From Layer 2 to Layer 3 and Back Again

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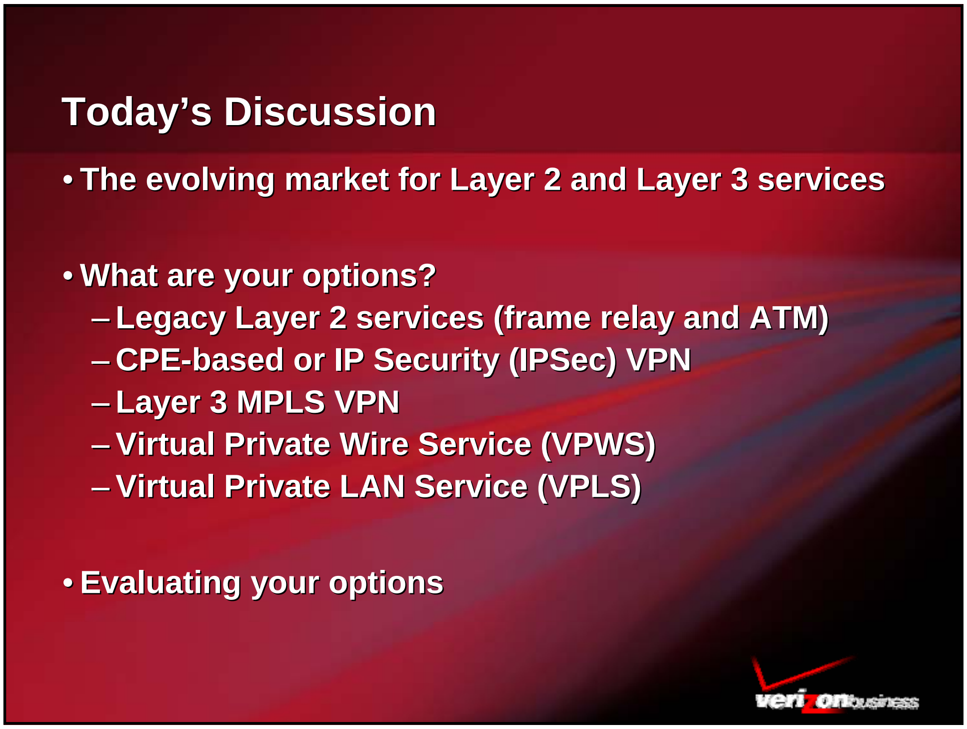
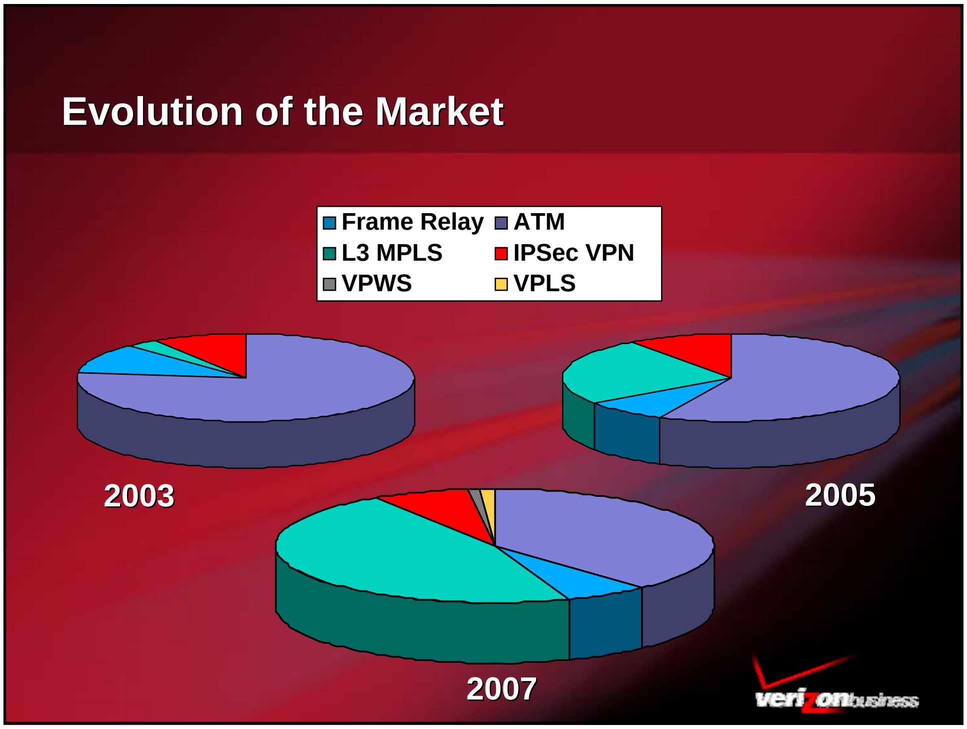


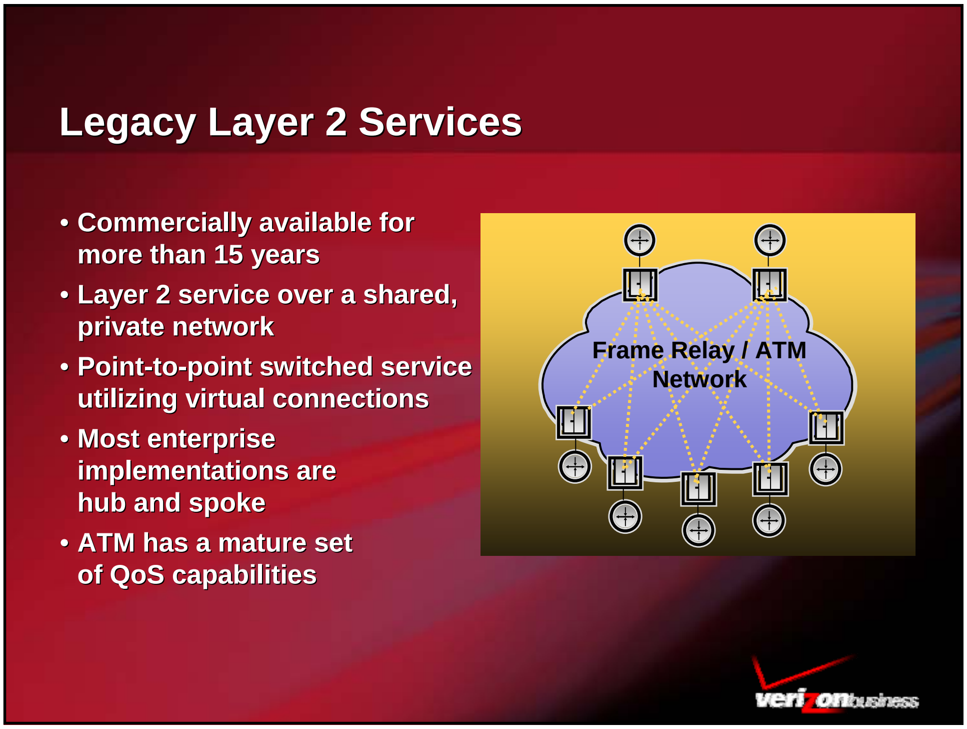
Today's Discussion

- The evolving market for Layer 2 and Layer 3 services
- What are your options?
  - Legacy Layer 2 services (frame relay and ATM)
  - CPE-based or IP Security (IPSec) VPN
  - Layer 3 MPLS VPN
  - Virtual Private Wire Service (VPWS)
  - Virtual Private LAN Service (VPLS)
- Evaluating your options



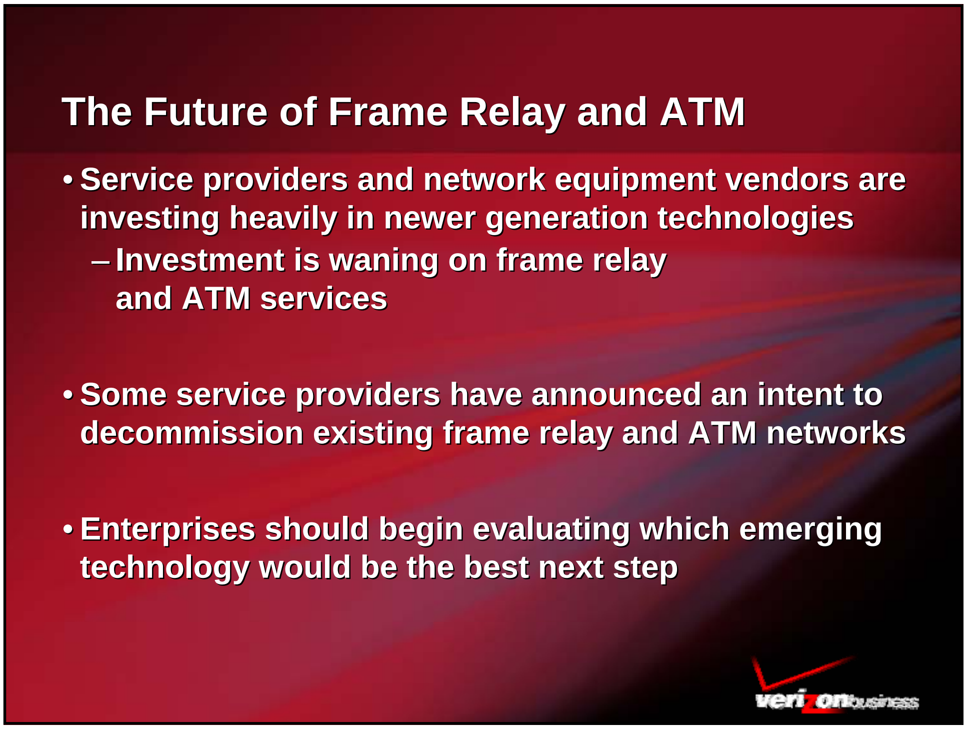
Evolution of the Market

Legacy Layer 2 Services



Legacy Layer 2 Services

- Commercially available for more than 15 years
- Layer 2 service over a shared, private network
- Point-to-point switched service utilizing virtual connections
- Most enterprise implementations are hub and spoke
- ATM has a mature set of QoS capabilities

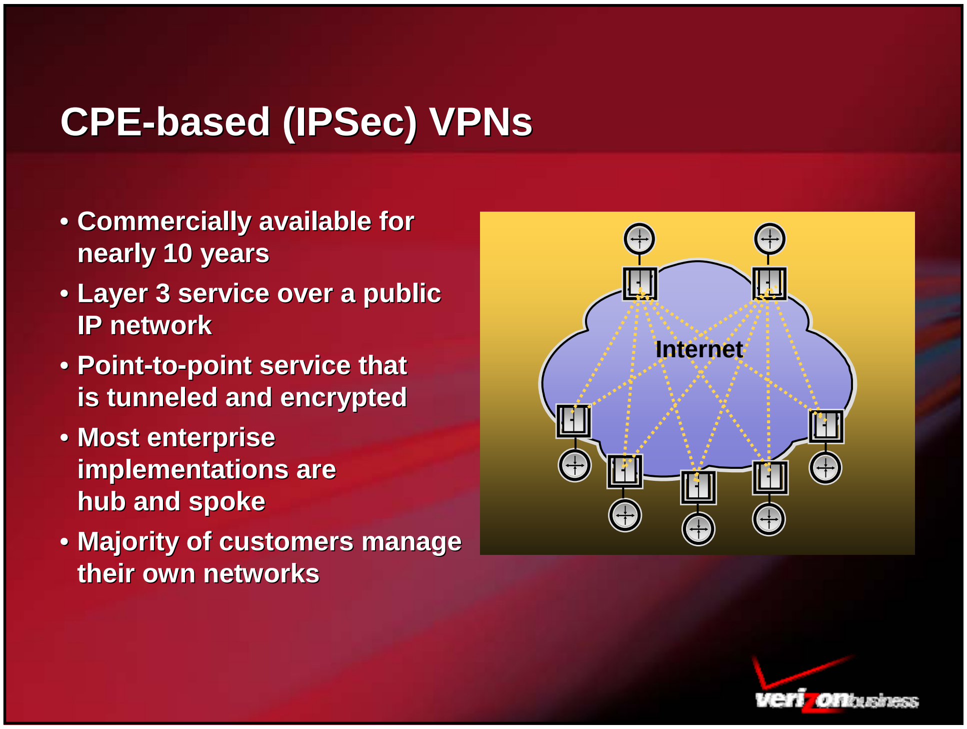


The Future of Frame Relay and ATM

- Service providers and network equipment vendors are investing heavily in newer generation technologies
  - Investment is waning on frame relay and ATM services
- Some service providers have announced an intent to decommission existing frame relay and ATM networks
- Enterprises should begin evaluating which emerging technology would be the best next step

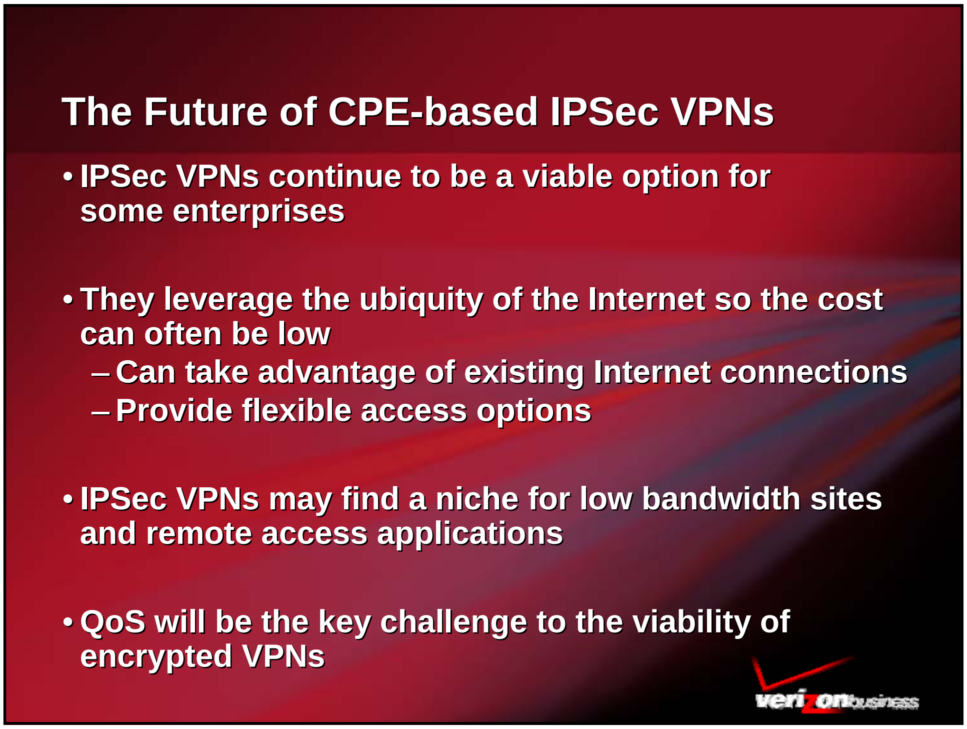
CPE-based (IPSec) VPNs

> **“Increase of real-time applications, convergence and demand for capacity will outstrip IPSec usefulness for site-to-site communications.”**
>
> – Yankee Group, 2005 Global Network Strategies Survey



CPE-based (IPSec) VPNs

- Commercially available for nearly 10 years
- Layer 3 service over a public IP network
- Point-to-point service that is tunneled and encrypted
- Most enterprise implementations are hub and spoke
- Majority of customers manage their own networks



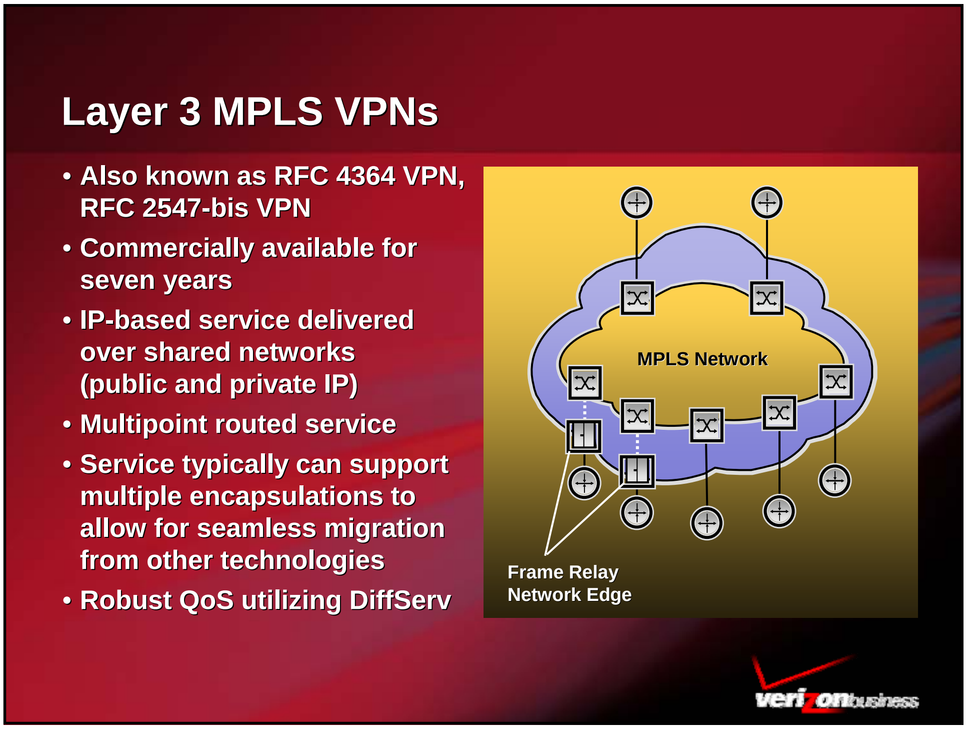
The Future of CPE-based IPSec VPNs

- IPSec VPNs continue to be a viable option for some enterprises
- They leverage the ubiquity of the Internet so the cost can often be low
  - Can take advantage of existing Internet connections
  - Provide flexible access options
- IPSec VPNs may find a niche for low bandwidth sites and remote access applications
- QoS will be the key challenge to the viability of encrypted VPNs

Layer 3 MPLS VPNs

"[MPLS VPNs'] true strength lies in its flexibility: MPLS can provide the performance and dynamic bandwidth characteristics of Ethernet as well as the inherent resiliency of IP routing…Providers design these networks today with business customers in mind."

– Forrester Wave: North American
MPLS Services, Q12006



Layer 3 MPLS VPNs

- Also known as RFC 4364 VPN, RFC 2547-bis VPN
- Commercially available for seven years
- IP-based service delivered over shared networks (public and private IP)
- Multipoint routed service
- Service typically can support multiple encapsulations to allow for seamless migration from other technologies
- Robust QoS utilizing DiffServ

MPLS Network
Frame Relay
Network Edge
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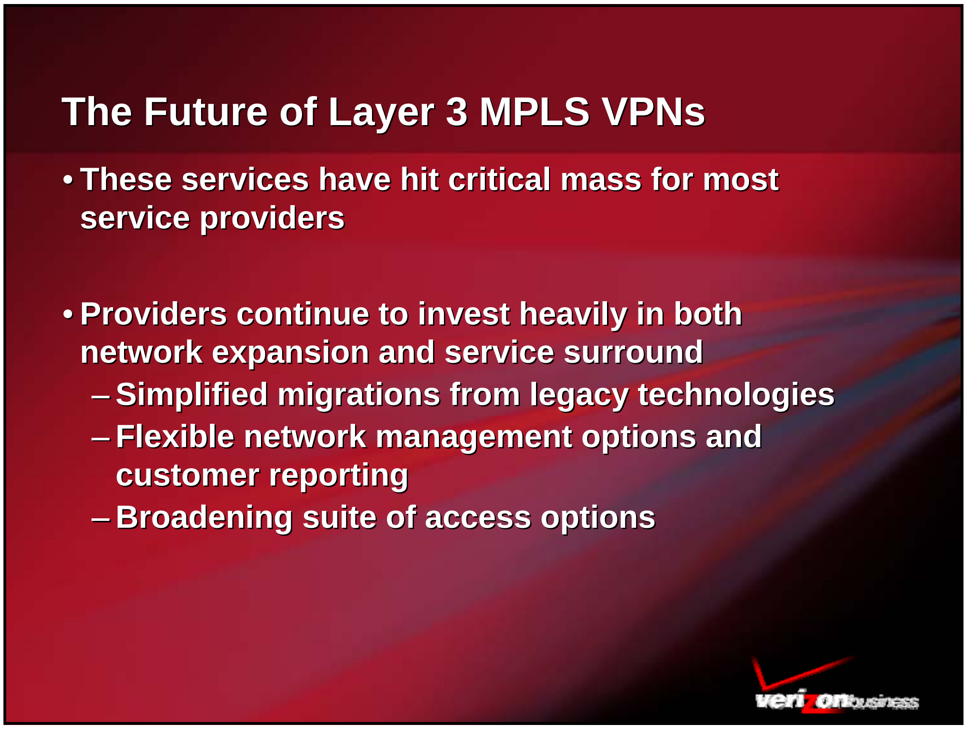

The Future of Layer 3 MPLS VPNs

- These services have hit critical mass for most service providers
- Providers continue to invest heavily in both network expansion and service surround
  - Simplified migrations from legacy technologies
  - Flexible network management options and customer reporting
  - Broadening suite of access options

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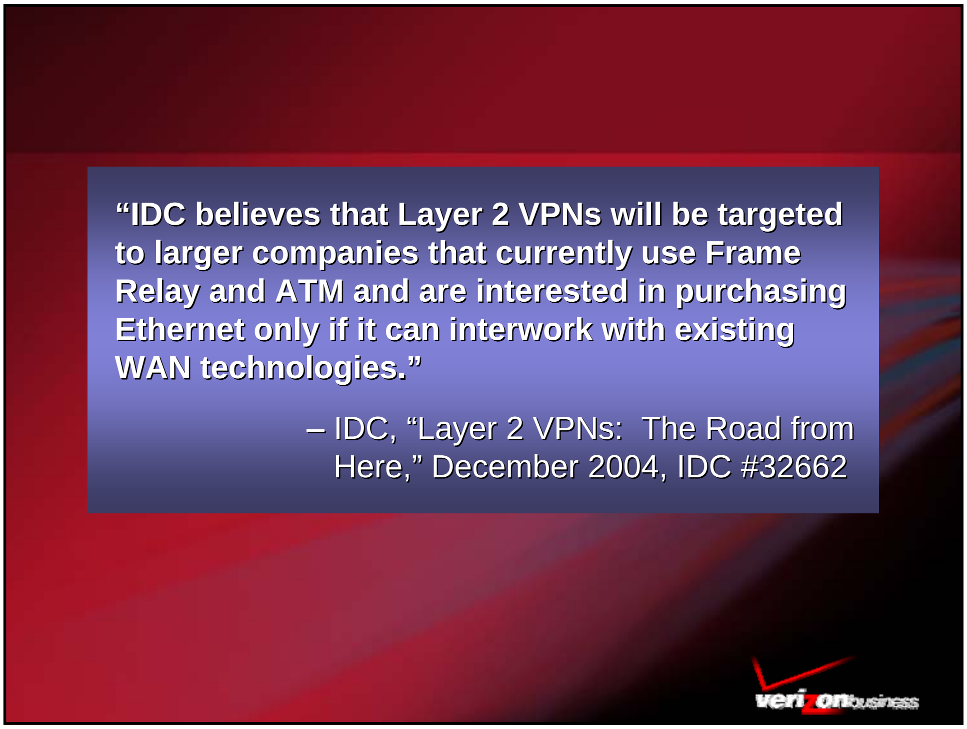
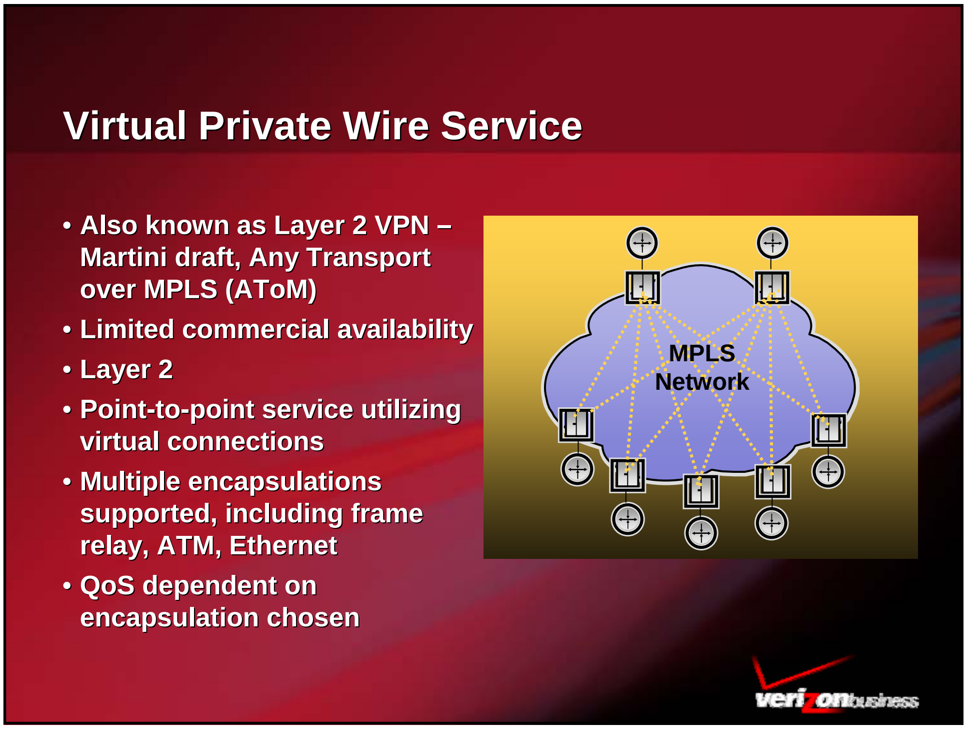
Virtual Private Wire Service



"IDC believes that Layer 2 VPNs will be targeted to larger companies that currently use Frame Relay and ATM and are interested in purchasing Ethernet only if it can interwork with existing WAN technologies."

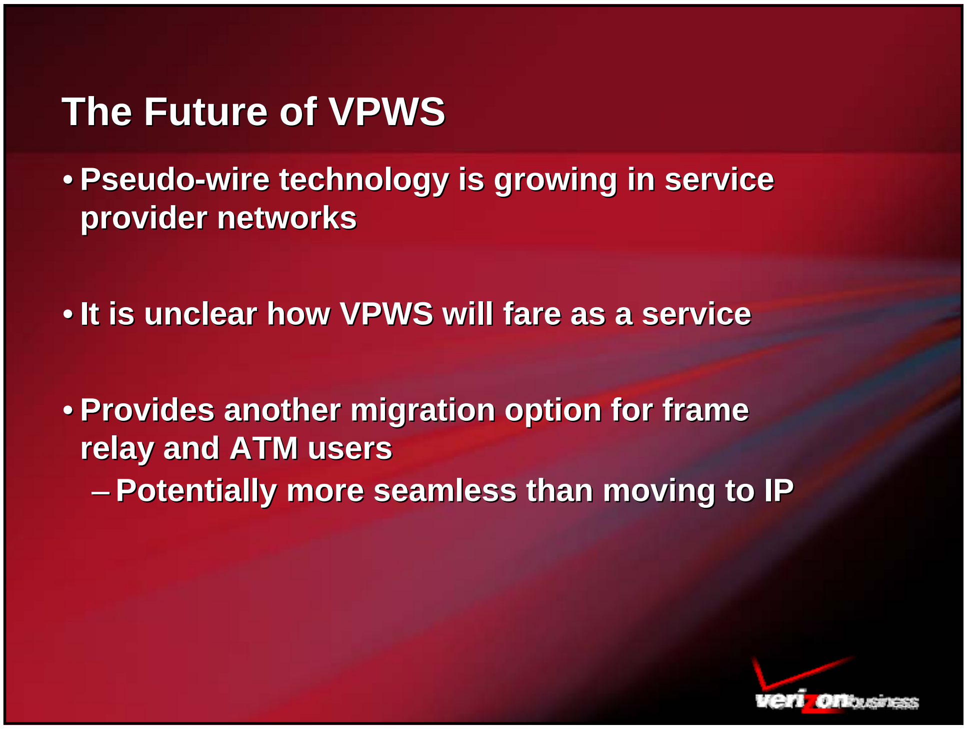
– IDC, "Layer 2 VPNs: The Road from Here," December 2004, IDC #32662



Virtual Private Wire Service

- Also known as Layer 2 VPN – Martini draft, Any Transport over MPLS (AToM)
- Limited commercial availability
- Layer 2
- Point-to-point service utilizing virtual connections
- Multiple encapsulations supported, including frame relay, ATM, Ethernet
- QoS dependent on encapsulation chosen

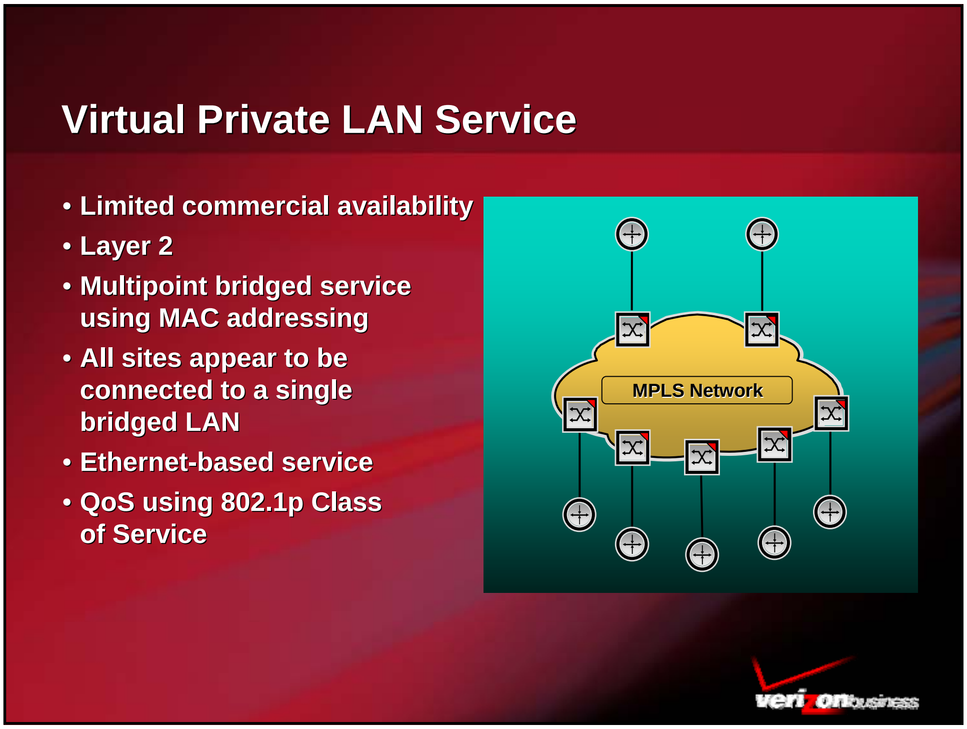
MPLS
Network



The Future of VPWS

- Pseudo-wire technology is growing in service provider networks
- It is unclear how VPWS will fare as a service
- Provides another migration option for frame relay and ATM users
  - Potentially more seamless than moving to IP

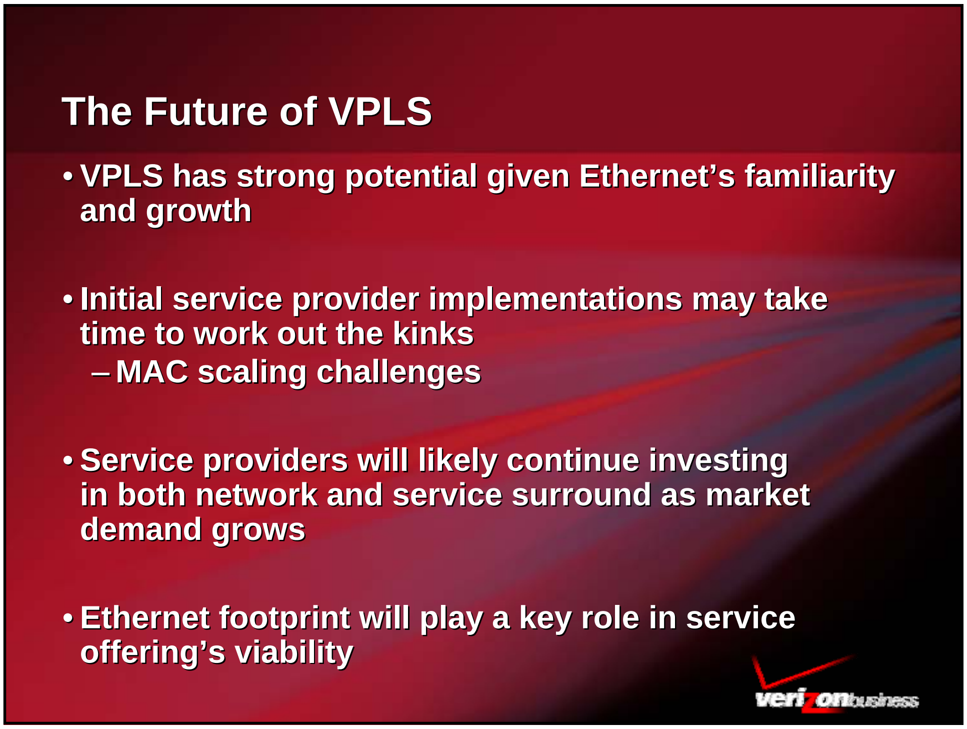
Virtual Private LAN Service



Virtual Private LAN Service

- Limited commercial availability
- Layer 2
- Multipoint bridged service using MAC addressing
- All sites appear to be connected to a single bridged LAN
- Ethernet-based service
- QoS using 802.1p Class of Service

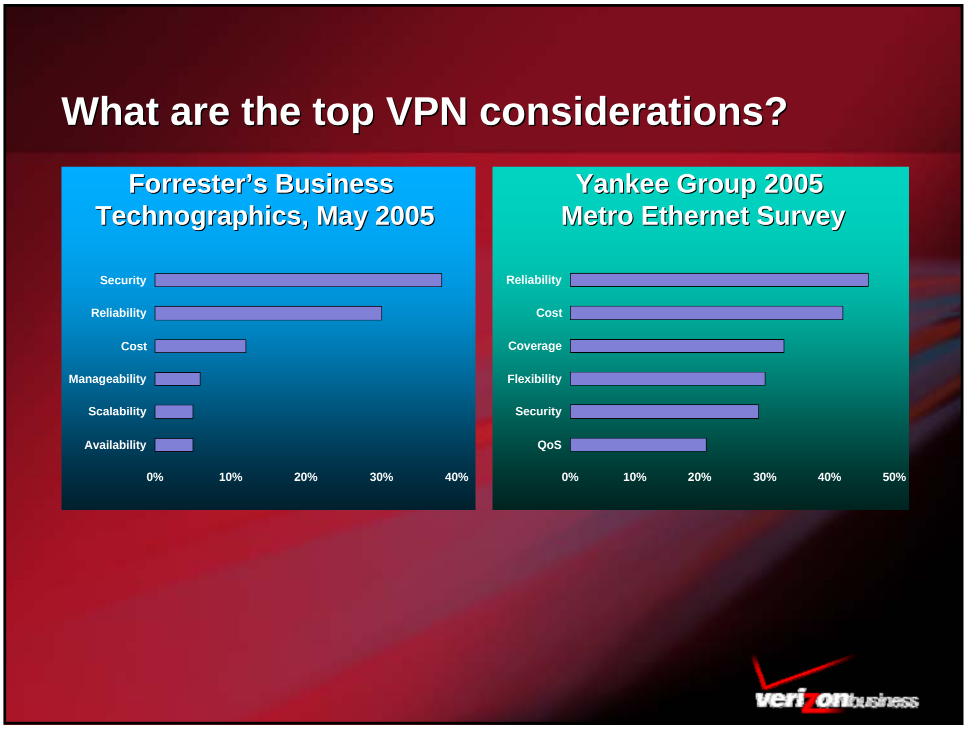
MPLS Network



The Future of VPLS

- VPLS has strong potential given Ethernet’s familiarity and growth
- Initial service provider implementations may take time to work out the kinks
  - MAC scaling challenges
- Service providers will likely continue investing in both network and service surround as market demand grows
- Ethernet footprint will play a key role in service offering’s viability

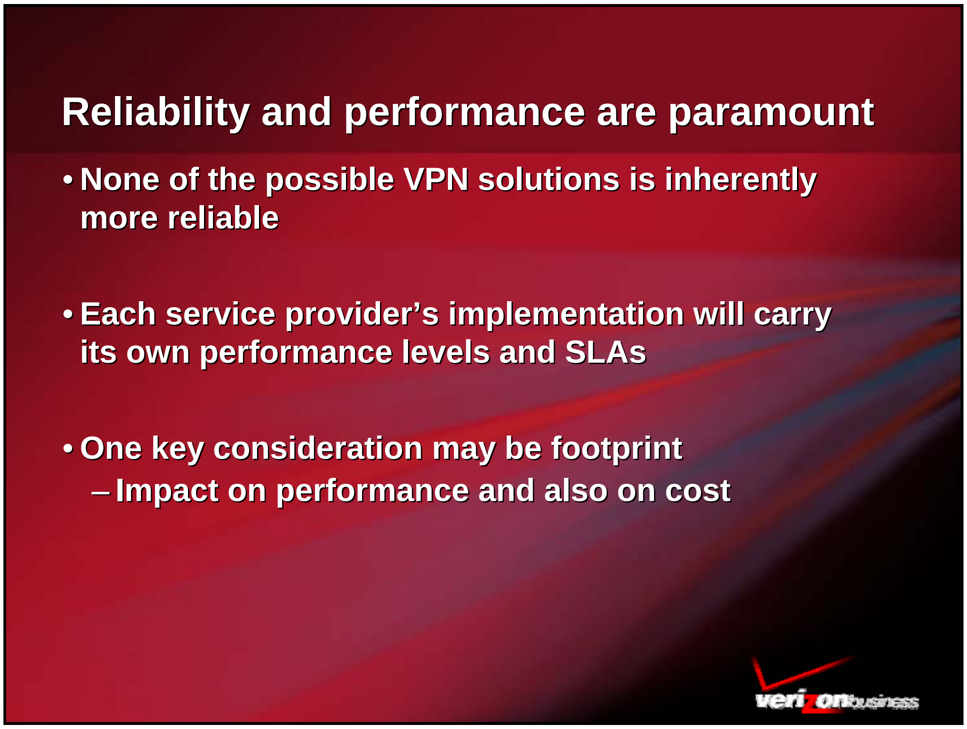
Key Enterprise Considerations



What are the top VPN considerations?

Forrester's Business Technographics, May 2005

Yankee Group 2005 Metro Ethernet Survey



Reliability and performance are paramount

- None of the possible VPN solutions is inherently more reliable
- Each service provider's implementation will carry its own performance levels and SLAs
- One key consideration may be footprint
  - Impact on performance and also on cost

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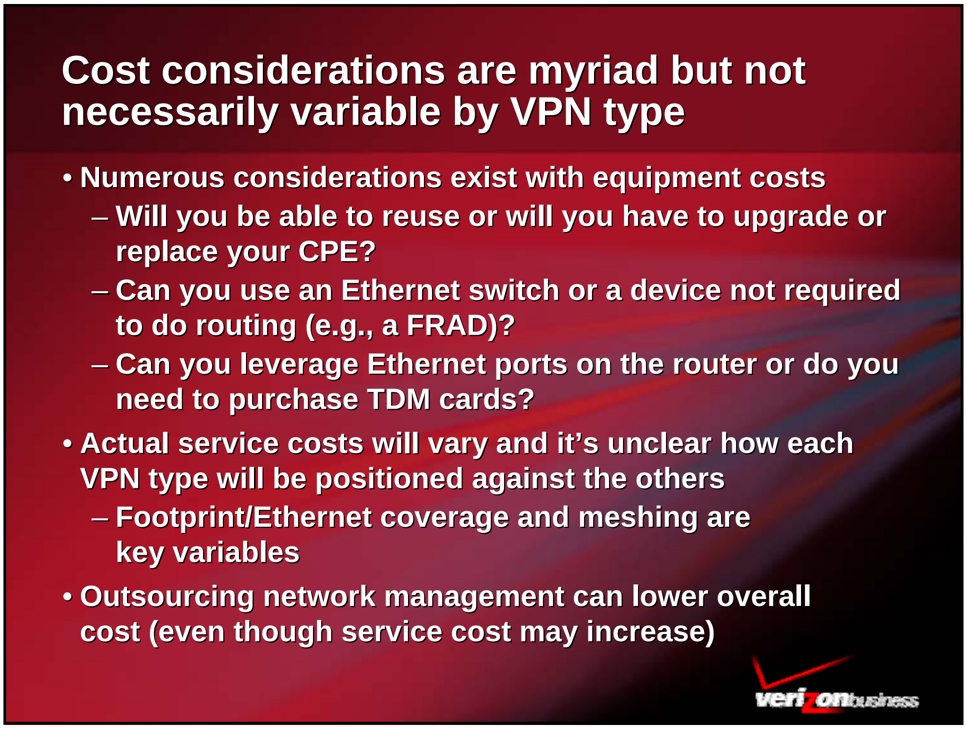
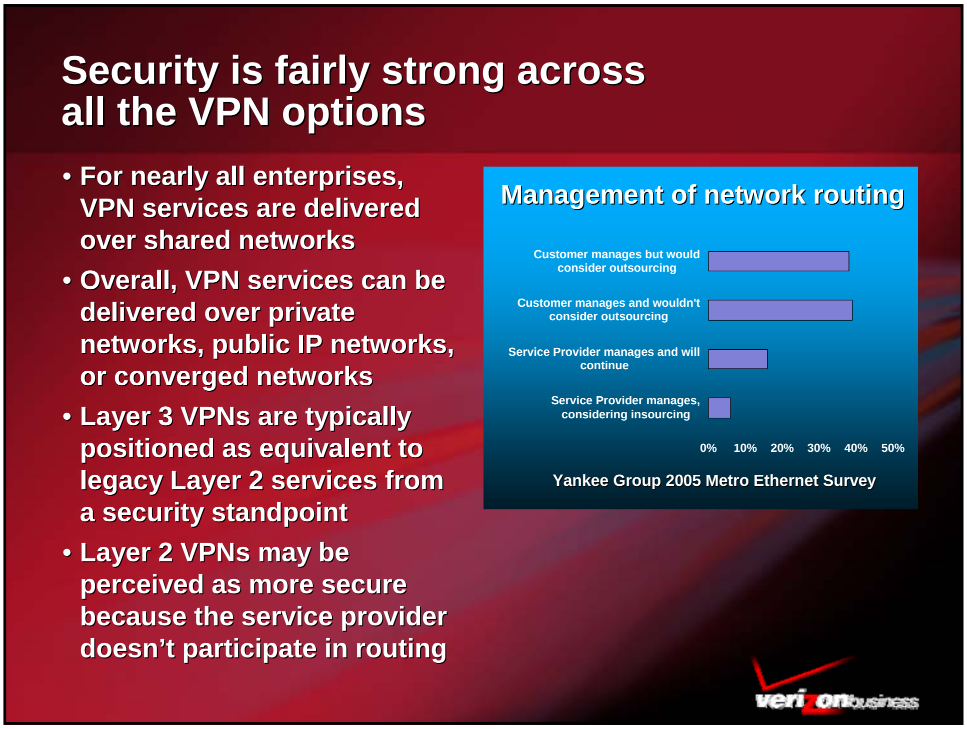


Cost considerations are myriad but not necessarily variable by VPN type

- Numerous considerations exist with equipment costs
  - Will you be able to reuse or will you have to upgrade or replace your CPE?
  - Can you use an Ethernet switch or a device not required to do routing (e.g., a FRAD)?
  - Can you leverage Ethernet ports on the router or do you need to purchase TDM cards?
- Actual service costs will vary and it's unclear how each VPN type will be positioned against the others
  - Footprint/Ethernet coverage and meshing are key variables
- Outsourcing network management can lower overall cost (even though service cost may increase)



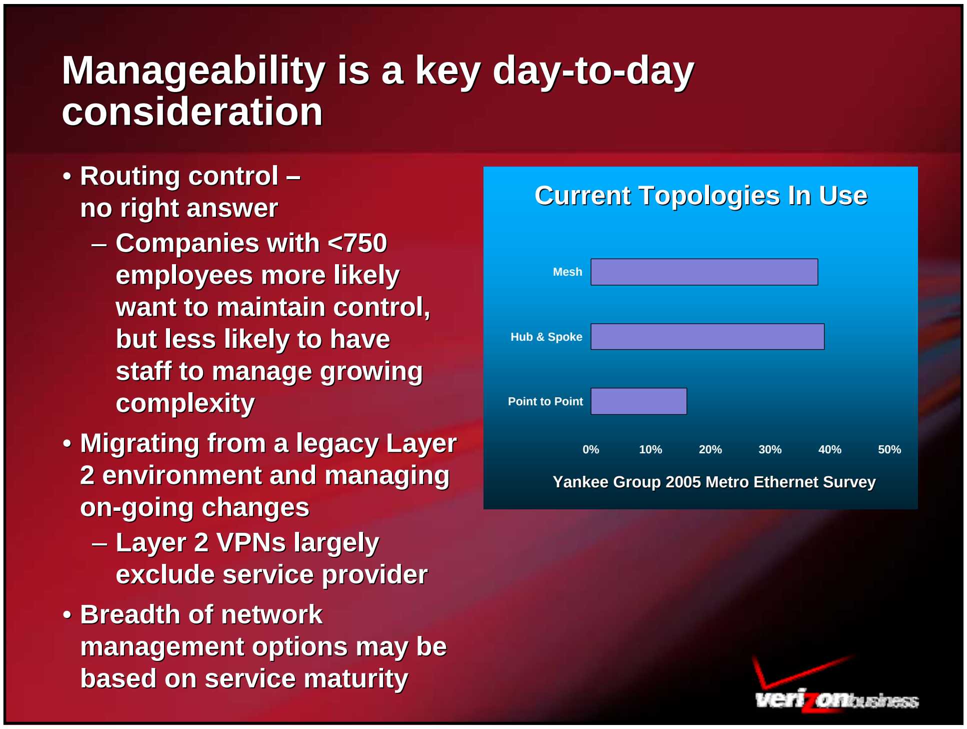
Security is fairly strong across all the VPN options

- For nearly all enterprises, VPN services are delivered over shared networks
- Overall, VPN services can be delivered over private networks, public IP networks, or converged networks
- Layer 3 VPNs are typically positioned as equivalent to legacy Layer 2 services from a security standpoint
- Layer 2 VPNs may be perceived as more secure because the service provider doesn't participate in routing

Management of network routing

Customer manages but would consider outsourcing
Customer manages and wouldn't consider outsourcing
Service Provider manages and will continue
Service Provider manages, considering insourcing
0%
10%
20%
30%
40%
50%

Yankee Group 2005 Metro Ethernet Survey

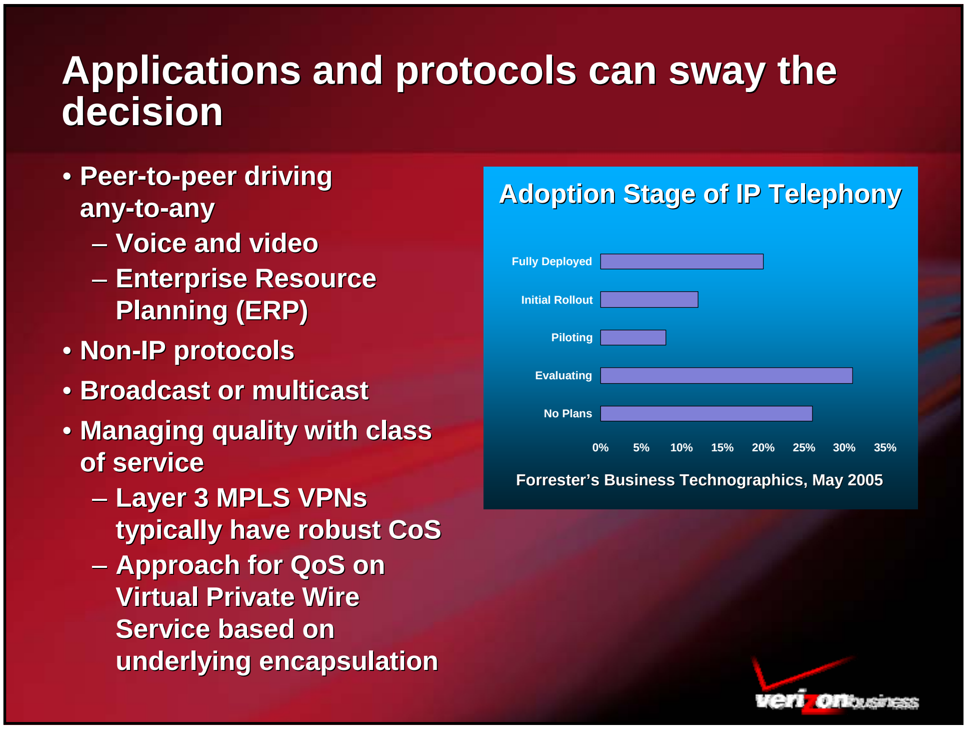


Manageability is a key day-to-day consideration

- Routing control – no right answer
  - Companies with <750 employees more likely want to maintain control, but less likely to have staff to manage growing complexity
- Migrating from a legacy Layer 2 environment and managing on-going changes
  - Layer 2 VPNs largely exclude service provider
- Breadth of network management options may be based on service maturity

Current Topologies In Use

Yankee Group 2005 Metro Ethernet Survey

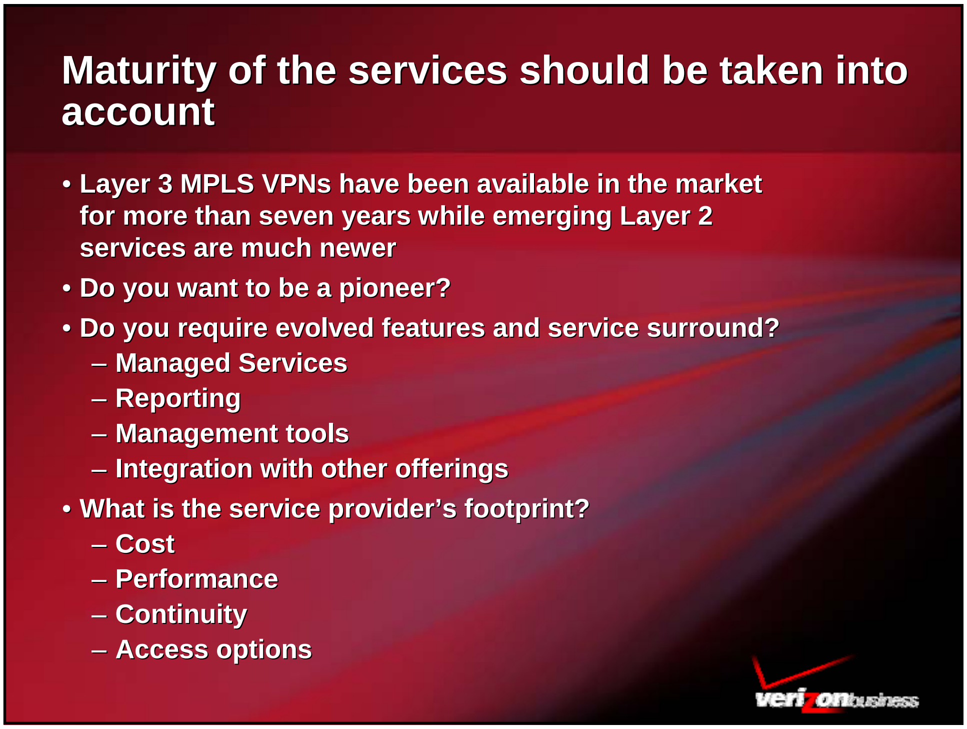


Applications and protocols can sway the decision

- Peer-to-peer driving any-to-any
  - Voice and video
  - Enterprise Resource Planning (ERP)
- Non-IP protocols
- Broadcast or multicast
- Managing quality with class of service
  - Layer 3 MPLS VPNs typically have robust CoS
  - Approach for QoS on Virtual Private Wire Service based on underlying encapsulation

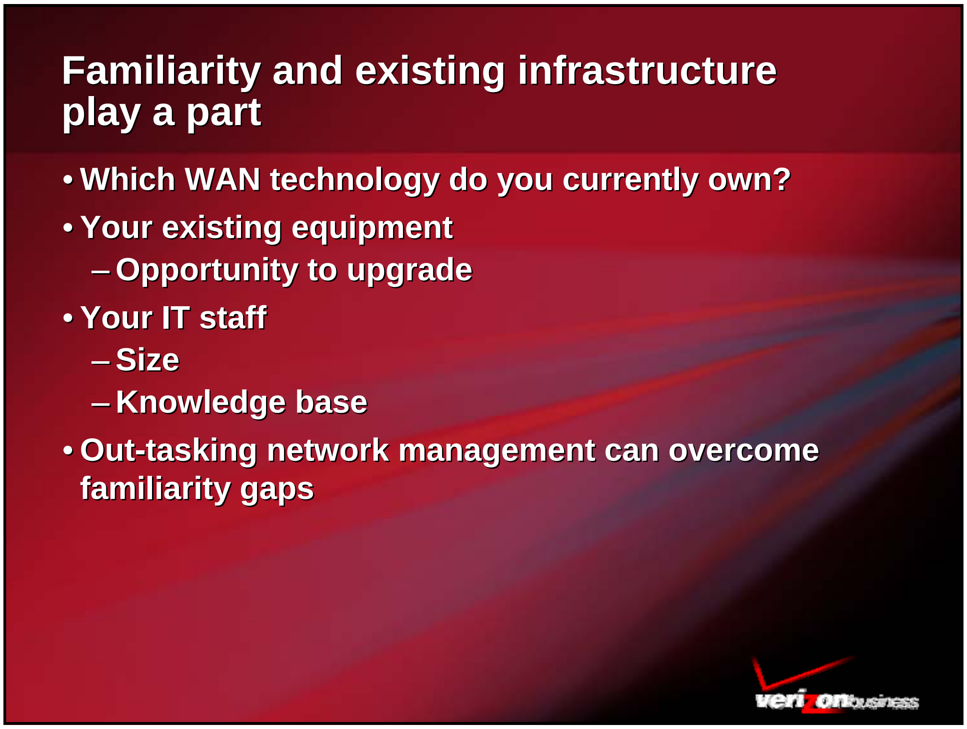
Adoption Stage of IP Telephony

Forrester's Business Technographics, May 2005



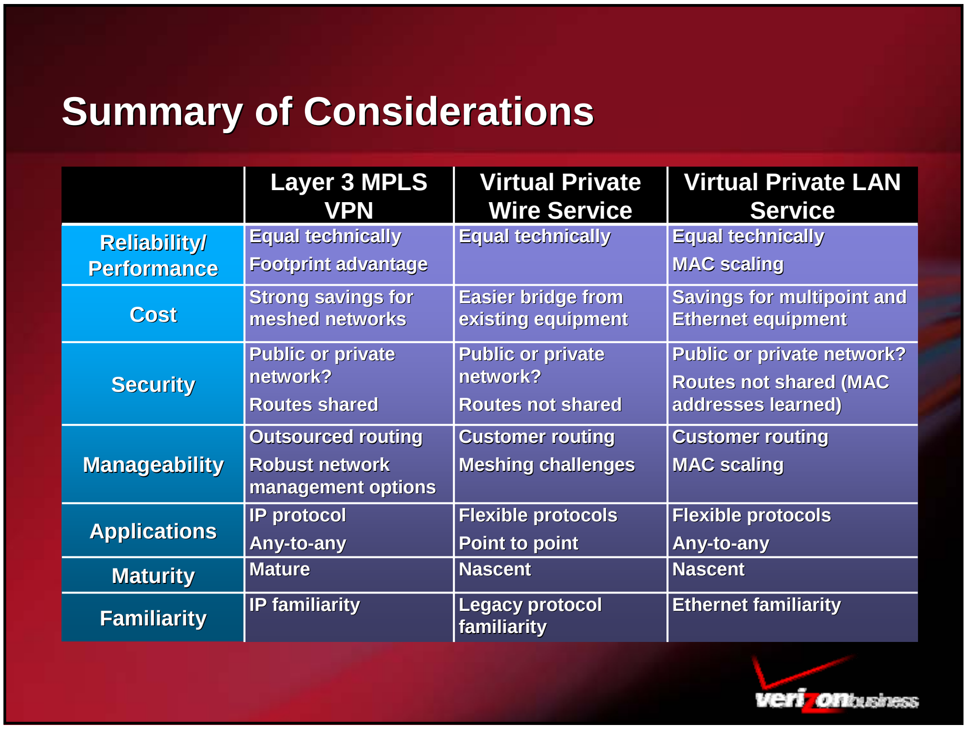
Maturity of the services should be taken into account

- Layer 3 MPLS VPNs have been available in the market for more than seven years while emerging Layer 2 services are much newer
- Do you want to be a pioneer?
- Do you require evolved features and service surround?
  - Managed Services
  - Reporting
  - Management tools
  - Integration with other offerings
- What is the service provider's footprint?
  - Cost
  - Performance
  - Continuity
  - Access options



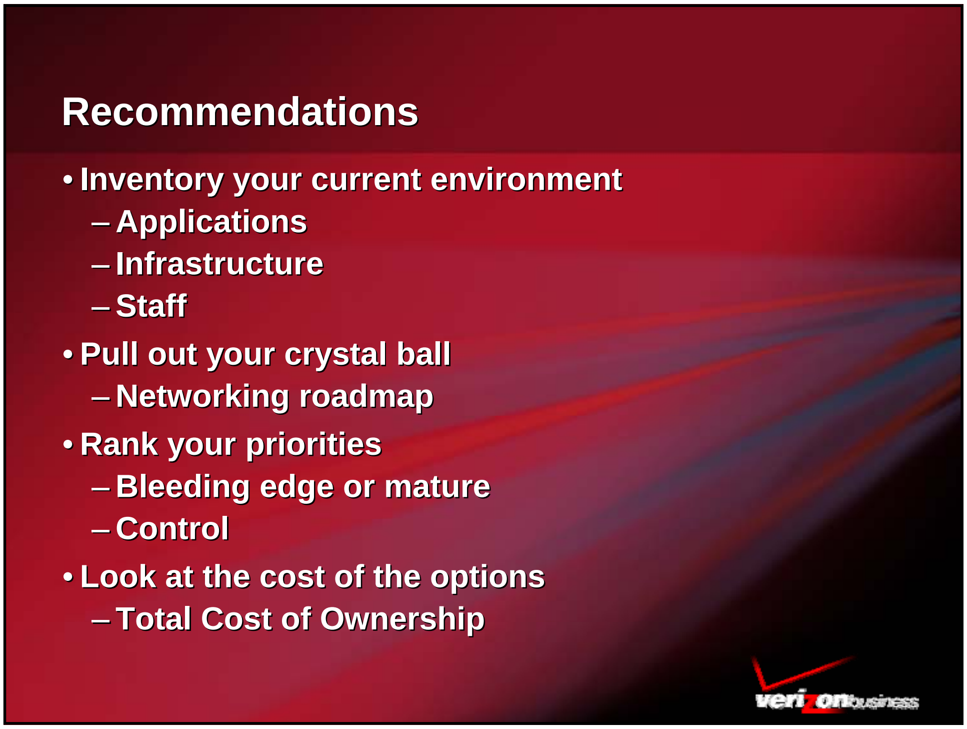
Familiarity and existing infrastructure play a part

- Which WAN technology do you currently own?
- Your existing equipment
  - Opportunity to upgrade
- Your IT staff
  - Size
  - Knowledge base
- Out-tasking network management can overcome familiarity gaps



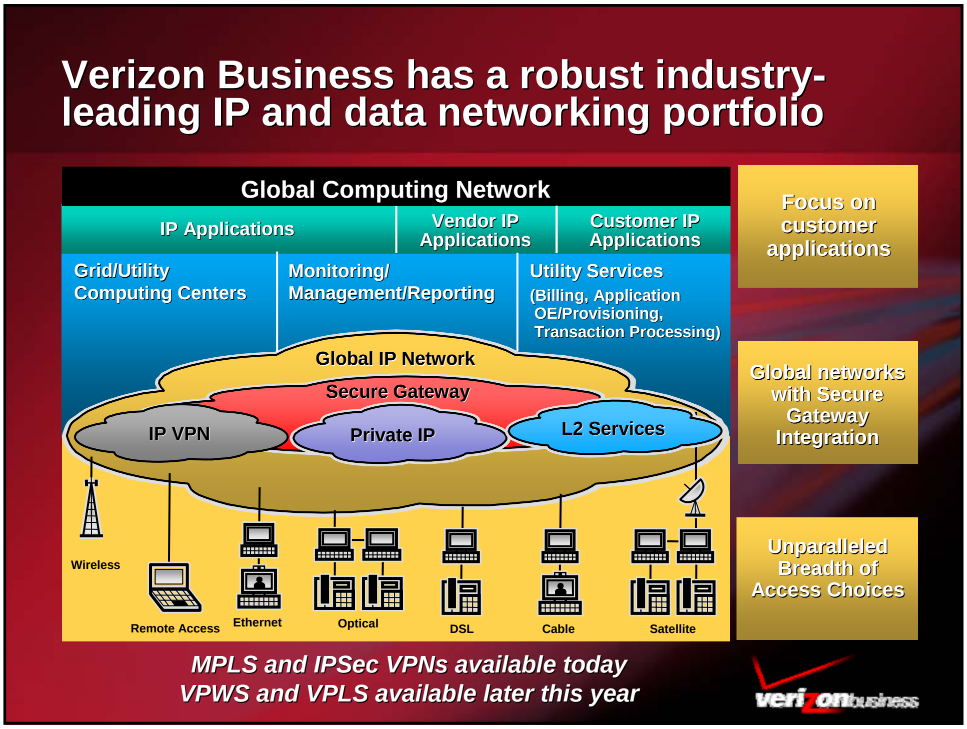
Summary of Considerations

	Layer 3 MPLS VPN	Virtual Private Wire Service	Virtual Private LAN Service
Reliability/ Performance	Equal technically Footprint advantage	Equal technically	Equal technically MAC scaling
Cost	Strong savings for meshed networks	Easier bridge from existing equipment	Savings for multipoint and Ethernet equipment
Security	Public or private network? Routes shared	Public or private network? Routes not shared	Public or private network? Routes not shared (MAC addresses learned)
Manageability	Outsourced routing Robust network management options	Customer routing Meshing challenges	Customer routing MAC scaling
Applications	IP protocol Any-to-any	Flexible protocols Point to point	Flexible protocols Any-to-any
Maturity	Mature	Nascent	Nascent
Familiarity	IP familiarity	Legacy protocol familiarity	Ethernet familiarity



Recommendations

- Inventory your current environment
  - Applications
  - Infrastructure
  - Staff
- Pull out your crystal ball
  - Networking roadmap
- Rank your priorities
  - Bleeding edge or mature
  - Control
- Look at the cost of the options
  - Total Cost of Ownership



Verizon Business has a robust industry-leading IP and data networking portfolio

Global Computing Network

IP Applications | Vendor IP Applications | Customer IP Applications

Grid/Utility Computing Centers

Monitoring/ Management/Reporting

Utility Services
(Billing, Application OE/Provisioning, Transaction Processing)

Global IP Network

Secure Gateway

IP VPN

Private IP

L2 Services

Focus on customer applications

Global networks with Secure Gateway Integration

Unparalleled Breadth of Access Choices

MPLS and IPSec VPNs available today
VPWS and VPLS available later this year

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