

Understanding Broadband Performance Factors

All megabits are not created equal. Speed is only one of many criteria in selecting the right broadband technology for your application.

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Consumers usually compare the performance of data connections by evaluating network speed, which is measured in bits per second and is typically discussed in units of Mbps (approximately 1,000,000 bits per second). However, this measurement can be quite deceptive because there are other important factors in specifying broadband services.

For example, a 30 Mbps cable modem connection may cost a residential consumer \$50 per month, while a business-grade Metro Ethernet service that delivers 10 Mbps Internet capacity can exceed \$500 per month – yet the Internet delivered through the Metro Ethernet service provides better value for many types of applications.

Why would a service with one-third the speed cost 10 times as much as the “faster” alternative? The answer is that all Mbps are not created equal. Factors such as latency, availability of the connection speed and the network’s Internet oversubscription rate affect the connection’s overall performance. In the example above, the 10 Mbps Metro Ethernet service’s total set of performance attributes provides a more robust and secure connection than a 30 Mbps cable modem.

Key attributes that impact performance include

- **Symmetry:** Cable modem and DSL services are typically asymmetrical, meaning that their upload (from user to network) and

download (from network to user) speeds are different. The download speed is generally greater than the upload speed by a factor of 10. Metro Ethernet services, on the other hand, are typically symmetrical, meaning that upload and download speeds are the same. For businesses that transfer large data or video files, asymmetrical services often present bottlenecks to both internal users and external customers.

A user on a typical cable modem service can download a 5 gigabyte (GB) file in less than 10 minutes, but uploading the same file would take more than 90 minutes – which would not be acceptable to a business creating and distributing large files.

- **Oversubscription to the Internet:** Because Internet service providers (ISPs) recognize that users in a given area do not all access the Internet at the same time, ISPs subscribe to only a portion of their networks’ total potential demand. For example, an ISP that has 1,000 subscribers with 10 Mbps service might contract for a 100 Mbps connection rather than the maximum 10,000 Mbps Internet connection its users might require. The ratio of a network’s maximum potential demand to its contracted rates is its oversubscription ratio. In this example, the oversubscription ratio is 100:1.

Cable modem and DSL providers often have a 100:1 or greater oversubscription

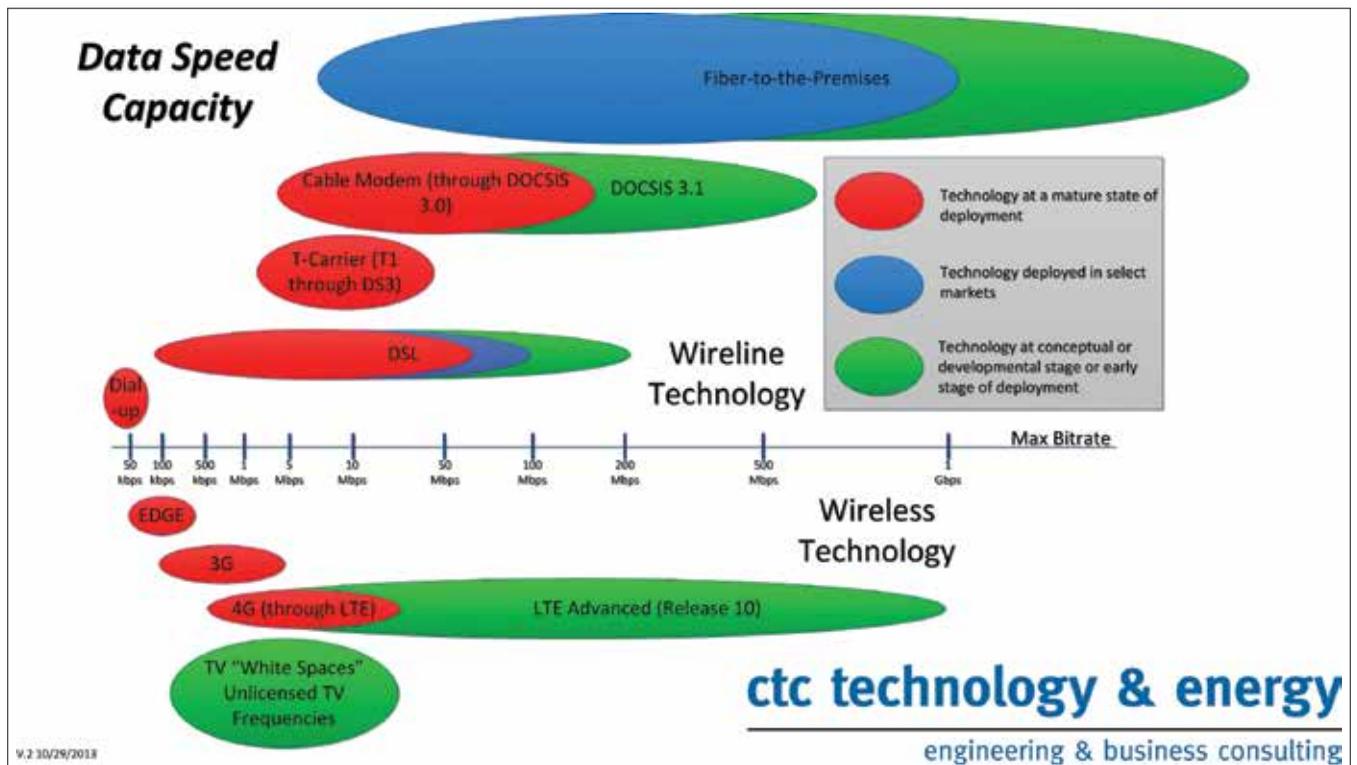


Figure 1: Capacity and Speed of Broadband Technologies

ratio for residential users and a 50:1 ratio for business users. If an ISP bundles Internet access with a Metro Ethernet service, the oversubscription ratio for that Internet access is often 10:1 or less.

At times, users on networks with high oversubscription rates do not notice the oversubscription; at other times, oversubscription brings their connections to a crawl – just like traffic on the weekend versus traffic during a weekday rush hour.

- **Availability of the data transport rate:** Metro Ethernet providers specify a committed information rate (CIR), which is the guaranteed

transport speed of the circuit connecting user locations, and the network will be designed to sustain at least that rate for all users guaranteed that rate. By contrast, cable modem and DSL services are often “burstable,” meaning that users may at times experience the advertised data rates, but that the average speed will vary greatly based on the traffic being generated over the provider’s distribution network. Performance parameters on a burstable service are rarely publicized or realized. Often a network operator cannot change this parameter without changing the network’s physical connections.

During periods of heavy network use, burstable subscribers experience the same traffic discrepancies drivers on the road during rush hour do.

Availability is often confused with oversubscription to the Internet, but they are different. Oversubscription applies to the network’s connection to the Internet, and availability applies to the “uptime” of the connection or transport between user locations or from the access point to the Internet. A service is available as long as it operates as promised. However, as mentioned, it may still be oversubscribed – in which case it is operating but may be operating well below the peak advertised speed.

- **Maximum usage:** A network service may have a maximum data usage (in bytes) for a given period. For example, many wireless service data plans specify the number of gigabytes that users can transmit during the month. These plans carry extra fees for exceeding the limit,

Oversubscription, which applies to the network’s connection to the Internet, is often confused with availability, which applies to the “uptime” of the connection.

and the ISP may actually slow down a user's connection speed as the usage limit is neared. Cable modem and DSL providers have raised the possibility of adding usage limits to their services (for example, Comcast has trials of bandwidth limits), but implementation of such policies has so far been limited.

- **Latency:** This is the delay between the instant a message is sent and the instant it is received. Latency occurs on a provider's network; if a connection is made over the Internet, additional delays are added there. Latency is not an attribute that users can specify with cable modem and DSL services. For Metro Ethernet and other higher-end transport services, latency is often a quality-of-service feature for which a user can contract (at an added price). At times, high latency will make it impossible for users to run certain applications. For example, satellite-based ISP services have an extremely high latency due to propagation delays (that is, the time it takes for a signal to reach the satellite). These delays prevent effective use of interactive services such as voice calls or interactive video.
- **Connection Type:** This attribute describes how a connection is made with other locations. For example, on a cable modem or DSL service, all connections to other locations are made through the Internet with Internet addressing schemes. This may require a user to set up a virtual private network (VPN) for secure communications among user locations. Establishing a VPN on the network requires cost, expertise and software and has an impact on performance. In contrast, higher-end data services, such as Metro Ethernet, enable a user to send traffic over the provider's network in virtual networks without connecting to the Internet, set up direct point-to-point connections, and limit which locations may connect with one another.
- **Security:** Although security is primarily a function of encryption and other techniques applied by users or application providers, traffic over a private network is inherently more secure than traffic on a network that establishes connectivity over the Internet. A cable modem or DSL user with multiple sites transmits packets over the Internet to connect between sites. With a higher-end service such as Metro Ethernet connecting user sites, the transport would remain on the network. In addition, higher-end services often have encryption options at the transport layer.
- **Port Rate:** Not all connections are equal. The network connection, drop, and customer premises equipment (CPE) define the potential connection speed at a customer site. The port rate is the maximum speed that the demarcation point to a customer can support. For cable modem services, this is defined by the network's DOCSIS version.

An example of the impact of capacity (bytes) and speed (Mbps) for selected services and network architectures

For business applications, broadband subscribers must consider such features as consistency, latency, capacity, security and symmetry in addition to maximum bandwidth.

is shown in Figure 1. As indicated, fiber-to-the-premises (FTTP) architecture offers far superior performance (capacity and speed) as compared with cable modem or DSL services. Indeed, with FTTP including GPON, residential and small-business users can enjoy many of the enhanced attributes discussed here without the higher price often associated with Metro Ethernet. ❖

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