
1.0 Principles for Cincinnati Bell Broadband Network Management

Cincinnati Bell strives to provide its customers with non-discriminatory broadband Internet access at high speeds and at a reasonable price. In order to meet this goal, Cincinnati Bell employs a number of reasonable network management practices.

This document describes the reasonable network management practices that apply to services and usage provided on Cincinnati Bell's network. Cincinnati Bell is not responsible for delays, congestion or any network management techniques that occur on the Internet or the networks of other carriers.

Subject to the reasonable network management practices, Cincinnati Bell does not block the ability of its customers to access lawful websites nor will Cincinnati Bell block applications that compete with its voice or video telephony services.

2.0 Service Description

Cincinnati Bell offers a variety of broadband high-speed Internet (HSI) options for residential consumers and small businesses. The offerings vary by download and upload speeds. Cincinnati Bell uses various technologies to provide HSI service and the technology deployed in a given geographical area determines the speed tiers that are available to consumers. Not all speed tiers and technologies are available in all areas. To review the HSI options available in your area, go to <http://cincinnatiBell.com/internet/>.

2.1 Service Technology

Cincinnati Bell operates a number of technology platforms:

- ZoomTown[®] HSI service uses asymmetrical digital subscriber line (ADSL) technology deployed over existing cooper loops;
- Fioptics[™] HSI service uses very-high-bit-rate digital subscriber line (VDSL) technology in areas where fiber has been deployed to the curb (known as "fiber-to-the-curb" or FTTC) and gigabit passive optical network (GPON) technology in areas where fiber has been deployed to individual homes (known as fiber-to-the-home or FTTH); and
- Data Over Cable Service Interface Specifications (DOCSIS) are used to provide HSI in areas of Lebanon, Ohio where Cincinnati Bell provides traditional cable TV service.

2.2 Service Performance

While Cincinnati Bell categorizes each HSI offering based on maximum speeds, the actual speed a customer experiences will vary depending upon numerous factors, many of which are beyond Cincinnati Bell's control. Common factors that can affect the actual speeds that a consumer receives include, but are not limited to:

- the capabilities or limitations of the customer's computer or other device;
- the number of computers or other devices in use in the customer's home network;
- the means of connecting to the Cincinnati Bell network (e.g., the condition of the home's inside wire or the type and condition of WiFi router);
- the distance of the home from the Cincinnati Bell broadband network aggregation point; and
- the performance of the content and application providers the consumer is accessing as well as their host network.

Performance can also vary depending upon the level of congestion on the network at a given time.¹ For example, consumers may experience slower speeds during peak usage times when many users are accessing the Internet simultaneously. The peak congestion period is typically between 7:00 pm – 11:00 pm Monday through Friday for wireline broadband Internet access.

The Federal Communications Commission (FCC) has conducted a study to determine what speeds consumers typically experience during peak usage times relative to the advertised speeds of the services consumers purchase. The FCC study was designed to measure the core connectivity between an Internet service provider (ISP) and its subscribers using a methodology that eliminated factors that can impact performance that are beyond the ISP's control (as explained above).²

Tables 1 and 2 show the various Cincinnati Bell HSI services for residential consumers and small businesses. Table 1 shows the ZoomTown and Fioptics HSI offerings which use ADSL, VDSL or GPON technology. Table 2 shows the HSI offerings available in Cincinnati Bell's Lebanon cable service area, which are deployed over cable facilities using DOCSIS technology. For each service offering, the table identifies the transport medium and protocol or technology used to provision the service and compares the maximum advertised speeds to the actual download and upload speeds and latency that consumers might expect during peak usage periods. The expected download and upload speeds and latency for each service offering were estimated by applying the FCC's Broadband Test results for comparable technologies.

¹ "Congestion" is a period during which customer demand exceeds network capacity. Congestion can occur due to high usage or consumer demand during certain times of the day (i.e. during peak times), particularly in highly populated locations.

² *Measuring Broadband America, A Report on Consumer Wireline Broadband Performance in the U.S.*, FCC's Office of Engineering and Technology and Consumer and Governmental Affairs Bureau, released August 2, 2011. The report is available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-308834A1.pdf

Table 1

**Expected Performance of Cincinnati Bell
ZoomTown and Fioptics HSI Service Offerings**

	ZoomTown Lite	ZoomTown 5Mbps	ZoomTown 7Mbps ¹	ZooTown 10Mbps
Advertised Speed (down/up) ²	768kbps / 512kbps	5Mbps/768kbps	7Mbps/768kbps	10Mbps/768kbps
Expected Download Speed (Mbps) ³	630kbps	4.1Mbps	5.74Mbps	8.2Mbps
Expected Upload Speed (Mbps) ³	486kbps	730kbps	730kbps	730kbps
Expected Latency ⁴	44 ms	44 ms	44 ms	44 ms
Transport	Copper	Copper	Copper	Copper
Protocol	ADSL/ADSL2+	ADSL/ADSL2+	ADSL2+	ADSL2+
	Fioptics 10Mbps	Fioptics 10Mbps	Fioptics 20Mbps	Fioptics 20Mbps
Advertised Speed (down/up) ²	10Mbps/1Mbps	10Mbps/2Mbps	20Mbps/2Mbps	20Mbps/5Mbps
Expected Download Speed (Mbps) ³	9.8Mbps ⁵	11.4Mbps	19.6Mbps ⁵	22.8Mbps
Expected Upload Speed (Mbps) ³	950kbp ⁵	2Mbps	1.9Mbps ⁵	5Mbps
Expected Latency ⁴	30 ms ⁵	17 ms	30 ms ⁵	17 ms
Transport	FTTC	FTTH	FTTC	FTTH
Protocol	VDSL2	GPON	VDSL2	GPON
	Fioptics 30Mbps	Fioptics 30Mbps	Fioptics 50Mbps	Fioptics 100Mbps
Advertised Speed (down/up) ²	30Mbps/5Mbps	30Mbps/10Mbps	50Mbps/10Mbps	100Mbps/20Mbps
Expected Download Speed (Mbps) ³	29.4Mbps ⁵	34.2Mbps	57Mbps	114Mbps
Expected Upload Speed (Mbps) ³	4.75Mbps ⁵	10Mbps	10Mbps	20Mbps
Expected Latency ⁴	30 ms ⁵	17 ms	17 ms	17 ms
Transport	FTTC	FTTH	FTTH	FTTH
Protocol	VDSL2	GPON	GPON	GPON
<p>1. This is a business class offering only.</p> <p>2. Advertised speeds reflect the maximum rates at which a line could be provisioned and is not a guarantee of service or speed.</p> <p>3. Expected download and upload speeds have been estimated based upon speed test results for comparable technology measured during peak usage periods (7pm -11pm Mon - Fri) as reported by the FCC's Office of Engineering and Technology and Consumer and Governmental Affairs Bureau in <i>Measuring Broadband America, A Report on Consumer Wireline Broadband Performance in the U.S.</i> The report is available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-308834A1.pdf</p> <p>4. Expected latency figures are the average latency for comparable technology as reported in the FCC's <i>Measuring Broadband America</i> report.</p> <p>5. Derived from an average of the results reported for DSL (copper) transport and FTTH transport in the FCC's <i>Measuring Broadband America</i> report.</p>				

Table 2

**Expected Performance of Cincinnati Bell
Lebanon DOCSIS HSI Service Offerings**

	Lite	Basic 10M	Premium 20M	SOHO ¹
Advertised Speed (down/up) ²	768kbps / 384kbps	10Mbps/1Mbps	20Mbps/2Mbps	8Mbps/1Mbps
Expected Download Speed (Mbps) ³	7.14Mbps	9.3Mbps	18.6Mbps	7.44Mbps
Expected Upload Speed (Mbps) ³	3.65Mbps	950kbps	1.9Mbps	950kbps
Expected Latency ⁴	28 ms	28 ms	28 ms	28 ms
Transport	Coax	Coax	Coax	Coax
Network Priority	6	5	4	4
Protocol	DOCSIS	DOCSIS	DOCSIS	DOCSIS
	Business Basic¹	Business Advanced¹	Business Professional¹	
Advertised Speed (down/up) ²	10Mbps/1.5Mbps	20Mbps/2.5Mbps	30Mbps/3.5Mbps	
Expected Download Speed (Mbps) ³	9.3Mbps	18.6Mbps	27.9Mbps	
Expected Upload Speed (Mbps) ³	1.4Mbps	2.4Mbps	3.3Mbps	
Expected Latency ⁴	28 ms	28 ms	28 ms	
Transport	Coax	Coax	Coax	
Network Priority	3	2	1	
Protocol	DOCSIS	DOCSIS	DOCSIS	
<p>1. This is a business class offering only.</p> <p>2. Advertised speeds reflect the maximum rates at which a line could be provisioned and is not a guarantee of service or speed.</p> <p>3. Expected download and upload speeds have been estimated based upon speed test results for comparable technology measured during peak usage periods (7pm -11pm Mon - Fri) as reported by the FCC's Office of Engineering and Technology and Consumer and Governmental Affairs Bureau in <i>Measuring Broadband America, A Report on Consumer Wireline Broadband Performance in the U.S.</i> The report is available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-308834A1.pdf</p> <p>4. Expected latency figures are the average latency for comparable technology as reported in the FCC's <i>Measuring Broadband America</i> report.</p>				

2.3 Impact of Specialized Services

Some applications and services share capacity with broadband Internet access service over the last-mile facilities that connect an ISP's network to the consumer's premises. These "specialized services" can reduce the bandwidth available for Internet service. Cincinnati Bell offers three such specialized services and subscribers should be aware of the potential impact of these services on the performance of the broadband Internet access service.

Fioptics Internet Protocol Television (IPTV)

IPTV is a delivery system through which television services are delivered using Internet Protocol standards over a packet-switched network instead of being delivered through traditional terrestrial RF cable television formats or satellite signals. Fioptics TV service delivered using VDSL technology deployed over fiber-to-the-curb facilities is an IPTV service. When using the TV and Internet simultaneously, bandwidth is allocated first to the TV streams with the remainder available for Internet applications. All IPTV video streams take priority over high speed Internet

traffic. Each high definition (HD) video stream requires 7Mbps per stream and a Standard Definition video stream requires 3 Mbps per stream.

Fusion WiFi

Cincinnati Bell's wireless affiliate, Cincinnati Bell Wireless LLC, offers Fusion WiFi which enables subscribers to send calls, data, and SMS (text) messages using unlicensed wireless spectrum and their home WiFi networks instead of the traditional wireless network. This unlicensed mobile access (UMA) service is used by customers to enhance their in-home wireless reception, increase their data speeds, or reduce their wireless minutes usage by utilizing the capacity of their wireline broadband network for wireless applications. Fusion WiFi works just like any other mobile service, except in the presence of a compatible WiFi network. At that point, wireless phones have built-in technology to support UMA will switch from a mobile network to a WiFi network. When transmitting signals via a Cincinnati Bell wireless router, Fusion WiFi creates a private network to transmit the wireless call, data or SMS. UMA technology can have the following impact on broadband download and upload bandwidth:

Table 3

Impact Rates of the UMA Service

UMA Activity	Download	Upload
Phone Call	~64Kbits/sec	~64Kbits/sec
SMS (Text) Message	<1Kbit/sec	<1Kbit/sec
Data Sessions	< 1.5Mbit/sec	<1.5Mbit/sec

PacketCable VoIP (Lebanon Cable service area only)

PacketCable voice over Internet protocol (VoIP) service shares the bandwidth from each individual cable node and is given priority over other IP traffic. A voice call does not reduce the amount of provisioned bandwidth for an individual customer but does subtract from the total amount of available bandwidth for use by best effort traffic. When the phone line on a specific modem is in use, the modem is dynamically given a dedicated amount of bandwidth for the voice call. The amount of bandwidth dedicated for PacketCable calls is completely dependent on the number of active voice calls in a node at any one time. If no voice calls are active, no bandwidth is used. It is possible that if there are enough active voice calls on a specific cable node that the performance of other applications such as web browsing or file sharing will be impacted.

Table 4

Impact Rates of the PacketCable Service

PacketCable Activity	Download	Upload
Phone Call (per line)	~87Kbits/sec	~87Kbits/sec

3.0 Network Management Practices

3.1 Congestion Management

Network congestion is similar to traffic congestion -- it is the result of an excessive amount of traffic (data packets) making simultaneous use of limited infrastructure (broadband networks). All ISPs rely upon some shared facilities to deliver services to the end user. ISPs cannot guarantee that the full bandwidth of each user's connection will always be available on demand. Even business customers who take advantage of expensive dedicated links are constrained by shared resources once their traffic reaches the Internet, which is beyond the control of any single service provider.

Congestion can be caused either by long-term trends, such as increased demand for Internet services, or by short-term and unexpected demand surges. According to the Cisco Visual Networking Index, consumer Internet traffic in North America is expected to experience a compound annual growth rate of greater than 30% through 2015.³ In addition, significant new developments, popular content releases, and even computer virus outbreaks can drive short-term spikes in utilization that can significantly affect bandwidth consumption. Cincinnati Bell is constantly analyzing traffic patterns and upgrading services and facilities to keep up with this demand. Cincinnati Bell's goal is to provide the highest possible speeds to the largest number of consumers at a reasonable price and on a non-discriminatory basis.

3.1.1 Congestion Management on the ZoomTown and Fioptics HSI Network

Congestion typically occurs in the aggregation layer of the network. The aggregation layer is found at the location where the facility to a customer premise joins the larger network and where traffic is routed over shared network facilities. For DSL-based services (ADSL and VDSL), aggregation begins in the part of the network known as the digital subscriber line access multiplexer (DSLAM). For GPON-based services, the analogous device/aggregation point is known as an optical line terminal (OLT). At the DSLAM and OLT, customers' services are aggregated onto a single circuit or path for delivery to the rest of the network. The uplink speeds and specific topologies at these aggregation points vary based on demand, availability, and the limitations of the particular DSLAM or OLT equipment.

Although Cincinnati Bell continually upgrades its facilities to address the long-term increases in Internet traffic, these upgrades cannot alleviate congestion caused by short-term spikes in demand that consumers may experience. During such periods of congestion when the amount of traffic attempting to traverse the network exceeds the available capacity at an aggregation point, all traffic passing through that aggregation point will be slowed until demand decreases. In other words, all traffic is treated the same and no consumers or applications are given priority. This is often referred to as Best Effort routing.

3.1.2 Congestion Management on the Lebanon DOCSIS HSI Network

In the Lebanon cable service area, the access portion of the DOCSIS network (i.e. the wire that connects a subscriber to the network) is shared between all customers along one or more segments of a shared coaxial line, known as a cable node. Each node in the Cincinnati Bell DOCSIS Network has multiple upstream frequencies. Each node also has a set of downstream frequencies that may be shared among several nodes. Congestion in this portion of the network varies based on demand and number of customers served. As described further below, each service level on the DOCSIS network is assigned a priority level and, during times of congestion, higher priority service levels are given priority over lower service levels.

³ Cisco Visual Networking Index: Forecast and Methodology, 2010-2015, available at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf

- **Prioritization during Congestion**

Each Lebanon HSI subscriber's cable modem has a "bootfile" that contains certain pieces of information about the subscriber's service to ensure that the service functions properly.⁴ For example, the bootfile contains information about the maximum speed that a particular modem can achieve based on the service level the customer has purchased and the priority value that corresponds to this service level⁵.

When utilization is below 100% of a Cable Modem Termination System (CMTS) port capacity, all traffic is handled equally and delivered in a standard "Best Effort" method. The priority value of the service level subscription has no affect. However, when a port is congested (i.e., reaches full capacity), a decision must be made about how to utilize or allocate bandwidth among subscribers. Cincinnati Bell uses a system called "Weighted Fair Queuing," which only applies when the CMTS has reached 100% utilization of a specific upstream or downstream port. When 100% capacity is reached, the priority value of a service subscription is used to calculate a ratio of total bandwidth to the bandwidth available to each customer utilizing the network at a given moment. Specifically, CMTS ports have what is commonly called a "scheduler" that puts all the packets coming from or going to cable modems on that particular port in a queue and then handles them in turn. A certain number of packets can be processed by the scheduler in any given moment. The CMTS uses an algorithm to determine what traffic to schedule. The different priorities are converted into "weights" (ratios) by the CMTS. This process is called a DOCSIS "Weighted Fair Queuing Scheduler." During times of congestion services with a higher priority⁶ are given a proportionally higher amount of the total available bandwidth. This means that all service levels are affected in times of congestion, but the affects will be more noticeable to a customer who has subscribed to a lower priority level service. It also means that higher priority traffic is not able to completely deplete the available bandwidth from lower priority services as they are only given a proportionally larger percentage of the bandwidth as opposed to all of the available bandwidth. This process is protocol and application agnostic, meaning that it does not differentiate between different types of traffic or applications. The prioritization is based only on the level of service to which the customer subscribes. All traffic of a given service level is treated the same.

- **Impact on customers during congestion**

The exact impact on a specific customer is difficult to predict since a variety of factors are involved including the type of application the customer is using as well as the level of congestion at the time. A user could find that a webpage loads more slowly than usual, a peer-to-peer upload takes longer to complete, or a VoIP call sounds choppy.

3.2 Application-Specific Behavior

3.2.1 ZoomTown and Fioptics HSI Services

For security purposes Cincinnati Bell blocks Port 23 (Telnet) for both incoming and outgoing traffic between any customer devices within the Cincinnati Bell network. In addition, as recommended by the Messaging Anti-Abuse Working Group, Port 25 (Simple Mail Transfer Protocol) is blocked outgoing to any external mail servers for customers with dynamic IP addresses in order to prevent the dissemination of SPAM from within the Cincinnati Bell domain.⁷ Other than these two measures to mitigate harms to the network and customers, Cincinnati Bell does not discriminate against any

⁴ The bootfile only includes information about the service that the subscriber has purchased. It contains no personal information.

⁵ See Table 2 for priority values assigned to each service offering.

⁶ For purposes of the Cincinnati Bell DOCSIS HSI service, priority level 1 is the highest priority level and level 6 is the lowest priority level.

⁷ See <http://www.uceprotect.net/downloads/MAAWGPort25English.pdf>.

particular traffic type or source/destination nor does it block or rate-control any specific protocols on its ZoomTown and Fioptics networks.

3.2.2 Lebanon DOCSIS HSI Service

In order to protect the DOCSIS network and its customers' computers from common viruses and other malicious attacks Cincinnati Bell blocks certain ports for all subscribers. In addition, depending upon the service level to which a customer subscribes, additional ports may be blocked. Blocking is based only on the TCP/UDP port and service level. No application level inspection or modification takes place. Port blocking applies only to inbound traffic; no outbound traffic is blocked or modified. Table 5 identifies the specific ports and the service level for which they are blocked for incoming traffic on Cincinnati Bell's DOCSIS HSI network.

Table 5

Blocked Ports on Lebanon DOCSIS HSI Network

Blocked Port	Service Level	Explanation
HTTP/HTTPS Server (TCP 80,443)	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	These ports are used to host a standard web (HTTP) and/or encrypted web (HTTPS) server.
FTP Server (TCP 21)	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	File Transfer Protocol - This port is used to host an FTP server.
Telnet Server (TCP 23)*	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	This port is used to host a Telnet server.
SMTP Server (TCP 25)*	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	Simple Mail Transfer Protocol - This port is used to host an email server.
POP3 Server (TCP 110)*	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	Post Office Protocol 3 - This port is used to host an email server.
IMAP Server (TCP 143)*	Lite, Basic 10M, Premium 20M, SOHO, Business Basic	Internet Message Access Protocol - This port is used to host an email server.
Windows File Sharing (TCP 135,137,139,445)	All	These ports are used for standard Microsoft Windows file-sharing. They are often vulnerable to malicious attack (for example – Sasser, Nimda, Conflicker).
IRC Server (TCP 6667)	All	This port is used for Internet Relay Chat servers. Viruses (i.e. botnets) often act as an IRC server.
* These ports are open for any customer with a static IP address.		

3.3 Device Attachment Rules

Cincinnati Bell does not prohibit the use of a non-supplied Cincinnati Bell DSL modem, router, or gateway on the Cincinnati Bell ADSL, ADSL2+, VDSL, VDSL2, or GPON networks. However, if a customer chooses to use their own device with Cincinnati Bell's broadband Internet service, Cincinnati Bell will not be able to provide support in the event of a problem.

Within the Lebanon cable service area, where DOCSIS technology is used, any DOCSIS 2.0 or 3.0 modem will work on the Cincinnati Bell DOCSIS network, providing the customer first contact Cincinnati Bell at (513)933-7201 to enable Cincinnati Bell to associate the device with their service address.

Cincinnati Bell provides all customers with a DOCSIS cable modem for use with its HSI for no additional cost. If a customer chooses to purchase and use their own DOCSIS cable modem they may be directed to contact the manufacture of the modem if problems arise and standard trouble shooting procedures indicate the modem may be at fault.

3.4 Security

Cincinnati Bell monitors network fault and performance 24 hours a day, 365 days a year to quickly detect and respond to service degradation or impairment. Threats to network health can take many forms such as port scanning, wherein one customer attempts to open multiple sessions with hundreds or thousands of other users in hopes of discovering exploitable vulnerabilities, or Denial of Service (DOS) attacks in which one or more users direct an unreasonably high amount of traffic at a particular destination in an effort to overwhelm its capacity to respond. In many cases, this type of malicious traffic originates from a customer whose computer has itself been compromised or infected with a virus. When such a threat is detected, Cincinnati Bell engineers will evaluate the impact or the potential for impact and take appropriate steps to mitigate damage to the network and Cincinnati Bell's customers.

4.0 Commercial Terms

4.1 Pricing

Cincinnati Bell's current ZoomTown and Fioptics pricing and offers can be found at: <http://cincinnatiBell.com/Internet/>

Lebanon DOCSIS HSI service pricing and offers can be obtained by calling (513) 933-7201 or by e-mailing lebanoncare@cinbell.com

4.2 Privacy Policies

[Click here](#) to view the latest copy of Cincinnati Bell's Privacy Policy.

4.3 Redress Options

Questions concerning Cincinnati Bell's network management practices should be directed to (513)397-HELP(4357), on-line via: http://www.cincinnatiBell.com/customer_support/contact_us/, or emailed to customercare@cinbell.com

In the Lebanon Cable service area all questions should be directed to (513)933-7201 or emailed to lebanoncare@cinbell.com

5.0 Law Enforcement Obligations

Nothing in these network management practices supersedes or limits the ability of Cincinnati Bell to address the needs of emergency communications or law enforcement, public safety or national security authorities, consistent with or as permitted by applicable law.

6.0 Glossary

ADSL - Asymmetric Digital Subscriber Line is a type of Digital Subscriber Line technology, a data communications technology that enables faster data transmission over copper telephone lines than a conventional voice band modem can provide. It does this by utilizing frequencies that are not used by a voice telephone call.

ADSL 2+ - extends the capability of basic ADSL by doubling the number of downstream bits.

Aggregation device - various methods of combining multiple network connections in parallel to increase throughput beyond what a single connection could sustain, and to provide redundancy in case one of the links fails.

CMTS - Cable Modem Termination System is a piece of hardware located in a cable operator's local network (generally in a "headend") that acts as the gateway to the Internet for cable modems in a particular geographic area. A simple way to think of the CMTS is as a router with interfaces on one side leading to the Internet and interfaces on the other side connecting to Optical Nodes and to customers.

CO - Central office, in telecommunications, data, video and telephony

DOCSIS – **Data over Cable Service Interface Specification** is a standard that allows for high speed Internet service to run over a cable TV System, generally over a hybrid fiber coaxial network in which fiber reaches to the cable node and coaxial cable runs from the node to the user's premises.

Downstream - is the process of sending data primarily in the downstream direction is *downloading*.

DSLAM - **Digital Subscriber Line Access Multiplexer** is a network device, located in the telephone exchanges of the telecommunications operators. It connects multiple customer Digital Subscriber Line (DSL) interfaces to a high-speed digital communications channel using multiplexing techniques

FTTC - **Fiber-to-the-curb** – is fiber going to a cabinet to get closer to the user's premises; typically within 300m.

FTTH - **Fiber-to-the-home** - fiber reaches the boundary of the living space, such as a box on the outside wall of a home.

GPON - **Giga Passive Optical Network** is a point-to-multipoint, fiber to the premises network architecture in which unpowered optical splitters are used to enable a single optical fiber to serve multiple premises, typically 16-128. A PON consists of an optical line terminal (OLT) at the service provider's central office and a number of optical network terminals (ONTs) near end users.

Headend – is a master facility for receiving television signals for processing and distribution over a cable television system.

Latency - is measured either *one-way* (the time from the source sending a packet to the destination receiving it), or *round-trip* (the one-way latency from source to destination plus the one-way latency from the destination back to the source).

Modem - **modulator-demodulator** is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

PacketCable – PacketCable is an architecture used to deliver voice service over IP on a DOCSIS network.

Router - is a home networking device, used as a gateway to connect devices in the home to the Internet or other WAN.

Throughput - is the sum of the data rates that are delivered to all terminals in a network.

Upstream - refers to the direction in which data can be transferred from the client to the server (uploading).

VDSL2 - **Very-high-bit-rate digital subscriber line 2** is an advanced standard of digital subscriber line (DSL) broadband wireline communications designed to support the wide deployment of triple play services such as voice, video, data, high definition television (HDTV) and interactive gaming. VDSL2 enables operators and carriers to gradually, flexibly, and cost-efficiently upgrade existing xDSL infrastructure.