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Broadband Basics: Understanding a Broadband Network

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Broadband, otherwise known as access to the internet, has become the equivalent of electricity in today's environment. Everyone needs it to fulfill life's daily activities: work, school, commerce, communication, or entertainment. Without it, consumers, and businesses alike, would be unable to participate in modern-day society.

A vast interconnected network of transport and access points is required to deliver this digital lifeblood. A broadband network consists of three main segments – access, core, and transport. We'll begin with the access network where a typical end user begins his or her internet journey.

Access Network

The access network is the part of a broadband network that connects end users – homes and businesses – to the core network. It's made up of the physical wired or wireless connections that allow end users' devices (phones, laptops, tablets, alarm systems, etc.) to access and connect to the internet. The access network utilizes rights-of-way to connect customers, spanning hundreds or thousands of square miles and typically comprises the bulk of a service provider's network assets. It's also often the costliest of all the network components to build and maintain.

Physical Wired Networks

To understand the physical connections, let's start at the customer's equipment and work backward through the network. Customer devices connect to the internet through a modem, router, or gateway inside the home or business. When these devices are installed, they are connected to a network interface device (NID) using a fiber, copper, or coaxial "drop" cable. A NID is commonly found on a home or building's exterior and connects that building to the rest of the access network.

As you move back into the access network from the customer's location, each NID connects to a network node using another cable called a "distribution cable." These network nodes are an aggregation point where the many distribution cables serving entire neighborhoods, or multi-tenant buildings, are condensed into a single cable. These aggregation points are passive in an all-fiber network, meaning they require no power and house no active electronics. Conversely, copper or coaxial-based broadband networks house active electronics in these nodes to amplify existing electrical signals or convert a passive optical signal to an electrical signal.

These nodes are connected to the broadband network by another cable called a "feeder" cable – typically a high-capacity fiber optic cable. Feeder cables aggregate the signals for tens, hundreds, or even thousands of end customers. As you may have deduced, a "wired" network requires a lot of cable, and an uninterrupted physical connection to the end user may not always be feasible. Enter the "wireless" network.

Fixed Wireless Networks

For fixed wireless networks, much of the architecture is the same, with a few exceptions. Signals to the NID are delivered wirelessly from the distribution points using a radio spectrum rather than over a wired fiber, copper, or coax connection. In this case, the NID at the customer location will include a radio that captures and transmits wireless signals. Customers can connect their devices to the network in the same way as they do with wired networks—by using a modem, router, or gateway.

Within a fixed wireless network, the network node is located at a wireless access point – typically a tower or tall structure such as a building. This wireless access point transmits and receives radio signals to and from the individual NID. Just like with wired networks, a fixed wireless network node on a tower is typically fed by a fiber feeder cable, although some fixed wireless nodes may also use wireless connections to reach the core of the network. Regardless of the method of transport, these signals must all be managed by the core network.

Core Network

The core of a typical broadband network contains an array of electronics that manage signals and data flow. If you've heard the terms central office, headend, or data center, these are essentially the facilities that house such electronics. The core network connects these facilities and is often referred to as the "metro ring." Regardless of the facility used, the core network's function is to route, aggregate, store, and manage the data transferred across the network. Core equipment consists of sophisticated electronics that direct internet traffic from the access (customer) network to the transport network.

The core network also has several network management systems to govern and manage all broadband network activities. Core network responsibilities include network operations center (NOC) functions and managing applications such as email, web hosting, and billing. Within the core network, operators can regulate the services and applications that end customers receive, including the broadband speeds that end customers receive.

Transport Network

A provider's core network connects to the global internet through a transport network – aka the long-haul network or the super-highway. These connections are what allow end customers to take full advantage of what broadband can offer. A "tiered operator" hierarchy maintains transport networks.

The local (Tier 3) broadband provider that individuals or businesses contract with for their services also have contracts with larger, regional (Tier 2) providers. By leasing bandwidth from regional providers with existing points-of-presence (PoP) that serve as a gateway or meeting point to the global internet, Tier 3 operators can reduce their capital investment. Global (Tier 1) operators aggregate data from multitudes of Tier 2 and Tier 3 operators at PoPs of their own, allowing internet traffic to flow across the globe. Designations of Tier 1, 2, or 3 are defined here very discretely for the sake of simplicity. However, individual network operators may offer different services depending on the infrastructure assets they have in a particular geographic area. For example, a Tier 1 may exclusively operate as backhaul transport in one area and offer local service to end users via their own access networks in others.

Conclusion

Beyond local or regional networks to global connectivity is where the internet's full complexity can be appreciated. The internet is truly a network of networks. In addition to building and maintaining their own infrastructure, broadband operators need to interconnect with other providers to deliver the internet's full capabilities. Key network components, including the access, core, and transport systems, work in harmony to deliver the modern-day equivalent of electricity to end customers' homes and businesses.

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