epitiro

GLOBAL BROADBAND BENCHMARKING

Peer-to-Peer Pressure

Evolution of the ISP Network Management Model

White Paper

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Executive Summary

This whitepaper introduces a new methodology for managing ISP networks and service levels in light of the growing consumer usage of bandwidth-consuming P2P applications. Epitiro's absolute coverage model aspires to capture metrics concerning both network performance and customer experience for applications including client/server data transfer, P2P file sharing, VoIP and video streaming.

The whitepaper contrasts the full scope of the new 'absolute coverage' model with the shortcomings of today's typical network management methodology that fails to capture customer-experience details or provide insight into competitor performance. The wealth of intelligence gathered with the absolute coverage model enhances the ability to operate Traffic Management schemes in addition to improving Network Planning, Customer Support and Marketing functions.

The paper also explores the anti-piracy, regulatory and consumer activities associated with surging popularity of P2P file sharing in both the U.S. and the EU.

Epitiro outlines the necessary steps and potential impact for ISPs, Regulators and Media companies transitioning to an absolute coverage solution, and recommends that those entities empower their key departments by making up-to-the-minute intelligence available on demand.

Introduction

The growing use of peer-to-peer (P2P) file sharing is raising bandwidth demand to an all-time high. Subscribers are demanding full bandwidth allocation during peak periods of the day as video, music and game files are shared around the World Wide Web, straining the network capabilities of ISPs and ultimately affecting customer experience.

The possibility of relief through ISPs having the right to block illegal piracy traffic may or may not be forthcoming and is dependant on the country or regional area. Whilst the French regulator ARMT[1] is taking initiatives to empower ISPs to control illegal file sharing, the US's Federal Communications Commission[2] (FCC) is investigating Comcast Ltd for illegally filtering P2P traffic.

Regardless of the legal wrangling, legitimate file-sharing sites are moving P2P traffic from an underground activity into the mainstream. Sites such as the BBC's iPlayer and Channel4's On Demand offer legal video content whilst P2P Next recently announced a £10m ($20m U.S.) E.U. grant for developing a Bit Torrent client[3] with the BBC, the European Broadcasting Union (EBU) and 19 universities, all collaborating on Europe's next-generation Internet television distribution system. Subscribers will increasingly be able to tap into legitimate live broadcasts plus a global back catalogue of music and video – all on demand.

As ISPs begin to struggle with meeting bandwidth demands, regulators and consumer advocate groups are questioning the industry's ability to deliver the level of service promised.

Under mounting pressure from UK consumers, the Ofcom Consumer Panel[4] has called on Ofcom and the ISP industry to develop a code of practice. This move strongly suggests that ISPs are misleading and short-changing subscribers. Further causing discontent, The Gadget Show[5] launched an overwhelmingly popular speed test application for consumers to easily check their level of service. Some ISPs have pushed back through "fair usage" and "legal traffic" policies, and many are using rudimentary traffic management techniques based on "de-prioritising" P2P data.

ISPs are forecasting a tremendous, and arguably unfair, burden should they be forced to become the new media path for music and video. Plusnet's report[6] on the impact of the BBC's iPlayer claims its costs of carrying 'streaming' traffic have jumped threefold with total streaming traffic up 66% in one month. Yet the massive increase is based on a mere 2% of Plusnet subscribers using iPlayer – just a tip of the tip of the iceberg.

Part of the solution for enabling ISPs to cope with increased traffic may be realised in emerging technologies that intelligently source the many disparate files that comprise a complete P2P download. The concept is based around software that automatically detects peers on the same network - such as employees of the same company or residents of the same neighborhood who share the same DSL loop - thus eliminating the congestion caused by P2P applications transferring files from around the globe. Content distributors call this strategy "edge-of-network distribution" because it uses

the "edges," or low-traffic back roads of the internet, rather than the crowded backbones. Yet for this technology to move forward ISPs, media providers and P2P application developers will need to work in concert – a partnership that may take years to develop – and will rely on access to extensive subscriber and network intelligence.

Certainly ISPs will require ready access to meaningful and current intelligence to manage both traffic and customer expectations throughout the forthcoming era of broadband usage. Access to data on true customer demand, traffic management and network performance will be vital for setting ISP service levels and planning network expansion.

This paper explores the limits of the current network management and customer satisfaction measurement model whilst introducing a beneficial new absolute coverage model pioneered by Epitiro.

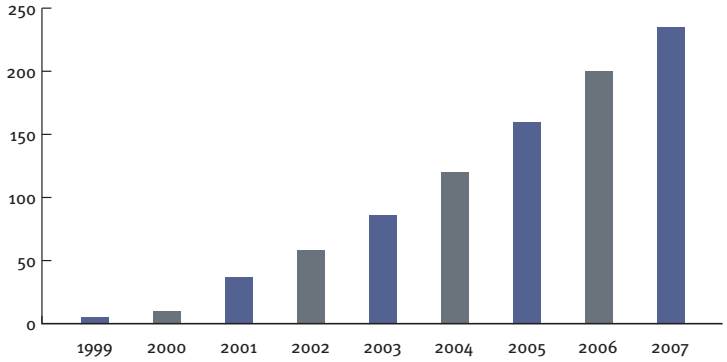

Figure 1: Graph showing a total of 235 million broadband subscribers by end of 2007, according to data published by the Organization of Economic Co-Operation and Development.

Analysis of Current Management Model: Part-Coverage

Today, ISPs typically collect intelligence on network performance from two feedback streams: network management tools measure the physical network whilst feedback from subscribers provides a view of customer satisfaction. The data available from these feedback streams provides partial coverage of the ISP's actual service level. The shortcomings of this management model are significant, ultimately leaving decision-makers to act on insufficient information.

In the partial coverage model, the scope of the network tested is usually restricted to the core and urban nodes as extending test capabilities to the "edge" – where subscribers reside – is not financially feasible. The costs for deploying and installing test probes to subscriber homes would probably exceed the annual broadband service fees that an ISP collects.

Further compounding the problem with the partial coverage model, many of the installed network management solutions are limited to testing only client/server operations, stopping short of the more difficult to achieve P2P performance measurement testing. An independent report by the IFPI[7] estimates up to 80% of ISP traffic comprises distribution of copyright-infringing files. Hence, the inability to understand network performance with respect to P2P is certainly a major risk for ISPs.

Customer experience intelligence is particularly compromised in the partial coverage model as, without a presence in the CPE, emerging end user quality algorithms are unable to be deployed. Consequently ISPs rely largely on feedback in the form of customer complaints. Whilst complaints are a valuable stream of customer experience intelligence, objections represent both the pinnacle of customer dissatisfaction and a point where ISPs either operate in fire fighting mode or risk losing a customer. A recent O2 survey[8] revealed Britons are very dissatisfied with both broadband service and customer service. Ultimately operating costs or revenues are negatively affected in fire fighting mode. Moreover, ISPs only receive a trickle of the available customer experience data as typically a small portion of customers actually take the time to complain whilst those having a positive experience rarely provide any feedback.

Until now the current partial coverage model has been adequate now for rolling out broadband networks. However, its lack of reach to the customer, inability to fully test P2P traffic and absence of customer experience metrics will not provide the level of intelligence ISPs will require in the pending era of broadband usage.

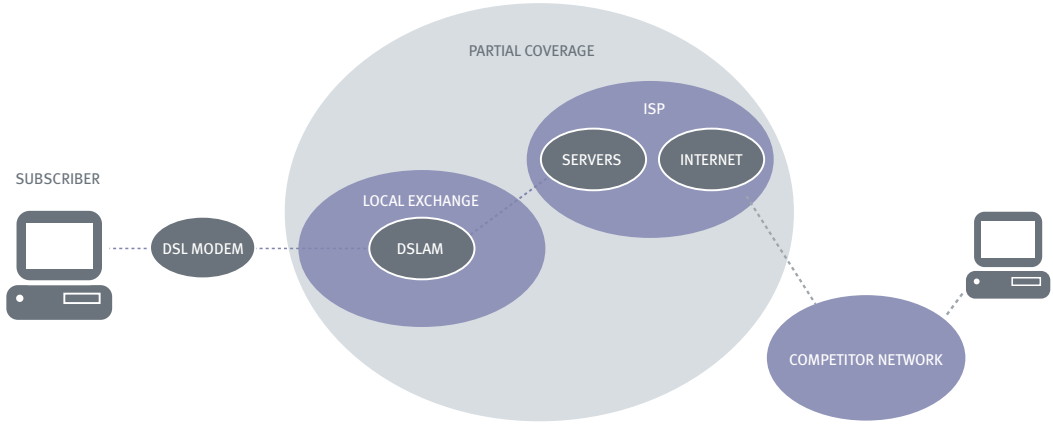

Figure 2: Diagram showing the limitations of the Partial Coverage model including no metrics on customer experience or CPE. Competitor performance is also not monitored with the Partial Coverage model.

The Next Generation Management Model: Absolute Coverage

Epitiro's vision of an ideal network management capability is based on a solution that provides a full assessment of the network from both an operational and customer experience viewpoint. The Absolute Coverage model provides ISPs with the following;

- 100% Granularity - full coverage of the network including each and every customer with the ability to expand as new subscribers join and easily retrofit to an existing customer base

- P2P and Client/Server Testing – network performance data including the most popular usage of the internet, P2P, as well as client/server data thus covering web, email, VoIP and video applications

- Continuous Monitoring - Up-to-the-minute data, readily available to all departments of an ISP.

- Competitive Analysis – A view of how other ISPs conduct traffic management, including P2P files

To achieve the absolute coverage model technically a presence is required not only in the core, backbone and network nodes, but at each subscriber location, ideally within the CPE. Epitiro's Desktop Agent™ is a pioneering example of a software test application that can reside in a subscriber's PC and provide ISP performance and customer experience data from the network edge.

How Absolute Coverage Works

In the absolute coverage model, the software application resident in the CPE performs P2P, client/server and CPE tests then forwards the measurement data to a central repository. There, authorised users from ISPs can view the data at any level of granularity, sorting the data by any relevant field.

The most practical place to embed a software test application is within subscriber PCs. Functioning either invisibly to the subscriber, or openly sharing test results, the software test application can be deployed as part of the new subscriber start-up process as well as downloaded to the installed base.

The software test application checks the CPE functionality by testing the resident hardware, software (including viruses) and configuration. Testing of broadband connectivity and popular applications such as video streaming, web surfing, emailing, VoIP and P2P file sharing is dynamically executed so that it has no impact or perceivable effect on the end user.

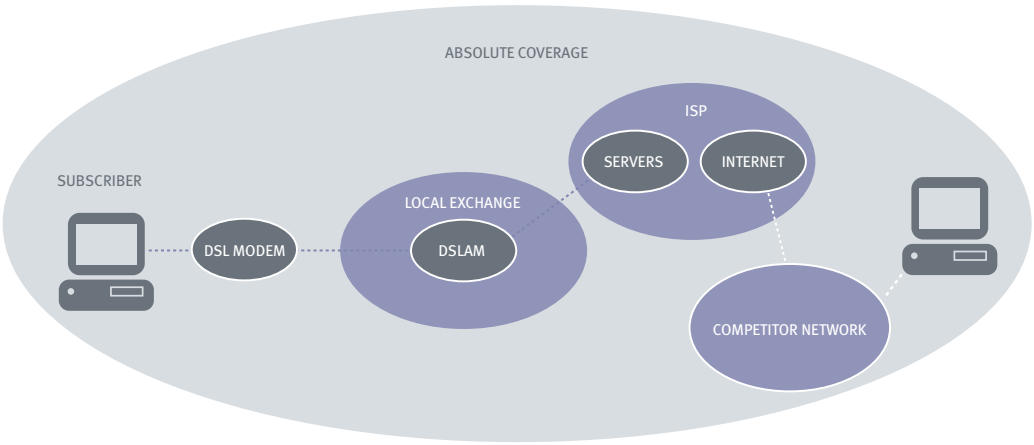

Figure 3: Diagram showing the capabilities of the Absolute Coverage model including metrics on customer experience, CPE, core network performance and also competitor performance.

Types of Measurements

Ideally, ISPs, media companies and regulators would benefit from understanding both the technical merit of broadband networks and the actual user experience. The breadth and depth of this type of information would be useful throughout the entire organisation. Hence, the absolute coverage model provides analysis of the network from a technical viewpoint and measures customer experience.

Network Performance

Network performance measurements are a collection of individual metrics considering the technical aspects of the network. The measurements are made with the network handling Client/Server and P2P traffic.

Client/Server Analysis

Typical network management measurements for client/server include upload/download rate, IP address, ping, packet loss etc. Though these metrics are commonplace today in the core network, an understanding of the actual performance at the CPE is an essential element of the absolute coverage model. Latency and throughput, for example, are two key metrics that affect a customer's perceived quality of service and thus should be measured directly to and from the CPE.

Peer to Peer Analysis

A peer-to-peer analysis differs from the traditional client/server model as the PC-based software agents involved act as both clients and servers. The application must be able to find other applications that are willing to share information. Port-based analysis is the most basic and straightforward method to detect P2P users in network traffic, though clients can easily avoid detection by masking or changing ports. However, a more thorough measurement Application layer (L7) protocol analysis (Deep Packet Inspection) will detect P2P traffic from clients using non-default or dynamic ports. Typically this works by monitoring IP packets passing through the network the data payload referenced to defined P2P application signatures.

Traffic Shaping Effectiveness can also be analysed by comparing P2P traffic performance with client/server (i.e. HTTP) along the same path, by initially running a P2P TCP-based transfer immediately followed by an HTTP transfer. Further, by using signature-based analysis Traffic Shaping Effectiveness can be measured using a small selection of software agents, thus avoiding making testing a burden on the network.

Customer Experience Testing

ISPs striving to deliver an acceptable quality of service to subscribers need access to end user experience information. Quality is subjective and based on the experience an end user has compared to what was expected. Consequently the most practical to method to measure customer experience is to simulate the execution of popular software applications and use perceptual analysis software to rate the quality.

VoIP

Packet loss, jitter and latency are typical key measurements for analysing network performance. Voice communication is, however, a two-way real time application and customer experience is based on the combined affect of all network degradations. Industry has adopted ITU standard P.862 PESQ[9] (Perceptual Evaluation of Speech Quality) as the preferred method of understanding actual customer experience. PESQ provides a Mean Opinion Score (MOS) representing the average quality rating a cross-section of atypical subscribers would express. MOS scores for voice communication include the combined affects of degradations in delay, volume, echo and audible distortions.

Video Streaming

Much like VoIP, analysis of video streaming is best accomplished by understanding both the individual technical metrics and overall quality (MOS) rating. Video streaming is more complex than VoIP as it is comprised of both visual and audible components. Different metrics are required to analyse each component, whilst measurements concerning the synchronicity between audio and video are also important for understanding overall customer experience. It is expected that the ITU will provide a practical standard for measuring quality that industry will embrace as a result of the work conducted by Study Group 9 (SG9) in consideration of digital, analogue and HDTV, based on ITU-D J.144 being the one standard somewhat embraced by early adopters.

Business Advantages for ISPs for using Absolute Coverage

The absolute coverage methodology provides ISPs, regulators and media companies with timely, accurate and extensive insight into network performance and customer experience. . According to Epitiro's Internet Performance Index (IPI)[10], O2 recently showed that ISP service can improve. For the first time O2 has scored in the top five consumer ADSL broadband providers in the UK. The ISP ranked third in terms of technical performance over the second half of 2007, just behind Plusnet. With the potential of 100% coverage – i.e. 24/7 metrics on every subscriber – there is virtually unlimited potential for the key departments within ISPs to improve effectiveness.

Traffic Management

Traffic Management is a commonplace activity amongst ISPs striving to balance peak demands for bandwidth whilst providing an acceptable level of service for all customers. Operating an efficient traffic management scheme requires the summed knowledge of actual user experience, an understanding of the effect of any traffic management apparatus and an accurate forecast of demand vs. capability to deliver. The absolute coverage model not only provides feedback on the effect of traffic management efforts, the wealth of data can also be used for accurate forecasting of bandwidth demand.

Competitor Analysis

Understanding the traffic shaping and service levels of the competitive ISPs will increasingly be a concern as service providers strive to win and retain subscribers. The absolute coverage model provides full insight into an ISP's network plus it provides direct comparative information on competing ISPs.

Network & Capacity Planning

The challenge of network planning – building just enough infrastructure to account for subscriber growth, usage trends and potential traffic - can be greatly assisted with the comprehensive data accumulated via absolute coverage. Analysis of bandwidth consumption by postcode, for example, can dictate the type of infrastructure required for a student housing area.

Regulatory Representatives

Governments around the world are increasingly seeing effective broadband as a necessary foundation block for a country's financial success. Consequently regulatory bodies are demanding evidence that service levels are adequate today and expanding for the future.

Within Europe, the EC Universal Service Directive[11] (Universal Service Order (USO) in UK) sees access to telephone service as a right for all EU citizens. Though access to broadband service is not yet a right, there is overwhelming evidence that government in the UK sees it as essential. Recently the UK government announced a £30M project[12] to ensure schoolchildren and low-income families have broadband access. Further, the ground swell from consumers dissatisfied with actual vs. offered broadband speeds has provoked Ed Richards, CEO of Ofcom, to ask leading ISPs to provide consumers with information on the actual speed being achieved[13]. The increase in P2P traffic has undoubtedly caused broadband service levels to dip and, accordingly, consumers and regulators to press for answers.

Meanwhile the Centre for American Progress[14] (CAP) has harshly criticised the US government for not progressing broadband communications.

A recent OECD[15] report lists the US in 15th place, whilst an ITIF[16] report puts the US at a marginally better 12th place when averaging penetration, speed and price. Again consumer advocate groups are pressuring ISPs via the US regulatory body the Federal Communications Commission (FCC) to provide real data. The Broadband Consensus of America Act[17], awaiting a vote in the senate in early 2008, will force the FCC to publicly release information on actual broadband speeds.

With demand for performance data to be made readily available to regulators and the general public the need for easy access to network traffic measurements is paramount. The chore of collecting the data for authorities to review is made relatively easy with the absolute coverage model. With 24/7 coverage to each and every subscriber, actual broadband performance metrics can be made readily available.

Customer Support

Today's Customer Support is largely a reactive area, responding to requests for assistance as they occur. Usually within a contact centre environment, first level support agents collect subscriber details and fault symptoms and run through rudimentary troubleshooting procedures. With no diagnostic capability at the CPE and neither party technically skilled, the chances of success are compromised. With absolute coverage providing 24/7 monitoring, support staff are alerted to faults which can be addressed in some cases before a customer experiences a problem. Second line support and field service engineers have access to detailed analysis for executing swift and accurate troubleshooting.

Marketing/Sales

The absolute coverage model provides Marketing and Sales teams with the necessary information to plan and execute successful growth campaigns. For example, bandwidth-hungry users may be approached with higher-level packages to suit their usage or offered CPE upgrades. Behavioural analysis may lead to target marketing of further products and services. Further, by understanding competitor performance, ISPs can use the data as the basis forsuccessful promotional campaigns or adjust service and costs inconsideration of market conditions.

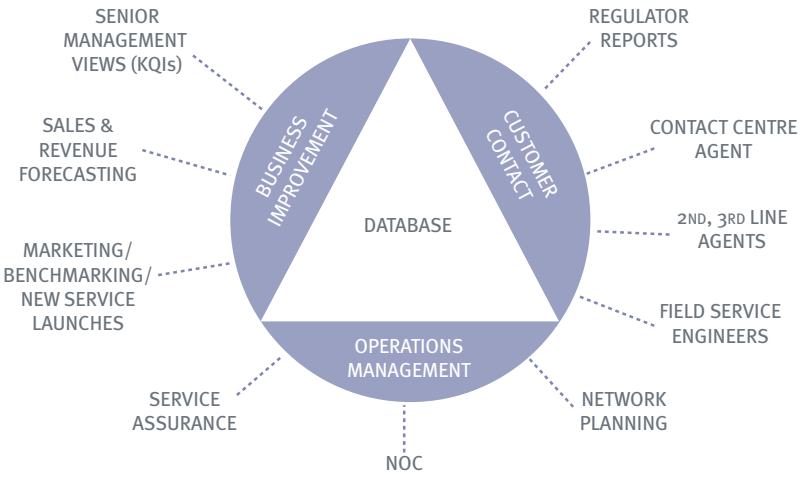

Figure 4: Applications of Absolute Coverage Data.

Making The Change

ISPs, regulators and media companies embracing an absolute coverage model will have an opportunity to orchestrate change throughout their organisations. For example, Customer Support could shift from being predominantly reactive to proactive thus changing the roles of contact centre support agents significantly. Marketing efforts could become much more focused and targeted whilst Quality Assurance staff should continue to raise standards without incurring undue cost. All of these efforts are made possible by the availability of expansive and current data.

In practical terms, overlaying an absolute coverage solution within the confines of an existing test and management solution (that ISPs undoubtedly possess) is not a major obstacle. The deployment of software test applications to CPE can be accomplished through routine subscriber upgrades. Analysis probes located in the core network require only basic servers and thus are within the installation capability of typical IT engineers. None of the transformation activities require significant outages or downtime. The centralised database may be outsourced or in-house, depending on the ISP's preference.

In the absolute coverage model there are a significant number of metrics ranging from the most complex technical aspect to a simple subscriber name and number. Thus the training element for staff is based around the ability to understand the pertinent fields and organise the various views and bespoke reports to suit.

Measurements	Existing Part Coverage Model	Epitiro Absolute Coverage Model
Customer Experience	✗	✓
CPE Performance	✗	✓
Core Network Perfomance	✓	✓
Competitor Performance	✗	✓

Figure 5: Table comparing the coverage capabilities of the both the Partial and Absolutle Coverage Models.

Summary

In this the ‘ information age’ it is imperative that ISPs, regulators and media companies have access to network performance and quality of service information in order to make accurate business decisions. Continued increase in VoIP and peer-to-peer file sharing traffic, be it legal or not, will cause ongoing pressure throughout the broadband industry as more consumers demand bandwidth whilst regulators force ISPs to meet contractual obligations.

To successfully manage services in the new era of broadband, ISPs will require network performance and customer experience intelligence far beyond the limitations of today’s part-coverage model, which neither captures customer experience nor tests to the “edge” nor provides competitive analysis. Epitiro’s vision for the next network management model includes comprehensive technical and customer experience coverage with any and all measurement data being available on demand.

Appendix 1 - About Epitiro

Company Overview

Epitiro provides customer experience intelligence and benchmarking data on communication services including VoIP, video and broadband QoS. Millions of broadband tests are made annually via Epitiro's edge-based agents with the results made available to ISPs, media companies, regulators and other interested parties through on-line subscription service or the twice-yearly published Internet Performance Index report. Epitiro also offers bespoke test and monitoring solutions based on deployment of edge-based software test applications that report measurement data to a centralised database. Founded in 2001, the company is the chief source of intelligence for the ISPA (Internet Service Provider Association) awards and is based in Cardiff, Wales, UK.

Available Products & Technology

Epitiro's ISP-I™ solution compares the performance of the leading ISPs using data collected by dedicated computer test sites throughout the UK and Europe. ISP-I™ (P2P) is the industry's first and only platform with the ability to test network performance from a P2P viewpoint.

Epitiro also offers bespoke network test solutions. DataLite™ and Desktop Agent™ provide ISPs with an analysis of client/server (HTTP) performance whilst VocaLite™ extends that capability to include VoIP measurements including MOS. Epitiro also provides report generation capability, alarm threshold tools and data mining tools for ISPs.

www.epitiro.com

Appendix 2 - Terms & Definitions

Absolute Coverage Model – Network and Customer Experience Management model that collects ISP performance metrics between the core and edge (customer premises) on all aspects of broadband usage and customer experience including HTTP, P2P, VoIP and Video.

Application Layer (Layer 7) – Part of the Opens Systems Interconnect (OSI) Basic Reference Model, the Application Layer (Layer 7) is of particular interest as it contains ports, which can identify traffic as P2P.

CPE – Customer Premise Equipment, which includes a computer, modem, router and other gear located at a subscriber's premises.

DSL – Digital Subscriber Loop/Line, the broadband connection over telephone lines into a subscriber's premises.

FCC – Federal Communications Commission of the United States of America, the regulatory body for the U.S.

HTTP – Hyper Text Transfer Protocol is the OSI Application Layer protocol used in internet client/server communications.

IFPI – International Federation of the Phonographic Industry, London, UK interested in protecting artists and publishers copyrights. Present in over 75 countries with 48 affiliates.

ISP – Internet Service Provider

ITU – International Telecommunications Union comprised of members of industry, striving to establish communication industry standards by recommending thoroughly researched and proven methodologies and technologies.

Jitter – The amount of data traffic received out of sequence at a network node, typically measured at the far end of a communications path. Jitter is measured as percent of out-of-sequence data received. In VoIP, jitter sounds like garbled speech.

Jitter Buffer – An application that correctly sequences received data before sending it to the next network node. Typically jitter buffers are used in VoIP phones to eliminate garbled speech.

Latency – The total time taken to deliver data packets from source to destination. In VoIP, jitter buffers may add unwanted latency.

MOS – A subjective Mean Opinion Score is the average group response to a particular question. In telecommunications, objective MOS algorithms (software) are used to estimate the quality of an end user's experience of voice and video transmissions.

OECD – Organization of Economic Co-operation and Development, an international organisation of thirty countries that accept the principles of representative democracy and a free market economy.

Ofcom – The regulatory body in the UK responsible for ensuring standards and fair competition.

Packet Loss – The number of packets that are lost in transmission, due to capacity issues, corruption or other transmission impairments. Usually measured as a percentage, packet loss can be corrected by re-requesting the data, though customer experience will be affected in VoIP and Video applications.

Partial Coverage Model – A 20th century network management model that primarily relies on customer complaints as its source for customer experience data. The scope of network performance data measured is usually limited to operations between the core and urban nodes and may not collect actual subscriber statistics.

PESQ – Perceptual Evaluation of Speech Quality, ITU-T P.862.2 recommended MOS algorithm to estimate the listening quality of narrow band (telephone) communications.

Ping - A rudimentary "call-and-await-reply" test process to confirm the presence of a far end node and the state of the communication path across an IP network. Ping estimates the round-trip time in milliseconds.

Port - a special number present in the header of a data packet typically used to map data to a particular process running on a computer. HTTP is offically assigned port 80 ,while Bit Torrent unofficially uses port numbers 6881-6999.

P2P – Peer-to-peer is a file-sharing technique that uses diverse connectivity between participants in a network and the cumulative bandwidth of network participants to satisfy a request for a complete file, rather than conventional centralised resources where a relatively low number of servers provide all data to a service or application.

Traffic Management - A means of ensuring users have best possible bandwidth allocation (customer experience) at any given time.

Traffic Shaping – A method of optimising network performance by prioritising certain types of data transmission. For example, bandwidth-hungry P2P file-sharing processes may be recognised by traffic shaping devices and throttled back, thus freeing up bandwidth for all users.

Appendix 3 - References

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