



Designing the Enterprise WAN

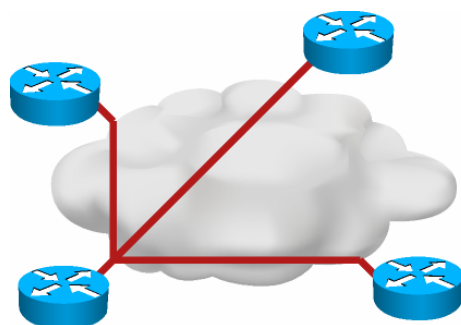


Designing Remote Connectivity

Traditional WAN Technologies

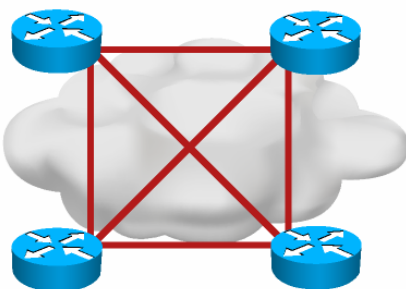
	Description
Leased lines	<ul style="list-style-type: none">▪ A service provider establishes a dedicated connection.
Circuit-switched PSTN (phone service, analog modems, ISDN)	<ul style="list-style-type: none">▪ A dedicated circuit path is established for the duration of a call.▪ ISDN combines voice, data, and backup.
Packet- and cell-switched (Frame Relay, SMDS, ATM, MPLS)	<ul style="list-style-type: none">▪ A service provider creates PVCs or SVCs.▪ ATM uses cells and provides support for multiple QoS classes.

WAN Topologies



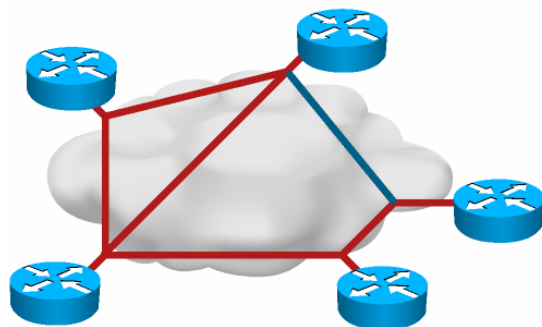
Star, or Hub-and-Spoke, Topology

- Benefits: Network simplicity, low number of circuits
- Drawbacks: Suboptimal traffic flow, no redundancy



Full-Mesh Topology

- Benefits: Any-to-any connectivity, high level of redundancy
- Drawbacks: Configuration complexity, number of circuits



Partially Meshed Topology

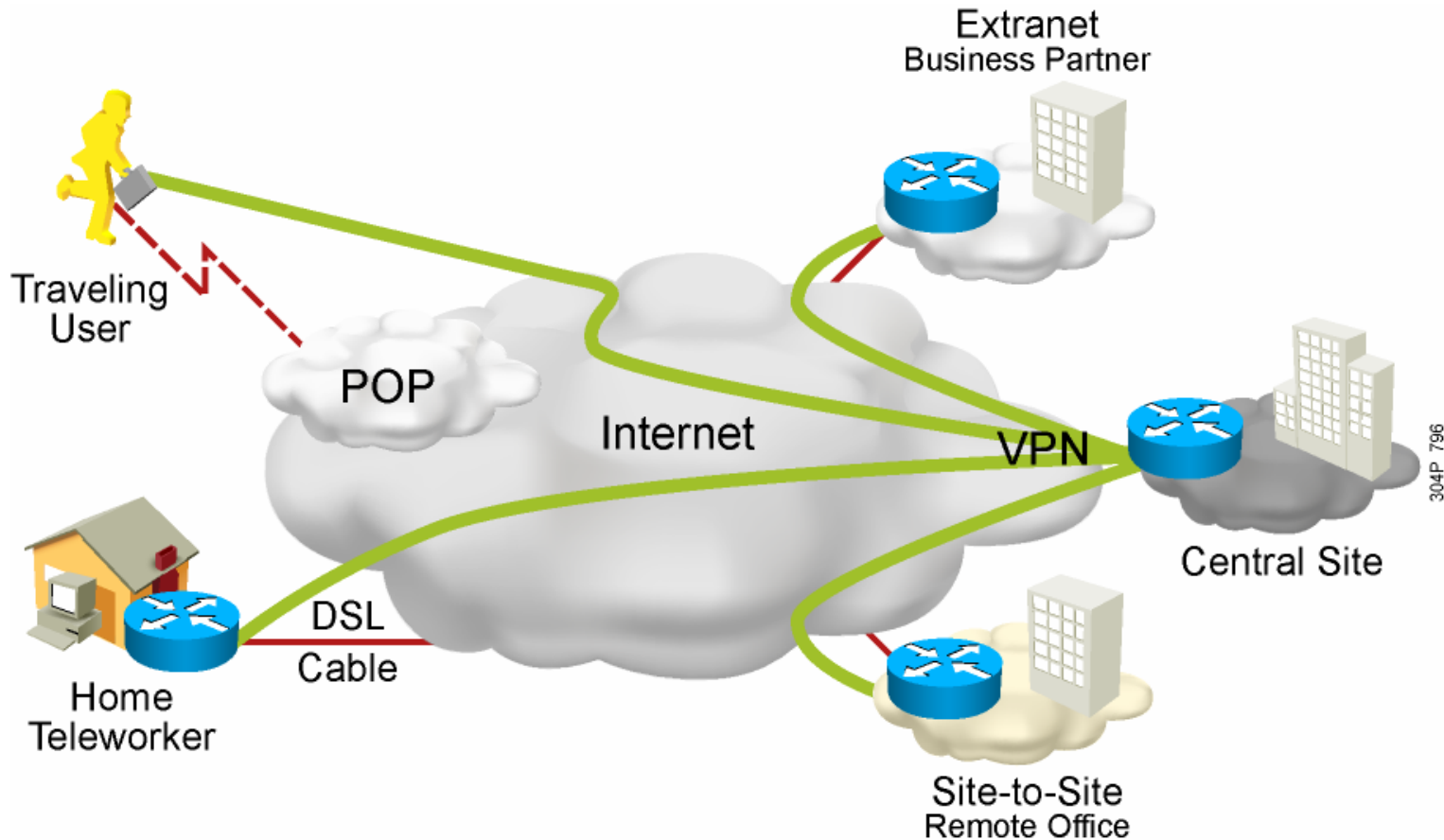
- A compromise between star and fully meshed

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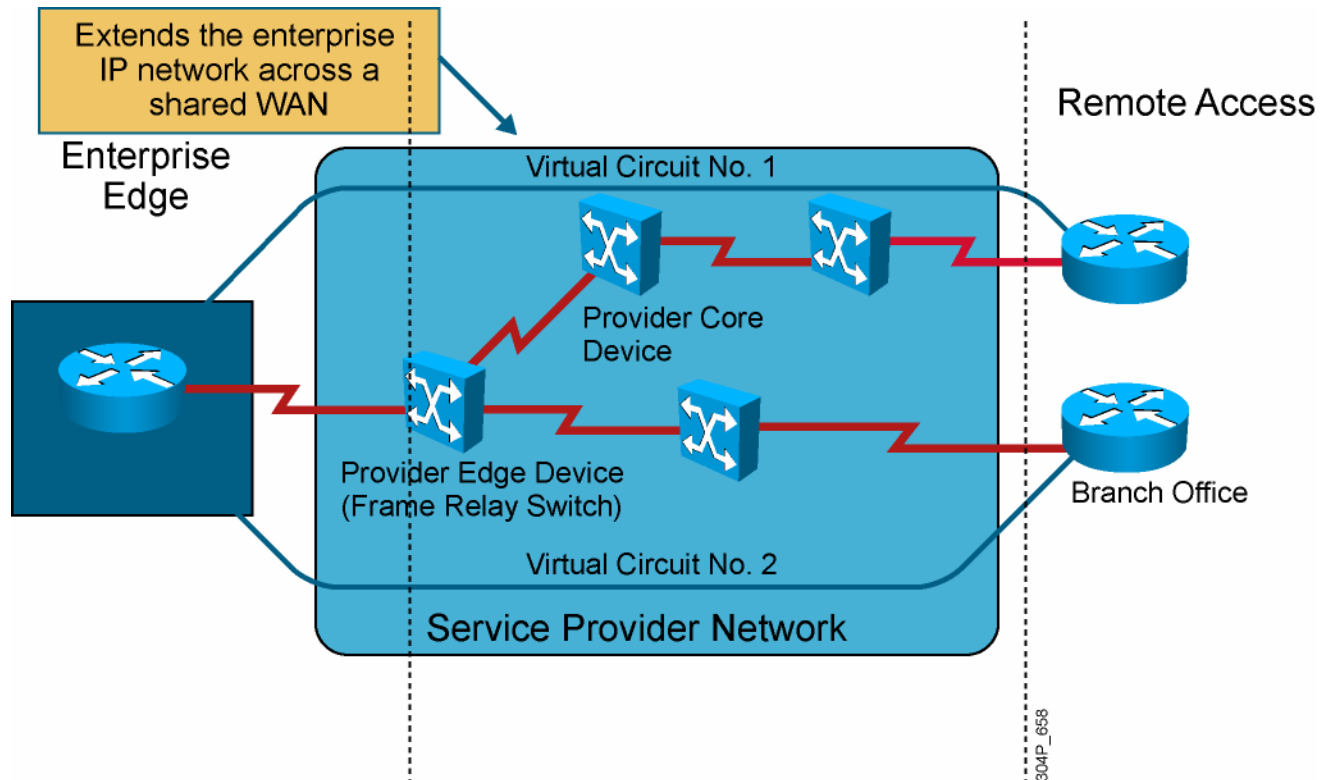
Designing the Remote-Access Network

- **Objective:** Provide a unified solution for remote access
- Grant the connection seamlessly, as if in company headquarters
- Application requirements include:
 - Low to medium-volume data file transfer and interactive traffic for teleworkers and traveling workers
 - Voice services for teleworkers
- **Connectivity option:** IP access through an on-demand or always-on connection
- Technologies include dial-up, DSL, cable, and wireless

Overview of Virtual Private Networks

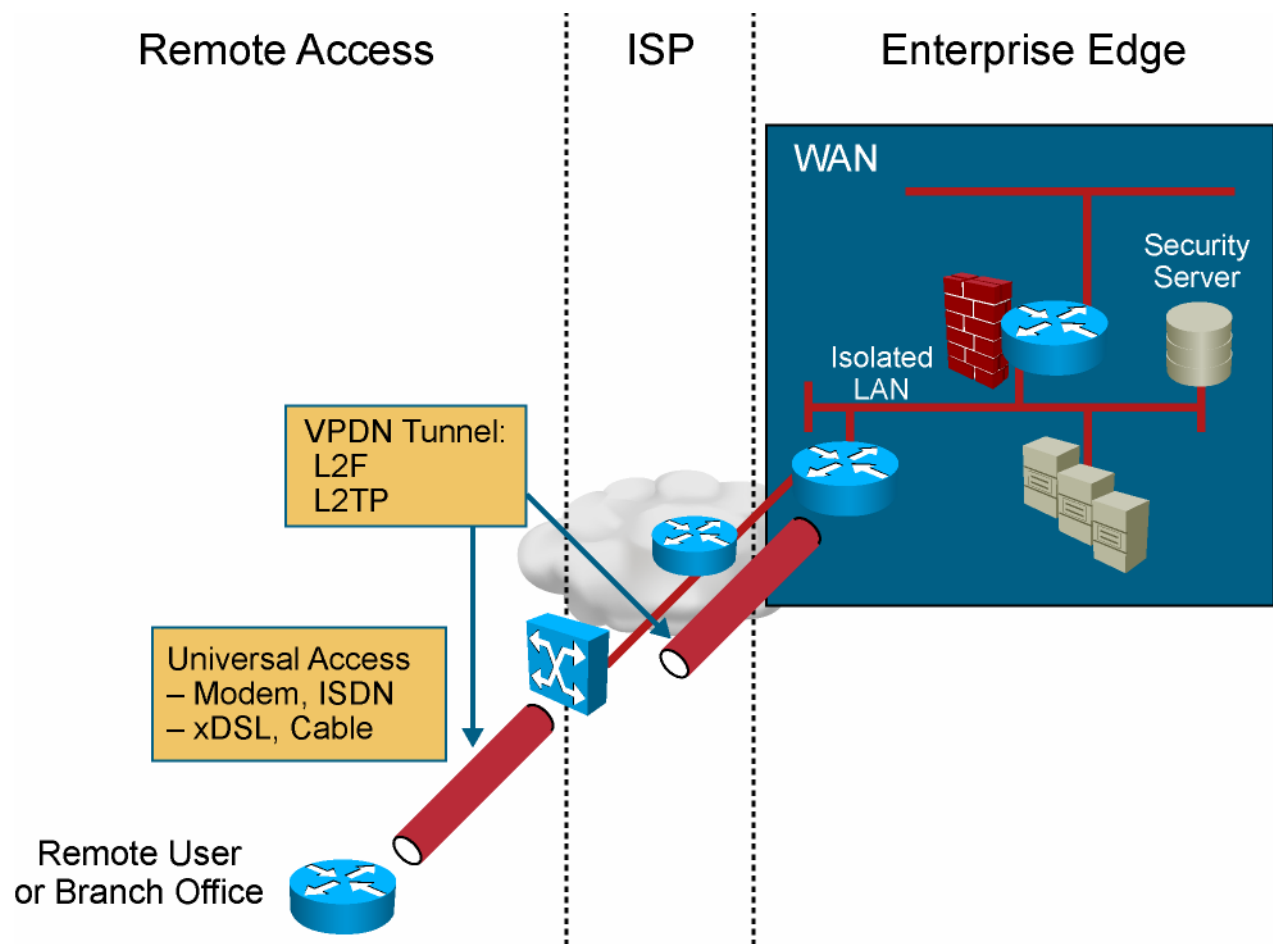


Connectivity Option: Overlay VPN



VPNs may replace dedicated point-to-point links with emulated point-to-point links sharing common infrastructure.

Connectivity Option: Virtual Private Dial-Up Network



Connectivity Option: Peer-to-Peer VPN

Provider participates in the enterprise routing:

- Uses MPLS VPN technology
- Enables organization to use any IP address space
- No overlapping IP address space problems

Benefits of VPNs

Flexibility

Extend network to remote users

Enable extranet connectivity to business partners

Set up and restructure networks quickly

Network Cost

Dedicated bandwidth and dial-up cost savings

Reduced WAN and dial infrastructure expenditures

Scalability

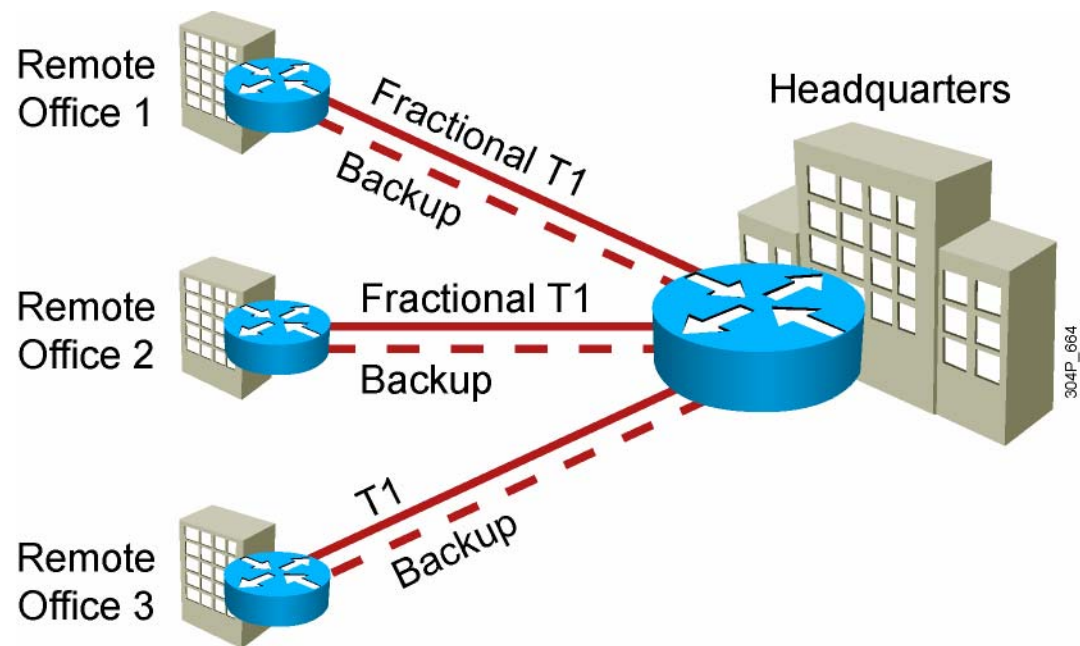
Leverage and extend classic WAN to more remote and external users

Improve geographic coverage

Simplify WAN operations

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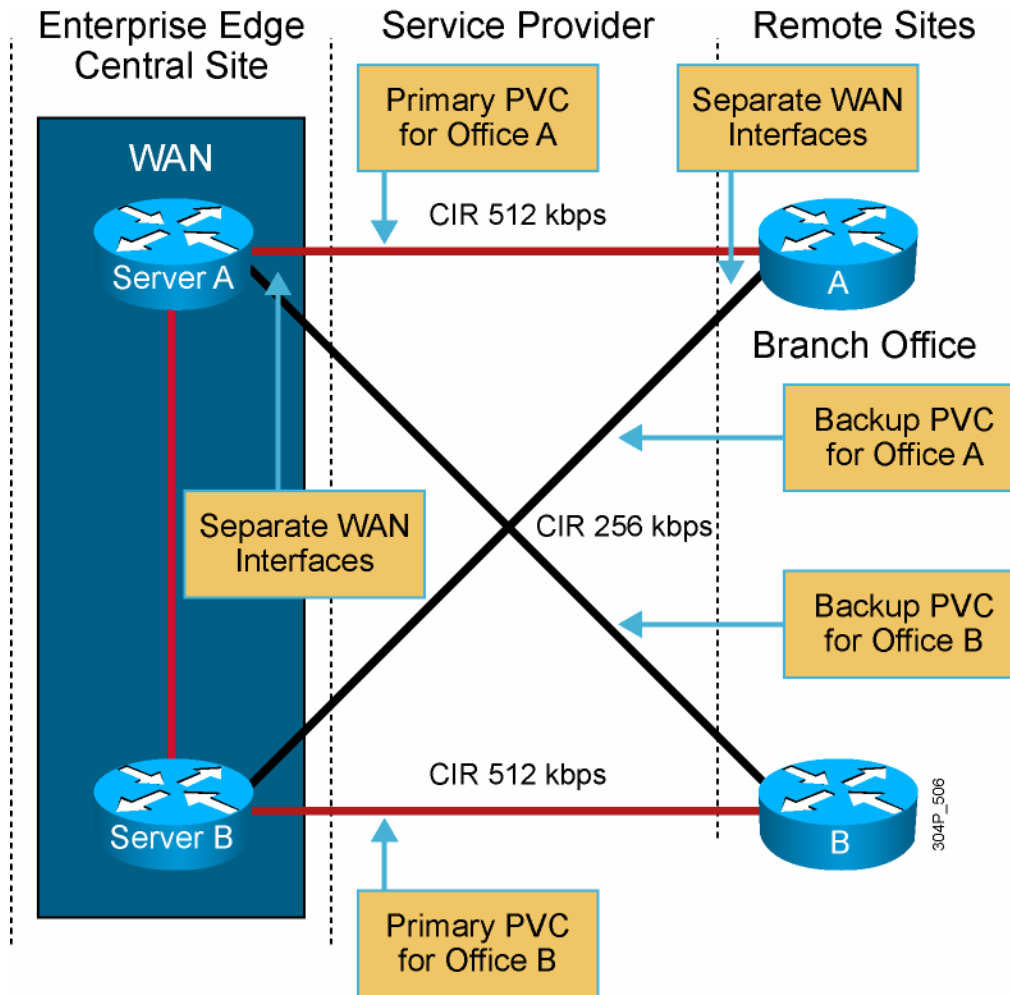
WAN Backup Technologies



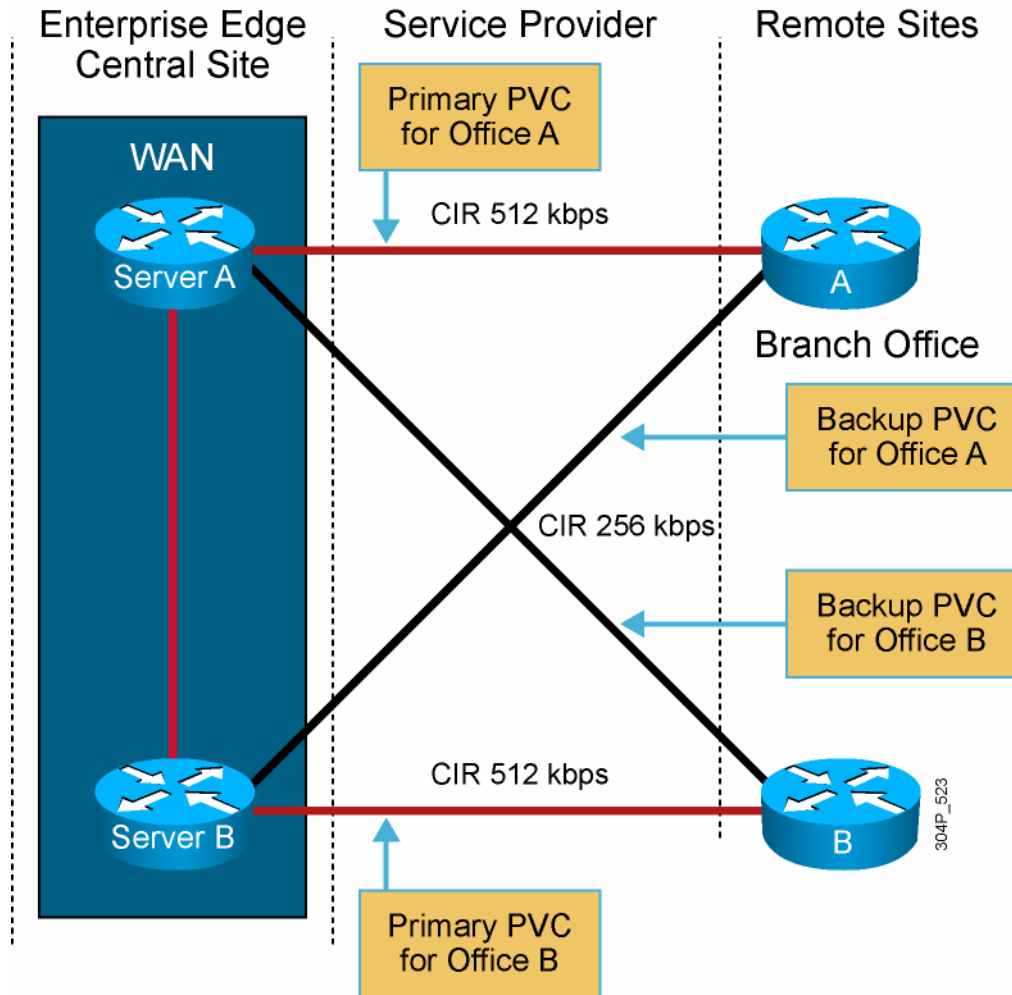
Backup options:

- Dial backup— analog or ISDN
- Permanent secondary WAN link
- Shadow PVC
- IPsec tunnel across Internet

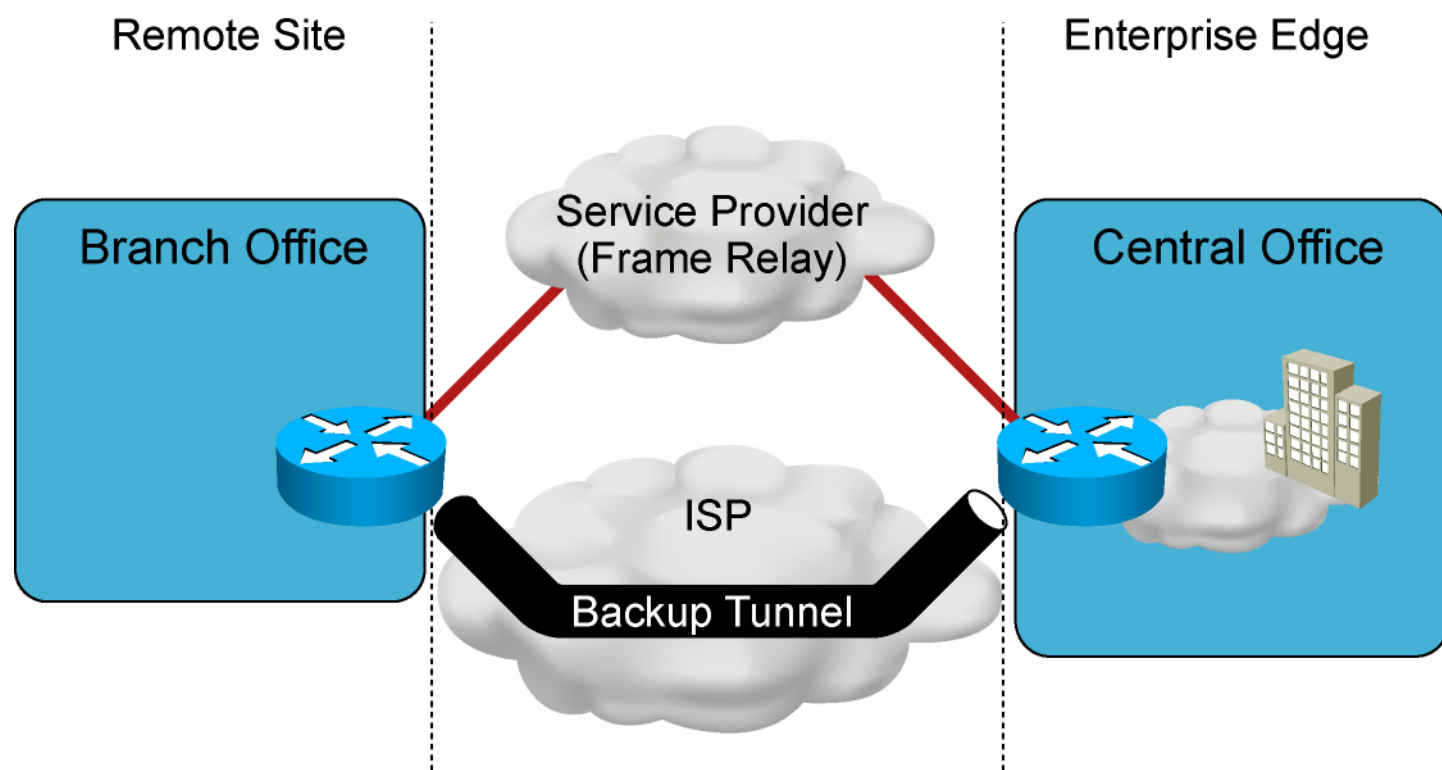
Example: Permanent Secondary WAN Link



Example: Shadow PVC



WAN Backup over the Internet



Layer 3 Tunneling

- GRE can encapsulate a variety of protocol types inside IP tunnels.
 - It is simple and flexible for basic IP VPNs.
 - Packet payload is not encrypted.
 - Provisioning of tunnels is not very scalable.
- IPsec encapsulates IP inside of IPsec tunnels.
 - Packet payload can be encrypted.
 - IPsec receiver can authenticate source of packets.
 - It uses IKE and PKI.

Enterprise WAN Architecture Considerations

- Support for network growth
- Appropriate availability
- Operational expense
- Operational complexity
- Voice and video support
- Effort and cost to implement
- Support of network segmentation

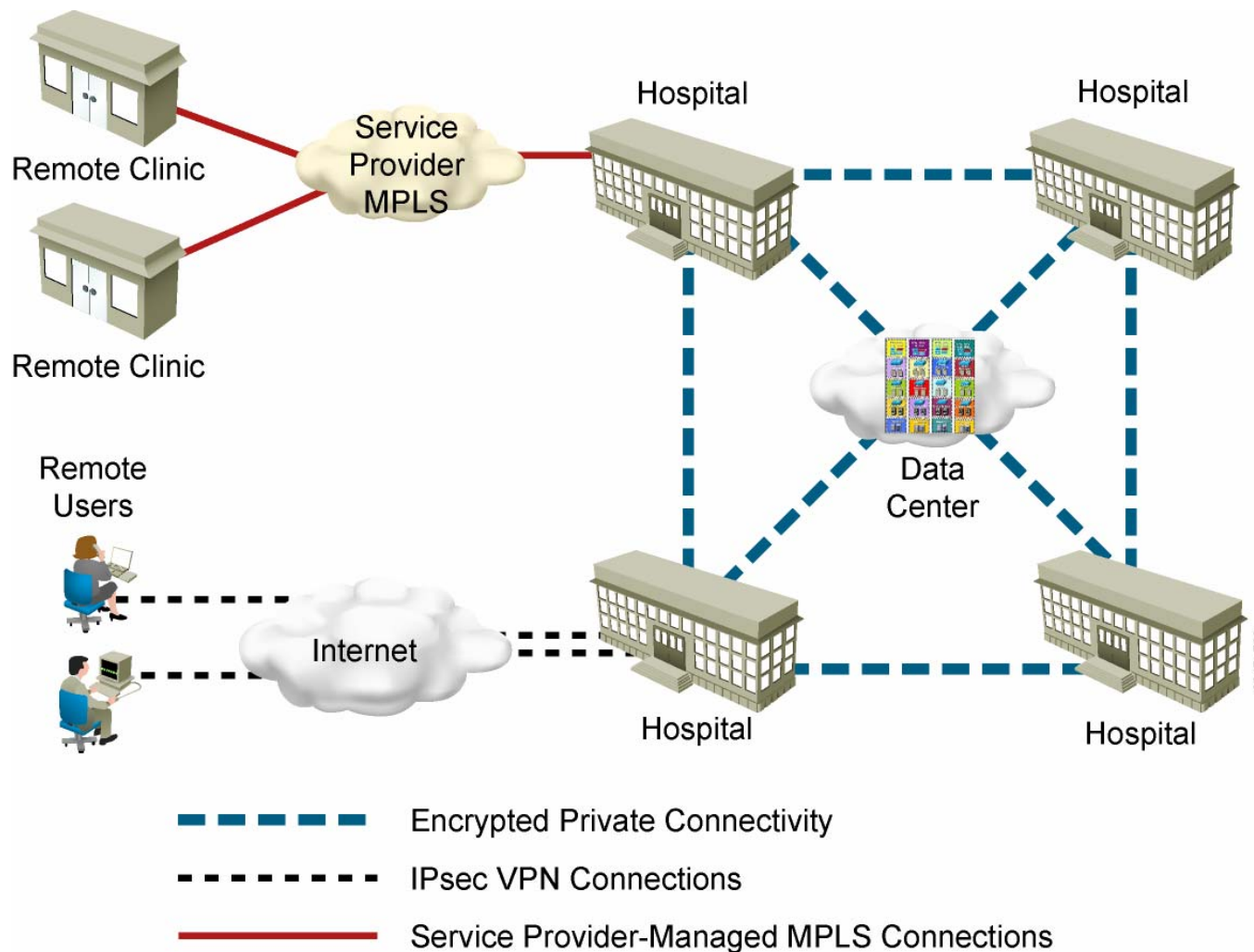
Cisco Enterprise MAN and WAN Architecture

- Private WAN (optionally encrypted)
- ISP service through site-to-site and remote-access IPsec VPN
- Service provider-managed IP or MPLS VPN
- Self-deployed MPLS

Cisco Enterprise WAN and MAN Architecture Comparison

	Private WAN	ISP Service	SP MPLS and IP VPN	Self-Deployed MPLS
Secure transport	IPsec (optional)	IPsec (mandatory)	IPsec (mandatory)	IPsec (mandatory)
High availability	Excellent	Good	Excellent	Excellent
Multicast	Good	Good	Good	Excellent
Voice and video support	Excellent	Low	Excellent	Excellent
Scalable network growth	Moderate	Good	Excellent	Excellent
Easily shared WAN links	Moderate	Moderate	Moderate	Excellent
Operational costs	High	Low	Moderate, depends on transport	Moderate to high
Network control	High	Moderate	Moderate	High
Effort to migrate from private to WAN	Low	Moderate	Moderate	High

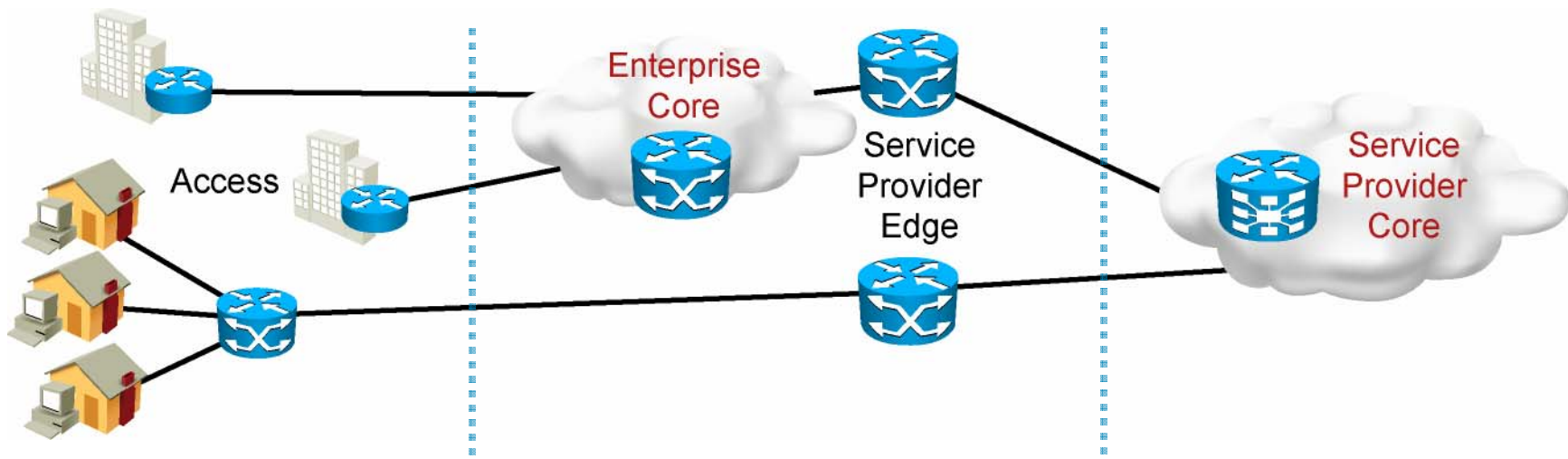
Example: Cisco WAN Architectures in the Healthcare Environment



Selecting Enterprise Edge Hardware Components and Software Features

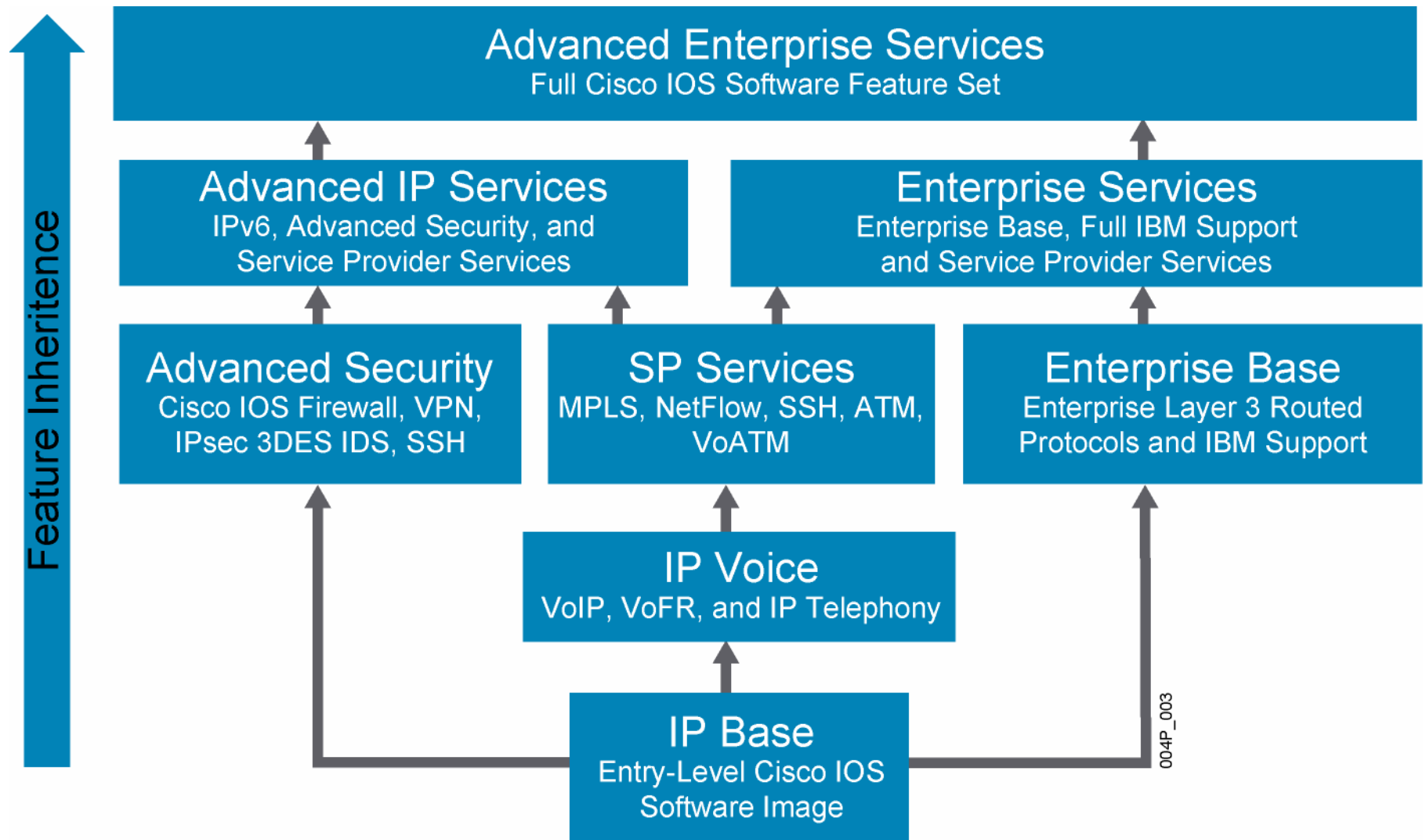
- Hardware selection incorporates the selection of data link layer functions and features of a particular device
Considerations: Port density, packet throughput, future expandability, redundancy
- Software selection focuses on network layer performance
Considerations: Forwarding decisions, bandwidth optimization, security

Cisco IOS Software in the Network



Cisco IOS Software T IP Services and Ease of Deployment	Cisco IOS Software S IP Services and Infrastructure	Cisco IOS Software XR Scale and Availability
<ul style="list-style-type: none"> ▪ Broadband access ▪ Mobility and wireless ▪ Data center ▪ Security ▪ IP communications 	<ul style="list-style-type: none"> ▪ High-end enterprise core ▪ Service provider edge ▪ Virtual Private Networks (MPLS, Layer 2 and Layer 3) ▪ Video and content multicast 	<ul style="list-style-type: none"> ▪ Large-scale networks ▪ High availability ▪ In-service software upgrade

Cisco IOS Packaging



Cisco IOS Packaging Technology Segmentation

	Data Connectivity	VoIP and VoFR	ATM, VoATM, MPLS	AppleTalk, IPX, IBM Protocols	Firewall, IDS, VPN
IP Base	X				
IP Voice	X	X			
Advanced Security	X				X
Enterprise Base	X			X	
SP Services	X	X	X		
Advanced IP Services	X	X	X		X
Enterprise Services	X	X	X	X	
Advanced Enterprise Services	X	X	X	X	X

Comparing Router Platforms and Software Functions

Hardware	Software	Function
800, 1800, 2800, 3800, 7200	Cisco IOS T Releases 12.3, 12.4, 12.3T, 12.4T	Supports access routing platforms providing fast, scalable delivery of mission-critical enterprise applications
7200, 7301, 7304, 7500, 10K	Cisco IOS S Release 12.2SB	Delivers midrange broadband and leased-line aggregation for enterprise and service provider edge networks
7600	Cisco IOS S Release 12.2SR	Delivers high-end Ethernet LAN switching for enterprise access, distribution, core, and data center deployments, and high-end Metro Ethernet for service provider edge
12000, CRS-1	Cisco IOS XR	Provides massive scale, continuous system availability, and service flexibility for service provider core and edge. (Takes advantage of the massively distributed processing capabilities of the Cisco CRS-1 routing system and the Cisco 12000)

Comparing Multilayer Switch Platforms and Software Functions

Hardware	Software	Function
800, 1800, 2800, 3800, 7200	Cisco IOS S Release 12.2SE	Provides low-end to midrange Ethernet LAN switching for enterprise access and distribution deployments
4500, 4900	Cisco IOS S Release 12.2SG	Provides midrange Ethernet LAN switching for enterprise access and distribution deployments in the campus, and supports Metro Ethernet
6500	Cisco IOS S Release 12.2SX	Delivers high-end Ethernet LAN switching for enterprise access, distribution, core, and data center deployments, and high-end Metro Ethernet for service provider edge

Use the Cisco Feature Navigator to find the right Cisco IOS and Catalyst operating system software release and features.

Summary

- Traditional WAN technologies include leased lines, circuit-switched PSTN, and packet-switched networks.
- Remote-access networks connect teleworkers and traveling employees.
- A VPN provides connectivity over a shared infrastructure with the same policies and performance as a private network.
- WAN backup strategies are needed to provide high availability between remote sites.
- The Cisco Enterprise WAN and MAN Architecture provides integrated QoS, network security, reliability, and manageability.
- Enterprise WAN design includes selecting the appropriate components, including hardware and software.