

## Keynote VoIP Competitive Intelligence Study Overview

In September 2006, Keynote Systems reported on the results of Wave 3 of its Voice Service Quality Competitive Intelligence study that evaluated how end-users perceive the core reliability and audio clarity of leading VoIP Service Providers.

This study is unique because this was the first time Keynote compared relative performance of PSTN (regular analog) service, Softphone services (e.g. Skype, MSN Messenger Live, Vonage), Broadband VoIP services (e.g. Vonage, Verizon VoiceWing, Packet8, AT&T) and Digital Cable services (e.g. Time Warner Digital Phone, Comcast Digital Phone) in New York and San Francisco monitoring locations. Keynote - an independent, trusted authority on Internet performance - conducts benchmarking studies for various industries on an ongoing basis, to assess the experience of end-users with key applications over time. The VoIP Competitive Intelligence study, first launched in July 2005 (Wave 1) and followed by Wave 2 in January 2006, evaluates critical performance factors that affect the consumer's experience with VoIP service, in the New York and San Francisco markets. Keynote's Wave 1, Wave 2 and Wave 3 studies, widely quoted in industry publications and leading newsletters worldwide and based on an industry-standard methodology, has already helped service providers enhance their end-user experience and reduce attrition rates dramatically. Wave 3 of the study features several new service providers especially the softphone providers including Skype, MSN Live Messenger, Vonage softphone and also Comcast digital phone in San Francisco.

Analysts estimate that residential adoption of VoIP service is bound to grow exponentially from 6.9 million homes in 2006 to over 23.7 million homes in 2010. The SMB and enterprise market forecasts are equally aggressive. Even so, VoIP reliability and audio clarity remain important factors that limit the widespread adoption of VoIP in consumer markets. Indeed, Keynote found in its first study that VoIP providers on average were able to complete calls only 96.9% of the time with a Mean Opinion Score (MOS) of less than 3.5 - considerably worse than the standard for traditional phones of 4.2! It should not be surprising then that 52% of respondents in a recent survey by Harris Interactive indicated VoIP call quality as a key barrier to adoption. How can VoIP providers in the residential and SMB market overcome consumer perception of poor reliability

and call-quality and live up to the dial-tone quality that consumers have come to expect over the years? Keynote's Competitive Intelligence study reveals the facts that help VoIP providers overcome the quality barrier relative to traditional phone service. Keynote evaluates audio quality as well as underlying network performance - whether DSL, or Cable - that affect the end-user experience and compares them across various VoIP service providers and traditional phone service. With this insight, Keynote provides actionable recommendations to help improve end-user facing service quality and capitalize on growing market adoption.

The poor end-user experience is one of the major factors for the customer attrition / churn. The data and recommendations provided by these studies have helped VoIP providers in addressing one of the key concerns to their profitability i.e. the proactive monitoring of the customer pain points related to the voice service quality.

### Study Participants

Keynote measured and evaluated the performance of the following thirteen consumer VoIP Service Providers as part of this competitive intelligence study. With the exception of Time Warner that offers service in New York area, and Comcast in the San Francisco area, other providers offer VoIP service in both the metropolitan areas. The profiled providers are:



### Wave 3 Study Objectives

Following were the primary objectives of the Wave 3 VoIP Competitive Intelligence Study:

- Rank the relative performance of PSTN, PacketCable, VoIP hard phone, and VoIP soft phone service providers.
- Examine peak and prime-time performance variations.

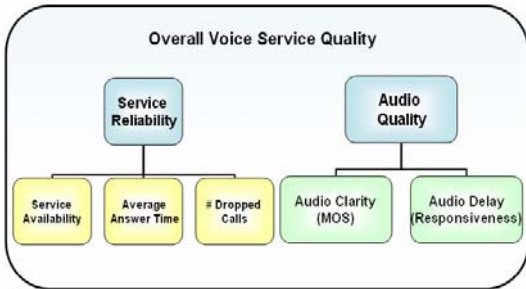
- Identify the industry trends in service level performance since the last Keynote study.
- Identify the range of performance between the best voice service providers and the worst.
- Identify the strengths and weaknesses of each service provider and voice service technology.

- Is VoIP service as reliable as PSTN (Public Switched Telephone Network) service?
- On which provider's VoIP service does the call audio sound the best?
- Which VoIP service provider had the most dropped calls?
- Which network carriers have the highest network level jitter?
- Are residential consumers using VoIP better off on cable modems or DSL?

**Summary of Wave 3 Results**

Keynote ranked service providers in two categories - Most Reliable and Best Audio Quality.

Service Availability, Average Answer Time, and Dropped Calls Performance Factors all contributed to the Most Reliable ranking. Audio Clarity (MOS) and Audio Delay contribute to Audio Quality ranking.



The overall analysis is performed based on evaluating the network carriers in nine Key Performance Factors. The Key Performance Factors are:

- Service Availability
- Average answer time
- Dropped Calls
- Average MOS (Mean Opinion Score)
- Percentage of Calls with Acceptable MOS
- MOS Standard Deviation
- Average Audio Delay
- Percentage of Calls with Acceptable Audio Delay
- Audio Delay Standard Deviation

Each Key Performance Factor represents a distinct aspect of VoIP call performance; as illustrated by the selection of results presented below. It is rare for a single VoIP service provider or network carrier to excel in all ten aspects. Keynote's Competitive Intelligence Study Report presents detailed analysis and results for each performance aspect separately.

The full report provides detailed answers to questions like:

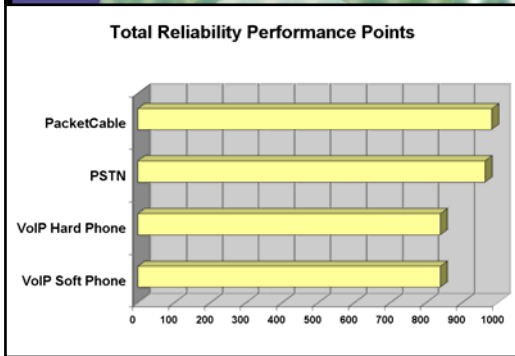
The following sections offer highlights of the findings key performance factors:

**General Observations**

- Most service providers have shown improvement over the past year in key performance indicators such as Service Availability and Average MOS.
- Most Service Providers measured an average one-way audio delay between 150 and 250 ms. The best measured delay was 62 ms; the worst was 335 ms. For a comfortable conversation, the optimum suggested delay is 150ms or less.
- Most Service Providers measured an average Mean Opinion Score somewhere between 3.0 and 4.0. The best measured average was 4.24; the worst was a 2.64.
- PacketCable service providers had superior Reliability and Audio quality performance.
- VoIP Service Providers had a higher variation between primetime and non-primetime hours in audio delay than in Mean Opinion Score.
- DSL connections delivered more consistent primetime versus non-primetime hour audio delay performance, but cable modem connection delivered more consistent Mean Opinion Scores.
- Most VoIP service providers still have many calls with temporal clipping or audio holdover causing service degradation.

**Reliability Overview**

- PacketCable service providers are more reliable than PSTN, VoIP Hard Phone, and VoIP Soft Phone service providers.



using voice sample to evaluate speech quality using PESQ (Perceptual Evaluation of the Speech Quality) provides true idea of the end-user experience.

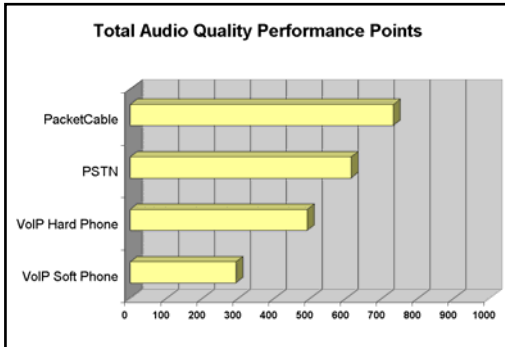
**Study Results Availability**

The study results are available in two formats:

- An overview presentation, which reveals general industry trends and highlights the performance of only the best VoIP Service Providers and Network Carriers. The insight gained from this competitive intelligence helps executives identify general areas of service improvement that will have the maximum impact on VoIP customer experience.
- A detailed presentation that analyzes each of the ten performance factors in depth. The detailed presentation includes analysis of the data across VoIP Service Providers, Network Carriers, network connection types, and different cities. The presentation also reports on the network-level performance of each Network Carrier. Armed with this intelligence, IT Managers can tune specific aspects of their VoIP service to provide better performance to customers than their competition.

**Audio Quality Overview**

- PacketCable service providers had better overall audio quality than PSTN, VoIP Hard Phone, and VoIP Soft Phone service providers.



**About Keynote Systems**

Keynote Systems, The Internet Performance Authority®, is the worldwide leader in e-business performance management services. Over 2,100 corporate IT departments and 19,000 individual subscribers rely on Keynote’s growing range of measurement and monitoring, service level and customer experience management services to improve e-business performance by reducing costs, improving customer satisfaction and increasing profitability. Keynote Test and Measurement products provide enterprises with the tools to align IT and e-business goals. Keynote’s SLM solution suites offer comprehensive approach to the problem of managing e-business service levels effectively for IT, application deployment and support personnel and e-business executives. To learn more about Keynote’s Competitive Intelligence Study, visit: [http://www.keynote.com/solutions/ci\\_voipStudies.html](http://www.keynote.com/solutions/ci_voipStudies.html) or contact us at [sales@keynote.com](mailto:sales@keynote.com) (1-800-KEYNOTE).

**Audio Characteristic Analysis: Keynote Distinction**

	All Calls		Calls with MOS < 3.1	
	# of calls	Percentage	# of calls	Percentage
Back Clipping	710	0.93%	27	0.25%
Front Clipping	32465	42.37%	10666	96.92%
High Frequency Clipping	1668	2.18%	939	8.53%
Hiss	130	0.17%	87	0.79%
Holdover	52205	68.13%	10845	98.55%
Hum	24504	31.98%	10721	97.42%
Other Clipping	44656	58.27%	10781	97.96%
Static	226	0.29%	51	0.46%
<b>Total</b>	<b>76630</b>		<b>11005</b>	

Our analysis found that the calls with MOS < 3.1 (consider unsatisfactory quality) had higher frequency of bad audio characteristic values, indicating that measuring network parameters only (latency, jitter, packet loss etc.) does not provide accurate end-user perspective of the voice service quality. Keynote’s methodology of