Nätverksteknik B - WAN Technologies

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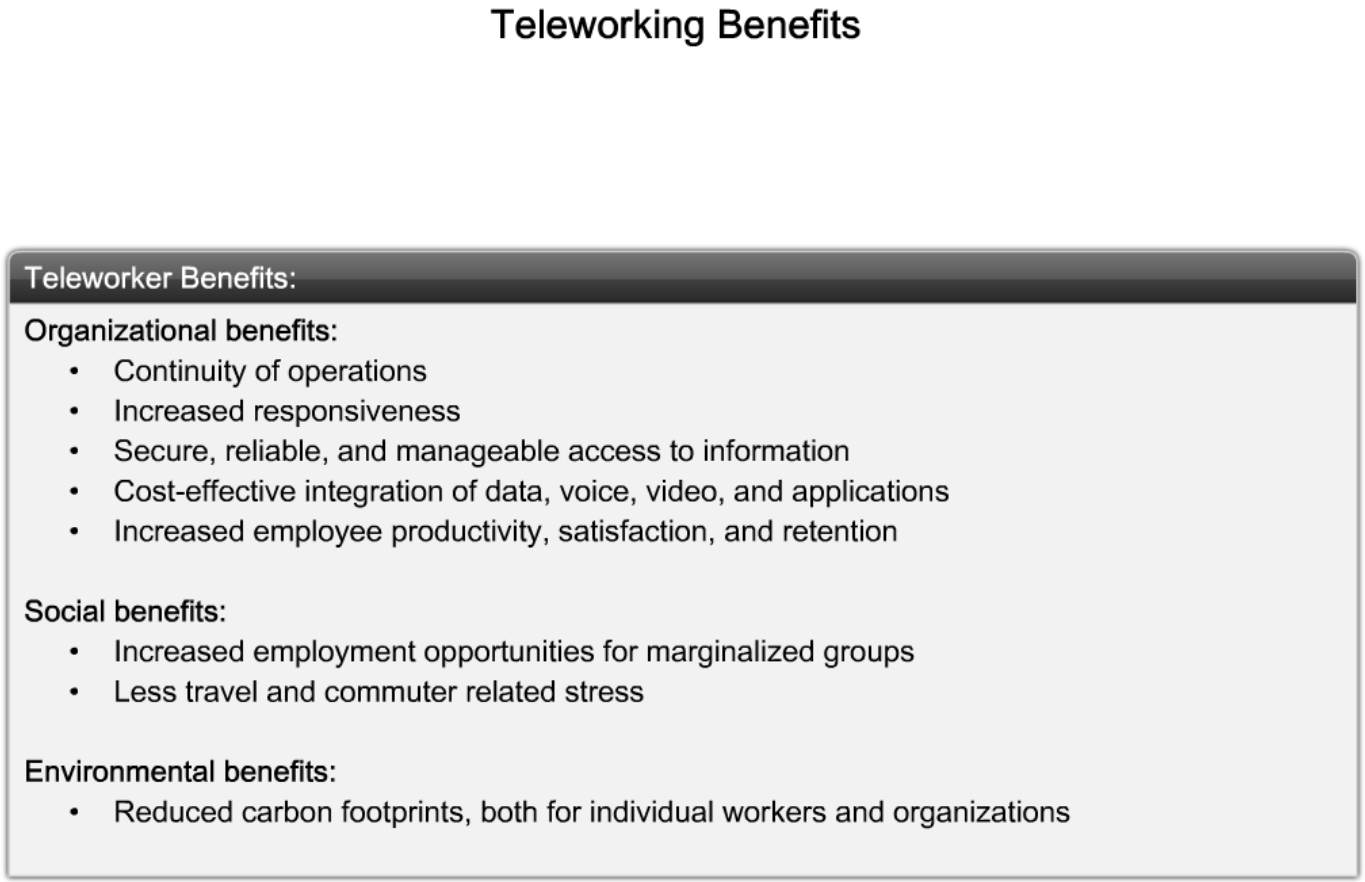
- Teleworker Services,
- Broadband
- VPN
- DHCP

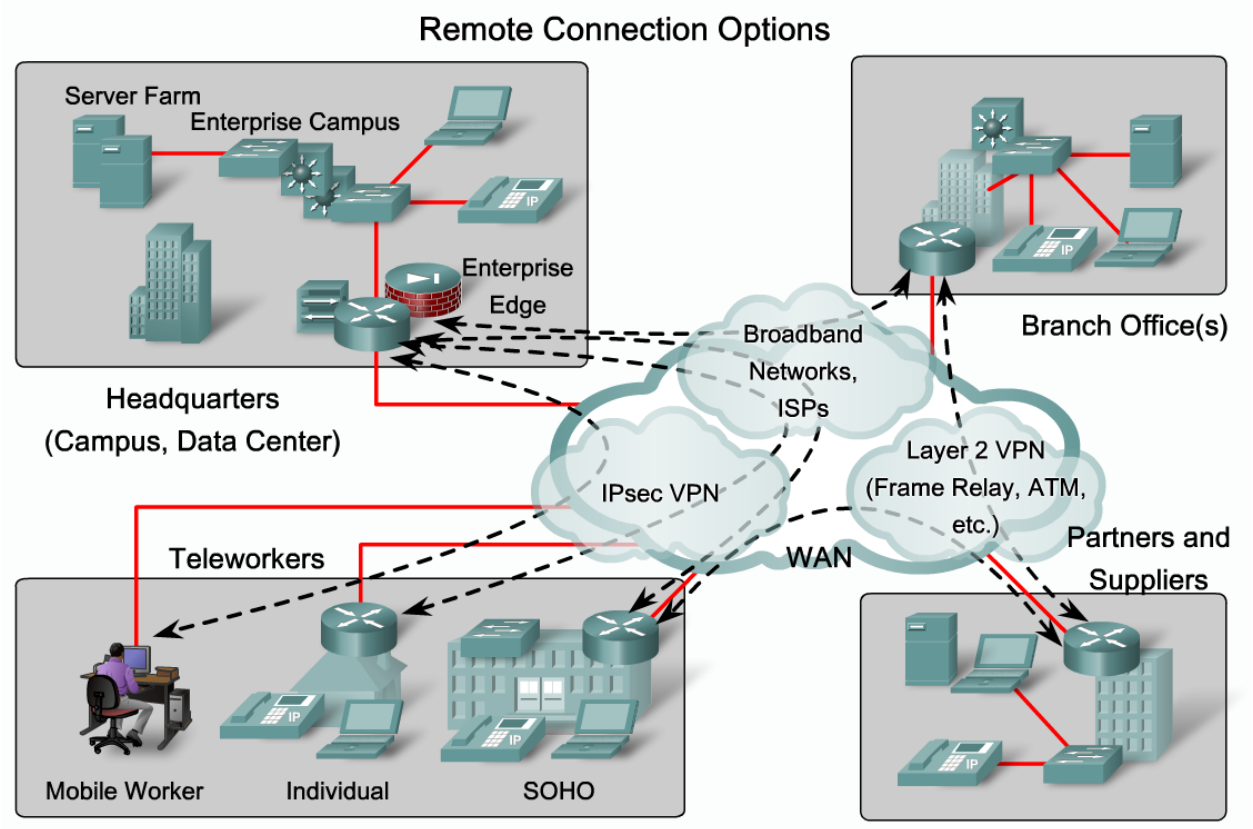
Definition – Teleworker

"Teleworker is when an employee performs his or her job away from a traditional workplace, usually from a home office."[3]



Figur: Benefits of being able to work remotely[3]

Technologies for remote connection



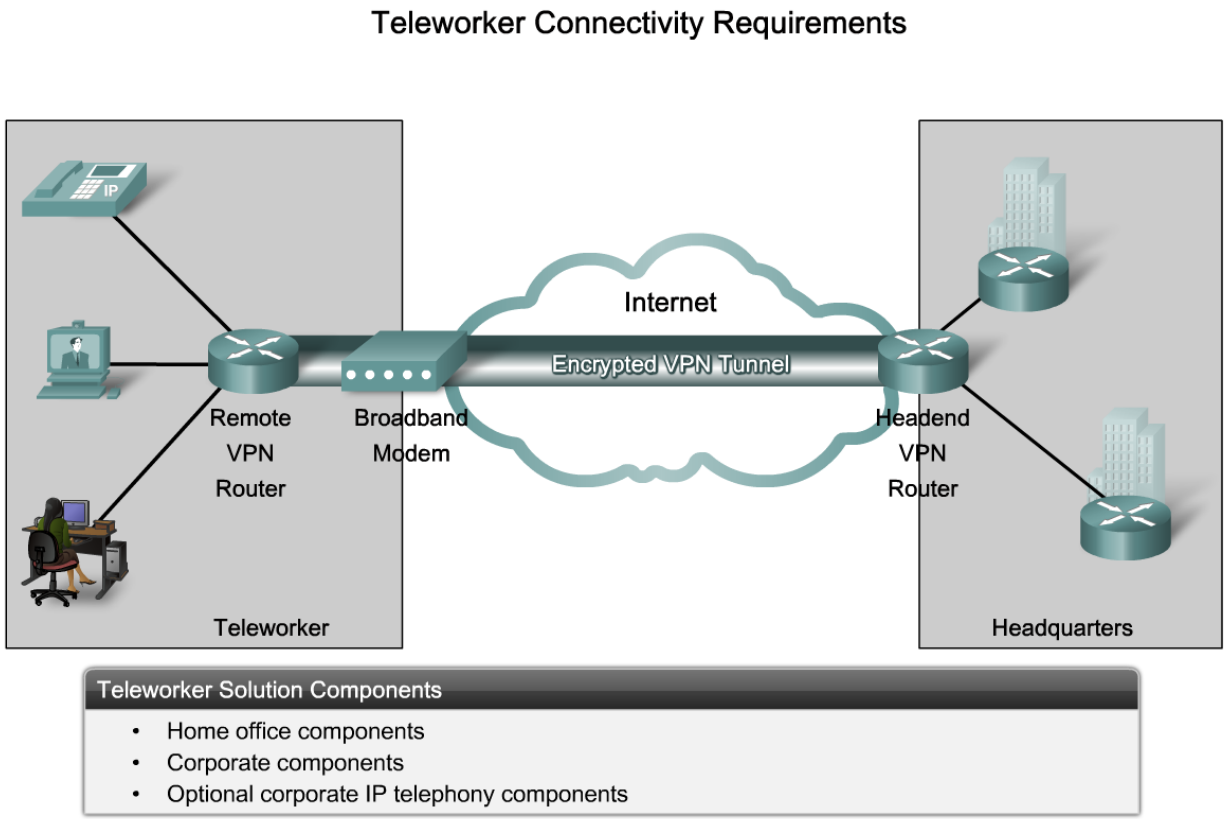
Figur: Multiple ways to connect remotely. [3]

Definition - Broadband

"A type of high-speed data transmission in which the bandwidth is shared by more than one simultaneous signal. " [**broadbandDictionary**]

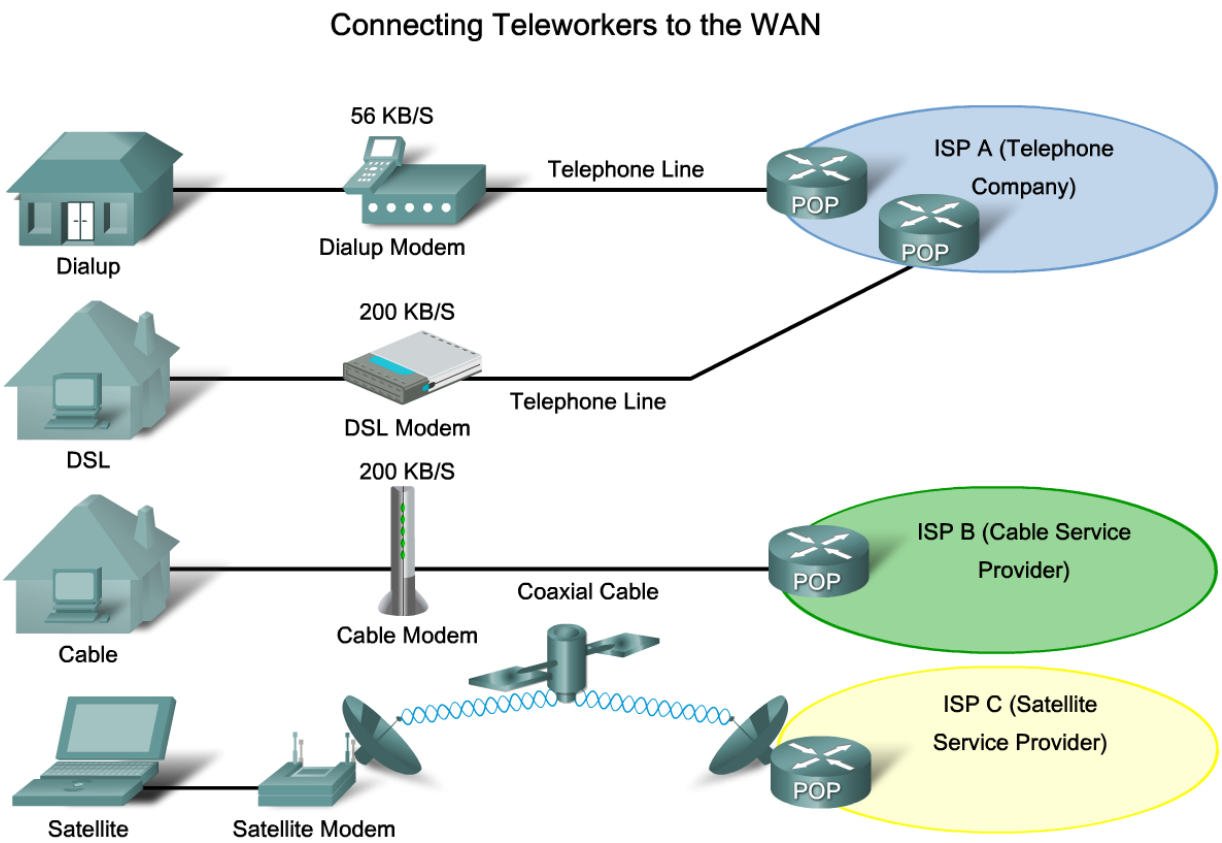
Broadband Technologies

- DSL.
- Fiber-optic.
- Coaxial Cable.
- Wireless.
- Satellite.



Figur: Requirements for remote connections [3]

Connecting teleworkers

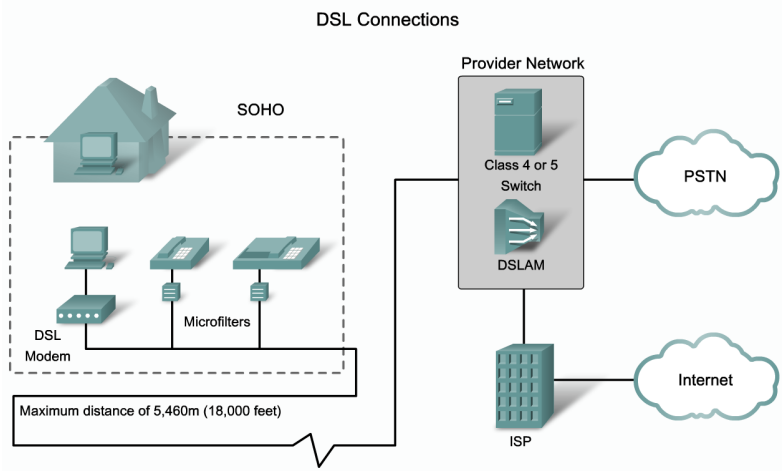


Figur: Technologies to connect to a network [3]

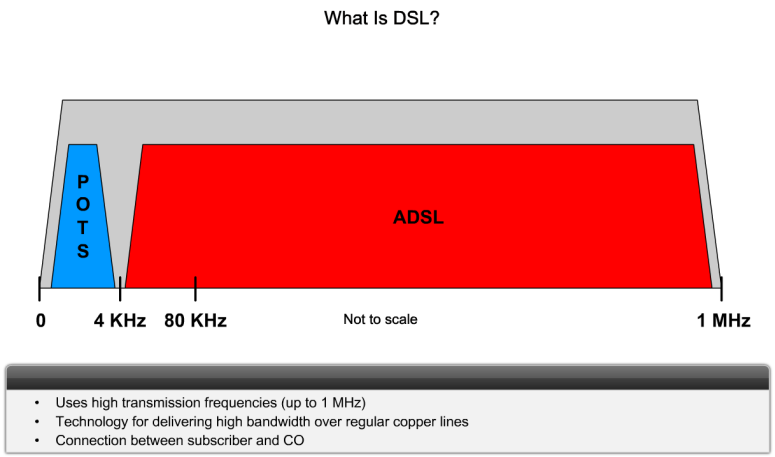
DSL

DSL

- Provided by phone operators (Telia).
- Use the telephone lines.
- Cables support up to 1.1 Mhz (later 2.2 Mhz ADSL2+)
- More expensive than dial-up, but supports higher bit-rate.
- Speed vary based on distance to Central Office (CO).
- 200 Kb/s and higher.

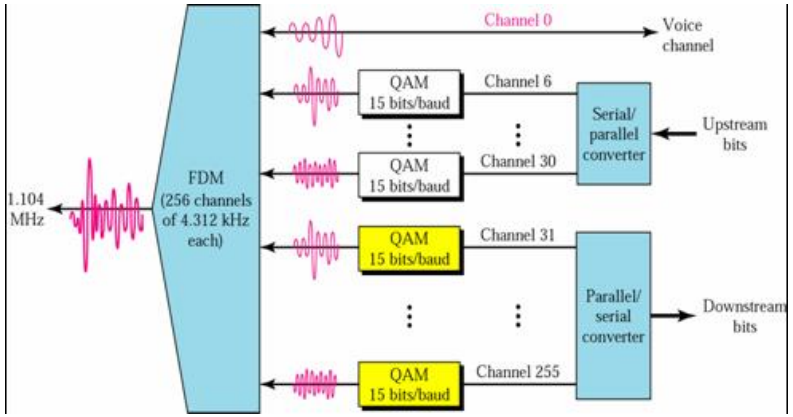


Figur: Connecting DSL [3]

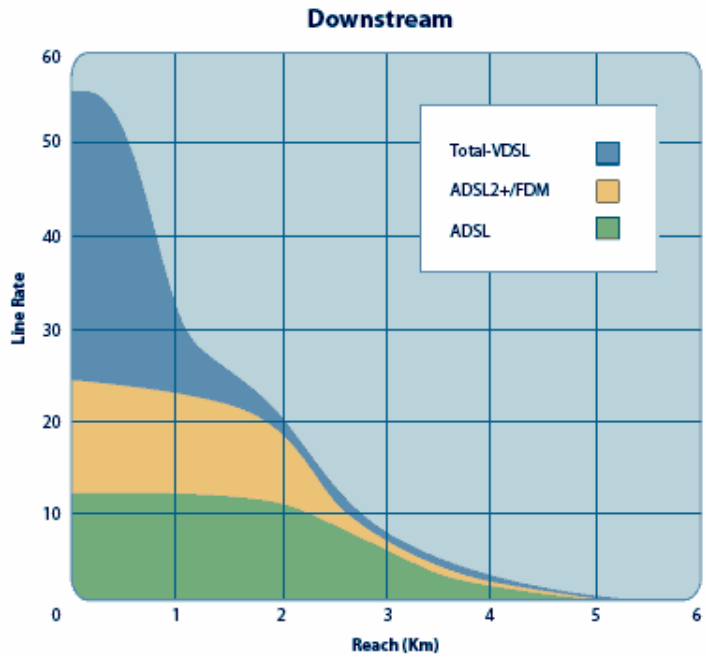


Figur: DSL Bandwidth use [3]

- 256 channels.
- Each channel is 4kHz
- Channel 0 used for POTS.
- Channels 1-5 are unused.
- Usually around 25 channels used for upstream (one for control).
- The rest is for downstream (one for control).



Figur: Discrete Multitone Technique [1]



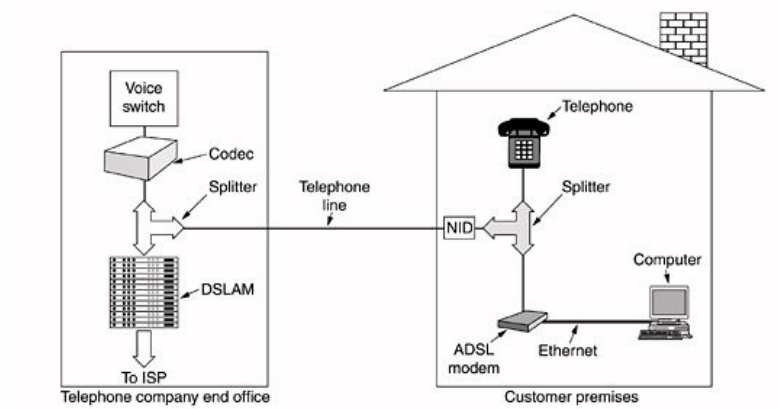
Figur: Graph showing bandwidth versus distance in DSL [**adslwiki**]

Microfilter

Microfilter is a passive low-pass filter, One end connects to the phone, the other connects to the wall jack.

Splitter

A splitter separates the DSL-traffic from the POTS traffic. Located at the Central Office and at the customer.



Figur: A typical ADSL equipment configuration [2]

Internet over Cable TV network

TDMA

Time Division Multiple Access – Share the same frequency channel using timeslots.

FDMA

Frequency Division Multiple Access – Media is shared using different frequencies.

CDMA

Code Division Multiple Access – Share the same frequency channel using by using different codes.

Internet access through coaxial cables.

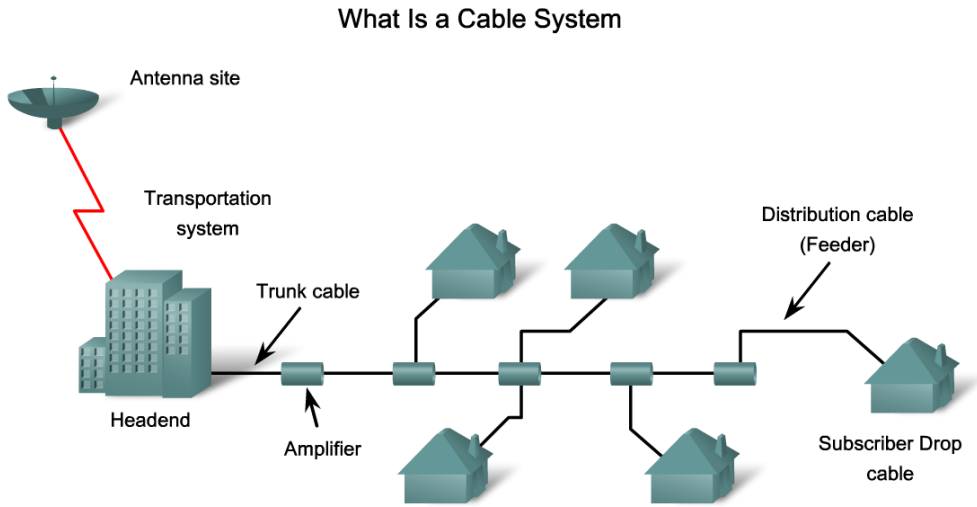
- Usually provided through a Cable TV provider (Com Hem).
- Same cable as used to provide TV.
- Cable usually handles 750Mhz up to 1Ghz.
- Speeds from 200Kb/s and higher.
- Not affected by distance to ISP.
- Affected by number of subscribers.

Community Antenna Television

- Invented by John Walson in 1948.
- Poor TV reception.
- Erected an antenna at local mountaintop and connected the antenna to his store using a cable and signal boosters.

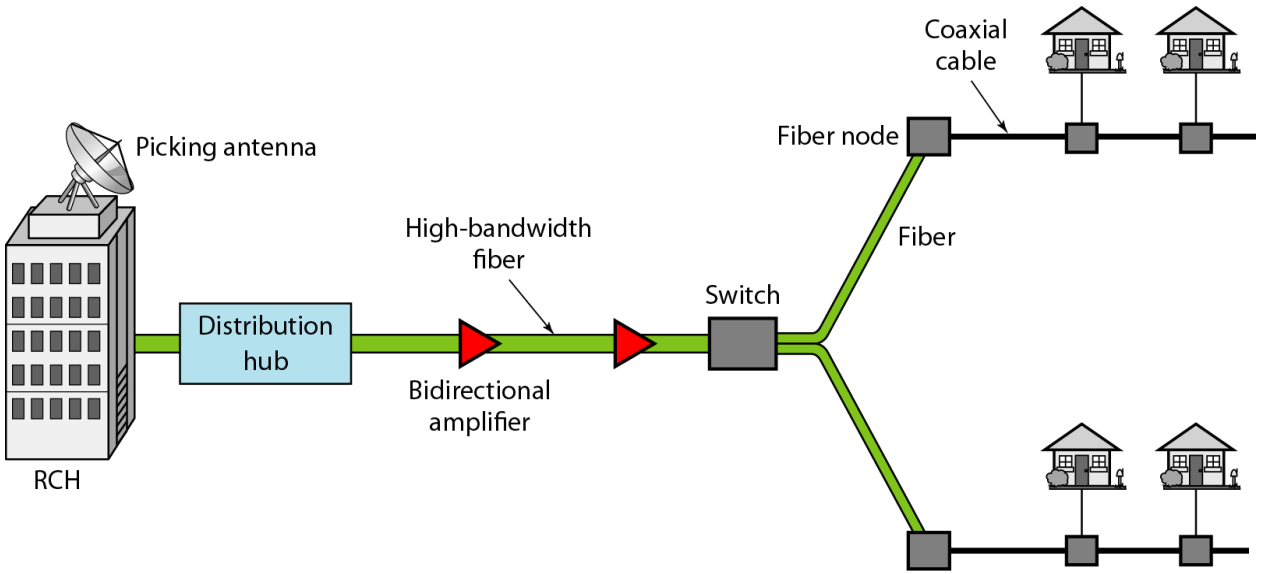
Components in Cable-TV network

- Antenna site – Placed for optimum signal reception. 7
- Headend – Receives the signals from the Antenna, and then distributes the signal.
- Distribution Network – Network to distribute the signal to all subscribers.
- Subscriber drop – Connects the subscriber to the distribution network.



- CATV originally meant "community antenna television." This form of transmission shared TV signals.
- Cable systems were originally built to extend the reach of TV signals and improve over-the-air TV reception.

Hybrid Fiber-Coaxial network (HFC)



Figur: Hybrid Fiber-Coaxial Network [1]

Cable TV for Data transfer

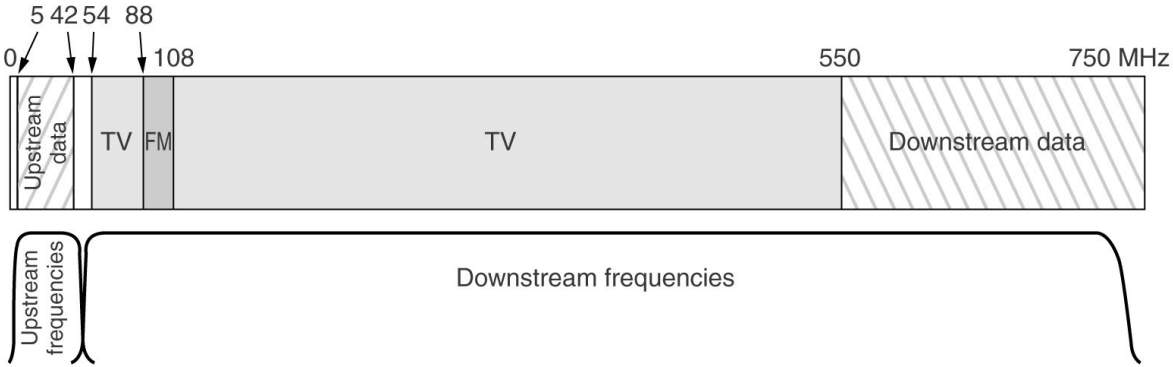
Cable TV companies started using the same network to distribute internet access.

Data over Cable TV network

- TV only needed 496Mhz out of 750Mhz.
- The rest of the frequency band could be used for data transfer.

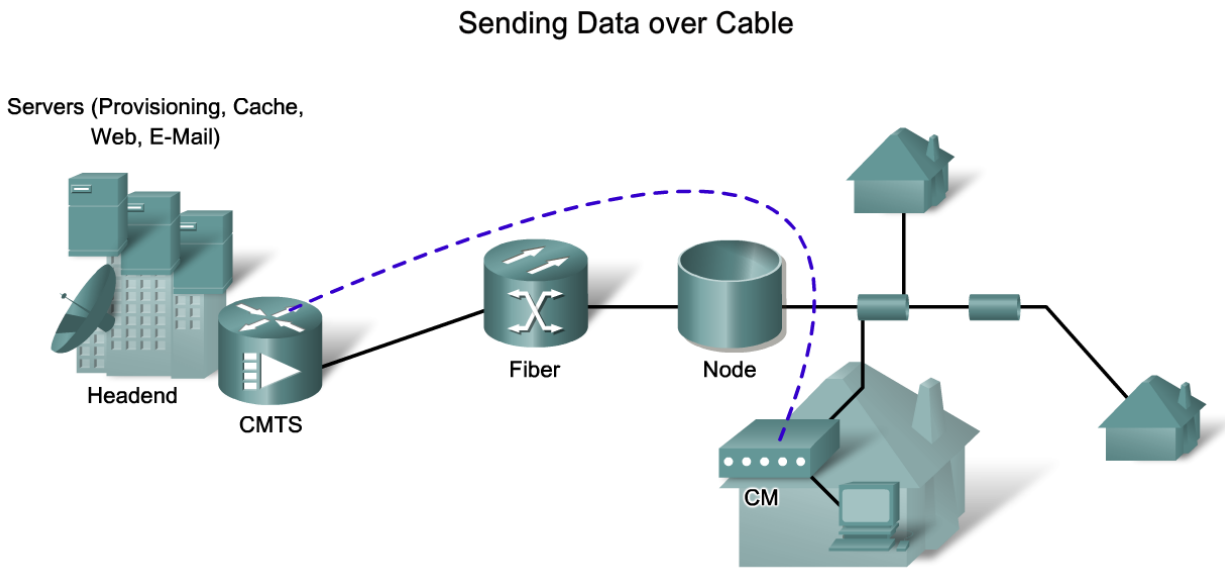
Channels

- Each channel occupy 6-8 Mhz.
- Downstream – 6bits/baud.
  - 1 bit for FECN.
  - 5 bit data/baud.
  - The standard specifies 1 Hz for each baud.
- Upstream – 2 bits/baud.
  - Lower frequencies means more susceptible to noise. Other modulation technique.
  - The standard specifies 1 Hz for each baud.



Equipment

- CMTS – Cable Modem Termination System
  - Placed in the distribution hub.
  - Receives data from the internet and sends it to a combiner.
  - Receives data from the subscriber and send it out to the internet.
- CM – Cable Modem.
  - Placed at the subscriber.
  - Modulates and demodulates the signal, same as an ADSL modem.
  - A filter is needed at the subscriber to separate Video from Data.

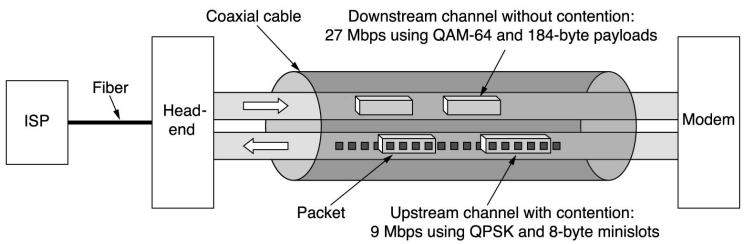


Sharing upstream bands

- Upstream data band is 37Mhz = 6 Channels upstream.
- Upstream data band is divided into channels using TDM.
- Each subscriber is given a mini-slot (usually 8 bytes).
- A timeslot can be shared, then a CDMA scheme can be used.

Sharing downstream bands

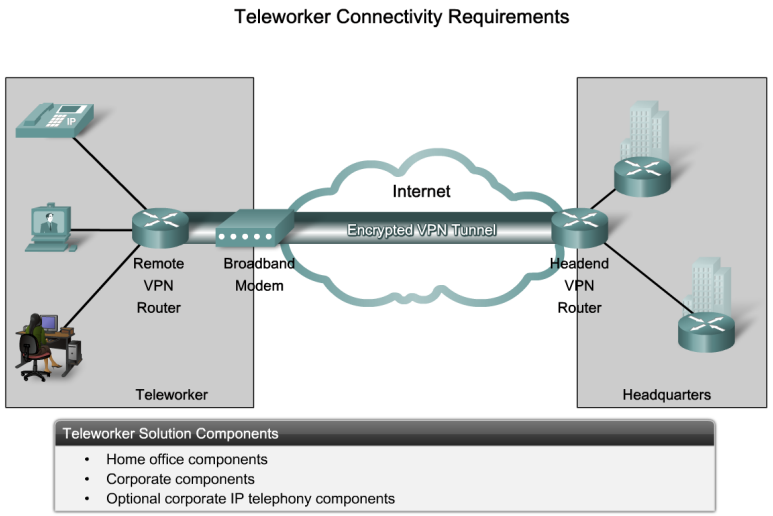
- Downstream data band is 200Mhz = 33 Channels downstream.
- Only one sender, no contention.
- 204 bytes packet (184 bytes payload)



Figur: Upstream and Downstream channels (North America) [3]

Virtual Private Networks

Public versus private network infrastructure



Figur: Private and public network infrastructure [3]

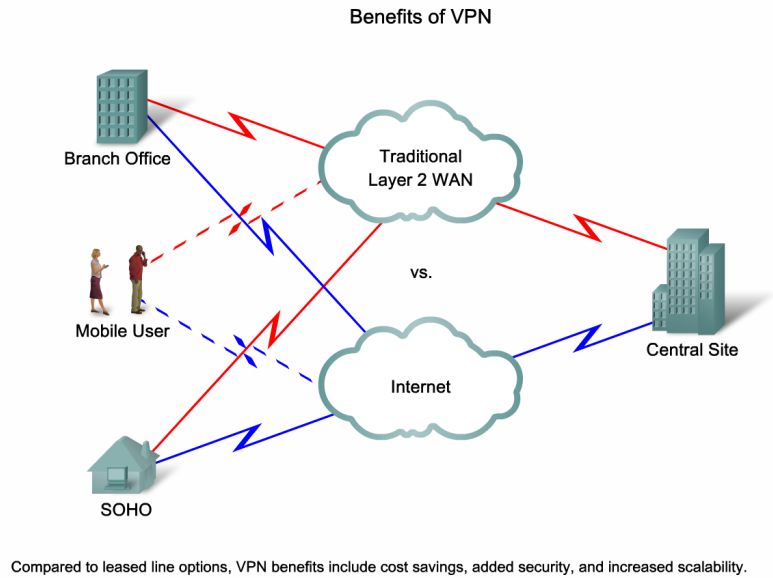
Virtual Private Network

Allows us to securely connect to a remote network over a public network.

Virtual and Private

- Virtual
  - A virtual network is established over the public network, usually with the help of tunneling.
- Private
  - Measures are taken such that the data sent over this virtual network is kept secret from the public network, usually with the help of an encryption technique.

- Cost – A simple internet connection can be used to establish a WAN-connection.
- Security – Privacy is ensured using strong encryption and authentication mechanisms.
- Scalability – Allows use over existing infrastructure.



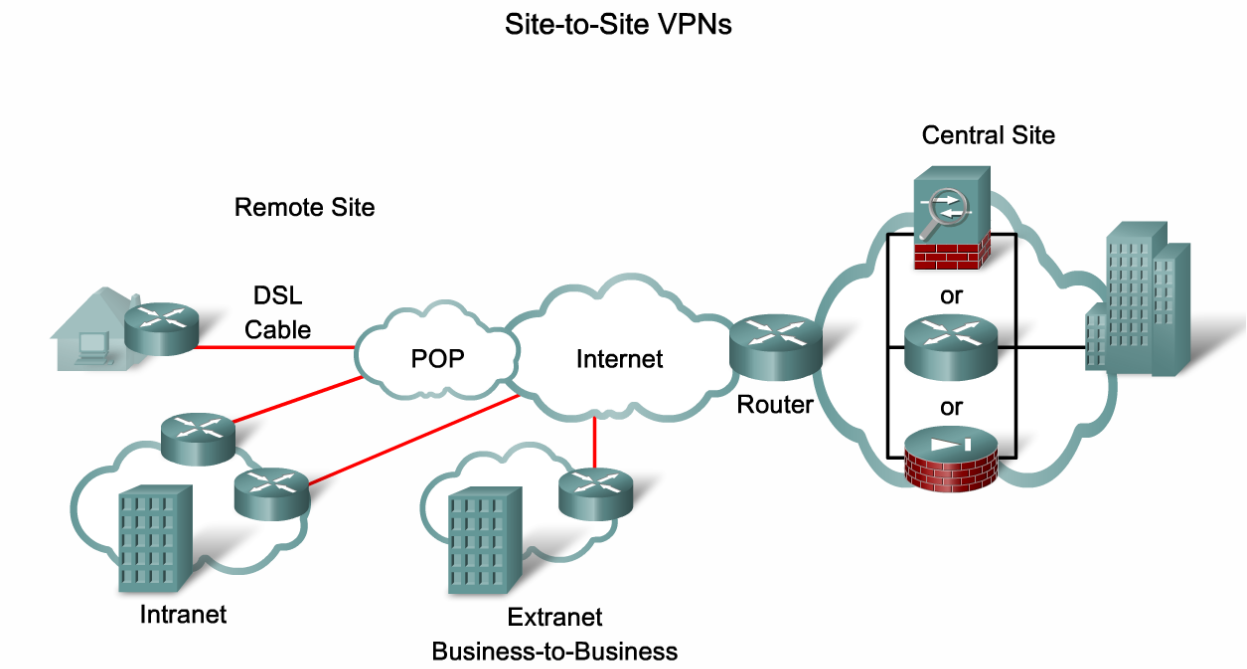
Figur: Benefits of VPNs [3]

Site-to-Site

Provides access between two sites.

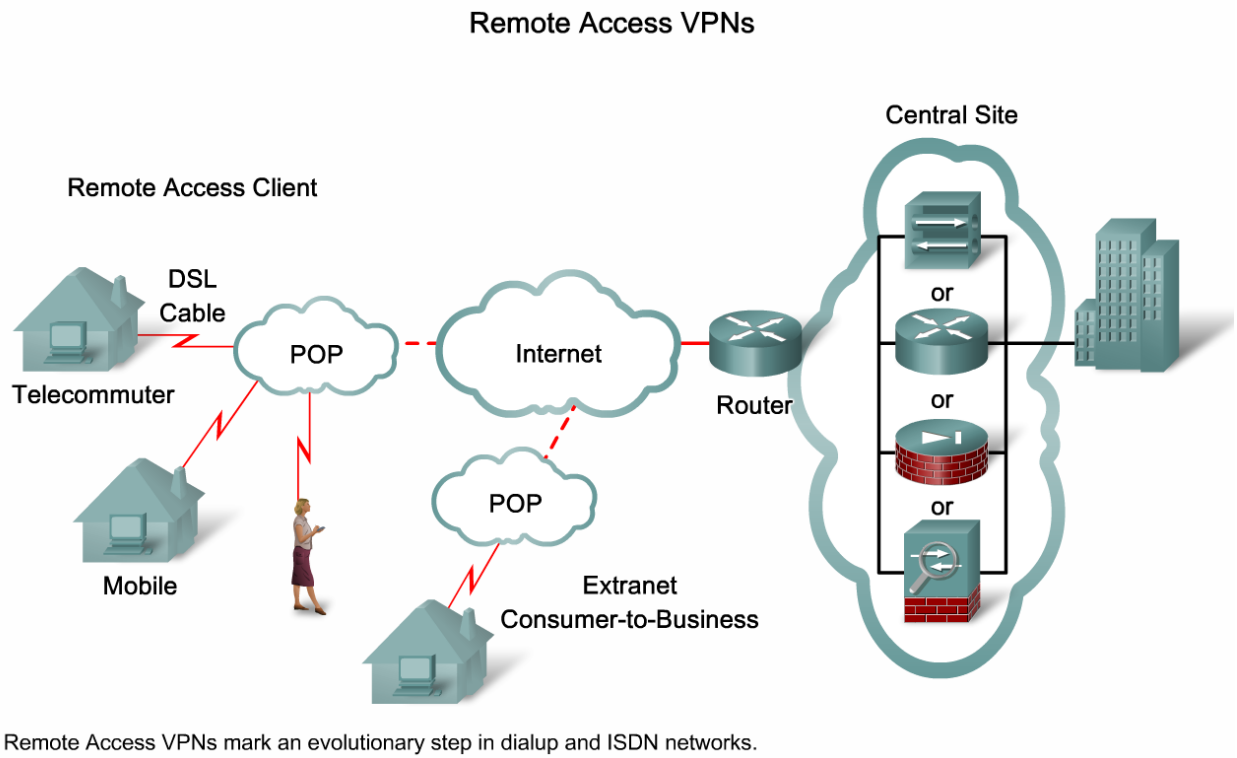
Remote-access VPNs

Provides remote users a connection to the company or organisations intranet.



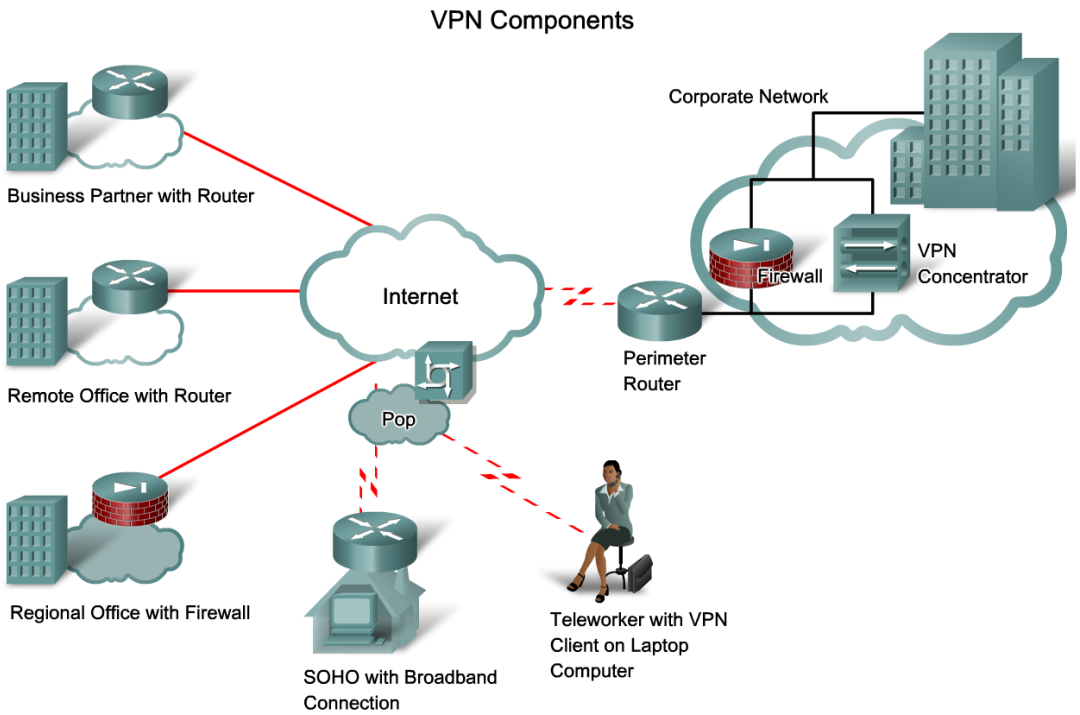
Figur: A Site-to-Site VPN [3]

Remote-access VPNs



Figur: A Remote-access VPN [3]

VPN Components



Figur: Components of a VPN [3]

Characteristics of Secure VPNs

Characteristic	Purpose
Data Confidentiality	Protects data from eavesdroppers (spoofing).
Data Integrity	Guarantees that no tampering or alterations occur.
Authentication	Ensures that only authorized senders and devices enter the network.

Figur: Characteristics of a VPN [3]

VPN Security

Tunneling Protocols

Carrier protocol:

- The protocol over which the information is traveling (Frame Relay, ATM, MPLS).

Encapsulating protocol:

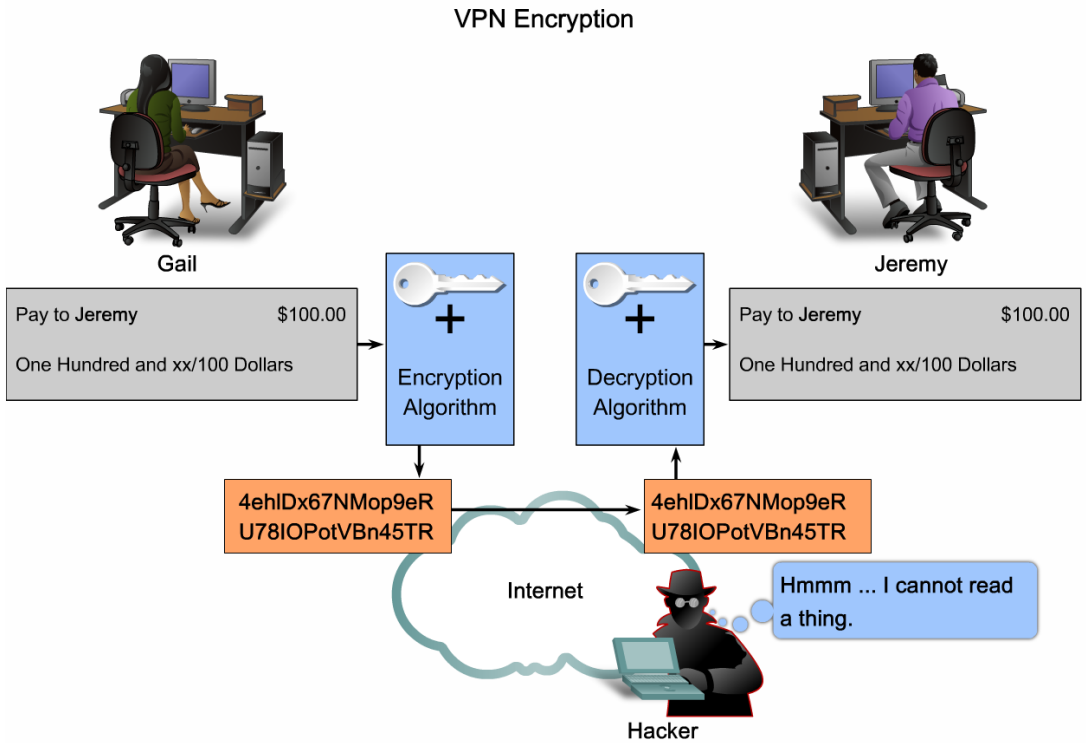
- The protocol that is wrapped around the original data (GRE, IPSec, L2F, PPTP, L2TP).

Passenger protocol:

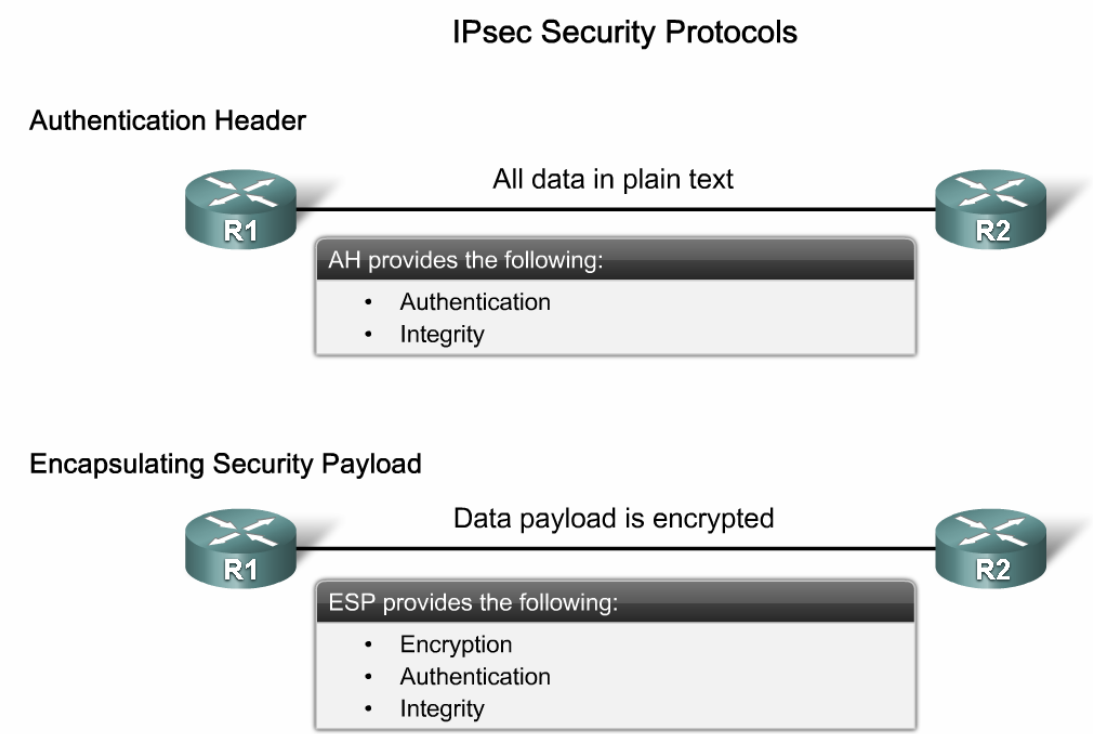
- The protocol over which the original data was being carried (IPX, AppleTalk, IPv4, IPv6).

Figur: Tunneling protocols [3]

VPN Encryption techniques



Figur: VPN Encryption [3]

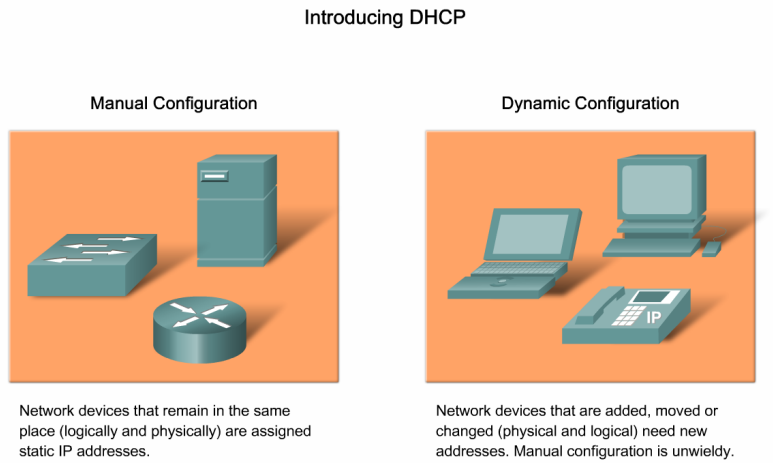


Figur: IPsec [3]

IP Addressing Services and Issues

IP addresses

- IP addresses are depleting.
- Services such as DHCP and NAT helps prolong the usage of IPv4.
- IPv6 is meant as a replacement for IPv4.



Figur: Purpose of DHCP [3]

DHCP

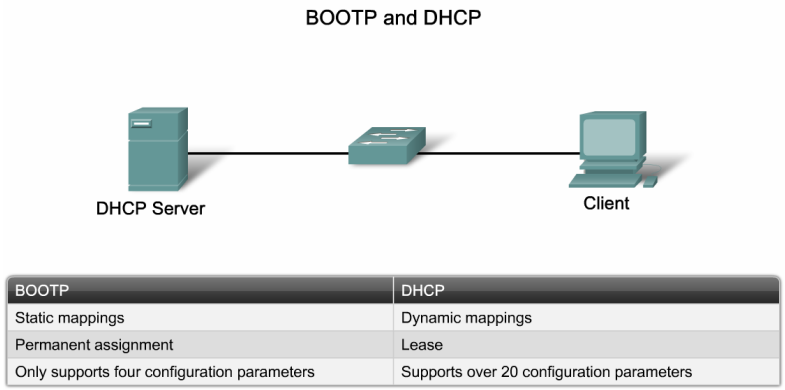
- Allows us to specify a pool of available addresses.
- Information such as default gateway and DNS can also be included.

Assigning IP addresses

- Manual Allocation
  - Preallocate the IP address.
- Automatic Allocation
  - DHCP server allocates automatically an IP-address from a pool.
  - No lease time.
  - Permanently assigned to the host.
- Dynamic Allocation
  - DHCP server allocates automatically an IP-address from a pool.
  - Limited period of time.

BOOTP

- Designed for manual pre-configuration.
- Limited amount of information.

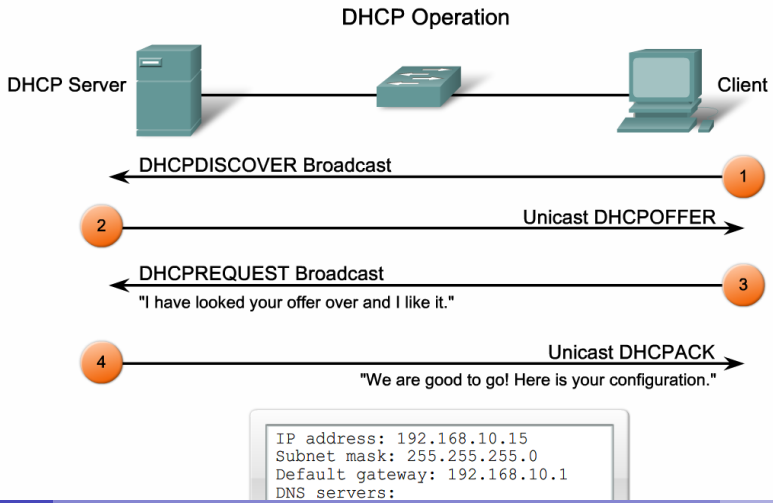


BOOTP	DHCP
Static mappings	Dynamic mappings
Permanent assignment	Lease
Only supports four configuration parameters	Supports over 20 configuration parameters

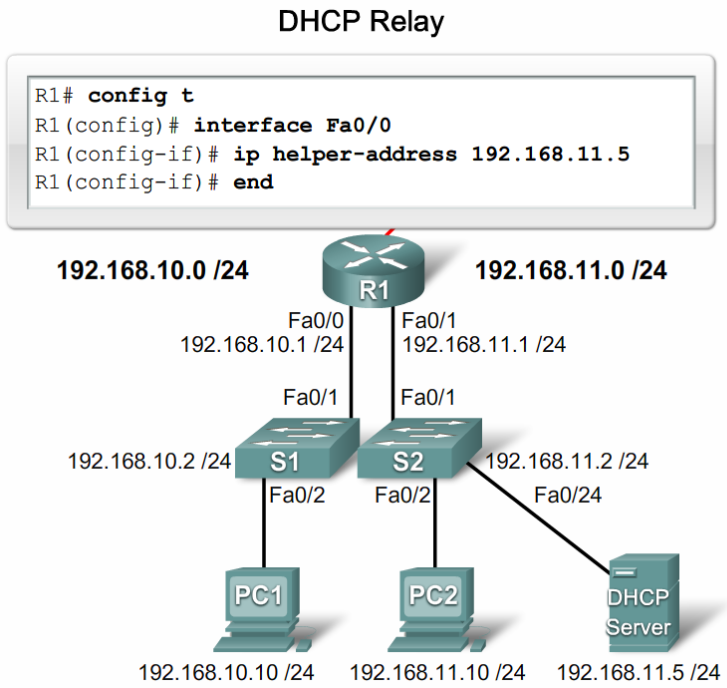
Figur: Bootstrap Protocol [3]

DHCP process

- DHCP discover – Client broadcasts a discover message to find a DHCP-server on the network.
- DHCP offer – A DHCP server responds with a DHCP offer message containing an IP address for the client.
- DHCP request – Client responds with a DHCP Request message. Sent as broadcast.
- DHCP acknowledgement – DHCP server verifies with an acknowledgement.



- Problem if DHCP server is located on another Subnet.
- `Router(config-if)#ip helper-address`
- Relays DHCP messages (amongst other things)



Figur: Relay DHCP messages [3]

References


Behrouz A. Forouzan och Sophia Chung Fegan. *Data communications and networking*. 4. ed. Boston: McGraw-Hill, 2007. ISBN: 0-07-125442-0 (International ed.)


Andrew S. Tanenbaum och D. Wetherall. *Computer networks*. 5th ed. Boston: Pearson, 2011. ISBN: 9780132553179 (hft.) (International ed.)


Bob Vachon och Rick Graziani. *Accessing the WAN : CCNA exploration companion guide*. Indianapolis, Ind.: Cisco Press, 2008. ISBN: 978-1-58713-205-6 (hardcover w/cd).