling; 911 Requirements for IP-Enabled Service Providers*, Notice of Proposed Rulemaking, PS Docket No. 07-114, CC Docket No. 94-102, WC Docket No. 05-196, at ¶ 1 (rel. June 1, 2007)

before the Commission adopted its E911 rules for IVSPs, Vonage was working to bring its subscribers emergency calling service.[5] Since the Commission's adoption of interconnected VoIP E911 rules in its 2005 *VoIP E911 Order,* Vonage has worked aggressively to fulfill the Commission's mandate and bring E911 service to all of its subscribers.[6] Vonage now provides basic or enhanced 911 service to 97% of its subscriber lines, or more than 2.2 million lines.[7] Vonage has rolled out these capabilities in large areas that it does not yet serve, and, as a result, can provide E911 service to an additional 1,773 PSAPs that do not yet serve Vonage subscribers.[8]

Today, as required by the Commission's rules, Vonage collects registered location information from its subscribers and, using the native 911 network, routes emergency calls and delivers location information using this subscriber-reported location information. This approach provides public safety with the caller's precise and validated street address just as with traditional wireline services. Armed with this information, public safety can proceed directly to the source of the emergency call. There is no technologically feasible alternative that can provide emergency responders with more precise or reliable location information for Vonage subscribers.

In order to ensure that its customers continue to receive the most accurate and reliable 911 and E911 service Vonage can provide, Vonage has been actively exploring

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[5] *See, e.g., VoIP E911 Order* at ¶ 25 n.83 (describing Vonage efforts to deploy 911 service); *see also Nuvio Corp. v. FCC,* 473 F.3d 302, 305-306 (D.C. Cir. 2006) (same).

[6] Vonage has also taken an aggressive approach to emergency calling provision in the U.K., providing 999 dialing to its subscribers in advance of any regulatory requirement that Vonage do so.

[7] Letter from Scott Blake Harris, Counsel to Vonage America, Inc., to Marlene Dortch, Secretary, Federal Communications Commission, WC Docket No. 05-196, at 1 (filed June 29, 2007).

[8] *Id.* at 1 n.1.

the development of autolocation technology for more than three years. Vonage is critically interested in the development of technology that will improve the safety of its customers, and equally interested in ensuring that new technologies are adopted in a manner that maximizes its customers' safety. In particular, Vonage believes that anything less than an orderly transition to mature autolocation technology could reduce, not improve, public safety, as untested, inadequate, or unreliable technologies could be substantially less effective than today's solution – providing customer-supplied location information directly to PSAPs.

Vonage encourages the Commission to first articulate specific standards and performance criteria that an acceptable VoIP autolocation solution must satisfy. By ensuring that specific standards and reliable solutions are in place before mandating autolocation capabilities, the Commission and industry can avoid the false starts and disruptions that have delayed prior E911 deployments, maximizing the speed at which IVS autolocation can ultimately be deployed.

Based on developments thus far, Vonage believes the quickest path to widespread, reliable, and accurate IVS autolocation will be network end-point location information. Even the most effective radio-frequency (RF) technologies have significant limitations as IVS autolocation solutions. GPS, for example, is unable to reliably report location indoors, where most IVS use takes place, while Wi-Fi approaches suffer from limited coverage outside of urban areas. Nor is there any combination of technologies (and combining technologies poses additional problems) that can provide a reliable, ubiquitous and sufficiently accurate substitute for today's customer-reported location information.

By contrast, wireline broadband network providers[9] have access to detailed knowledge of the physical location of their networks and are uniquely positioned to correlate this knowledge to particular devices or IP addresses. Moreover, with the advent of CALEA obligations, broadband providers may be required to have the ability to provide user location information to law enforcement, a capability that could become the basis for a VoIP autolocation solution. And unlike RF triangulation approaches, the coverage of network end-point based solutions will be co-extensive with the network, ensuring that users can access the network's autolocation capabilities anywhere they can connect. Network end-point based solutions also minimize privacy concerns, as they need not enlarge the set of providers responsible for deriving user location information. Finally, network end-point based solutions will be backwards-compatible with IP devices already deployed, minimizing any delay or consumer disruption that could be caused by solutions that require new hardware. NENA and others have already recognized the potential of network end-point based location solutions and have begun to take the steps necessary to make such solutions broadly available. Vonage therefore urges the Commission to encourage continued progress towards development and adoption of network end-point based solutions for IVS autolocation.

II. THE COMMISSION'S CURRENT RULES RESULT IN DELIVERY OF THE MOST ACCURATE AND RELIABLE LOCATION INFORMATION CURRENTLY AVAILABLE.

There are many varieties of interconnected VoIP services, and the Commission should not subject these varied services to a single set of autolocation requirements. It is particularly critical that the Commission recognize the distinction between fixed, nomadic, and mobile interconnected VoIP service. For fixed and nomadic services,

[9] In this context, the relevant broadband network provider is the provider of network access.

moving to CMRS location requirements would degrade, rather than improve, the accuracy and reliability of emergency caller location information.

Vonage's service is primarily nomadic – in other words, Vonage customers can use their ATAs to make and receive Vonage calls over any broadband connection anywhere in the world.[10] The wired nature of ATAs, including their lack of an independent power source, makes it unlikely that these devices would be moved frequently, much less constantly, and they thus do not provide mobile service akin to the mobility of CMRS. While Vonage service can be used with more portable devices, such as laptops loaded with softphones, only a small minority of Vonage subscribers use their service in this way. The vast majority rely on ATAs for their service. Subscribers that do move their ATAs have multiple methods available to update their 911 Registered Location, and Vonage and its partner voice positioning centers are, in many cases, able to use this new information to route calls and provide location information within minutes of a subscriber's update.

Public safety has long explained the importance of accurate and precise location information, including the importance of having a street address to which to dispatch emergency service.[11] Vonage today provides public safety with customer-reported and

[10] Fixed IVS is IVS that can be used over one particular wireline or other fixed broadband connection to the Internet. Nomadic IVS is IVS used over devices that can be relocated and used over any broadband connection, but does not include IVS used over devices such as Wi-Fi phones, PDAs and laptops that have their own power source and/or are capable of continuous IVS while moving from broadband connection to broadband connection and/or are designed to be carried with the consumer and relocated frequently. Nomadic IVS is provided over wireline or other fixed broadband connections to the Internet. By contrast, mobile IVS is IVS used over devices such as Wi-Fi phones, PDAs and laptops that have their own power source and/or are capable of continuous IVS while moving from broadband connection to broadband connection and/or are designed to be carried with the consumer and relocated frequently. Mobile IVS includes IVS that is provided over Wi-Fi, WiMax, or cellular broadband connections to the Internet.

[11] *See, e.g., Joint Petition for Clarification of the National Emergency Number Association and the Voice on the Net (VON) Coalition,* WC Docket Nos. 04-36 & 05-196 at 5 (filed July 29, 2005) ("Ensuring that the PSAP is provided an accurate and unambiguous location of an emergency is critical to the functioning of

MSAG-validated street addresses, directing public safety to the correct door to kick down.[12] CMRS accuracy standards, by contrast, require accuracy that ranges from 50 to 150 meters for handset-based technologies and from 100 to 300 meters for network-based technologies.[13] In densely populated areas, knowing location within 50 meters (much less 300) may not direct public safety to the right door, the right floor, or even the right building.

Range of accuracy is not the only source of uncertainty in CMRS autolocation information standards. Rule 20.18 contemplates that 5% of CMRS attempts to locate subscribers will not meet even the 50/150 meter or 100/300 meter standard.[14] These routine margins of error are simply not present when a PSAP receives registered location information provided by a Vonage subscriber.[15]

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the E9-1-1 system."); *Reply Comments of APCO*, WC Docket No. 05-196 (filed Sept. 12, 2005) ("Any approach that relies upon geographic coordinates will … fail to take into consideration dense residential/business areas, where a single coordinate (however accurate it may be) could encompass multiple addresses.").

[12] *See* Remarks of Jonathan S. Adelstein, Commissioner, Federal Communications Commission, to E9-1-1 Institute Round Table Forum at ¶ 8 (July 19, 2007) ("First responders need to know the right door to kick in.").

[13] 47 CFR § 20.18(j)(1).

[14] 47 CFR § 20.18(h)(1-2).

[15] The FCC's current IVS E911 rules require more precise ALI information than is required in other contexts in addition to CMRS. For example, there is no standard approach to MLTS 911 location accuracy. The FCC has thus far deferred to the states on this issue, *see Commission Seeks Comment About Status of State Actions to Achieve Effective Deployment of E911Capabilities for Multi-Line Telephone Systems (MLTSs)*, Public Notice, 19 FCC Rcd 23801 (2004), and only a minority of states have adopted any standards for MLTS 911 location accuracy. Similarly, mobile satellite services are not subject to E911 requirements, but rather are required to establish emergency call centers to handle emergency calls. *Revision of the Commission's Rules to Ensure Compatibility With Enhanced 911 Emergency Calling Systems; Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements; Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band*, Report and Order and Second Notice of Proposed Rulemaking, 18 FCC Rcd 25340, 25347-57 (¶¶ 20-39) (2003) .

In addition, there are many PSAPs to which Vonage delivers location information that are not capable of receiving or using automatic location information of the sort provided by CMRS carriers. For example, a number of PSAPs can accept validated street addresses but not latitude/longitude, either because they are not equipped to accept location information delivered in latitude/longitude format or because they do not have adequate mapping capabilities to dispatch help on the basis of x,y coordinates.[16] These PSAPs can and do accept the registered location information Vonage provides. In other circumstances, as well, Vonage has worked with public safety to adapt Vonage's 911 service to the equipment or infrastructure on which a particular PSAP relies, resulting in delivery of more information to the PSAP than is provided by CMRS carriers.

Vonage also has the capability of delivering 911 calls to multiple emergency service numbers and has often done so at public safety's request. As a result, in areas like Los Angeles, Indianapolis and San Diego, Vonage routes 911 calls to a targeted emergency service number that covers a small geographic area of the city. CMRS carriers in those areas, by contrast, route all their 911 calls to a smaller number of emergency service numbers, which, in certain locations, can add to the amount of time necessary to dispatch help.

In a small subset of cases where nomadic customers have reported incorrect location information, autolocation information may, in theory, be superior to customer-reported street address. Importantly, the training and experience of PSAP staff equips them well to handle the rare call that may arrive with incorrect location information, as

[16] *See, e.g.*, David H. Williams, *The Deadline for the E911 Mandate Approaches . . . Where Do Things Stand?*, Directions Magazine Nov. 30, 2005 (observing that "the vast majority of PSAPs throughout the country are incapable of receiving and using a caller's latitude and longitude").

even street address location information for traditional wireline calls can occasionally be inaccurate or incomplete.[17] In any event, there is not yet any technically feasible way to automatically derive the location of an IVSP caller.[18] Even if there were, degrading location information for the vast majority of calls in order to improve location information for a small minority simply does not make sense. The Commission should only adopt new IVSP location requirements if those requirements are technically feasible and provide public safety with more accurate and precise location information overall than IVSPs provide today.

III. IT IS NOT CURRENTLY TECHNOLOGICALLY FEASIBLE FOR IVSPS TO AUTOMATICALLY LOCATE THEIR SUBSCRIBERS.

As recently as 2005, the Commission concluded that providers of nomadic (or, as the Commission termed them, "portable") services "often have no reliable way to discern from where their customers are accessing the VoIP service."[19] The FCC's *Vonage Order* specifically recognized that Vonage "has no means of directly or indirectly identifying the geographic location of a . . . subscriber."[20] Less than a year ago, the Commission again recognized the current impossibility of locating TRS and VoIP calls that originate on the Internet.[21] There is no new evidence before the Commission to suggest that it is

[17] For example, accurate street address information for new developments may not be available to PSAPs.

[18] *See infra* Part III.

[19] *VoIP E911 Order* at ¶ 25.

[20] *Vonage Order* at ¶ 23.

[21] *Telecommunications Relay Services and Speech-to-Speech Services for Individuals with Hearing and Speech Disabilities*, 21 FCC Rcd 14554, 14557 (¶ 10) (CGB 2006) (explaining that "the current state of technology does not allow a means of automatically determining the geographic location of TRS calls originating via the Internet, including VRS calls" and noting "that a similar issue exists with respect to VoIP service").

now technically feasible to automatically locate IVSP subscribers generally or Vonage subscribers in particular.

Vonage has been working aggressively for years to identify and evaluate technologies that may enable Vonage to automatically locate its subscribers. Unlike vendors and solutions integrators, Vonage is not invested in the success of any particular technology or solution, and thus is particularly well-suited to help the Commission to evaluate potential autolocation solutions. Vonage likewise encourages the Commission to consider convening a technical advisory committee that includes representatives from public safety, IVSPs, technology vendors, and network providers to evaluate possible IVS autolocation solutions. Vonage's own evaluation and testing demonstrate that even the most promising technologies are far from providing reliable and ubiquitous autolocation capability, much less capabilities that would improve on the Commission's current subscriber-reported information requirement.

The record already assembled in this docket, furthermore, establishes that it is not currently technologically feasible for CMRS providers to comply with the Commission's Rule 20.18 requirements if compliance testing is conducted at the PSAP level. Stakeholders across the industry offered comments in response to the first section of the NPRM confirming that current accuracy standards cannot be achieved at every PSAP using existing technology,[22] and no commenter contradicted these statements.[23] Further,

[22] Comments of NENA, PS Docket No. 07-114, CC Docket 94-102, at 1 (filed July 5, 2007); Comments of Qualcomm Incorporated, PS Docket No. 07-114, CC Docket 94-102, WC Docket 05-196, at 4 (filed July 5, 2007) ; Comments of T-Mobile USA, Inc., PS Docket No. 07-114, WC Docket 05-196, at 2 (filed July 5, 2007) ("T-Mobile Comments"); Comments of Verizon Wireless, PS Docket No. 07-114, WT Docket 94-102, WC Docket 05-196 at 10-14 (filed July 5, 2007) ("Verizon Wireless Comments").

[23] Even TruePosition does not claim that it could satisfy current accuracy standards at every PSAP using existing technology. Instead, TruePosition claims its hybrid solution can meet the 100/300 network-based accuracy requirement in "virtually all cases." Comments of TruePosition, Inc., PS Docket No. 07-114, CC

IVSPs face additional hurdles not faced by CMRS providers in deriving autolocation information. Unlike CMRS providers, IVSPs typically do not have their own wireless networks available to provide location information.[24] Without this essential piece of an autolocation system, IVSPs cannot duplicate the network-based or assisted GPS technologies on which CMRS providers rely to automatically derive location. This fundamental disparity independently renders IVSP compliance with proposed CMRS accuracy standards technically infeasible.

A. No Currently Available VoIP Autolocation Solution Provides Ubiquitous and Reliable Autolocation Information.

Although some technologies show promise, Vonage has yet to identify a comprehensive autolocation solution for IVSPs that provides location information more accurately than the existing self-reporting approach. This assessment is consistent with Commission's observation in the *VoIP E911 Order* that currently "there is no way for portable VoIP providers reliably and automatically to provide location information to PSAPs for these services without the customer's active cooperation."[25] Vonage provides its overview of existing and emerging technologies as an Appendix to these comments. Most significantly, each solution evaluated by Vonage relies to a certain extent on RF to resolve the location of a device, and therefore effectiveness is limited in cases where RF signals are unable to reliably penetrate certain buildings, structures, and terrain. In addition, many proposed VoIP autolocation technologies are still prototypes and, even if

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Docket 94-102, WC Docket 05-196, at 5 (filed July 5, 2007). Hybrid solutions, however, are required to comply with the more stringent 50/150 meter handset-based accuracy requirement.

[24] Independent IVSPs like Vonage also do not have access to the underlying broadband network, and thus face location challenges not faced by providers such as cable IVSPs that control the underlying broadband access network used to provide their service.

[25] *VoIP E911 Order* at ¶ 57.

potentially effective, will take years to deploy and even then may only be available in limited areas.

While Vonage continues to examine existing and emerging technologies to determine whether they could enable Vonage devices to automatically locate themselves without requiring customer intervention, no sufficiently accurate in-building RF autolocation solution exists today that can identify a dispatch address for all IVS devices. Vonage is unaware of any E911 autolocation identification technologies presently capable of widespread deployment that match the accuracy of the Commission's current requirements. For this reason, it is not technologically feasible or in the best interests of the public and public safety for the FCC to replace its current subscriber-reported location requirement with an autolocation mandate.

IV. CHANGES TO EXISTING REQUIREMENTS SHOULD COME ONLY AFTER THE FCC CLEARLY DEFINES ITS OBJECTIVES, TECHNOLOGY CAPABLE OF SATISFYING THOSE OBJECTIVES IS AVAILABLE, AND THE FCC PROVIDES FOR AN ORDERLY TRANSITION TO NEW REQUIREMENTS.

The Commission has not yet clearly defined its IVSP autolocation goals or established criteria to evaluate whether particular autolocation technology can meet those goals or improve on current solutions. This is a critical first step, as all autolocation technology offers tradeoffs between, for example, speed deriving location and accuracy of location fix. Once the FCC has identified its goals and performance parameters, it will be able to objectively evaluate new and emerging technology, and thereby adopt achievable and technology-neutral location requirements that maximize public safety. Further, by identifying its priorities, the Commission will spur industry action towards those goals and thereby ensure they are reached as quickly as possible. Vonage

recommends that the FCC, at minimum, adopt four performance criteria for evaluating autolocation solutions: accuracy; timeliness; coverage; and civil addressing.

Accuracy – The Commission's existing requirements provide a baseline against which all potential new accuracy requirements should be measured. Specifically, no new location solutions should be adopted unless they ensure delivery of location that is more accurate than the subscriber-reported address used today.

Timeliness – Most autolocation technologies present a tradeoff between delay and accuracy. Longer acceptable time limits in which to fix and deliver location increase accuracy and reliability, but longer time limits also create risks of unacceptable delays in dispatching emergency services. With guidance from public safety and other interested parties, the Commission should define the maximum acceptable period for a technology to automatically determine location.

Coverage – Any IVS autolocation solution should ensure that location information is available anywhere in the United States that the subscriber is able to access the network.

Civil Addressing – For non-mobile IVS devices located at identifiable addresses, any autolocation solution should be capable of delivering street address rather than longitude and latitude coordinates.

Once the Commission has established its goals for using these criteria, it can take additional steps to encourage development of autolocation technology that meets those goals. Similarly, the Commission will, with these criteria in hand, be able to evaluate the performance of existing technology to determine when new requirements that improve overall location performance are technically achievable. This approach is important to

ensuring that achievable solutions are quickly deployed. By contrast, adopting requirements that are technologically infeasible and thus fail to satisfy the requirements of the Administrative Procedure Act would likely (and unnecessarily) delay deployment. As many initial commenters have also explained,[26] it would be arbitrary and capricious for the Commission to adopt autolocation standards that are not technologically feasible.[27] Similarly, the Commission lacks the express statutory authority that is necessary to support adoption of technology-forcing measures. Against this backdrop, any adoption of infeasible requirements would almost certainly delay improvements in autolocation requirements by subjecting them to lengthy court challenges and diverting industry efforts and energy away from achievable solutions.

In addition, any change to existing location information requirements must be accompanied by a transition plan that allows for an orderly migration to any new requirements or technology. Because the FCC should have as its paramount goal ensuring that any changes to its E911 rules improve rather than degrade public safety, it is essential that any transition to new requirements or technologies be carefully managed. In particular, the Commission must ensure that emerging technologies are sufficiently mature to be reliable and to improve on existing solutions. In addition, a clearly defined transition will enable all of the entities involved in providing 911 and E911 service to work together to integrate new solutions as quickly and effectively as possible.

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[26] Verizon Wireless Comments at 10-14; T-Mobile Comments at 11-12; Comments of AT&T, Inc., PS Docket No. 07-114, CC Docket 94-102, WC Docket 05-196, at 6-7 (filed July 5, 2007).

[27] *Alliance for Cannabis Therapeutics v. DEA*, 930 F.2d 936, 940 (D.C. Cir 1991) ("Impossible requirements imposed by an agency are perforce unreasonable."); *Bunker Hill Co. v. EPA*, 572 F.2d 1286, 1301 (9th Cir. 1977) ("The record must establish that the required technology is feasible, not merely *possibly* feasible.").

V. BROADBAND NETWORK END-POINT LOCATION HOLDS THE GREATEST PROMISE FOR UBIQUITOUS AND RELIABLE IVS AUTOLOCATION.

As detailed above, no existing or emerging RF-based technologies for location identification can improve on the FCC's current subscriber-reported location requirements. There is no single RF-based technology, for example, that both provides nationwide coverage and reliably locates users both inside and outdoors. Moreover, triangulation technologies provide location fixes that are sufficiently broad – typically tens or hundreds of meters – that they cannot direct public safety to the correct street address for the caller. In addition, RF technologies do not provide sufficiently precise elevation information (if elevation information is available at all) to determine from which floor of a building an emergency call has been made.

Network end-point location approaches do not have these flaws, and provide additional benefits. First and foremost, network end-point based solutions are by definition available anywhere the network is available, removing the coverage concerns posed by device-based solutions. Second, network end-point based solutions minimize privacy concerns because they rely on information already available rather than requiring additional entities to derive user location. Third, network end-point based solutions will be backwards-compatible with existing CPE, requiring, at most, software updates, and thus will avoid the customer disruption and delay that attends any solution that requires upgraded hardware.[28] Finally, because traditional wireline PSTN emergency calling location information is likewise derived from the network end-point information, network

[28] *See, e.g., Joint Petition of CTIA and the Rural Cellular Association for Suspension or Waiver of the Location-Capable Handset Penetration Deadline*, 22 FCC Rcd 303 (2007); *Request for a Limited Waiver of United States Cellular Corporation*, 22 FCC Rcd 360 (2007); *Request for Waiver of Location-Capable Handset Penetration Deadline by Verizon Wireless*, 22 FCC Rcd 316 (2007).

end-point location approaches would best fulfill public and public safety expectations about the reliability and accuracy of autolocation information.[29]

Standards bodies have already recognized the promise of network-end point location solutions, and are actively working to develop standards to make network end-point location available for call location purposes.[30] Wireline facilities-based broadband network operators know the physical layout of their networks – including network endpoints – and can correlate these locations with devices on the network via unique device identifiers such as the MAC address of a cable or DSL modem. In addition, in most cases last-mile network operators have relationships with the ISPs that provide access to the Internet, facilitating an association of a physical location with a unique identifier at the network level such as an IP address. The network operator is thus in a unique position to leverage its knowledge of the network to provide a degree of location accuracy that simply is not available to IP-based end-user applications that sit on top of the network, including IVS. While it is not technically feasible today for IVSPs to use network end-point approaches to automatically locate their subscribers, the FCC should

[29] Because the Commission has recently concluded that IVS is more analogous to wireline toll than CMRS service, it would be appropriate to move toward location technologies that are likewise analogous to those available for traditional wireline phone service. *Assessment and Collection of Regulatory Fees for Fiscal Year 2007*, Report and Order and Further Notice of Proposed Rulemaking, MD Docket No. 07-81, 07-140 FCC Rcd 1, 7 at ¶ 16 (August 6, 2007); *Universal Service Contribution Methodology; Federal-State Joint Board on Universal Service; 1998 Biennial Regulatory Review—Streamlined Contributor Reporting Requirements Associated with Administration of Telecommunications Relay Service, North American Numbering Plan, Local Number Portability and Universal Service Support Mechanisms; Telecommunications Services for Individuals with Hearing and Speech Disabilities, and the Americans with Disabilities Act of 1990; Administration of the North American Numbering Plan and North American Numbering Plan Cost Recovery Contribution Factor and Fund Size; Number Resource Optimization; Telephone Number Portability; Truth-in-Billing and Billing Format; IP-Enabled Services*, Report and Order and Notice of Proposed Rulemaking, WC Docket No. 06-122, CC Docket 96-45, CC Docket 98-171, CC Docket 90-571, CC Docket 92-237, NSD File No. L-00-72, CC Docket 99-200, CC Docket 95-116, CC Docket 98-170, WC Docket 04-36, 21 FCC Rcd 7518, 7545 (¶ 53) (June 27, 2006).

[30] *See* Comments of Cisco Systems, Inc., WC Docket Nos. 04-36 & 05-196, at 5-6 (filed Aug. 15, 2005) (discussing standard-setting efforts).

recognize the promise of these approaches and encourage industry and standards bodies to continue their efforts to swiftly develop network end-point standards and technology.

A. NENA, NRIC and IETF Have Recognized the Autolocation Capabilities of Broadband Networks.

The Commission correctly recognized in its *VoIP E911 Order* that NENA's leadership "will likely play a critical role in the provision of E911 services by interconnected VoIP service providers."[31] Not long after this *Order* was issued, NENA finalized and released its interim VoIP architecture for next generation 911 services, known as the "i2" architecture.[32] This architecture underscores the autolocation capabilities of broadband networks by introducing a new network element—the Location Information Server ("LIS")—responsible for determining the physical location on a network.[33] Although NENA ultimately determined that the method by which an end-user's VoIP device would obtain its location from the network was "out of scope for the i2 solution,"[34] NENA and other entities have confirmed that the LIS requirement will be incorporated in the next generation "i3" E911 standard.[35]

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[31] *VoIP E911 Order* at ¶ 21

[32] *See generally* Interim VoIP Architecture for Enhanced 9-1-1 Services (i2), NENA 08-001 (rel. Dec. 6, 2005) ("NENA i2 Architecture"), available at http://www.nena.org/9-1-1TechStandards/Standards_PDF/NENA_08-001_V1_12-06-05.pdf. (last visited Aug. 20, 2007).

[33] *Id*. at 18-19 (§ 2.3.8).

[34] *Id*. at 83

[35] *See, e.g.*, Alliance for Telecommunications Industry Solutions Emergency Services Interconnection Forum, Location Acquisition and Location Parameter Conveyance for Internet Access Networks in Support of Emergency Services, Revision 1.0 (Apr. 5, 2007) ("Draft ATIS Report") at § 4.2, available at http://www.atis.org/esif/Docs/NGES/NGES-050-002-R4f.doc (last visited Aug. 9, 2007); Future Steps for the Evolution of E9-1-1: Immediate, Migratory, Long Term NG9-1-1 at 1 (May 2005), available at http://nena.org/VoIP_IP/I_short_descriptions%20for%20web1.pdf (last visited Aug. 17, 2007) (i3 architecture will support all of the capabilities provided by the i2 architecture); NENA VoIP Location Working Group, Attachment: Background – Location Requirements at 7 (May 30, 2006) ("NENA VoIP Location WG Requirements"), available at ftp://ftp.tiaonline.org/TR-41/TR41.4/Public/Archive/2006-

As NENA has explained, "[t]he LIS is a "critical component in the support of emergency services for VoIP."[36] The NENA architecture provides that the LIS shall "be configured and maintained by the entity that provides/maintains the physical or logical access facility for endpoint equipment" on the network.[37] For residential markets, campuses, and enterprises alike, this entity is the network administrator and/or ISP/access provider.[38]

NENA's determination that Internet access providers should make location information derived from the network available echoes the findings of the Network Reliability and Interoperability Council ("NRIC") VII Focus Group. That group, tasked with addressing long-term E911 issues, has set forth its recommendation of architecture properties that should be required of future emergency communications networks.[39] The NRIC Focus Group report, recognizing that "newer technologies make it impractical for the entity providing communications services to know where the user is," recommends that every Access Infrastructure Provider ("AIP") supply location information to endpoints on the network.[40] The AIPs described by the NRIC focus group include the

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Archive/2006-08-Montreal/TR41.4-06-08-015-M-NENA-BackgroundLocation.doc (last visited Aug. 17, 2007).

[36] NENA i2 Architecture at 78 (§ 4.8.1).

[37] *Id.* at 19 (§4.8.1).

[38] *Id*. For enterprise markets, this role might be assumed by the IT administrator that serves as the access provider for the enterprise. *See id.*

[39] *See generally* Report of the NRIC VII Focus Group 1B: Enhanced 9-1-1 Longer Term Issues, Architecture Properties that Emergency Communications Networks are to Provide by the Year 2010 (Sept. 23, 2004) ("NRIC Report"), available at http://www.nric.org/meetings/docs/meeting_20040923/NRIC%20VII%20Focus%20Group%201B%20Report_Sept.%20v10%20_120304_.pdf (last visited Aug. 17, 2007).

[40] *Id.* at 6.

network providers that own the "last mile" connection, as well as ISPs.[41] For data networks such as the IP-based networks used by VoIP services, the NRIC focus group explained that "the data provider . . . can supply endpoints with location, and the endpoints can provide this location on the call signaling when placing an emergency call."[42]

Finally, the recommendations of NENA and the NRIC focus group are consistent with work being done within the Internet Engineering Task Force ("IETF") to develop mechanisms to determine and acquire location information for communications using IP-based technologies.[43] Among other things, the IETF Geopriv Working Group has "provided recommendations for a standardized format to use in representing location, with enhancements to ensure that security and privacy methods are available to diverse location-aware applications."[44] As NENA has observed, "[t]he general approach being supported in the Internet Engineering Task Force (IETF) is to determine and acquire location information at the point of origin in the access network."[45]

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[41] *See id*. at 19.

[42] *Id* at 19.

[43] *See, e.g.*, IETF Georpiv Working Group Internet-Draft, HTTP Enabled Location Delivery (HELD) (Jul. 9, 2007), available at http://www.ietf.org/internet-drafts/draft-ietf-geopriv-http-location-delivery-01.txt (last visited Aug. 20, 2007); IETF Georpiv Working Group Internet-Draft, Revised Civic Location Format for PIDF-LO (Feb. 15, 2007), available at http://www.ietf.org/internet-drafts/draft-ietf-geopriv-revised-civic-lo-05.txt (last visited Aug. 20, 2007); IETF Georpiv Working Group, Request for Comment, Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses Configuration Information (RFC 4776) (Nov. 2006), available at http://www.ietf.org/rfc/rfc4776.txt (last visited Aug. 20, 2007).

[44] NENA VoIP Location WG Requirements at 7.

[45] NENA Requirements for Location Information to Support Emergency Services (Draft) (May 30, 2006) at 6, available at http://ftp.tiaonline.org/tr-41/tr41.4/Public/Archive/2006-Archive/2006-08-Montreal/TR41.4-06-08-017-M-NENA-LocationRequirements.pdf (last visited Aug. 20, 2007).

In short, wireline broadband networks are inherently capable of implementing a method of providing location information to devices and applications on the network, and organizations tasked with providing best practice recommendations and operational standards urge that this path be taken to improve E911 for users of interconnected VoIP.

B. CALEA Obligations of Network Operators May Include Autolocation.

As a practical matter, even if the desire to facilitate E911 autolocation for VoIP does not drive the implementation of a network end-point based solution correlating physical location with network location, network operators may be required to deploy similar capabilities to comply with the provisions of the Communications Assistance for Law Enforcement Act ("CALEA").[46] In 2005, the Commission concluded that CALEA obligations apply to "facilities-based broadband Internet access … providers,"[47] a determination subsequently upheld by the U.S. Court of Appeals for the D.C. Circuit.[48] Section 103 of CALEA requires that covered entities provide certain assistance capability requirements to law-enforcement, including "call-identifying information."[49] CALEA defines "call-identifying information" as "dialing or signaling information that identifies the origin, direction, destination, or termination of each communication generated or received . . . ."[50] The Commission has yet to determine what call-identifying information

[46] 47 U.S.C. § 1001, *et seq*.

[47] *Communications Assistance for Law Enforcement Act and Broadband Access and Services*, First Report and Order and Notice of Proposed Rulemaking, 20 FCC Rcd. 14989, 15001 (¶ 23) (2005).

[48] *See generally Am. Council on Educ. v. FCC*, 451 F.3d 226 (D.C. Cir. 2006).

[49] 47 U.S.C. § 1002.

[50] 47 U.S.C. § 1001(2).

means in the broadband context.[51] But if the Commission defines call-identifying information in the broadband context to include network end-point location information, network operators may be obligated to provide similar location information in the near future.

CONCLUSION

Vonage applauds the Commission's E911 efforts for IVS, and is eager to continue working with the Commission to ensure that robust autolocation solutions are developed and deployed as quickly as possible. As the Commission considers this issue, however, it should be careful to preserve public safety by adopting only those solutions that are technically feasible and that improve on the Commission's current requirements, which deliver precise customer-supplied location information to public safety. As an important first step, the Commission should articulate criteria for an acceptable solution, addressing requirements including accuracy, timeliness, coverage, and civil addressing. While many entities are working to develop device-based solutions to VoIP autolocation, early results indicate that these approaches have significant drawbacks – such as limited indoor or rural coverage, or inability to determine elevation – that restrict their potential effectiveness as an IVS autolocation solution. The Commission should therefore take

[51] *See Communications Assistance for Law Enforcement Act and Broadband Access and Services*, Second Report and Order and Memorandum Opinion and Order, 21 FCC Rcd 5360, 5365-66 (¶ 14 & n.28) (2006).

note of the progress towards and benefits of network end-point based solutions, and take steps to encourage the swift development of a network end-point based approach to IVS autolocation solutions.

Respectfully Submitted,

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APPENDIX

Overview of Currently Available and Emerging Autolocation Technology

1. GPS/AGPS

The Global Positioning System ("GPS") is frequently cited as a possible autolocation solution for VoIP providers. GPS is a satellite-based navigation system operated by the U.S. Department of Defense. A GPS receiver on the ground determines its location by using signals from a subset of these satellites through a method known as "satellite ranging." GPS satellites broadcast their location information, and the GPS receiver obtains this information and estimates the distance from the GPS satellite by using the travel time of radio signals. By obtaining its position relative to at least three satellites, the GPS receiver is able to provide a reasonably accurate two-dimensional approximation of its location – typically within 100 meters and, depending on various factors, potentially within 15 meters or better. By acquiring information from at least four satellites, the GPS receiver also is able to estimate its altitude, though altitude estimates have limited reliability because of inaccuracies in the mathematical model of the earth's surface used to perform that calculation. The number of satellites required to obtain location information at a specific point may be larger based on the geometry of the satellites that happen to be in view at the time of position fix.

The primary disadvantage of GPS-based solutions is their limited ability to be used indoors, where the overwhelming majority of VoIP use takes place. GPS utilizes transmission signals originating from space, and a GPS receiver requires a minimally obstructed overhead path to acquire the position of each satellite. Although GPS receivers sometimes will be able to receive weak signals without directly "seeing" the

satellite through multipath propagation of a GPS signal (*e.g.* a signal bouncing off a wall and through a window to reach the GPS receiver), such signals can introduce substantial inaccuracies by making the satellite appear further away than it actually is.[52] GPS also is particularly ill-suited for dense urban environments—which have the highest concentration of broadband subscribers and thereby potential density of VoIP users—because of its inability to accurately resolve a receiver's correct altitude (*e.g.* by providing the specific floor a where a caller is located in a multi-story building) even in those cases where other structures do not prevent the receiver from acquiring GPS signals.

Some solutions providers have attempted to address the inherent limitations of GPS by augmenting the system with a terrestrial-based assistance server, which enables the receiver to use a weaker GPS signal. Under this Assisted GPS ("AGPS") model, an alternative channel transmits data messages typically carried on the GPS signal from the assistance server to the GPS receiver, enabling the receiver to narrow significantly the range of its possible geographic locations. In this way, an AGPS system enables the receiver to calculate its position in much less time than with standard GPS, in addition to making use of weaker GPS signals. However, the necessary information that AGPS requires through the alternative channel is still not available for VoIP services, because a stabilized frequency reference is not available over an IP-based network.

While CMRS licensees employ cellular networks as the alternative channel, this option is not viable for VoIP providers. As a threshold matter, no wireless providers have offered third-party access to their networks for this purpose. More fundamentally,

[52] Accordingly, while certain GPS receivers may be able to operate in some indoor environments, the concern of attenuation of the signal passing through various materials (wood, drywall, etc.) remains.

however, GPS assisted by a cellular network still suffers degraded indoor performance. Cellular signals operate in the range of 800 to 1900 MHz—frequency bands with less than ideal propagation characteristics for indoor use—and this limitation is compounded by the relatively low power at which cellular towers and cellular devices operate to enable frequency reuse and small handheld devices. As a result, cellular signals typically attenuate as they pass through structures. Moreover, even when signals do successfully penetrate buildings, they often reflect off surfaces and split, arriving via numerous indirect routes. In other words, AGPS presents many of the same multipath reception issues faced by GPS. While Vonage believes that GPS technologies represent the most advanced and proven autolocation technology currently on the market, its limitations as an indoor application make it infeasible for use by the majority of Vonage's customers.

2. LORAN-C

The LOng RAnge Navigation system ("LORAN") is a terrestrial navigation system implemented by the United States and other countries before the advent of GPS. LORAN employs low frequency radio transmitters that calculate the time interval between multiple LORAN stations to determine the position of an object. LORAN, and in particular LORAN-C (which operates in the low frequency 90 to 110 kHz band), is a proven technology with a long history as a navigation aid for ships and aircraft. However, the U.S. government has made no commitment to maintain the LORAN-C system (and there have been many proposals to scrap the system), which presents a substantial risk for any autolocation solution that would rely on this infrastructure.

Moreover, even assuming that the government provides assurances regarding the continued operation of LORAN, there are several reasons why LORAN-C is not viable as

an autolocation solution for VoIP. First, LORAN-C is relatively inaccurate compared to other autolocation technologies, providing location information only to within 160 to 400 meters. Although the U.S. Coast Guard has developed systems using a differential signal to increase LORAN accuracy to 30 meters or better, these systems have not yet been implemented. Second, because of the propagation characteristics of the LORAN-C frequency band, the LORAN signal is frequently degraded by land-based structures. Finally, LORAN-C receivers are large and expensive, and typically require large and expensive antennas to operate. While efforts to miniaturize LORAN-C receivers are underway, no such systems are available for commercial deployment in VoIP devices.

3. Positioning Based on Broadcast Signals

One company has promoted an autolocation solution based on the location of the VoIP device relative to at least three different broadcast television signals. This solution has the most promise of the proposed autolocation solutions for indoor use because the superior propagation characteristics of television frequencies and permissible power transmit levels relative to services in other bands enable the signals to better penetrate dense foliage and buildings. Television signals have the added benefit of transmitting from known, fixed locations that are already in place. Because terrestrial television infrastructure is highly correlated with population density, coverage should be available for the majority of VoIP users. Accuracy for this system has been projected at 50 meters or better.

One key disadvantage of television signal-based positioning is a requirement for additional infrastructure deployments before the signals can be used. Unlike signals specifically intended for use in geolocation applications, broadcast signals are not locked

to a known time reference. Accordingly, customized reference servers must be deployed in each urban area to calculate the timing offset of broadcast signals. Such deployments have been limited to a handful of areas, although Vonage understands that deployments will increase substantially in the near future. In addition, VoIP devices must include a tuner to access the signals along with a processing device capable of performing the calculations that support the location determination. VoIP devices would also need an antenna with the necessary tuning characteristics for television frequencies. Vonage is not aware of an economical tuning/antenna solution available now, but does expect these solutions to emerge over the next few years, particularly if unlicensed use of TV white space frequencies drives product development and demand.

Finally, as with other autolocation solutions based on radio frequency triangulation, a solution that makes use of broadcast signals would not reveal the altitude of the VoIP device, limiting its utility in dense urban environments. Barometers might be used in connection with triangulation to provide an altitude positioning solution, but barometers are ineffective in many larger buildings due to the positive pressure ventilation systems used to create air flow.

4. Wi-Fi Positioning

One vendor has promoted an autolocation solution based on a database of public and private wireless access points ("WAPs") operating using IEEE 802.11 ("Wi-Fi") standards. Because each WAP is uniquely identifiable based on the media access control ("MAC") address of its base station,[53] if a device knows the location of several WAPs

[53] A MAC address is a unique alphanumeric identifier associated with a network adaptor. See PC Magazine Encyclopedia, available at http://www.pcmag.com/encyclopedia_term/0,2542,t=MAC+address&i=46422,00.asp (last visited Aug. 20, 2007).

(provided over the IP network by the vendor), it can provide a fairly accurate estimate of its current location, often within 20-40 meters. Vonage understands that the vendor has already mapped the location of WAPs in the top 100 metro areas.

Wi-Fi technology has the potential to provide excellent coverage in densely populated urban areas – a requirement that correlates positively to current distribution of VoIP users. Wi-Fi receivers are also inexpensive compared to proprietary radio receivers, and some VoIP equipment already has the ability to communicate with Wi-Fi networks.

The primary drawback of WAP-based positioning solutions is that they lack coverage outside of densely populated urban areas. Although WAP deployments have increased steadily, the power/range limitations imposed on unlicensed devices such as WAPs make it unlikely that the majority of locations in the country will have access to a sufficient number of overlapping WAP signals at any given time. In addition, because WAPs are small, portable devices that are easily redeployed, and their low cost makes them susceptible to replacement in favor of new equipment, a Wi-Fi based positioning technology solution will not be reliable unless the vendor constantly updates its WAP maps. Should the device be unable to acquire several simultaneous overlapping signals from WAPs whose locations are known, the vendor's back-up solution—attempting to derive location information by making an educated guess as to the general location of the device's ISP—provides only municipality-level information, and even then not in all circumstances. Finally, like GPS/AGPS, a Wi-Fi based positioning system does not have the ability to determine the altitude of the VoIP device, limiting its usefulness in urban areas where Wi-Fi coverage is greatest. While Vonage believes this solution holds

promise for Wi-Fi enabled VoIP devices in urban areas, coverage limitations limit its usefulness as a widespread E911 location solution.

5. Other Radio Frequency Triangulation in Unlicensed Bands

Vonage is aware of one vendor that has proposed the use of unlicensed frequency bands to obtain location information. This vendor has designed small RF transmitters that draw very little battery power and could be included in VoIP devices. These transmitters operate in the unlicensed 915 MHz or 2.4 GHz bands, and like many other autolocation solutions would obtain position information via triangulation. The transmission protocol proposed is proprietary, and designed to allow much greater coverage with fewer receiving towers than a transmission standard such as Wi-Fi that emphasizes speed over coverage. However, as no permanent infrastructure (such as the receivers that must be placed on towers to enable triangulation) has been set up to support these transmitters, this solution is unavailable to deploy in the near term.

6. Combined Technologies

In order to increase the likelihood of obtaining an accurate location fix, solutions providers may propose autolocation solutions that combine two or more automation technologies. But such approaches are as simple as proposing the aggregation of multiple, disparate technologies onto each device (*e.g.* advocating a single device solution incorporating GPS, terrestrial triangulation capable of functioning indoors, barometric pressure readings, and perhaps other technologies). Adding multiple technologies will increase device complexity and cost, may decrease device functionality, and almost certainly will introduce unforeseen complications, creating a whole that is less than the sum of its parts. Moreover, as the above analysis demonstrates, there is no

combination of proven or available technologies that will provide a reliable autolocation solution for urban, suburban, and rural environments today, much less one that matches the precision of the Commission's existing subscriber-reported location approach.