



# **What Can Be Measured Can Be Managed: An Approach to Maintaining Broadband Voice Service Quality**

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## Executive Summary

The transition from traditional switched wireline voice service to multiple applications, including voice, carried over a single home or business broadband connection is well underway. By the end of 2010, 31% of the more than 87 million residential telephone access lines in the United States used interconnected Voice over Internet Protocol (VoIP) connections provided over cable fiber-based connections networks. These numbers will continue to grow rapidly, as the large wireline carriers decommission their embedded base of copper circuits and encourage customers to move from traditional time-division multiplexed (TDM) services to bundled services carried over broadband connections. These services will include VoIP as the vehicle for traditional voice communications. As both carriers and the Federal Communications Commission (FCC) have pointed out, as this transition continues, voice will become just another application riding on a data stream—but an application that will remain important for customers, because it will continue to provide their point of access for emergency services. The speed, size, and importance of this transition make it critical that providers, customers, and state regulators work together to ensure that the quality of service provided over these new networks remains equivalent to or better than that of the older TDM networks.

As customers and businesses move from traditional voice services to broadband-enabled products, identifying the standards needed to measure and ensure the quality of service provided by these new networks will become increasingly important. Although the new broadband networks use Internet protocol rather than traditional time-TDM switching, the buyers of these services will still need networks that are reliable and available during emergencies. They will continue to want outages and other service issues diagnosed and corrected on a timely basis; accurate billing; clear calls; and a network that is available even during periods of high congestion. For these reasons, customers will continue to look to state regulatory commissions to ensure that the service provided by these new networks will meet the same stringent standards as the current Public Switched Telephone Network (PSTN).

Regulators will need to consider six key issues in building a culture of service quality for broadband networks.

- (1) Should "voice over broadband" services be held to the same quality standard as services provided over TDM networks? Which, if any, of the current wireline voice standards continue to be important in a broadband world?
- (2) Could the FCC's VoIP outage reporting rules and Connect America Fund (CAF) requirements provide state regulators with sufficient information on the frequency and level of service outages in their jurisdictions to ensure network quality and availability, or should states consider developing additional standards?
- (3) Should there be a single set of standards for all providers and all states, or are individual standards based on type of service and type of carrier necessary? For example, should there be different quality expectations for interconnected VoIP providers and over-the-top providers?

- (4) What tools might states use to ensure providers meet baseline quality standards?
- (5) How should these new standards be developed and implemented? Could a "culture of quality" lead providers to develop voluntary standards or service level performance agreements?
- (6) Are current consumer protections against slamming, cramming, and the release of customer proprietary network information (CPNI) sufficient to protect users of these new networks?

What can be measured can be managed. Service-quality metrics are important to diagnose existing problems and prevent new ones. The FCC now requires interconnected VoIP carriers to provide notice of network outages that will affect consumers, businesses, and the public safety community, but the newly promulgated outage-reporting requirements apply on a national basis and thus provide insight only into the operation of the network as a whole, and then only after the fact. State regulatory evaluation will fill the gap between national and local needs. In order to do this, state regulators and legislators will need to respond to the challenge presented by these new networks by evaluating existing performance metrics to determine which ones should be applied to the new networks. These metrics will include existing wireline service measures such as timeliness of installation, repair intervals, outage frequency, customer complaint levels, and the ability for customers to reach a company's repair and billing-service representatives. They will also require new broadband performance metrics such as speed, delay, packet loss, and jitter.

A number of states, including New York and California, are reviewing provider performance against existing quality-of-service standards to evaluate the impact of the transition to the new broadband networks on existing service. These investigations, as well as Colorado's review of competition, universal service, and the regulatory requirements necessary to respond to these new services will provide insight into what service metrics are and will be required and how they might best be implemented.

Although legislation in 24 states has limited or in some cases completely eliminated public-utility-commission oversight of VoIP and other broadband-enabled services, these commissions retain their mission to ensure that consumers and first responders have immediate and reliable access to emergency services. The need to ensure access to 911 and enhanced 911 services regardless of the technology used to provide those services may give regulators the tools they need to monitor service quality. In addition, the requirements imposed on carriers that accept CAF support from the FCC may provide a baseline for the level of service that must be provided by broadband-enabled networks.

Creating a culture of quality that will ensure that broadband-enabled voice services meet standards for availability, maintenance, and billing accuracy will become a key goal for state commissions as the transition to the public broadband network continues to accelerate. Commissions have a number of options for providing that oversight, including ensuring that users of broadband-enabled services can reach emergency services, monitoring customer complaints, and working with the companies offering these products to develop service-level agreements that will ensure customer satisfaction.

# Table of Contents

<b>Introduction</b> .....	<b>1</b>
<b>I. Should Broadband Service Quality Be Tracked and Measured?</b> .....	<b>4</b>
A. Importance of service quality.....	4
B. Operational versus technical measures of service quality .....	6
<b>II. What Should We Track and Why?</b> .....	<b>8</b>
A. Wireline metrics.....	9
1. Average installation interval in days.....	10
2. Percentage of installation commitments met .....	10
3. Out-of-service repair interval in hours.....	11
4. Repeat out-of-service calls.....	11
5. Network outage reporting/total number of trouble reports per month per 100 lines.....	11
6. Number of consumer complaints .....	12
7. Customer-experience metrics.....	12
B. Broadband voice metrics.....	12
1. Broadband-enabled voice service – VoIP.....	12
2. Key VoIP service parameters.....	14
C. Tools for measuring VoIP service quality .....	15
1. Defining voice-service quality .....	16
2. Customer-focused quality measurements .....	17

<b>III.</b>	<b>Service-Quality Investigations.....</b>	<b>21</b>
<b>A.</b>	New York: "Is the focus on new networks reducing support for existing customers?" .....	22
<b>B.</b>	California: "How has network maintenance affected service quality?" .....	24
<b>C.</b>	Other state proceedings.....	25
<b>IV.</b>	<b>Building a Culture of Broadband Service Quality .....</b>	<b>27</b>
<b>A.</b>	What service-quality measurements are appropriate for broadband networks? .....	27
<b>1.</b>	Technical metrics .....	27
<b>2.</b>	Customer-experience metrics.....	28
<b>B.</b>	Who could establish and enforce quality metrics for broadband-enabled voice networks? .....	29
<b>C.</b>	Could commission/provider collaboration ensure broadband service quality? .....	30
<b>V.</b>	<b>Conclusions.....</b>	<b>33</b>

# What Can Be Measured Can Be Managed: An Approach to Maintaining Broadband Voice Service Quality

## Introduction

The transition from traditional switched wireline voice service to multiple applications, including voice, carried over a single broadband connection is well underway. According to recent FCC statistics, by the end of 2010, 31% of the more than 87 million residential telephone connections in the United States were Voice over Internet Protocol (VoIP) connections provided over broadband networks from cable companies, traditional wireline providers, and over-the-top voice providers.<sup>1</sup> These numbers will continue to grow, as the large wireline carriers encourage customers to move from traditional time-division multiplexed (TDM) services to broadband connections and bundled services that include VoIP. As both companies and the FCC have pointed out, as the transition to broadband-enabled services continues, voice will become simply one of many applications provided over a data connection. Although in the future voice will be an "application," it will remain important for customers, because it will continue to provide customers with access to emergency services. The speed, size, and importance of this transition make it critical that companies, customers, and state regulators work together to develop a culture of quality that ensures that the service provided over these new networks is equivalent to or better than that of the older services networks.<sup>2</sup>

As customers and businesses move from traditional voice services to broadband-enabled products, ensuring that all customers can remain connected to one another and have access to emergency services will become a central issue for the transition from the PSTN to the new broadband public network. Although the underlying technology will change, customers will continue to demand the same level of availability and performance from their broadband networks as that provided by the wireline voice services from which they are transitioning.<sup>3</sup> They will expect that the new networks will be reliable, particularly in emergencies; that

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<sup>1</sup> *FCC 8<sup>th</sup> Broadband Progress Report*, 8/16/2012, p. 15. The FCC statistics include fixed IP-enabled services provided by both cable companies and incumbent carriers using IP-based transmission. An additional group of customers has abandoned the wireline network altogether to move to wireless services.

<sup>2</sup> Despite the growth of texting and other non-traditional communications services, a significant number of customers will continue to depend on voice services as well as data services, even as the FCC's Broadband Plan comes to fruition. Voice will remain an important vehicle for contact with friends, family, business contacts, and emergency services.

<sup>3</sup> While wireless customers may have become inured to dropped calls or poor voice quality, customers who continue to purchase "wired" service from their cable providers, ILECs, or even over-the-top vendors expect these services to meet a higher quality standard. Many customers will even expect their IP-enabled services to continue to work during power outages.



problems will be diagnosed and corrected on a timely basis; that billing will be accurate; and that the clarity of calls and the availability of the network will not be degraded, even during periods of high congestion. In addition, despite the fact that in an increasing number of states these networks are no longer subject to commission oversight and/or regulation,<sup>4</sup> customers will continue to look to their state commissions to ensure that network quality, reliability, and availability remain high.

For these reasons, the question of ensuring service quality, and particularly the ability for customers to access emergency services, will (and in many cases already has) become a critical issue for state regulators. State commissions are already facing the questions of how they can ensure that the old networks continue to function at high levels as customers migrate to new services, as well as what they should (or can) do to ensure that the new networks meet customer expectations for service quality. In order to help customers understand and react to the new communications paradigm introduced by broadband services, regulators need to understand how to define and measure voice quality provided over broadband networks, including determining what, if any, standards should survive from the old circuit-switched regime.

Regulators will face six key issues in ensuring service quality for broadband networks.

- (1) Should "voice over broadband" services be held to the same quality standard as services provided over TDM networks? Which, if any, of the current wireline voice standards continue to be important in a broadband world?
- (2) Could the FCC's VoIP outage-reporting rules and CAF requirements provide state regulators with sufficient information on the frequency and level of service outages in their jurisdictions to ensure network quality and availability, or should states consider developing additional standards?
- (3) Should there be a single set of standards for all providers and all states, or are individual standards based on type of service and type of carrier necessary? For example, should there be different quality expectations for interconnected VoIP providers and over-the-top providers?
- (4) What tools might states use to ensure that providers meet baseline quality standards?
- (5) How should these new standards be developed and implemented? Could a "culture of quality" lead providers to develop voluntary standards or service-level performance agreements?

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<sup>4</sup> Lichtenberg, Sherry, *The Year in Review, The Status of Telecommunications Deregulation in 2012*, available at <http://communities.nrri.org/documents/317330/0179150e-ef83-4e94-bf94-80c7af830ab6>

- (6) Are current consumer protections against slamming, cramming, and the release of customer proprietary network information (CPNI) sufficient to protect users of these new networks?

Broadband connectivity will allow users to connect to services and information beyond their local areas, but a failure of the voice component of these services will have the same negative consequences as a failure of the PSTN, risking the health and safety of the same consumers whom broadband providers seek to benefit. To that end, this paper proposes a framework for developing quality-of-service guidelines for broadband-enabled voice services. It addresses the operational/quality issues that commissions will need to consider in order to ensure that broadband-enabled voice is a satisfactory replacement for traditional TDM service. It does not address the legal question of how commissions might implement quality standards, but rather seeks to provide an outline for developing a "culture of quality" that will benefit companies and consumers alike. The paper focuses on "wired" broadband connectivity (DSL, FTTP/FTTN, and cable), although the recommendations provided here might be useful in the future to develop metrics for wireless and potentially even satellite connections.

**Part I** of the paper defines quality of service and asks whether broadband service quality should be tracked and measured as narrowband services are today. This section also proposes an "operational definition" for service metrics that applies to communications services regardless of the underlying network infrastructure that carries the calls and discusses why service quality remains important. **Part II** reviews current wireline quality-of-service standards in order to provide a framework for recommending metrics for the new services. This part discusses the key metrics that providers and others may use to judge the quality of broadband service. These metrics include connection speed (also referred to as bandwidth), latency, and jitter, as well as customer-facing metrics such as timeliness of installation and repair, trouble reporting, and billing accuracy. This part also reviews the FCC's broadband quality initiatives, including the Broadband Outage Reporting Order and the requirements for broadband providers that accept Carrier Access Fund (CAF) monies, in order to determine whether they are sufficient for ensuring that customers receive the service they need. **Part III** of this paper reviews quality-of-service issues being addressed by New York and California, as well as investigations in the District of Columbia, and proposals for service quality measurement in Colorado. While these proceedings focus on the services provided over existing narrowband networks, the questions they ask are important in determining what performance standards are most important for consumers. Finally, **Part IV** asks, "How can states build a culture of broadband service quality and initiate a service-quality-measurement regime?" This part reviews the key questions regulators must address as the evolution to an all-broadband network environment continues and proposes ways regulators and providers might work together to ensure that the services they provide meet both quality standards and user expectations.

## **I. Should Broadband Service Quality Be Tracked and Measured?**

Management guru Peter Drucker understood the importance of metrics in ensuring quality in manufacturing. His statement, "What gets measured gets managed," remains a cornerstone for quality-of-service studies.<sup>5</sup> A corollary to this statement is that that which is managed will meet the standards required to ensure that it works as designed and meets customer expectations.

Webster defines quality as a "peculiar and essential character; a degree of excellence."<sup>6</sup> As NRRI noted in its 1996 paper on telecommunications service quality, "The most important dimensions of [telecommunications] service quality are availability, reliability, security, flexibility or choice, simplicity, and assurance."<sup>7</sup> As we move from a single switched wireline network with well-established standards and metrics to new broadband networks, where voice is simply one of many applications provided by a broadband pipe, we need to understand how to define, measure, and ensure that our networks continue to provide the "degree of excellence" users expect. In this section, we look at methods of defining and measuring the quality of voice services based on the dimensions described above.

Quality of service for wireline networks has usually been defined on a state-by-state basis using metrics developed jointly between the incumbent local exchange carriers (ILECs) and state public utility commissions. These metrics generally focus on the ability of the carrier to install voice service in a timely and non-discriminatory matter, to repair outages within specific time frames, to bill services accurately, and to provide customer support. Metrics are standards driven (i.e., repair X% of trouble within Y hours).

### **A. Importance of service quality**

High-quality voice communications, whether over narrowband or broadband connections, will remain important for both consumers and businesses for the foreseeable future. Despite the rise of texting, tweeting, and other text-based applications, voice communications continue to provide the most effective and immediate way for callers to reach first responders in the event of an emergency, as well as simply to communicate with each other. Voice calls provide immediate, two-way contact with emergency personnel and information on the location of the emergency; it also allows first responders to return calls to seek additional information about the location or type of problem, provide step-by-step help in resolving emergencies, or even notify

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<sup>5</sup> Drucker, *The Practice of Management*.

<sup>6</sup> *Merriam-Webster Dictionary*.

<sup>7</sup> Davis, Blank, Landsbergen, Zearfoss, Hoag, Lawton. *Telecommunications Service Quality*, NRRI 1996.

consumers of potential emergency situations in advance.<sup>8</sup> Regardless of the underlying technology used to provide voice calls, consumers and businesses will continue to depend on them to report problems, summon emergency assistance, and obtain information critical to their daily lives.

For this reason, the quality of voice calls will continue to be important for businesses, consumers, and regulators. As New York Attorney General Schneiderman pointed out in that state's quality-of-service docket, maintaining high-quality communications services is necessary to ensure that "customers receive fair value for their monthly charges, that public health and safety is protected through reliable telephone service, and that the . . . economy can thrive for the benefit of all residents and businesses in the state."<sup>9</sup>

How should we define high-quality communications service? At a minimum,

- calls must be completed as dialed;
- information must not be garbled by poor quality connections;
- the network must be readily available, even in times of high usage and congestion; and
- consumers must get what they've paid for.

Stories highlighting the need for high-quality telecommunications service (including those that involve service failures) appear in the media nearly every day. During the summer 2012 fires in Colorado and California, emergency authorities used automated outbound calling programs to notify residents of pending evacuations.<sup>10</sup> Other states use similar techniques to alert residents to critical issues on an immediate basis. The telecommunications network must be readily available to support this sort of outbound, proactive calling to protect residents in case of emergencies. It must also be available to ensure that residents can reach emergency personnel to report emergencies and summon help.

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<sup>8</sup> Reverse 911 calling has been used in Colorado, California, and other states to notify residents of the need for evacuation (KRDO.com).

<sup>9</sup> *Petition of Attorney General Eric T. Schneiderman to Modify the Verizon Service Quality Improvement Plan*; Case 10-C-0202, April 25, 2012.

<sup>10</sup> Texting services are also used for this process in some states, but outbound voice calling remains the preferred contact method. See T-Mobile *ex partes* in FCC PS dockets 11-153 and 10-255. "T-Mobile USA, Inc. fully appreciates the need for its customers to be able to contact 911 when they need to do so. Text-to-911 can be an important avenue to do so under certain circumstances, although voice-to-911 calling is preferable whenever possible because of technical limitations with text-to-911 services and because voice calls can also potentially provide PSAPs [public safety answering points] with additional critical information from the caller." *Facilitating the Deployment of Text-to-911 and Other Next Generation 911 Applications; Framework for Next Generation 911 Deployment*, PS Dockets No. 11-153 and 10-255.

When the network fails, as it did during the June 2012 East Coast rain and wind storm (the "derecho"), the consequences can be severe. The failure of the Verizon public-safety network during the June storm left callers across Virginia and West Virginia without the ability to reach emergency responders for days. As the FCC pointed out in its Public Notice seeking comment on 911 resiliency and reliability in the wake of the storms, "This network failure resulted in over 1 million people . . . not being able to call 911 successfully due to the failure of public-safety answering points and their backup systems."<sup>11</sup>

These experiences point out that tracking and testing service quality will continue to be important, even as the network transitions from traditional switched wireline service to broadband-enabled networks. Although deregulation has reduced the states' legal authority to respond to some consumer issues through regulatory oversight, regulators need to remain vigilant regarding the availability, continuity, and access to emergency services. Only by understanding and tracking service quality will they be able to do so.

## **B. Operational versus technical measures of service quality**

As the examples in the previous section show, quality of service is an "operational" as well as a technical concept; that is, voice service must meet both technical standards, such as percentage of availability, and usability standards, like voice quality. Regardless of the underlying technology that provides the service, customers must have access to networks that allow them to initiate and complete calls on demand. They must be able to hear and understand their communications with others. And they must receive timely provisioning, repair, and billing. Operationally, these metrics apply to all communications networks, irrespective of the technology actually used to initiate, carry, and terminate this traffic.

Thus, as it affects consumers, quality of service may be defined most broadly as the ability of users to access and use the network when they need it, particularly in emergency situations. Operational quality of service is technologically agnostic. It does not depend on the type of underlying network, the technology that carries the calls, or even the company (or companies) that provides the service. This is an important concept to keep in mind as we explore the ways in which regulators and providers might join together to develop quality-of-service metrics for the new broadband voice networks. Although current wireline service-quality measures track the technical behavior of calls as they transit the circuit-switched network, the switches and wires that connect the providers' central-office switching equipment with the

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<sup>11</sup> Federal Communications Commission, Public Safety Bureau Notice, DA 12-1153, *Public Safety and Homeland Security Bureau Seeks Comment on 9-1-1 Resiliency and Reliability In Wake Of June 29, 2012, Derecho Storm In Central, Mid-Atlantic, And Northeastern United States*, PS Docket No. 11-60, July 18, 2012.

customer's home, and the Public Switched Telephone Network (PSTN),<sup>12</sup> these service "qualities" are not limited to calls carried over these traditional networks. The new broadband-enabled networks may require new ways of measuring technical service quality, but consumers will expect that the operational voice-service qualities will not change.

The public broadband telephone network (PBTN)<sup>13</sup> will utilize hardware, software, and transport protocols different from the traditional PSTN, but in order to connect callers to each other and meet emergency-service requirements, it will need to adhere to operational standards remarkably similar to those of our current networks. Although the PBTN will largely be a network of networks, consisting of multiple interface points and including both managed connection paths (such as those provided by the ILECs and cable companies) and "over-the-top" (OTT) connections that use public facilities (such as those provided by Skype, Google, and other OTT providers), it will still need to allow callers to communicate with each other regardless of location or the underlying technology used to create and transport the call.

To ensure that the PBTN continues to allow communications "from anyone, to anyone, at any time," it will need a clearly defined set of performance and quality objectives. Because the operational outcome of calls carried by both the narrowband and the broadband networks will be the same—connection and communication—these metrics will likely track to a large extent with current wireline metrics in order to ensure measurable and manageable service quality. The key task for providers and regulators will be to determine what these metrics should be and build a culture of performance quality even where traditional regulation is no longer available. The following section of this paper discusses wireline and broadband performance metrics in order to identify the critical measures that will be needed evaluate the voice services provided by broadband-enabled networks.

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<sup>12</sup> These measures also track the behavior of the companies that provide the communications capability. We discuss this issue later in this paper when we review potential quality measures for broadband voice networks.

<sup>13</sup> The PBTN designation is the author's.

## II. What Should We Track and Why?

Service-quality measurements (metrics) serve two important purposes:

1. They provide the data that providers and commissions need to identify service-affecting problems before they impact customer health and safety by hampering the ability to contact first responders.
2. They allow consumers to measure the performance of one carrier against another and to use that data to select the provider that best suits their needs.

Metrics are important for managing the network and ensuring its health. As the FCC notes in its Broadband Outage Reporting Order,

Tracking network performance is critical to ensuring that customers are able to reach emergency services. Obtaining outage information . . . is the most effective method for the Commission to know whether and how well providers are meeting their statutory obligation to provide 9-1-1 and Enhanced 9-1-1 (E9-1-1) service. Without detailed information about outages that occur, the Commission is unable to analyze communications vulnerabilities, especially as they pertain to 9-1-1 services, or to share aggregate information with industry to help prevent future outages.<sup>14</sup>

Both wireline and broadband metrics evaluate the performance and availability of the network. As we noted earlier, wireline metrics focus on service availability, trouble reporting, and problem resolution. Standard broadband metrics focus on similar areas, including the speed of connections, how well calls are completed (packet loss), and whether delay reduces voice quality. These metrics provide commissions with a baseline for developing the service-quality performance indicators necessary to track and improve the performance of broadband-enabled voice connections (although additional metrics may be needed to determine how well these new services meet customer needs). Although state regulators are generally precluded from applying traditional quality-of-service metrics to VoIP or other broadband voice services, in many cases they have retained the ability to prescribe service requirements for emergency service availability, carriers of last resort, and, to some extent, eligible telecommunications carriers.<sup>15</sup> As we discuss later, commissions may also work collaboratively with carriers to develop and track performance outside of the regulatory arena. Finally, because products such as digital subscriber line (DSL) service use the same wireline circuits as traditional voice services, some of

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<sup>14</sup> FCC Outage reporting order.

<sup>15</sup> The FCC has included broadband metrics in the rules governing those carriers that accept monies from the Carrier Access Fund. If these carriers are designated as ETCs by the state, the state commission might also be able to prescribe some performance requirements. See Bluhm, Peter, *State Commissions' Authority to Mandate Service Quality Standards When Designating Eligible Telecommunications Carriers*, NRRI, June 2009.

the existing wireline metrics (for example, the level of trouble reports and the mean time to repair problems) may provide an assessment of VoIP service quality even without specific measures.

In order to better understand the key quality-of-service metrics tracked by the states, we review them here. We also address the quality-of-service dockets open in New York and California.

#### **A. Wireline metrics**

In general, state-level retail wireline-quality metrics focus on the critical areas necessary to ensure that the PSTN overall and services to individual customers are available when customers need them. For wireline networks, this concept is expressed as a network service availability level of 99.999%.<sup>16</sup> In addition to tracking network availability, quality-of-service metrics also report the time it takes to install new service, the number of calls blocked due to network congestion, the length and frequency of network outages, customer trouble rates, and the time required to respond to and correct customer troubles reports.<sup>17</sup> The metrics exclude performance problems caused by bad weather, customer issues (including problems caused by failures of customer-provided equipment), or other events beyond the companies' control. In many cases, the metrics also address the time required to install or re-install service, the ability of consumers to reach their carriers to report problems or ask service questions (generally tracked as the time customers require to reach a carrier agent), the accuracy of billing, the number of complaints lodged against carriers, and the time needed to resolve them.

In general, the FCC and the states have tracked seven key wireline-performance metrics in order to assess service quality. These measures include:<sup>18</sup>

1. Average installation interval in days
2. Percentage of installation commitments met
3. Out-of-service repair intervals in hours
4. Repeat out-of-service calls

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<sup>16</sup> Broadband-network providers cite similar service-availability levels in their service-level agreements, but do not generally provide service guarantees to retail consumers. For example, Fireline Broadband Networks, a competitive supplier, cites a service-availability goal of insuring that its network "is available and capable of forwarding IP packets 99.99% of the time, averaged over a calendar month."

<sup>17</sup> See Lilia Perez-Chavolla, *Survey of State Retail Telephone Quality of Service Regulations for Selected Categories of Service: Metrics, Penalties and Reports*, NRRI, 2004, available at <http://nrri.org/pubs/telecommunications/04-09.pdf>

<sup>18</sup> These measures have been reported in the FCC ARMIS reports available at <http://fjallfoss.fcc.gov/eafs7/PresetMenu.cfm>. The ARMIS data applied to circuit-switched networks only. Not all carriers were required to file ARMIS data. Much of this requirement has been phased out, limiting the information available to commissions in states that have removed the quality-of-service requirement.



5. Trouble and network outage reporting: Total number of trouble reports per month per 100 lines
6. Number of consumer complaints
7. Billing accuracy

States have also added specific metrics to the generic list based on consumer needs and commissions' experience with the level of service provided by carriers. States like New York and California, for example, track the time required for customers to reach live operators in the company business office and at the repair bureau, the number of missed installation appointments, the percentage of installations completed within specific timeframes (for example, five days), the percentage of troubles not cleared within 48 hours, and billing accuracy.<sup>19</sup>

The Scoping Memo and Ruling in California's ongoing quality-of-service proceeding (Rulemaking 11-12-001) points out that "the goal of . . . service quality measures [is] to ensure that telecommunications carriers provide relevant information to the Commission so that it may adequately protect California customers and the public interest."<sup>20</sup>

Although the number of state regulatory commissions with the authority to set quality-of-service standards has been significantly reduced as competition has replaced regulation, quality-of-service metrics continue to apply to eligible telecommunications carriers and carriers of last resort.<sup>21</sup> States also retain at least some ability to ensure that customers may continue to reach emergency services, regardless of the technology they use. We describe those metrics here to provide an overview of the key indicators necessary to ensure that consumers are receiving the level of service necessary to ensure their safety, security, and satisfaction.

### **1. Average installation interval in days**

The time period between an accepted customer order and the actual date on which the service is installed. The time required for carriers to install new service is important in ensuring that customers can get service when they need it.

### **2. Percentage of installation commitments met**

This metric tracks whether carriers meet promised dates for installing service. Utah sets a three-day window for installations and requires

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<sup>19</sup> Billing accuracy has become less critical as an indicator of quality problems as carriers have moved away from usage-based billing for voice services to "buckets of minutes" and "anytime/all-distance plans." This measure may regain its importance as carriers begin charging their broadband customers based on the amount of capacity they use.

<sup>20</sup> California General Order 133-C requires ILECs and CLECs to track and report on three specific metrics. The metrics do not apply to VoIP providers.

<sup>21</sup> Lichtenberg, *Telecommunications Deregulation*.

carriers to pay a penalty to customers for missed appointments (Utah Administrative Code, R746-340-8). New York tracks the percentage of missed appointments (16 CRR-NY 603.3). California tracks appointments met. Maine's proposed metric for Providers of Last Resort (POLR) will track both the success of the POLR in meeting its service commitments and "the average number of business days between the order due date and work completion date for orders missed due to service provider reasons."<sup>22</sup>

**3. Out-of-service repair interval in hours**

Service that does not work, or that works only sporadically, makes it impossible for customers to reach emergency services. The out-of-service repair interval tracks the average amount of time required to repair service outages. Commissions use this metric to determine whether customers are receiving adequate service and to ensure that problems are corrected in a timely fashion. As repair intervals increase, customers are less likely to be satisfied with their service.

**4. Repeat out-of-service calls**

This metric tracks providers' ability to correct service failures the first time they are reported. Repeat troubles may indicate a problem with the overall health of the network or the provider's physical facilities.

**5. Network outage reporting/total number of trouble reports per month per 100 lines**

This metric provides commissions with information on the health of the overall network by tracking and reviewing the level of problems encountered by customers on a monthly basis. Examined in conjunction with information provided by the FCC's National Outage Reporting System (NORS), the metric allows commissions and providers to diagnose and resolve issues that threaten the health of the network overall.<sup>23</sup> Maine is considering requiring POLRs to track "service outages of at least 500 access lines that are out of service over five minutes."<sup>24</sup>

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<sup>22</sup> *Proposed Maine POLR Rule*, 65-407, Chapter 201.

<sup>23</sup> The FCC VoIP Outage Reporting Order (FCC 12-22) credits the NORS reports with helping to identify and correct both company-specific and generic network problems.

<sup>24</sup> Maine Public Utilities Commission, *Proposed Rule 65-407*, Chapter 201: "Provider of Last Resort Service Quality."

## **6. Number of consumer complaints**

Customers are best able to identify quality-of-service issues. By tracking the number of complaints received on a monthly basis, commissions may identify service problems before they become endemic. While legislation has reduced the number of commissions that can require carriers to respond to consumer complaints, many continue to work with providers directly or through their consumer advocates to identify and address issues that affect multiple customers.

## **7. Customer-experience metrics**

State commissions track a number of other metrics, including average answer time for service and billing issues, billing accuracy, network blocking, support for directory assistance and operator-handled calls, and company responses to specific events, such as weather. In all of these cases, the purpose of the metrics is to identify problems before they become severe enough to impact customer health and safety.

### **B. Broadband voice metrics**

Quality broadband-enabled voice communications are critical. Although legislation in 24 states prohibits state commissions from regulating broadband-enabled services, including VoIP, all parties (legislators, regulators, and carriers) are united around the goal of ensuring that broadband-enabled services are reliable, available, and provide the ability for users to contact first responders. They are simply divided on how to ensure that capability.<sup>25</sup> If competition is to replace regulatory oversight as a means of ensuring service quality, consumers will need performance comparisons to understand their options and education to help them choose the service that is best for them.

This section identifies metrics that commissions might use to determine the success of broadband voice providers in meeting the goal of available and reliable communications. It focuses specifically on metrics for VoIP services rather than broadband connectivity as a whole, because VoIP appears to be the application that will ultimately provide the majority of customers with access to emergency services.<sup>26</sup>

#### **1. Broadband-enabled voice service – VoIP**

Consumers, companies, and regulators generally use the term *VoIP* to refer to communications carried over a high-speed data connection that allow users to communicate

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<sup>25</sup> Lichtenberg, *Telecommunications Deregulation*.

<sup>26</sup> Recipients of FCC broadband support from the CAF are required to provide voice as well as data services.

verbally both with each other and, most importantly, with public-safety officials (e.g., 911). Although broadband-enabled services use a different technology from TDM services provided over the existing PSTN, they perform the same basic function: connecting one caller with another. In the case of emergency services, these calls must also identify the caller's location and telephone number.<sup>27</sup> Consumers perceive VoIP and other broadband-enabled voice communications services simply as "telephone service," and thus have the same expectations for service quality and availability regardless of the medium their carrier uses to transmit a call.

California's recently enacted telecommunications legislation defines VoIP as a voice-communications service that

(A) Uses Internet Protocol or a successor protocol to enable real-time, two-way voice communication that originates from, or terminates at, the user's location in Internet Protocol or a successor protocol. (B) Requires a broadband connection from the user's location. (C) Permits a user generally to receive a call that originates on the public switched telephone network and to terminate a call to the public switched telephone network.<sup>28</sup>

The bill clarifies the differences between traditional circuit-switched telephone service and IP-enabled services. The bill specifies that those services that use

ordinary customer-premises equipment with no enhanced functionality [to] originate and terminate [calls] on the public switched telephone network, [that] undergo no net protocol conversion, and provide no enhanced functionality to end users due to the provider's use of Internet Protocol technology [are] not VoIP service[s].<sup>29</sup>

Customers can subscribe to facilities-based VoIP and over-the-top VoIP. Facilities-based VoIP providers use their own broadband transmission network to deliver service to their customers. Over-the-top (OTT) services utilize broadband facilities provided by others. In many cases, over-the-top VoIP service users can move their service from one location to another simply by plugging their VoIP telephone into a broadband Internet connection wherever they are located.<sup>30</sup>

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<sup>27</sup> Interconnected VoIP providers must provide location information. Nomadic providers provide a "registered location" for their customer, usually the billing address.

<sup>28</sup> VoIP providers continue to contribute to the state's universal-service-access program and provide E-911 access. The bill does not eliminate the state commission's ability to track complaints from VoIP customers and provide that information to the FCC. S.B. 1161, 2011–2012 Sess. (Ca. 2012), available at <http://go.usa.gov/YxU5>

<sup>29</sup> Id., CA Public Utilities Code, Section 239.a. (2) (as amended)

<sup>30</sup> See Sherry Lichtenberg, *Fundamentals of Telecommunications*, NRRI, 2011.

In some cases, customers may even assemble their own service by purchasing piece parts from multiple providers (for example, a broadband connection from one supplier, a router from another, and a handset from a third provider). When there is a service problem, customers will need to be their own technicians, isolating the trouble to the part of the service that caused it. Ultimately, performance metrics will need to be adjusted to fit this new paradigm, because the VoIP provider can be responsible only for its own network reliability and performance.

## 2. Key VoIP service parameters

Should broadband-enabled VoIP networks provide the same quality level for voice service as that provided by PSTN, or has the availability of multiple communications tools rendered this question moot? We do not attempt to resolve that issue here; instead, we provide metrics that commissions and others may use to evaluate VoIP service quality. On a technical level, VoIP should be able to function in emergencies, including those times when calling volumes exceed normal loads. Calls should be completed without delay and should not be misrouted. Packets should not be dropped. On a "human" level, callers should be able to hear and understand each other. Call setup should be rapid. Support should be available when customers need it. In simple terms, VoIP should provide the equivalent of traditional toll-quality telephone service.

Broadband service quality is generally measured on a technical level based upon the speed with which data can be transferred, the ability of the packets containing the data to reach the recipient without delay, and the ability of the network to carry the data without loss. Broadband network providers refer to these components as speed (also referred to as bandwidth), latency, packet loss, and jitter. We define these terms below.<sup>31</sup>

1. **Speed** (also referred to as bandwidth) refers to the amount of data that can be transferred per second over a broadband connection. The FCC USF/ICC Transformation Order requires broadband providers receiving ETC support to provide users with the ability to download data at 4 megabits/second and upload data at 1 megabit/second.<sup>32</sup> VoIP is not bandwidth intensive, requiring speeds of only 24kbps to 90kbps, so all providers should be able to deliver adequate voice quality, regardless of the technology they use to provide VoIP service (i.e., cable, DSL, FTTH, FTTN<sup>33</sup>), assuming that the connection is stable and working at full capacity.
2. **Latency** (packet delay) refers to time it takes for the packets containing the call to reach the called party, measured in milliseconds (ms). Long delays cause calls to

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<sup>31</sup> Which VoIP Dictionary.

<sup>32</sup> FCC Transformation Order at ¶186.

<sup>33</sup> Digital Subscriber Line Service, Fiber to the Home (FTTH); Fiber to the Node (FTTN).

be choppy or users to be unable to communicate. Delay is a problem for satellite communications, although VoIP calls may also experience some delay, depending on the network. The International Telecommunications Union (ITU) recommends that one-way delay should not exceed 400ms for acceptable speech quality, with a delay of less than 100ms providing quality equivalent to the circuit-switched network.

3. **Packet Loss.** Calls transmitted via the broadband network are divided into "packets," with each packet containing part of the information to be communicated. When a packet is lost, some of the information being communicated does not reach the called party. Because the brain compensates for some of this loss by simply anticipating what will be said, a packet loss of up to 5% will go largely unnoticed. Anything above that level reduces call quality.
4. **Jitter** also measures round-trip packet delay. Lower-speed networks will have more jitter and thus reduced call quality. Higher-speed networks will have less jitter than lower-speed networks.

The USF/ICC Transformation Order defines speed, latency, and capacity as the three core characteristics of acceptable broadband service. Eligible Telecommunications Carriers (ETCs) receiving funding from the CAF order must provide actual download speeds of 4Mbps and upload speeds of 1Mbps. Because latency affects a consumer's ability to use real-time applications, including VoIP, ETCs accepting CAF funding must offer sufficiently low latency to use these services. Finally, while the Order does not specify a monthly "capacity allowance" for customers purchasing a basic broadband package, it proposes that urban and rural capacity allowances should be equivalent.<sup>34</sup>

### C. Tools for measuring VoIP service quality

As FCC Commissioner Ajit Pai points out in his October 2012 statement regarding California's telecommunications deregulation bill, the transition to broadband networks and the services they provide are accelerating (and inevitable), and state and federal regulators should adopt regulation and oversight to address the transition from individual services to the "converged services" provided by those networks.

Voice, video, and data are simply different bundles of packets traveling over next-generation networks, rather than different services supplied by niche providers. [In the] all-IP future, cable, telephone, satellite, and wireless companies will compete with each other to bring innovative services at better prices to American consumers.<sup>35</sup>

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<sup>34</sup> Transformation Order, ¶86-100.

<sup>35</sup> FCC Commissioner Ajit Pai statement on California deregulation bill. October 2, 2012. <http://www.fcc.gov/document/commissioner-pai-statement-california-ip-deregulation-bill>

How will we recognize quality of service in this broadband future? Which of the tools in our current box of metrics are still relevant to these new networks? Even if they can no longer "regulate" broadband-enabled services, how might legislators and regulators ensure that service is being provided at levels adequate to meet the duties of carriers to ensure the health and safety of the consumers they serve? We review the service measurements that could be applied to broadband-enabled voice services in the following paragraphs.

### **1. Defining voice-service quality**

Voice quality is subjective and lies "in the ear of the beholder." How can we discriminate between "good" broadband voice service and "not so good" service? Can we use the existing level of service provided by the PSTN as a guidepost?

Commenters generally agree that the toll-quality voice service provided by the PSTN is the benchmark by which new networks can be evaluated. The Multiservice Switching Forum (MFS) uses eight service metrics to describe the standards that the new broadband networks should meet.

1. Voice quality should stay high during the entire call.
2. Calls should not be dropped due to network congestion or sudden increases in traffic.
3. The network must support the same volume (millions) of call attempts supported by today's PSTN.
4. If the network becomes overloaded due to a mass-calling event such as voting for your favorite on *American Idol* or *Dancing with the Stars*, calls that cannot be carried must be rejected without degrading the overall capacity of the network.
5. Emergency calls and high-priority calls must take precedence over other calls when the network is congested.
6. Call setup time must be comparable to TDM setup time.
7. The network must be secure from denial-of-service attacks and spoofing.
8. The network must be able to provide the telecommunications service priority (TSP) handling and the other specialized services currently provided by the PSTN.<sup>36</sup>

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<sup>36</sup> Gallon, Chris, MSF Technical Report, MSF-TR-QoS-001-FINAL. *Quality of Service for Next Generation Voice Over IP Networks*, p. 4.

## **2. Customer-focused quality measurements**

In addition to meeting technical requirements, VoIP providers will need to meet customer expectations for service quality, including providing calls that "sound good," service that is installed on time, and accurate and reliable repairs. To that end, several existing wireline quality-of-service "provider" metrics are relevant to the new networks. These metrics include installation intervals, timeliness of repair, service availability (i.e., number and duration of outages), billing accuracy, and responsiveness to customer issues. These metrics would provide customers, carriers, and commissions the information necessary to evaluate the performance of the new networks on an independent basis.

### **a. Installation interval**

Traditional voice-service metrics have included a firm interval for service installation—generally between three and five days. The average installation interval remains important in judging the ability of VoIP providers to meet their service commitments, but the prevalence of self-installed products and the ability for customers to choose their own installation dates suggests that a metric tracking a company's average installation interval would be a more appropriate measurement.<sup>37</sup> Commissions that track installation intervals for broadband products, either based on company reporting or the tracking of consumer-provided information, will want to separate promised intervals from requested intervals and screen out self-installations.

### **b. Timeliness of repair**

Telecommunications service must be available when customers need it, regardless of the type of service or type of provider. Tracking the timeliness of repairs (how long it takes from the initial customer trouble report to service restoration), therefore, will continue to be an important metric for both customers and regulators. The traditional wireline metrics provide exclusions for customer-provided equipment (CPE) in the calculation of this metric. Because customers may not only bring their own equipment but also "bring their own" broadband provider, this metric should be measured only to the service delivery point, with appropriate exclusions for multi-provider installations.<sup>38</sup>

### **c. Service availability**

Service availability comprises two metrics—the service provided to individual consumers (mean time to repair individual problems) and network availability. State commissions have

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<sup>37</sup> This requirement could be modified for customers who are installing "basic service" as defined under the CAF requirements and those who have no interim product to use until installation is complete.

<sup>38</sup> This paper deals only with premise VoIP service offered over fixed broadband connections. We make no recommendations here for dealing with multiple providers in nomadic VoIP scenarios or with wireless service provided in a customer's residence.



long collected data on the status of the telecommunications network, both for individual customers and statewide. As we noted in the discussion of wireline service standards, this metric generally tracks mean time to repair (the average time it takes to return a customer to service), the percentage of customers out of service for x hours (generally greater than 24), and the percentage of repeat troubles. Service availability will continue to be an important metric as the network transitions from TDM to VoIP. As the FCC pointed out in its rulemaking on VoIP outage reporting, tracking the number and type of VoIP outages is the best way to determine that carriers are providing the quality of service necessary to ensure that their customers have access to 911 and Enhanced 911 (E911) service. Detailed information on outages is necessary "to analyze communications vulnerabilities, especially as they pertain to 911 services, [and] to share aggregate information with industry to help prevent future outages."<sup>39</sup>

The FCC Outage reporting order extends the Commission's wireline-outage reporting rules to facilities-based and over-the-top VoIP service providers. These companies must provide an initial notification to the FCC "within 240 minutes of discovering that they have experienced, on any facilities that they own, operate, lease, or otherwise utilize, an outage of at least 30 minutes' duration that potentially affects a 9-1-1 special facility."<sup>40</sup> Providers must notify the FCC "within 24 hours of discovering that [they] have experienced . . . an outage of at least 30 minutes' duration that potentially affects at least 900,000 user minutes of interconnected VoIP service and results in complete loss of service; or potentially affects any special offices and facilities."<sup>41</sup> Providers must submit a final report on these outages no more than 30 days after the outage occurs.

Although the FCC Outage Reporting Order will provide the FCC with information necessary to monitor and improve the health of the broadband-enabled voice network as a whole, it does not provide state commissions with the state-level performance information they require; nor does it address a provider's success in dealing with individual customer problems. For this reason, states will still need to consider developing state-level service-availability metrics or applying current availability metrics to the new network.

#### **d. Billing accuracy**

Billing accuracy has become increasingly important as customers have moved to bundled broadband products that include VoIP. The FCC's Second Quarter 2012 Report of Inquiries and Informal Complaints lists billing issues and rates as one of the top five consumer concerns in the

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<sup>39</sup> *Proposed Extension of Part 4 of the Commission's Rules Regarding Outage Reporting to Interconnected Voice Over Internet Protocol Service Providers and Broadband Internet Service Providers*, Notice of Proposed Rulemaking, PS Docket No. 11-82, 26 FCC Rcd 7166 (2011) (NPRM).

<sup>40</sup> See 47 C.F.R. § 4.5(e). Special facilities for 911 include connections to emergency-service answering points.

<sup>41</sup> See 47 C.F.R. § 4.5(b).

Bundled and VoIP Service category, representing 35% of the complaints received by the agency.<sup>42</sup> Wireline billing questions represent only 3% of the inquiry/complaint volume, either as a result of commission oversight or customer familiarity with wireline bills. The complaint volume for broadband billing may increase as providers move from "all-you-can-eat billing" to data caps.<sup>43</sup>

Even large businesses and governments are not immune to billing errors. As an October 2012 story in the *DC Examiner* newspaper points out, billing accuracy is a significant concern for both residential and business customers.

Verizon has overbilled Fairfax County by more than \$3 million for phone service since 2006, and despite regular complaints, the billing problems remain so routine that the cash-strapped county has had to assign personnel to monitor its phone bill. The phone company has already refunded \$3.1 million to the county after overbilling it for services, but the county's Department of Information Technology just wrote Verizon to identify 97 additional billing errors costing \$190,000.<sup>44</sup>

Despite the limitations on regulatory oversight of VoIP and other broadband products, billing accuracy remains an important quality-of-service indicator for regulators and companies alike. Commissions that continue to accept (but not necessarily act on) customer complaints may want to establish a separate category for tracking billing problems. In addition, commissions may work with providers to ensure that billing information is clear and that customers understand the way they will be billed for the services they receive.

#### **e. Company responsiveness (call answer time)**

Wireline metrics track the time required for customers to reach live operators at their carrier's offices, in order to report trouble or resolve other questions (generally billing). The absolute requirement for a metric that tracks access to a "live operator" has become diluted over time, as more customers have chosen to report trouble via web-based systems or other self-service processes (email, voicemail, on-line reporting). Despite the increase in other access methods, the ability to reach an operator remains important for trouble reporting. In conjunction with mean time to repair, trouble levels, and outage reporting, tracking repair-call answer time could provide insight

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<sup>42</sup> *FCC Second Quarter 2012 Report of Inquiries and Informal Complaints*, available at <http://www.fcc.gov/document/second-quarter-2012-report-inquiries-and-informal-complaints>

<sup>43</sup> FCC Commissioner Ajit Pai appears to agree with the need to monitor the issue of data caps and usage-based pricing, noting in an October 4, 2012 interview with *TR Daily* that "it's important for the Commission to monitor the situation. I'm certainly not in favor of the Commission micromanaging the network management decisions of carriers, cable operators, and others, but we need to take account of what the realities of the marketplace are for consumers. I'm not opposed to a monitoring role for the Commission." *TR Daily*, 10/5/12.

<sup>44</sup> *Washington Examiner*, 10/4/12, "Verizon Overcharges Fairfax \$3.1M for Phone Service."

into the adequacy of repair processes, as well as an understanding of the reliability and availability of a company's service.

### III. Service-Quality Investigations

Both the FCC and state commissions have recognized that what can be measured can be managed and improved. The FCC cites its program for tracking and working with carriers to resolve and prevent large-scale network outages as increasing the quality and reliability of the overall network.

Over the years, [the FCC's tracking of network outages] has consistently resulted in reductions in the number of outages, as evidenced by a decrease in the number of outage reports filed. More important, the net decrease in the frequency of reported outages reflects an increase in the reliability of the communications infrastructure, which thereby leads to an increase in the availability of the public safety services that rely on the communications infrastructure. In short, as a result of reporting and our subsequent analysis, measureable reliability improvements have been achieved, and reporting has led to improvements in the engineering, provisioning, and deployment of communications infrastructure and services.<sup>45</sup>

State regulators and the FCC began to track retail service quality and implement metrics, including outage reporting, shortly after the breakup of the Bell System. The number of states developing new quality metrics or modifying existing metrics increased after the passage of the Telecommunications Act in 1996 (TA96), as the shift to competitive markets and new technologies appeared to result in diminished service quality and company responsiveness. The states implemented new metrics to ensure that the changes to the telecommunications industry caused by local competition did not negatively impact consumers.

NRRI's 1996 paper on service quality examined this issue in detail. NRRI surveyed state commissions in early 1996 to determine what changes (if any) they were implementing as a result of the Act. Thirty jurisdictions responded that they were revising their existing service-quality standards or implementing new ones as a result of service problems that appeared to stem from the move toward competition. These problems included provisioning delays, repair delays, billing errors, and the inability of consumers to reach their providers.<sup>46</sup>

The immediate concern of state regulatory commissioners and staff responsible for [the] quality of service provided by regulated monopolies [after the Act was] that preparing the way for competition [might] directly or indirectly lead to a decline in service quality.<sup>47</sup>

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<sup>45</sup> *Outage Reporting Order*, ¶13-14.

<sup>46</sup> *Id.*, pp. 2-3.

<sup>47</sup> Davis, Blank, Landsbergen, Zearfoss, Lawton, and Hoag, *Telecommunications Service Quality*, NRRI, March 1996.

Service-quality investigations in New York and California, as well as questions raised by the Connecticut, Virginia, and West Virginia commissions about carrier responses to recent weather events, suggest that the transition from circuit-switched telecommunications to broadband-enabled services may be having a result similar to the initial degradation of service quality observed in the early days of local competition. We discuss these investigations in the following paragraphs.

**A. New York: "Is the focus on new networks reducing support for existing customers?"**

The New York Public Service Commission (NY PSC) sets minimum quality-of-service standards for carriers under Public Service law Section 94.2, which gives the commission

general supervision of all . . . telephone corporations . . . and telephone lines within its jurisdiction . . . and shall have power to and shall examine the same and keep informed as to their general condition, . . . the manner in which their lines and property are . . . operated or managed, conducted, and operated with respect to the adequacy of and accommodation afforded by their service and also with respect to the safety and security of their lines.<sup>48</sup>

The NY PSC telecommunications quality-of-service metrics provide the commission with a window into the performance of carriers in the state. The commission began to be concerned about declines in Verizon's service-quality performance beginning in 2008.

Beginning in the summer of 2008, Verizon's timeliness-of-repair performance fell short of the threshold levels defined in the Commission's service standards. While over time there have been fewer out-of-service conditions in the aggregate, the percentage of customers who are out of service for more than 24 hours has increased over time.<sup>49</sup>

Verizon worked with the commission to indentify the root cause for the service problems and to develop a new set of metrics more suited to current conditions in the state; that is, the declining number of circuit-switched lines provided by Verizon, the increase in VoIP and wireless products, and the state of competition. Verizon argued that the existing service-quality standards were outdated and did not take into account changes in technology, including the availability of alternative voice products such as wireless that customers could use until their landline service was restored. According to Verizon, changes in technology have reduced the customer impact of the loss of telephone service, because the majority of customers have

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<sup>48</sup> *New York Public Service Law* Section 94.2. The current investigations do not address the question of whether this definition includes oversight of broadband networks.

<sup>49</sup> Order 10-C-0202 – Verizon Service Quality Improvement Plan. *Order Adopting Verizon New York Inc.'s Revised Service Quality Improvement Plan With Modifications (Issued and Effective December 17, 2010)*.

alternate means of communications available to them. Indeed, Verizon notes, many customers "even request that the company postpone repairs beyond the 24-hour interval provided for in the New York service metrics."<sup>50</sup>

Based on these arguments, in 2010, the commission adopted new service-quality metrics that applied only to those "core customers" who have no option other than to use Verizon's circuit-switched basic service for their telecommunications needs.<sup>51</sup> The proceeding remained open to allow the commission to continue to track Verizon's performance and to order changes if needed.

In April 2012, the Attorney General of New York (AG) filed comments in this proceeding, taking a different view of Verizon's performance and of the revised metrics by which that performance is tracked. According to the AG, despite the limited number of customers on whom Verizon must focus and the reduction in the requirement for speedy installation and repair, the quality of service for core customers (and, by extension, all Verizon wireline customers) has not improved. In his petition to modify the Verizon Service Quality Improvement Plan (SQIP), the AG suggests that Verizon's increased focus on new services such as wireless and FiOS has allowed the quality of the circuit-switched network to erode to the point where it will not meet "reasonable statewide service-quality standards, including network technical quality, customer service, installation, repair, and billing . . . and ensure[s] that services . . . are provided in a manner consistent with public safety."<sup>52</sup>

The AG's filing in this proceeding illuminates a critical issue facing state regulatory commissions during the transition from the traditional circuit-switched voice network to a broadband-enabled network—how to ensure that existing service quality remains intact during the transition process. It also points out the need to ensure that the new services will provide customers with equal or better service quality than the existing services.

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<sup>50</sup> Id.

<sup>51</sup> The NY PSC defines core customers as those that have wireline service only, cannot change providers due to their use of Lifeline, do not have the option of using wireless service, or are elderly. The proceeding remains open in order to track the performance against the revised metrics.

<sup>52</sup> New York Public Service Commission, *Petition of Attorney General Eric T. Schneiderman to Modify the Verizon Service Quality Improvement Plan*; Case 10-C-0202, April 25, 2012.

**B. California: "How has network maintenance affected service quality?"**

California is also reviewing the issue of wireline service quality and how it should be judged in light of the changes to network infrastructure. California General Order 133-C establishes minimum telephone service measures for basic telecommunications service as part of the commission's duty "to ensure that telephone corporations provide customer service that meets reasonable statewide service quality standards including, but not limited to, standards regarding network technical quality, customer service, installation, repair, and billing."<sup>53</sup>

The CPUC tracks and, when necessary, investigates major service interruptions and carrier performance against five customer-specific metrics:<sup>54</sup>

1. *Installation interval*

The length of time to install telephone service measured from the day and hour the customer requests the service until the time it is established.

2. *Installation commitments met*

Monthly count of the total installation commitments met and the commitments missed.

3. *Customer trouble reports*

Service-affecting and out-of-service trouble reports related to dissatisfaction with telephone-company services.

4. *Out-of-service repair interval*

The time required to restore service, from the initial report to service restoration.

5. *Answer time*

The time required for an operator to answer calls to the business office for billing and non-billing inquiries and to the repair office for trouble reports.

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<sup>53</sup> CA Public Utility Code § 2996, D.09-07-019 at 12.

<sup>54</sup> The quality-of-service standards apply to basic service provided by carriers of last resort, eligible telecommunications carriers receiving Lifeline or USF support, and carriers regulated under the Uniform Regulatory Framework (URF). This latter category includes the major CA ILECs, AT&T, and Verizon. Carriers report their performance to the Commission quarterly. The standards do not apply to enhanced service providers that "do not provide telephone service in addition to their information services." (GO 133-G, ¶1.g.) California is currently reviewing the definition of basic telecommunications service.

As in New York, customer complaint levels and the perceived slow response of carriers to performance outages have raised questions about the appropriateness and effectiveness of these measures, given the changes in the ways in which telecommunications services are provided. As a result of these questions, the CA PUC opened a rulemaking in 2011 to evaluate service-quality performance and to consider modification to the service-quality rules, and to

assess whether the existing GO 133-C service-quality standards and measures meet the goals of the Commission [and] are relevant to the current regulatory environment and market, and whether there is a need to establish a penalty mechanism for future substandard service quality performance.<sup>55</sup>

The Assigned Commissioner issued a scoping memo in the proceeding in September 2012,<sup>56</sup> determining that the proceeding will begin by examining the physical state of the network infrastructure to determine how they have been maintained and whether they are sufficient to meet service requirements. As the scoping memo points out, “Without ubiquitous functional infrastructure that is adequately maintained, services provided to customers will degrade. In extreme cases, facilities failures will lead to a complete loss of service, including E911, to customers served by those facilities.”<sup>57</sup>

In the second phase of the proceeding, the commission will focus on the quality of voice services provided to residential customers, including the applicability of service-quality rules or standards to services provided via different technological platforms.<sup>58</sup>

The California proceeding will not be completed until 2014. One of the key outcomes is expected to be the development of metrics that will ensure the health of the communications network going forward, particularly as it affects “the safety, health, comfort, and convenience of its patrons . . . and the public.”<sup>59</sup> The outcome of the proceeding may provide a template for other state commissions to use in determining how to develop and implement standards necessary for the transition of the network from switched-voice to broadband-enabled services.

### **C. Other state proceedings**

Connecticut, Virginia, and Maryland are also reviewing the quality of service provided by the ILECs in their states, both as a response to the 2011 and 2012 storms and based on the carriers' poor wireline-service performance over the last few years. In Connecticut, the

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<sup>55</sup> *Id.*, p. 3.

<sup>56</sup> *CA Rulemaking* 11-12-001.

<sup>57</sup> *Id.*

<sup>58</sup> *Id.*, p. 8.

<sup>59</sup> *California Public Utilities Code* §451.



investigation of responses to the 2012 snowstorms includes both telecommunications carriers and electric utilities.

In Colorado, the Public Utility Commission is reviewing the regulatory treatment of VoIP and IP-enabled services in Docket 12R-862T, *In the Matter of the Proposed Rules Regulating Telecommunications Providers, Services, and Products*, 4 Code of Colorado Regulations 723-2. Staff's comments in this docket propose that the commission keep VoIP and IP-enabled services deregulated in Colorado, but continue to evaluate the capabilities of new services to meet emergency-service requirements and investigate consumer complaints.<sup>60</sup>

In the District of Columbia, the Office of People's Counsel (OPC) brought a quality-of-service proceeding against Verizon Washington DC, Inc. on August 26, 2011.<sup>61</sup> The OPC initiated the proceeding as a result of numerous complaints from consumers and ratepayers throughout the city. The common theme of the complaints was that the existing Verizon DC telecommunications infrastructure in the District of Columbia was unreliable. The proceeding arose from OPC's allegations that Verizon DC failed to comply with the terms of the 2008 Price Cap Settlement Agreement, which were designed to ensure a high quality of service.

Additional states may open proceedings to examine quality of service for both existing and new networks as the transition to broadband-enabled services accelerates.

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<sup>60</sup> Colorado's telecommunications deregulation bill has been tabled indefinitely, allowing the state commission to continue to examine the best way to ensure broadband service quality.

<sup>61</sup> Public Service Commission of the District of Columbia, *In the Matter of the Petition of the Office of the People's Counsel for an Investigation into the Reliability of Verizon's Telecommunications Infrastructure in the District of Columbia*, FC 1090.

## **IV. Building a Culture of Broadband Service Quality**

Legislation in 24 states has removed broadband-enabled products in general, and VoIP, in particular, from regulatory oversight, but this "hands off broadband" stance does not mean that the broadband performance provided by carriers to end users is unimportant or that measuring this performance is unnecessary. As broadband adoption increases and the transition to an IP-enabled network continues, the quality of broadband telecommunications will have a key impact on health and safety. Because consumers will increasingly use these networks to reach first responders, they must be available, resilient, and able to meet the needs of their users to the same extent as that provided by the circuit-switched PSTN.

State regulators remain in a unique position to influence broadband service quality and to develop and track performance standards for these new networks, whether inside or outside the regulatory envelope. In doing so, they should consider the six questions we introduced at the beginning of this paper in order to ensure that the transition to broadband-enabled service does not result in performance gaps that might jeopardize the users. The following paragraphs discuss those questions and propose options regulators may consider in working with providers and consumers to build a culture of quality and implement performance goals that will ensure broadband service quality.

### **A. What service-quality measurements are appropriate for broadband networks?**

Quality standards allow us to evaluate performance and identify and correct problems before they escalate. Because consumers continue to see state regulatory commissions as their advocates in ensuring that the services they purchase are adequate to meet their needs, these regulators remain the best observers and evaluators of broadband performance. As carriers begin to decommission their existing networks and require customers to move to the new public broadband network, increasing numbers of users will be affected by any reduction in quality. Two sets of metrics, technical quality and customer experience, may provide the best way to look at network performance and quality in the future. We discuss these measurements below.

#### **1. Technical metrics**

##### **a. Network performance**

As we noted in our discussion of broadband metrics in Part II of this paper, a number of the existing performance metrics will remain important tools ensuring end-user quality of service even after the transition to a broadband network. These include the number of trouble reports received by carriers over a specific period, the mean time to repair trouble or restore service, and the level of repeat trouble reports. These metrics are indicators of the health of a provider's network in general, as well as the company's commitment to the level of maintenance required to keep the network functioning at required levels. This data can also be used to determine specific areas of concern; for example, reduced network performance when the weather is bad or when the network is congested.

The speed and latency of networks will also be an important indicator of service quality. The FCC will continue to monitor this information as part of the reporting requirements under the CAF and in its yearly studies of broadband adoption and quality. State commissions may want to compare the yearly FCC data to the information gathered.

State- or region-level outage-reporting requirements, perhaps based on the structure of the FCC Network Outage Reports (NOR), may also help regulators and consumers assess the quality of the networks that carry their calls. Providers themselves have made progress in this area, notifying customers and releasing information on network failures on a proactive basis. By building a culture of quality, state commissions can encourage providers not only to announce outages but also to provide clear explanations of their cause, their resolution, and measures that might have prevented them.

#### **b. Installation metrics**

As customers move from company installation to self-installation and bundled service, the time required to install service has become less important as an indicator of service quality than it has been in the past. Many customers no longer depend on a single voice product, making a single time component for providing customers with "working" service important only for those customers that have no other choice. Better metrics for evaluating installation may include technical accuracy (i.e., whether the service works as advertised), percentage of customer due dates met, and number of trouble calls within the first three months of service.

### **2. Customer-experience metrics**

#### **a. Customer complaints**

Customer complaints and concerns are an important tool for evaluating the success of the broadband-enabled voice networks in providing the service customers expect and need. Although legislation has limited (or, in some cases, even prohibited) state commissions from responding directly to complaints about VoIP or other broadband services, customers will continue to reach out to commission staff, consumer advocates, and other state authorities to resolve service-quality or performance issues. States may use this data, as well as data from the FCC broadband outage reports and quarterly FCC complaint data, to identify specific areas that require intervention. States that retain some control over ETCs and carriers of last resort may be able to use this data directly to ensure high levels of carrier performance. Finally, carriers themselves may be amenable to sharing aggregate performance data with state commissions, as a way of encouraging customers to transition to broadband voice services.

#### **b. Billing**

Usage caps, bundled offerings, and the availability of new services will complicate end-user billing and result in questions and concerns. While commissions can no longer require standardized billing or respond to billing complaints, they can review carrier performance by tracking consumer questions about and responses to these bills. Recent statements by both FCC Chairman Genachowski and Commissioner Ajit Pai suggest that the Commission, too, sees the

need to monitor the success of usage billing.<sup>62</sup> State commissions may work with the FCC to determine what impact (if any) usage caps have on the ability of customers to maintain voice services and understand how much service they have used and what it will cost them.

**c. Carrier responsiveness**

Carrier responsiveness is an important but subjective measure of performance. Customers need to reach carriers to report trouble, ask questions, or change their service. Current wireline metrics require carriers to answer calls to their help desks within specific time frames (x number of seconds to reach a live operator) and have measured their performance against this standard. Today, as a byproduct of the widespread availability of broadband access, carriers provide multiple ways for customers to contact them, including online chat, email, and web-based frequently asked question lists (FAQs), in addition to help desks staffed by live operators. The availability of these multiple communications channels signal the need for new, more granular responsiveness measures.

The ability to place a trouble report with a carrier in order to restore service remains a critical requirement for judging service quality, particularly for customers who have no option but their broadband-enabled voice service. These customers will need service in order to reach first responders and in other critical situations. Broadband providers and commissions should work together to track company responsiveness and develop a process for identifying problems and responding to them.

**B. Who could establish and enforce quality metrics for broadband-enabled voice networks?**

Most commenters credit the PSTN's high level of performance and reliability to the quality standards originally put in place for the network by the Bell System and monitored over the years by state and federal regulators. Carriers that use the PSTN adhere to well-established standards that guarantee the transmission quality necessary to successfully carry voice and data communications. These standards provide a set of rules for sound levels, testing, outage reporting, and the other tasks necessary to ensure that the network is available 99.999% of the time. Do these TDM network quality standards provide the proper standard for the public broadband network and the IP-enabled voice services it supports? Is such a standard appropriate or even achievable? Should there be a single set of standards for all carriers providing broadband-enabled voice services? Or should service standards be individualized for each type of provider—for example, one set of standards for interconnected VoIP provided over managed networks and a second set for the same type of services provided by services that use the public Internet? How states, providers, and the FCC answer these questions will be critical to ensuring that the new broadband networks continue to provide a reliable communications backbone to support critical public-safety requirements.

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<sup>62</sup> “Pai Speaks Out In Favor Of Speedy Action, Less Onerous Rules,” *TR Daily*, October 4, 2012.

Could a federal standard for broadband-enabled voice service quality, developed in collaboration with the states and monitored and enforced by the states, ensure broadband service quality? The FCC has begun to define broadband service-quality standards by setting performance metrics for carriers accepting CAF funds, as well as by establishing outage-reporting requirements, but they have not yet addressed the question of applying a single set of standards to all carriers. As the transition to a fully broadband network continues, a single set of baseline performance standards accompanied by an aggressive consumer-education program may be necessary to ensure service quality and help users understand and compare the competitive services available to them. These standards could include a requirement for battery backup to ensure service during commercial power outages, a minimum level of voice minutes available even when the customer's data allowance is exhausted, and standards for service availability and restoration. Experience with these new services will help regulators and companies determine which standards are most important for ensuring that consumers receive satisfactory service, including access to emergency services. Such a collaborative approach between the states and the federal government would ensure that voice quality standards meet the specific needs of individual jurisdictions, as well as the overall need to define and manage broadband voice quality.

State initiatives for defining and managing service quality are also under consideration. Colorado, for example, is reviewing the need to create standards that will ensure the availability of emergency services from VoIP carriers. Docket 12R-862T, which reviews the state's universal-service requirements, includes a proposal that the commission continue to have jurisdiction over VoIP and IP-enabled services under two conditions:

(a) to the extent such services are used to provide support for emergency telephone service, ... or (b) to the extent such services are used to provide local service to residential customers, in which case the commission may assist customers in resolving complaints regarding service quality or billing disputes with the appropriate provider.<sup>63</sup>

As the transition to broadband-enabled voice service continues, minimum standards will be necessary for all carriers. In the long term, separate standards may need to be developed for carriers using managed networks and those that depend on the Internet to deliver both voice and data traffic.

### **C. Could commission/provider collaboration ensure broadband service quality?**

The question of VoIP regulation (or non-regulation) remains open. The FCC has not precluded the states from addressing the issue of VoIP service quality, particularly as it applies to emergency services. Indeed, the FCC has treated VoIP services in the same manner as it treats wireline services in a number of decisions. It has required interconnected VoIP providers to provide connectivity to emergency services, is tracking carrier outages as they impact emergency

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<sup>63</sup> Colorado PUC Docket 12R-862T.

services, continues to consider at least some portion of VoIP transmission "intrastate" (and thus under the jurisdiction of state commissions), and has prescribed quality standards for CAF recipients. As the staff of the Colorado Public Utility Commission points out in its Reply comments in Docket 12R-862T, the FCC has not made a "blanket determination . . . whether or not IP-enabled services (which includes VoIP) are telecommunications services or information services,"<sup>64</sup> and it has not, therefore, determined how they might ultimately be regulated.

Given the open question of VoIP's classification and the limitations placed on the states by deregulation, is there a way for states to develop and track the metrics necessary to ensure that carriers provide a consistent level of service that meets customer expectations and ensures access to emergency services? Given the recognized need to ensure that the communications services are robust enough to ensure the health and welfare of the states' citizens, the need for quality-of-service standards should be recognized as technology neutral. For that reason, we propose three potential avenues to resolve this problem.

First, despite legislation, states retain authority over emergency services, consumer rights, and state universal-service programs. They might use this authority to create and enforce performance standards. For example, states might use their authority over emergency services to create a standards-based program to ensure that carriers provide the quality of service necessary to ensure access to 911 services on a continuous basis. Most of the legislation deregulating telecommunications retains some commission oversight of emergency services (i.e., 911/E911). Because network uptime is critical to a customer's ability to reach emergency services, states may be able to measure and track network quality, including mean time between failures, frequency of outages, and the mean time to restore service in order to ensure access to these services. States might also use their consumer-protection regulations to address a company's chronic failure to meet quality-of-service claims, or to address billing issues, particularly if those claims appear in advertising or sales literature. And, to the extent that carriers accept state USF funding, states might continue to require specific performance levels under their ETC rules.

Second, commissions could work with providers to develop baseline quality standards and to launch collaborative inquiries into failures. Collaborative processes were successful in developing and tracking quality of service for wholesale services provided under Sections 251 and 252 of the 1996 Act. They could be equally successful as a method for ensuring retail quality of service. By working with providers, consumer advocates, and others, commissions might develop a set of VoIP service measurements to which carriers would voluntarily subscribe. They might even issue a "state seal of approval" to those carriers that meet or exceed these quality standards on a regular basis.

And third, states might encourage providers to offer retail service-level agreements (SLAs) that include specific quality-of-service requirements. Large companies regularly negotiate SLAs with their providers. These agreements cover the way in which service will be provided, including installation intervals, mean time to repair outages, service availability,

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<sup>64</sup> Id., p. 32.

transmission speed, etc, and so on. These metrics are similar to the wireline service standards the states measure today. States, carriers, and the FCC could work together on a collaborative basis to develop retail service-level agreements, tracked and monitored by the state commissions in order to ensure that the performance of the new broadband networks meets or exceeds the performance of the circuit-switched PSTN.<sup>65</sup>

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<sup>65</sup> Current service-level agreements tend to focus on "best efforts" service quality. Comcast's service "guarantee" illustrates this limitation: "We shall not be liable for any inconvenience, loss, liability, or damage resulting from any interruption of the Services, directly or indirectly caused by, or proximately resulting from, any circumstances beyond our control, including, but not limited to, causes attributable to you or your property; inability to obtain access to the Premises; failure of any cable signal at the transmitter; failure of a communications satellite; loss of use of poles or other utility facilities; strike; labor dispute; riot or insurrection; war; explosion; malicious mischief; fire, flood, lightning, earthquake, wind, ice, extreme weather conditions or other acts of God; failure or reduction of power; or any court order, law, act or order of government restricting or prohibiting the operation or delivery of the Services."

## V. Conclusions

The transition to broadband-enabled networks poses new questions for commissions, providers, and consumers regarding tracking, measuring, and ensuring quality of service. As an article on service quality in *Connected Planet* points out,

Ultimately, like beauty being in the eye of the beholder, VoIP quality rests in the ear of the user. Quality is all about human perception. It isn't enough for a service provider to chase absolute quality. It's actually more important to strive for determinism. If the quality cannot be [specified], and an enterprise [or consumer] isn't sure every time they pick up the handset [that they will be able to hear and process the call], that is [the] wors[t] scenario.<sup>66</sup>

As the authority closest to the users of these services, state commissions are in the best position to work with consumers and companies to define and measure service quality. Commissions must consider what service-quality measurements are appropriate for broadband networks and how these measures could best be applied in their states. Companies must consider how to assure that the services they provide continue to meet or exceed the high standards provided by today's circuit-switched PSTN, regardless of whether they offer these services via managed networks or over the public Internet. And consumers must learn how to judge the quality of the networks and providers from whom they may choose before they move their communications to the broadband-enabled networks of the future. Despite legislation reducing or eliminating state commission oversight of VoIP, state commissions remain in the best position to work with all parties to develop, implement, and potentially enforce quality of service for broadband networks.

Measuring service quality remains one of the most important tools commissions have for ensuring that consumers continue to enjoy the reliable telecommunications service necessary for their health and safety. By continuing to track network and service outages, state commissions can identify service problems before they become widespread. And by reviewing customer complaints, state commissions may help companies to determine where telecommunications service falls short of goals. While legislation has limited the ability of state regulators to assert direct authority over VoIP and broadband-enabled services, these regulators remain in the best position to work with both sides of the communications equation (sellers and buyers) to define and meet the needs of both parties. Because the transition to broadband-enabled networks is escalating, commissions will want to focus on the questions discussed in this paper now, so that they may address them in a timely and proactive manner.

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<sup>66</sup> Vince Vittore, "Does QOS Matter for Voice over IP?" *Connected Planet*, 4/11/05



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