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 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.

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;
- the performance of the content and application providers the consumer is accessing as well as their host network; and
- the use of specialized services, such as IPTV, over last mile facilities.

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.

Estimated median download and upload speeds and latency for each speed tier offered by Cincinnati Bell is shown below in Table 1. The performance was derived from performance tests conducted for the FCC's Eighth Measuring Broadband America - Fixed Broadband Report ("Eighth Report").[2] This report is designed to measure the speed and latency that consumers typically experience during peak usage times relative to the advertised performance 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 eliminates factors that can impact performance that are beyond the ISP's control, such as limitations of the subscriber's PC or laptop, WiFi, inside wiring, etc. Individual subscribers experiences will likely vary. The Cincinnati Bell service tiers measured for the FCC's Eighth report were the 5 Mbps, 10 Mbps and 30 Mbps copper tiers and the 50 Mbps and 100 Mbps FTTH tiers. Table 1 reflects the actual Cincinnati Bell results from the FCC report for these service tiers. The results for the other tiers shown in Table 1 were estimated based on the performance of the comparable technology speed tiers that were measured by the FCC.

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[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] *Eighth Measuring Broadband America - Fixed Broadband Report*, released December 14, 2018. The report is available at: https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-eighth-report#block-menu-block-4.

Table 1

**Performance of Cincinnati Bell
ZoomTown, Fioptics, and Cable HSI Service Offerings**

Speed Tier	Download Speed*	Upload Speed*	Latency*
2 Mbps x .768 Mbps (Copper)[1]	1.49	0.58	40.95
5 Mbps x .768 Mbps (Copper)[2]	3.72	0.58	40.95
10 Mbps x 1 Mbps (FTTC)[1]	8.43	0.82	40.95
10 Mbps x 2 Mbps (FTTH)[2]	10.79	2.16	19.14
10 Mpbs x 1 Mbps (Coaxial Cable)[3]	11.39	1.11	21.00
20 Mbps x 2 Mbps (FTTC)[2]	18.01	1.82	34.64
20 Mbps x 2 Mbps (FTTH)[2]	21.58	2.16	19.14
20 Mpbs x 2 Mbps (Coaxial Cable)[3]	22.78	2.22	21.00
30 Mbps x 3 Mbps (FTTC)[1]	27.81	2.85	31.96
30 Mbps x 3 Mbps (FTTH)[2]	32.37	3.24	19.14
30 Mpbs x 3 Mbps (Coaxial Cable)[3]	34.17	3.32	21.00
50 Mbps x 3 Mbps (FTTC)[2]	45.03	2.85	31.96
50 Mbps x 10 Mbps (FTTH)[1]	53.96	10.79	19.14
50 Mpbs x 10 Mbps (Coaxial Cable)[3]	56.95	11.08	21.00
100 Mbps x 20 Mbps (FTTH)[1]	107.98	21.76	17.35
100 Mpbs x 20 Mbps (Coaxial Cable)[3]	113.90	22.16	21.00
250 Mbps x 100 Mbps (FTTH)[2]	269.95	108.82	17.35
500 Mbps x 125 Mbps FTTH)[2]	539.90	163.23	17.35
750 Mbps x 200 Mbps (FTTH)[2]	809.85	217.64	17.35
1 Gbps x 250 Mbps (FTTH)[2, 4]	900.00	272.05	17.35

* Median download and upload speed and latency during peak hours based on results from the FCC's Eighth Measuring Broadband America - Fixed Broadband Report ("FCC's Eighth Report") *(https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-eighth-report#block-menu-block-4*). Actual performance experienced by an individual subscriber may vary by location and time of day, as well as various factors on the subscriber's side of the network as described above.

[1] Actual Cincinnati Bell results from the FCC's Eighth Report.

[2] Estimated based on Cincinnati Bell results from the FCC's Eighth Report for comparable technology.

[3] Estimated based on aggregated results from the FCC's Eighth Report for comparable technology.

[4] The Cincinnati Bell network is engineered to provide download speeds of 1 Gbps, however, some customers may not be capable of achieving the maximum download speed due to limitations of their PC, laptop, WiFi routers, in-home wiring, etc.

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's IPTV is a specialized service that may impact the performance of some subscribers 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 via fiber-to-the-curb and fiber-to-the-home 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.

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. 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 as 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.

- **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.[3] 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 level[4].

  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 priority[5] 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

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

[4] Residential 10 Mbps is Priority Level 5, residential 20 Mbps is Priority Level 4, business SOHO 8 Mbps is Priority Level 3, business Basic 10 Mbps is Priority Level 2, and business Advanced 20 Mbps and business Professional 30 Mbps are Priority Level 1.

[5] 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.

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.[6] Other than these two measures to mitigate harms to the network and customers, Cincinnati Bell does not discriminate against any 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 2 identifies the specific ports and the service level for which they are blocked for incoming traffic on Cincinnati Bell's DOCSIS HSI network.

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[6] See http://www.uceprotect.net/downloads/MAAWGPort25English.pdf.

Table 2

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 provides all HSI subscribers with the appropriate gateway/modem (*i.e.*, an ADSL gateway/modem, DOCSIS/cable gateway/modem, or fiber/GPON gateway/modem, as applicable) configured to provide optimal performance with their service. Cincinnati Bell recommends using a Cincinnati Bell provided modem, which is specially configured to provide optimum service allowing the best support possible. However, Cincinnati Bell does not prohibit the use of lawful, non-harmful, third-party supplied modems, routers, or gateways on the Cincinnati Bell copper, fiber, or cable networks. If a customer connects his or her own device, Cincinnati Bell cannot guarantee the service will work and may not be able to provide support in the event of a problem. Customer provided gateways/modems are likely to be incompatible with Cincinnati Bell's video service, static-IP option, and many Internet services with speeds 50 Mbps or lower.

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 promotional pricing and offers can be found at: http://cincinnatibell.com/Internet/. The rate that applies at the end of any promotional period will be the standard rate in effect when the promotion expires. Consumers should call Cincinnati Bell Customer Service at 513-565-9890 prior to the end of their promotional period to determine the standard rate that will apply.

All plans include unlimited data usage.

Cincinnati Bell provides all HSI subscribers with the appropriate gateway/modem (*i.e.*, an ADSL gateway/modem, DOCSIS/cable gateway/modem, or fiber/GPON gateway/modem, as applicable) configured to provide optimal performance with their service. Subscribers are assessed a monthly fee of $8.99 for the Cincinnati Bell provided gateway/modem. When terminating service, the modem and power cord must be returned to Cincinnati Bell. A $120 charge will apply for non-returned equipment ($100 for the modem and $20 for the power cord). Cincinnati Bell recommends using a Cincinnati Bell provided modem, as these are specially configured to provide optimum service allowing the best support possible, however, if a customer chooses to use their own gateway/modem device and does not receive or returns the Cincinnati Bell provided gateway/modem, the monthly rental fee will not apply.

A one-time Activation fee of $29.99 may apply.

State sales tax applies to the monthly modem fee.

4.2 Privacy Policies

Click here to view the latest copy of Cincinnati Bell's Privacy Policy.

4.3 Redress Options

Questions or concern regarding Cincinnati Bell's broadband Internet service should be directed to 513-565-9890, on-line via: http://www.cincinnatibell.com/customer_support/contact_us/ , or emailed to customercare@cinbell.com. Consumers may also utilize the FCC's informal or formal complaint process by contacting the FCC at 1-888-225-5322 or on-line via: https://consumercomplaints.fcc.gov

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.

Download - is the speed of the connection when receiving data from the Internet to your computer.

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 commonly measured as the time it takes for a data packet to travel back and forth over the broadband provider's network. Lower latency means better quality, but a small amount of latency associated with the distance travelled is unavoidable. It 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 - **mo**dulator-**dem**odulator 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.

Packet Loss - is commonly measured as the percentage of packets that enter the broadband provider's network but are not delivered. The most common cause of packet loss is network congestion. Lower packet loss means better quality, but a small amount of packet loss is expected, and some applications adjust their sending rate by measuring packet loss.

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.

Upload – is the speed of the connection when sending data from your computer to the Internet.

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.