

## 11.1.6 WAN Services Facts

The following table describes common WAN services that are used to connect two networks through a WAN.

### WAN Connection Technologies

Service	Description
Public Switched Telephone Network (PSTN)	<p>The <i>PSTN</i> is the network used to place local and long distance phone calls.</p> <ul style="list-style-type: none"> <li>The PSTN is a circuit-switched network. A dedicated circuit is established when the call is placed and remains in place throughout the call.</li> <li>The local loop uses analog signals over POTS (through regular telephone cable wires). The long distance network typically uses digital signaling over fiber optic.</li> <li>End-to-end speeds are limited to 56 Kbps, a restriction imposed by POTS in the local loop at each end.</li> <li>A modem is required to convert digital signals to analog.</li> <li>Remote Access clients use the PSTN as a way to access the network or as a temporary or backup connection between sites.</li> </ul>
Integrated Services Digital Network (ISDN)	<p><i>ISDN</i> is a WAN technology that provides increased bandwidth within the local loop. These are two forms of ISDN:</p> <ul style="list-style-type: none"> <li>ISDN BRI (basic rate interface) uses digital signals over POTS. The traditional phone line is divided into separate channels, two 64 Kbps bearer (B) channels and one 16 Kbps control (D) channel. ISDN BRI is often called 2B + 1D.</li> <li>ISDN PRI (primary rate interface) uses digital signals over a T1 line with 23 64 Kbps B channels and one 64 Kbps D channel in North America (up to 1.544 Mbps), or over an E1 line with 30 64 Kbps B channels and one 64 Kbps D channel in Europe (up to 2.048 Mbps). ISDN PRI is often referred to as 23B + 1D.</li> </ul> <p>ISDN has the following characteristics:</p> <ul style="list-style-type: none"> <li>It is a circuit switching technology.</li> <li>It is a local loop technology. When calls reach the WAN cloud, they are converted to another protocol for transmission through the WAN.</li> <li>With ISDN BRI, you can use one channel for voice and one channel for data, or both channels for different voice calls. Depending on the implementation, you can also bond the B channels and use them together.</li> <li>ISDN PRI requires a CSU/DSU for the T1 line.</li> </ul>
Frame Relay	<p><i>Frame Relay</i> is a protocol used to connect to a WAN over dedicated (leased) lines.</p> <ul style="list-style-type: none"> <li>Frame Relay is a packet switching technology that supports variable-sized data units called <i>frames</i>.</li> <li>Frame Relay establishes a permanent virtual circuit between two locations. Because the circuit is permanent, there is no call setup or termination required.</li> <li>Virtual circuits can be configured in two different ways. <ul style="list-style-type: none"> <li>A point-to-point circuit is established between two locations.</li> <li>A point-to-multipoint circuit is a single circuit that can be used to reach multiple locations.</li> </ul> </li> <li>Frame Relay can be implemented over a variety of connection lines (e.g., T1, T3) and achieves faster speeds by using high-quality digital lines, which require less extensive error control than X.25 networks.</li> <li>Routers at the customer site connect to the T1 line through a CSU/DSU.</li> <li>When congestion occurs, the Frame Relay network simply drops packets to keep up. Frame Relay networks provide error detection, but not error recovery. It is up to end devices to request a retransmission of lost packets.</li> <li>When you sign up for Frame Relay service, you are assigned a level of service called a <i>Committed Information Rate</i> (CIR). At times, your actual bandwidth could be higher than the CIR, but the CIR represents the maximum guaranteed data transmission rate you will receive on the Frame Relay network.</li> </ul>
Asynchronous Transfer Mode (ATM)	<p><i>ATM</i> is a WAN communication technology originally designed for carrying time-sensitive data like voice and video. It can also be used for regular data transport.</p> <ul style="list-style-type: none"> <li>ATM is a packet switching technology that uses fixed-length data units called <i>cells</i>. Each cell is 53 bytes.</li> <li>ATM establishes a virtual circuit between two locations. <ul style="list-style-type: none"> <li>A <i>virtual channel</i> is a data stream sent from one location to another.</li> <li>A <i>virtual path</i> is a collection of data streams with the same destination.</li> </ul> </li> <li>The cell header includes labels that identify the virtual path information. ATM switches in the WAN cloud use the virtual path to switch cells within the WAN to their destination.</li> <li>ATM is connection-oriented (compared to Frame Relay, which is connectionless).</li> </ul>
Distributed Switching	<p><i>Distributed switching</i> is an architecture in which multiple processor-controlled switching units are distributed. There is often a hierarchy of switching elements with a centralized host switch and remote switches located close to concentrations of users.</p> <p>Distributed switching:</p>

	<ul style="list-style-type: none"> <li>Is often used in telephone networks, though it is often called host-remote switching.</li> <li>Is used in rural areas, where population centers tend to be too small for economical deployment of a full-featured dedicated telephone exchange, and the distances between these centers make the transmission costs relatively high.</li> <li>Many data-centric telecommunications platforms, such as routers and Ethernet switches, utilize distributed switching on separate cards within an equipment chassis.</li> </ul>
Multiprotocol Label Switching (MPLS)	<p><i>MPLS</i> is a WAN data classification and data carrying mechanism.</p> <ul style="list-style-type: none"> <li>MPLS is a packet switching technology that supports variable-length frames.</li> <li>MPLS adds a label to packets between the existing Network and Data Link layer formats. Labels are added when the packet enters the MPLS network and are removed when the packet exits the network.</li> <li>Information in the label is used to switch the packet through the MPLS network to the destination.</li> <li>MPLS labels can identify the route or even the network type to use. MPLS labels are often used to provide different classes of service for data streams.</li> <li>MPLS is a connection-oriented protocol.</li> </ul> <p>Cisco routers using MPLS are required to use the Cisco Express Forwarding (CEF) switching technology.</p>
Dynamic Multipoint VPN (DMVPN)	<p>DMVPN is a Cisco IOS Software solution for building scalable IPsec Virtual Private Networks (VPNs).</p> <ul style="list-style-type: none"> <li>Cisco DMVPN uses a centralized architecture that provides easier implementation and management for deployments that require granular access controls for diverse user communities, including:             <ul style="list-style-type: none"> <li>Mobile workers</li> <li>Telecommuters</li> <li>Extranet users</li> </ul> </li> <li>Cisco DMVPN also allows branch locations to communicate directly with each other over the public WAN or internet, such as when using voice over IP (VoIP) between two branch offices, but doesn't require a permanent VPN connection between sites.</li> <li>DMVPN:             <ul style="list-style-type: none"> <li>Reduces costs of integrating voice and video with VPN security.</li> <li>Enables direct branch-to-branch connectivity for business applications like voice.</li> <li>Offers a zero-touch configuration, dramatically reducing the deployment complexity in VPNs.</li> <li>Prevents disruption of business-critical applications and services by incorporating routing with standards-based IPsec technology.</li> </ul> </li> </ul>
SIP Trunk	<p><i>SIP trunking</i> is a method where business phone systems operate using an internet connection instead of a traditional phone line.</p> <ul style="list-style-type: none"> <li>SIP trunking is made available by SIP providers, which are similar to traditional phone companies, except SIP providers give access to phone lines over the internet.</li> <li>SIP trunking:             <ul style="list-style-type: none"> <li>Saves you money on your business phone.</li> <li>Makes it easy to scale your operation pain-free.</li> <li>Offers increased phone service reliability.</li> </ul> </li> </ul>