

# The New Aged MAN

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# Goals and Non-Goals

## ▶ Goals:

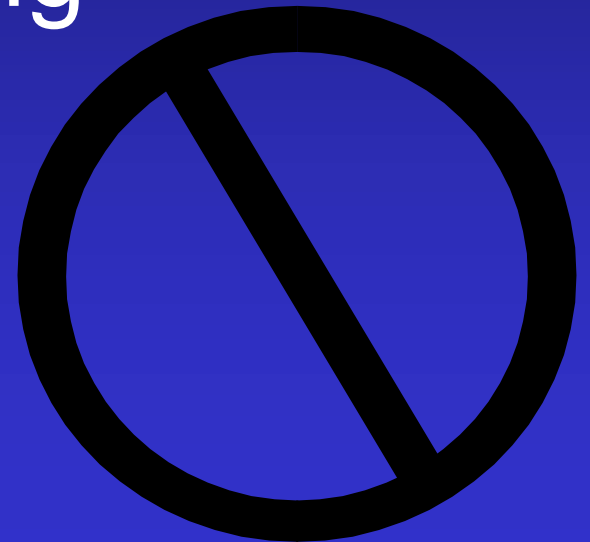
- Detail the various architectures being deployed by MAN Service Providers
- Describe the current generation of Service Provider MAN offerings
- Identify the management and SLAs associated with the current generation of Service Provider MAN offerings
- Provide some insight into the pricing of the current generation of Service Provider MAN offerings

## ▶ Non-Goals

- To declare a winning approach to MAN offerings
- To read every bullet on every slide

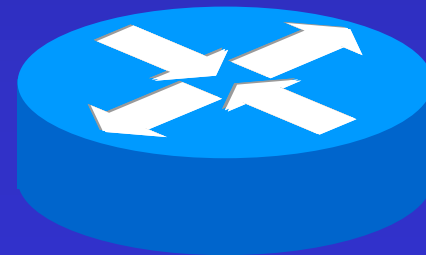
# Current Intra-LATA Services: Both for Connectivity and Access

- ▶ Expensive
- ▶ Highly subject to failure
- ▶ Difficult/time consuming to provision and configure



# MANs – Been There, Didn't Do That

- ▶ The concept of a MAN is not new, it has been tried multiple times before, with little success
  - In the late 1980s, FDDI was advocated as a MAN technology
  - In the mid-1990s, 10 Mbps Ethernet was deployed as a Transparent LAN Service (TLS)



# The New Age MAN – What's Different From a Few Years Ago?

- ▶ IP and Ethernet are notably more dominant technologies than existed even a few years ago
- ▶ There is much more fiber deployed today
- ▶ Native mode ATM is less of a viable alternative than it was
- ▶ There is more demand for high speed services than there was
- ▶ Enabling technologies are more fully developed. For example, CWDM & DWDM expand the capacity of each fiber with a lot more expansion to come

# The New Age MAN – What's Different From a Few Years Ago?

- ▶ Intra-LATA services have not dropped in price as much as have LAN and Inter-LATA services
- ▶ There is a broad range of service providers, both incumbents and emerging service providers, currently offering MAN services
- ▶ There is a broad range of MAN services being offered
- ▶ There are a number of higher level services being deployed that utilize high speed MAN services as an access technology

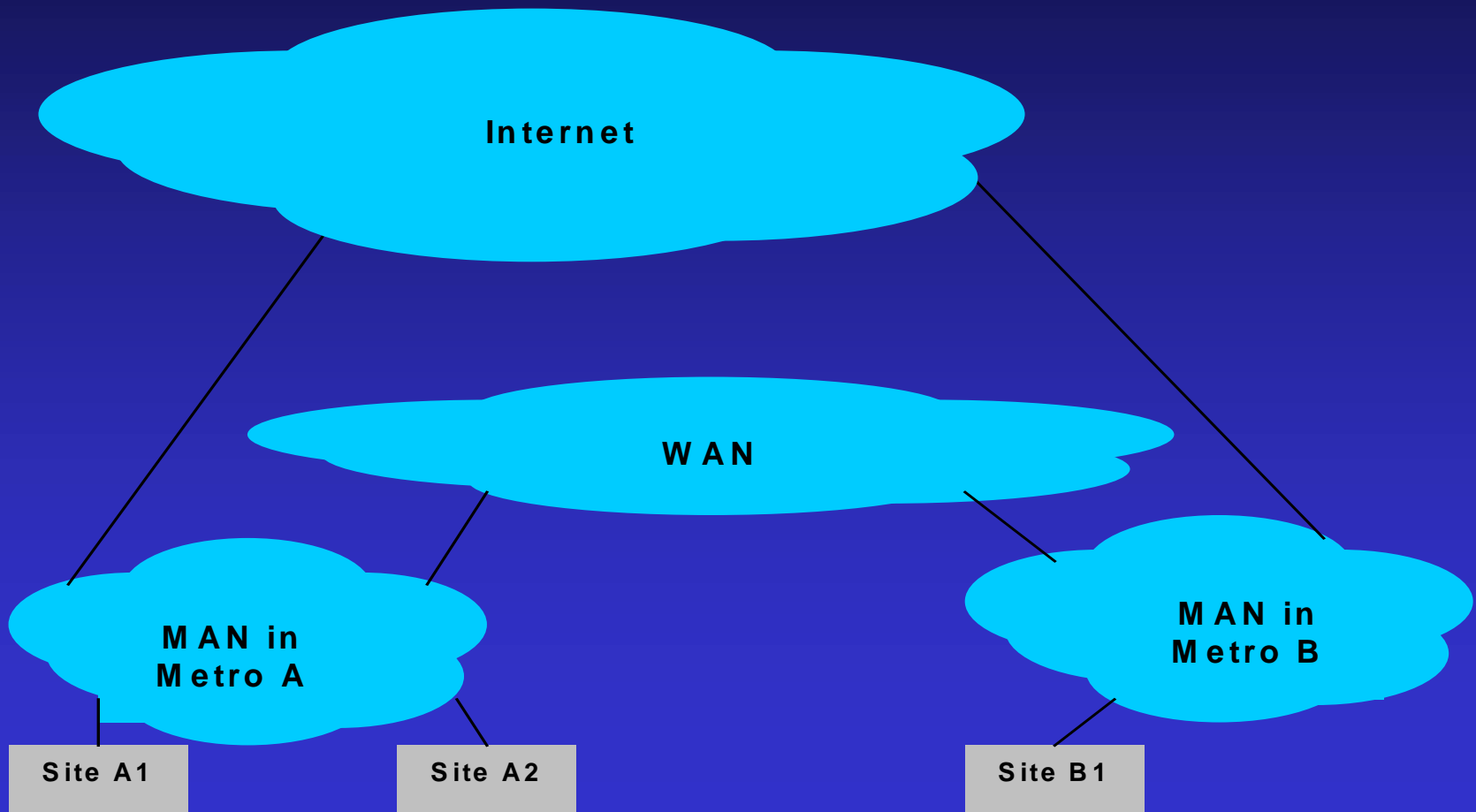


# New Aged MAN Services

- ▶ Current Transmission Services
  - Connectivity within a Metropolitan Area
  - Internet Access
  - WAN connectivity among Metropolitan Areas
- ▶ Potential Transmission Services
  - Access to VPNs
- ▶ Current or Potential Higher Level Services
  - Conferencing
  - Streaming Content
  - Storage Area Networks (SANs)
  - Hosted applications
  - Mainframe clustering and backup/restore



# MAN Service Topology





# Bandwidth

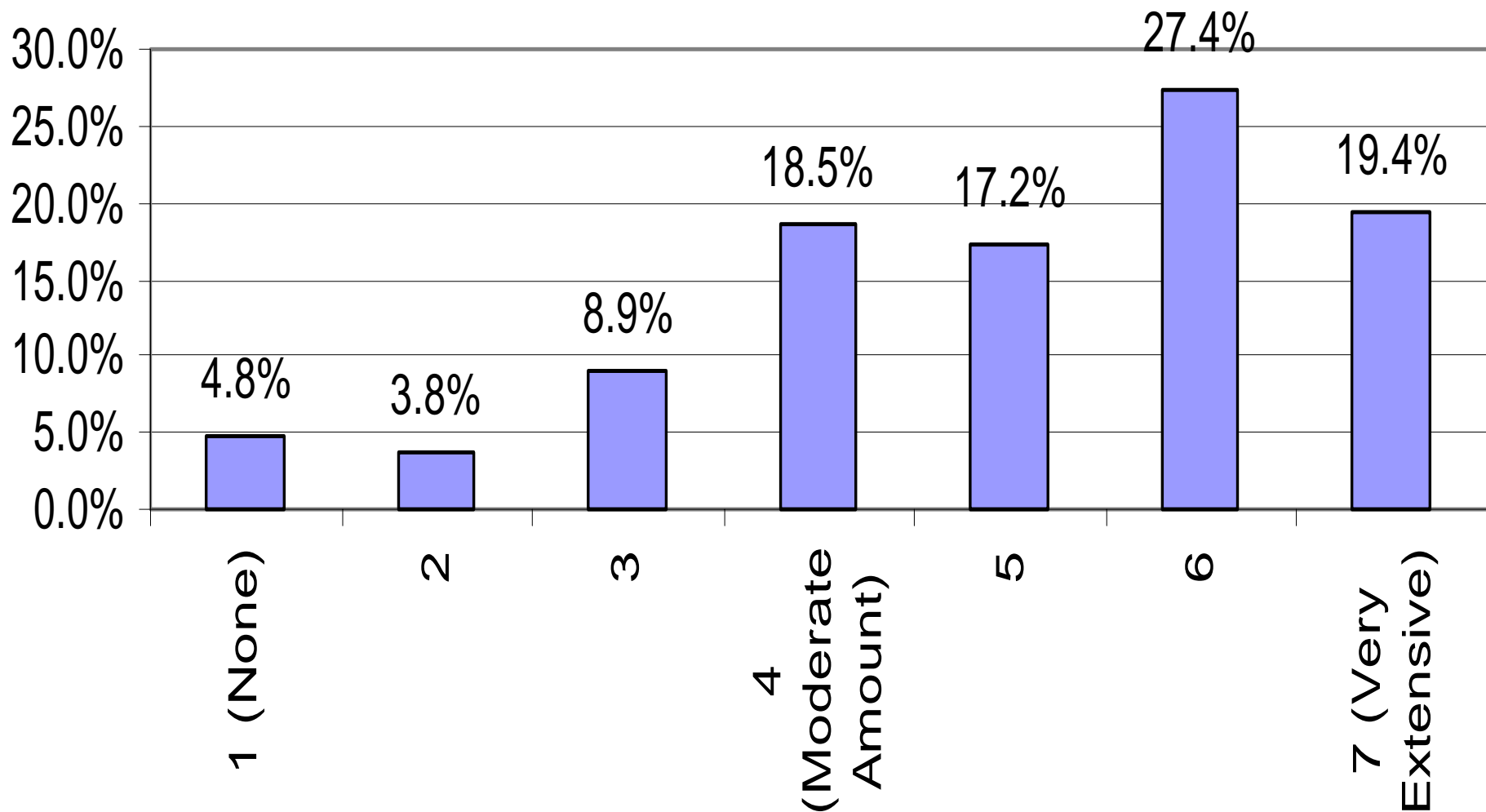
## ▶ Bandwidth Capacity

- Today's Ethernet Based Services provide bandwidth from 10 Mbps to 1 Gbps, with 10 Gbps on the horizon
- Alternatively, some MAN service providers are offering Lambda services

## ▶ Bandwidth Increments on Ethernet Based Services

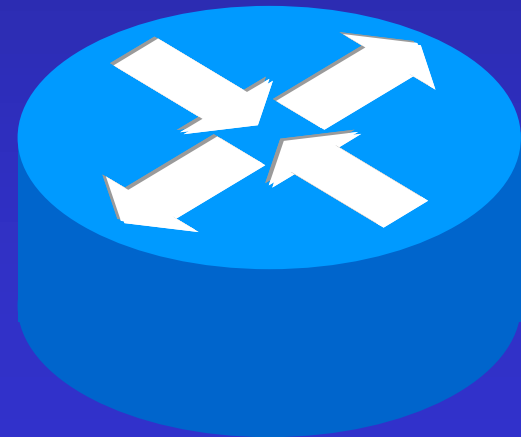
- As granular as 1 Mbps increments up to 1 Gbps
  - or, on increments such as:
- 1 Mbps up to a limit (i.e., 20 Mbps); then 10 Mbps increments up to a limit (i.e., 100 Mbps) and then 50 Mbps increments up to a limit (i.e., 700 Mbps)

# Marketplace Interest in Scalable Bandwidth



# Primary Enabling Technologies

- ▶ Long-haul Ethernet over dark fiber
- ▶ Coarse and Dense Wavelength Division Multiplexing (CWDM, DWDM)
- ▶ 1 and 10 Gbps Ethernet
- ▶ Optical Amplification
- ▶ IP Packet over SONET
- ▶ IP Packet over DWDM
- ▶ MPLS



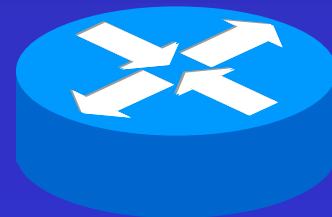
# Background

- ▶ Hardware vendors are packaging the enabling technologies into Service Interface Units (SIUs). SIUs are the service provider managed CPE to which enterprise routers and switches connect for MAN services.
- ▶ MAN services at  $>100$  Mbps require that an optical fiber exists between the enterprise site and the Service Provider's POP.



# Classifying SIUs

- ▶ SIUs fall into two broad categories:
  - Ethernet MAN Switches - Typically a Layer 2/Layer 3 switch that has been adapted for the MAN by the incorporation of Long Haul Ethernet and/or CWDM
  - DWDM shelves with Optical Add Drop Multiplexer (OADM) functionality and varying degrees of TDM, IP Switching, and SONET

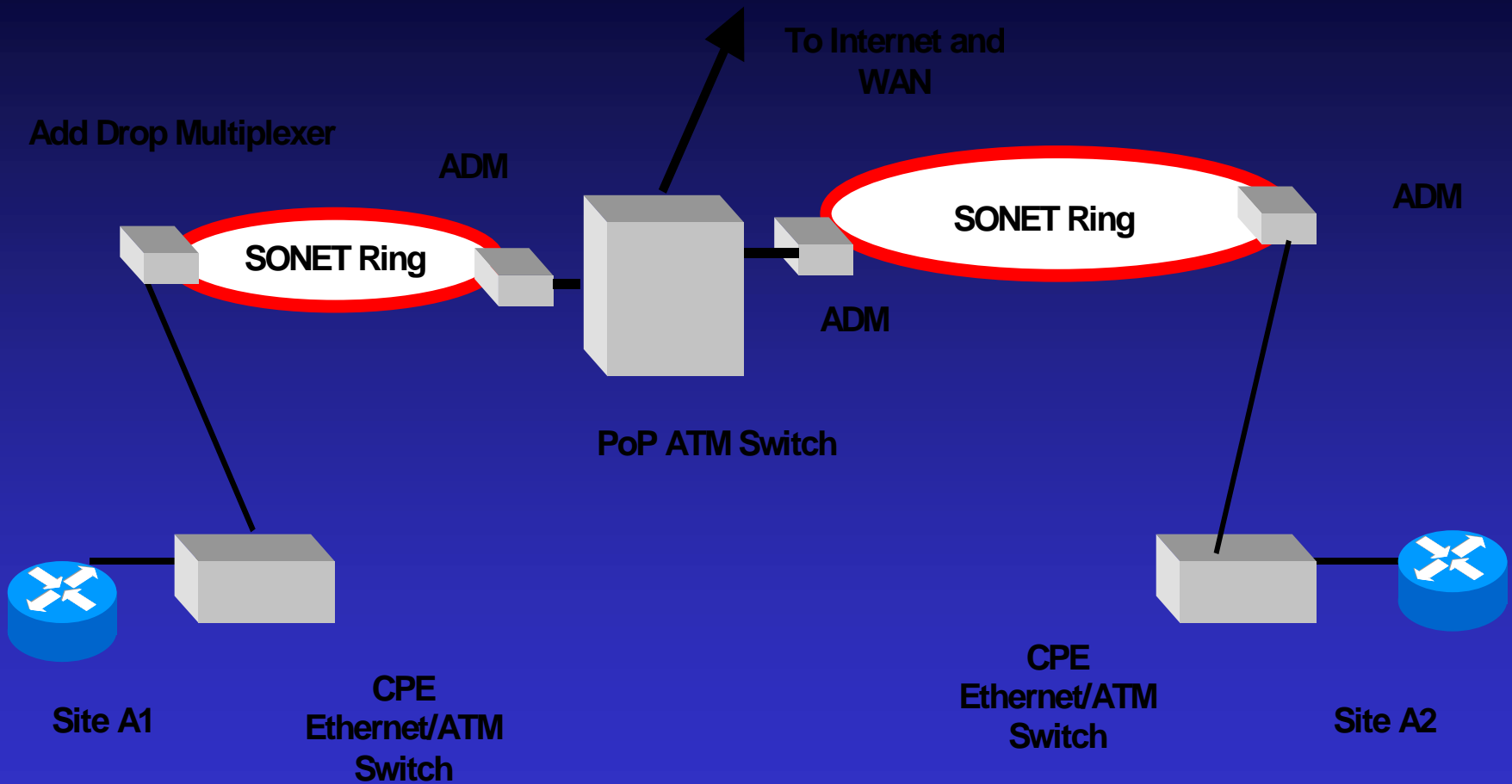


# The Underlying MAN Architecture Impacts:

- ▶ Flexibility to support new applications
- ▶ Bandwidth scalability
- ▶ Cost
- ▶ Reliability
- ▶ Security
- ▶ Manageability
- ▶ Quality of Service
- ▶ Ability to provision bandwidth quickly



# MAN Based on ATM/SONET



# TLS MAN Service Based on ATM/SONET

- ▶ Transparent LAN Services (TLS) is a traditional MAN service, available primarily from ILECs, such as SBC.
- ▶ The Ethernet traffic at site A1 is encapsulated as per RFC 1483 and bridged over the ATM network to site A2.
- ▶ A PVC would be configured for each pair of sites in the MAN

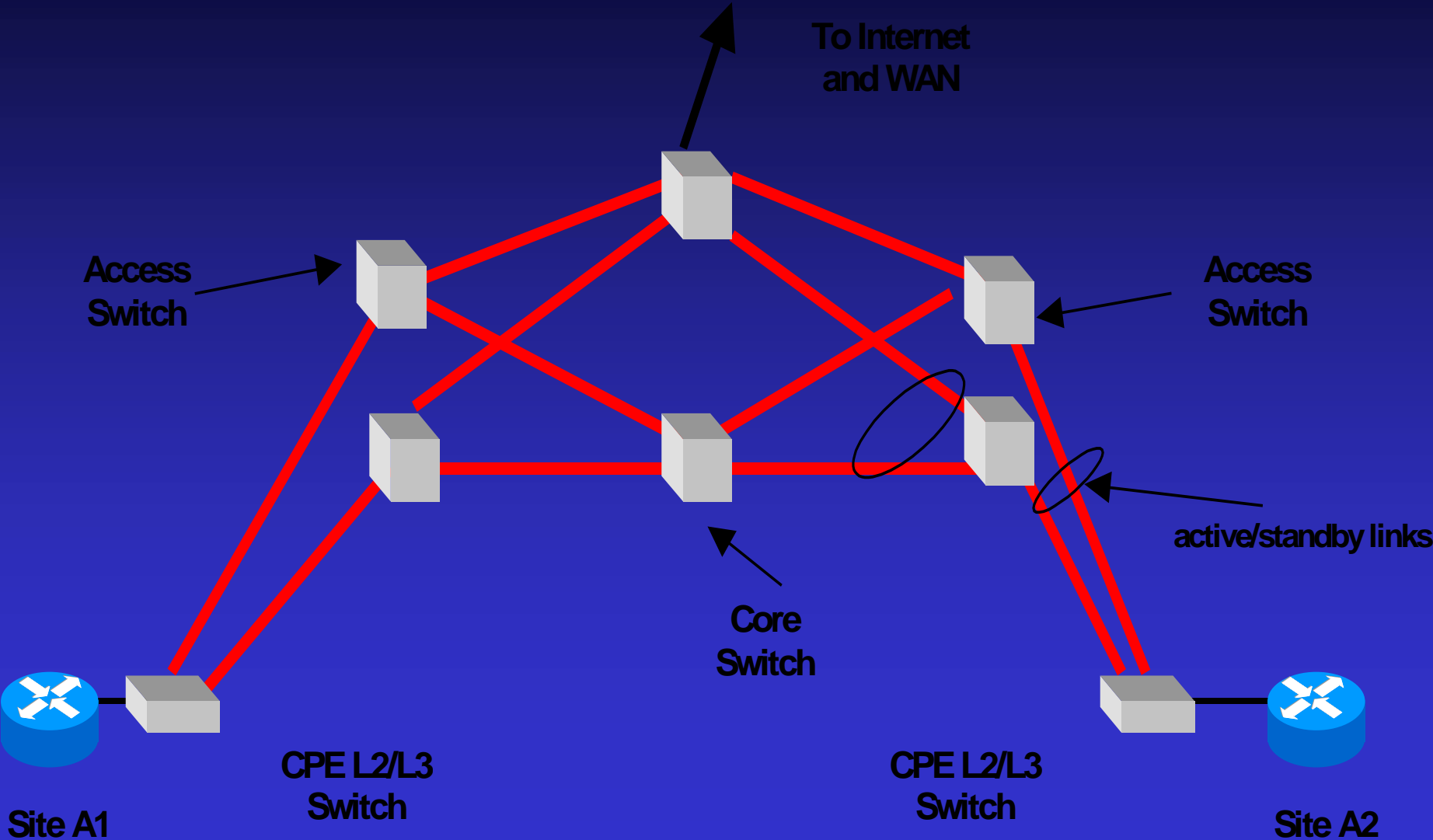




# TLS MAN Service Based on ATM/SONET

- ▶ The scalability and cost of this solution are determined by the ATM/SONET equipment
- ▶ SONET protection plus (potential) redundancy in the POP eliminate Single Points Of Failure (SPOFs) in the MAN
- ▶ With a dedicated SIU and PVC per site, security is equivalent to that of an ATM network
- ▶ For Internet and WAN connectivity, additional routed ports would have to be configured on the site switch/router, and additional PVCs established to the ISP or the provider of routed IP backbone services.

# MAN Based on IP Over Long Haul Ethernet



# MAN Based on IP Over Long Haul Ethernet

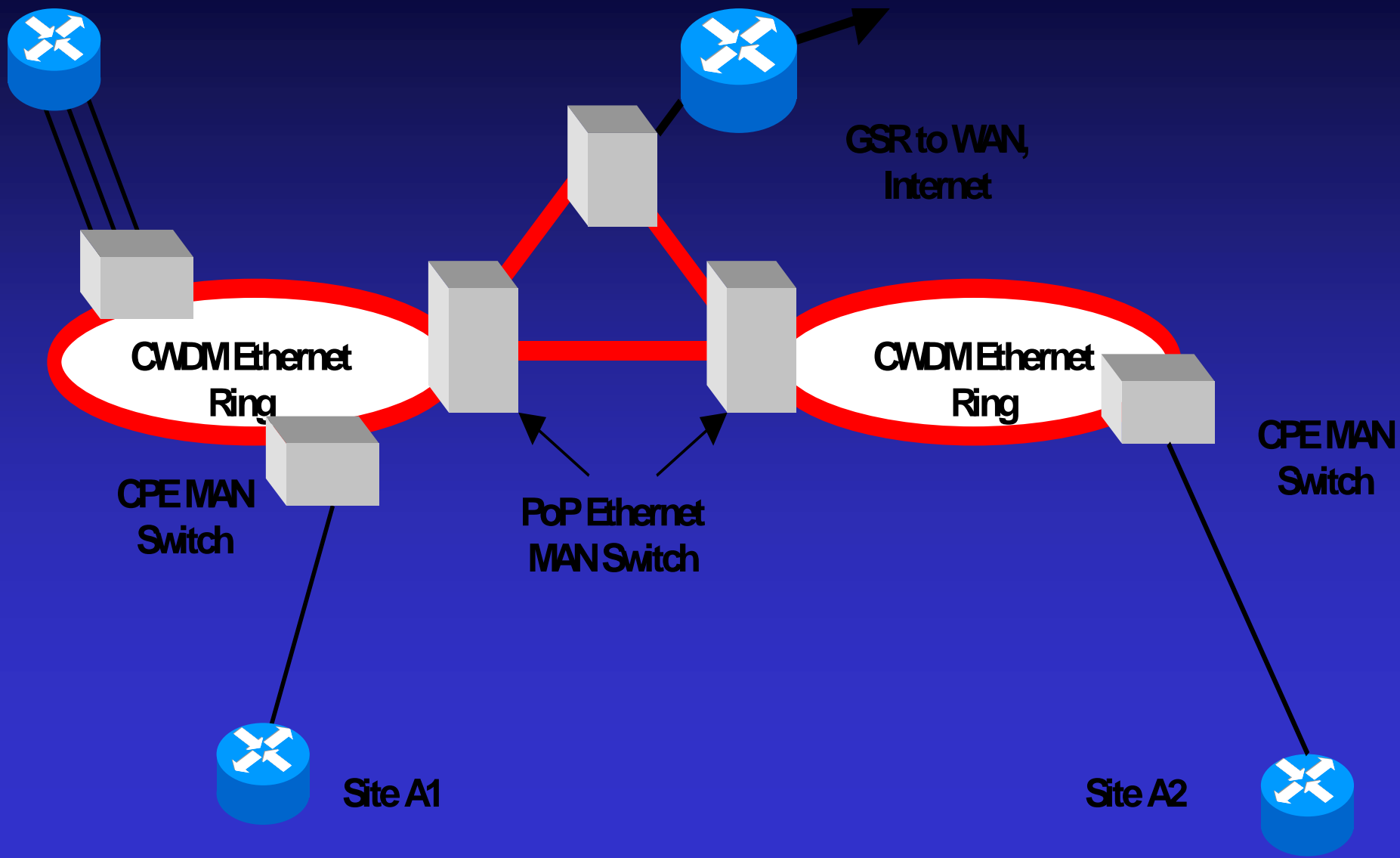
- ▶ This is an architecture deployed by MAN CLECs, such as Telseon using switches from RiverStone (Yago)
- ▶ The SIU at site A1 could be dedicated to a single subscriber, or shared by a number of subscribers in a multi-tenant building
- ▶ The traffic of each subscriber is encapsulated with a unique 802.1Q VLAN header and bridged over the MAN
- ▶ As was the case with the TLS, additional routed ports would have to be configured for Internet access and WAN services

# MAN Based on IP Over Long Haul Ethernet

- ▶ Scalability is provided by long haul versions of Fast Ethernet and Gigabit Ethernet
- ▶ Reliability is provided by a combination meshing (with excess capacity) and fast spanning tree
- ▶ Security is provided by VLAN tagging
- ▶ Note that additional security can be provided by implementing firewalls or MPLS



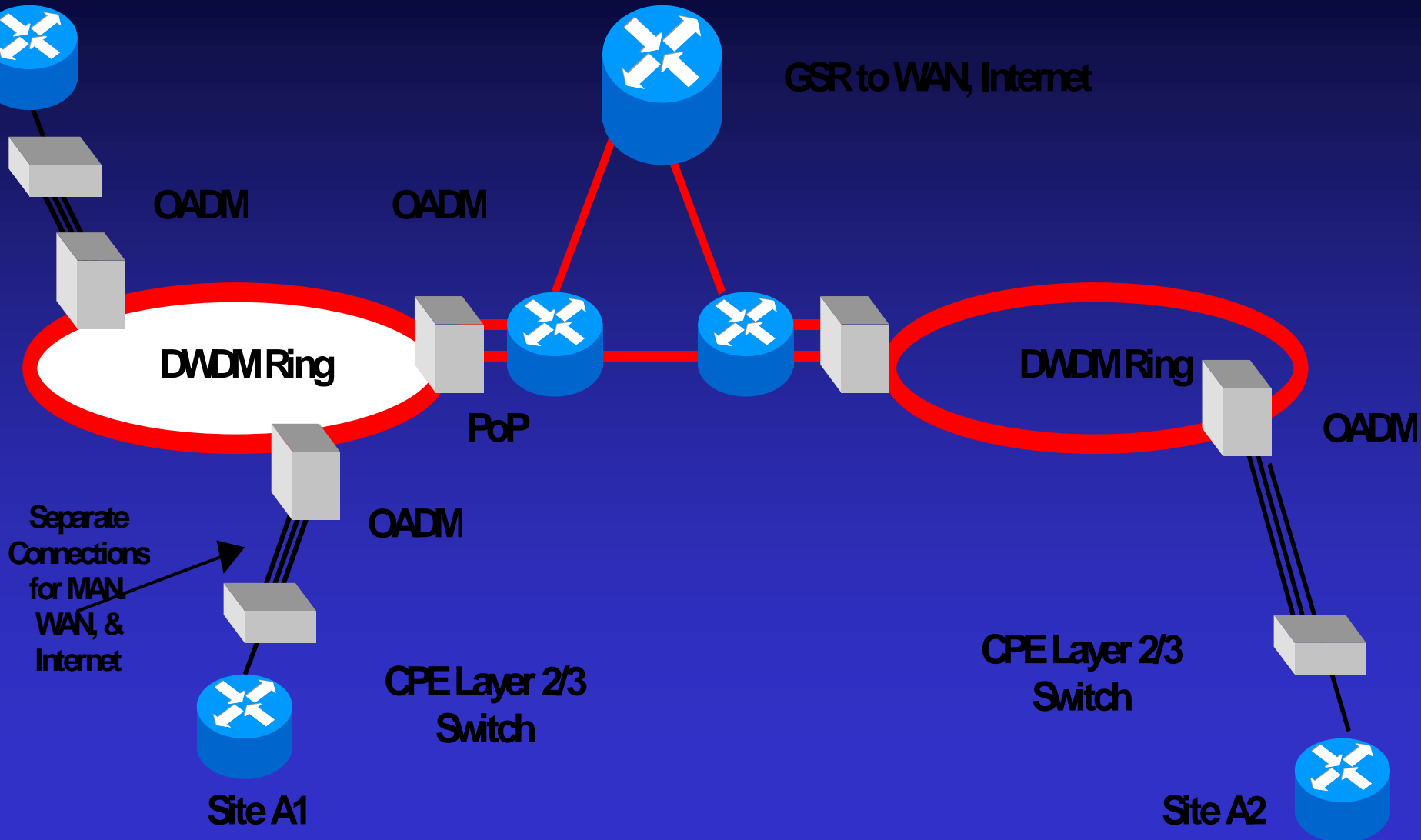
# MAN Based on IP Over Long Haul Ethernet and CDWDM Rings



# MAN Based on IP Over Long Haul Ethernet and CDWM Rings

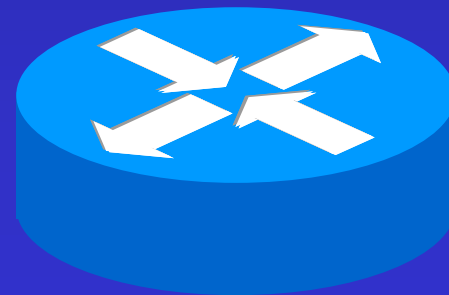
- ▶ Offered by Service Providers such as Yipes using switches from Extreme Networks
- ▶ CWDM provides either 4 or 8 wave lengths over each fiber strand
- ▶ A dual, self-healing Ethernet ring is used to daisy-chain among the customer sites with the CPE MAN switch providing added add/drop functionality
- ▶ Very similar characteristics as the preceding architecture
- ▶ There are a number of proprietary packet ring implementations. The IEEE is working on a Resilient Packet Ring (RPR) standard, called IEEE 802.17

# MAN Based on IP over DWDM Rings



# MAN Based on IP over DWDM Rings

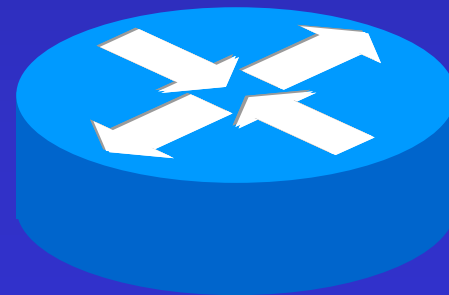
- ▶ This architecture is implemented by a variety of MAN service providers, including Verizon, Giant Loop, and XO Communications
- ▶ This is a variation of the previous architecture, using DWDM to link Optical Add/Drop Multiplexers (OADMs)--Lots of vendors here!
- ▶ One distinction among OADMs how much support for SONET is provided:
  - Framing
  - Protection/Restoration
  - TDM





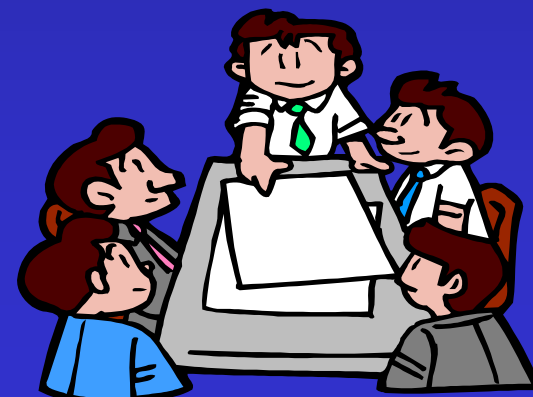
# MAN Based on IP over DWDM Rings

- ▶ Another primary characteristic of OADM is whether or not they allow multiple users to share a given Lambda
- ▶ One key aspect of the DWDM physical layer is that it is indifferent to the upper layer protocols. As such, OADM implementations can support:
  - SONET/ATM
  - Ethernet
  - Fibre Channel
  - ESCON



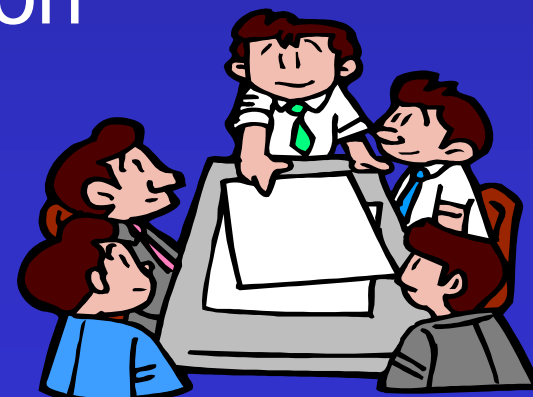
# Manageability

- ▶ Most Service Providers (SPs) currently give the customer read access to the SP's trouble tracking system
- ▶ Few SPs allow customers to directly enter trouble tickets into their system
- ▶ Few SPs allow customers to request bandwidth changes online



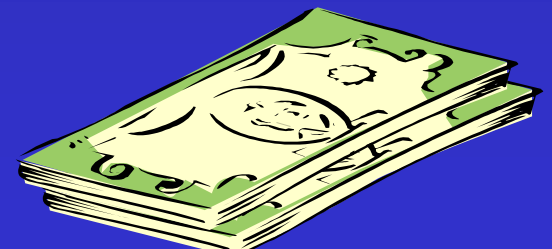
# Manageability Functionality Almost Always Missing Includes:

- ▶ Automated alerts of customer's fault or performance issues
- ▶ Real time SLA status
- ▶ Customer access to Fault Management and Service Assurance tools
- ▶ Online access to billing information



# MAN Service Pricing

- ▶ A lot of Individual Case Basis pricing
- ▶ Rule of Thumb for connectivity within a MAN or to the Internet:
  - \$2K/month for 10 Mbps service
  - \$3K/month for 100 Mbps service
  - \$8K/month for 1 Gbps service
- ▶ Service pricing may or may not have a distance sensitive component to it



# Additional Functionality

- ▶ Based on the Service Provider, the following may be part of the basic service, an add-on, or not even available:
  - Managed CPE
  - Managed Firewall
  - Managed Encryption Server
  - Digital Certificate Service
  - IP Filtering
  - NAT
  - Redundant Access



# SLA Parameters

- ▶ Bandwidth CIR
- ▶ Ability to Burst
- ▶ Packet Loss Ratio
- ▶ Latency
- ▶ Jitter
- ▶ Mean time to install
- ▶ Mean time to increase bandwidth
- ▶ Mean time to restore
- ▶ Availability



# SLA Credits

- ▶ Generally, the credits associated with MAN SLAs are only slightly stronger than those for legacy services.
- ▶ For example, it is typical to have the MAN SP pro-rate the Monthly Recurring Charge (MRC) for failure to meet the SLA.
- ▶ However, one MAN SP offers a credit of 30% of the MRC in the event that the monthly availability falls below 96%.



# Summary

- ▶ Many of the MAN services are essentially offered on an Individual Case Basis (ICB), so it is difficult to get information on pricing or service level agreements.
- ▶ New MAN services are evolving rapidly. Because of this, it is not wise to make a long term commitment to a MAN service provider, nor make a major investment in CPE
- ▶ The New Aged MAN does appear to be a step forward by providing a breakthrough in cost for WAN access, Internet Access, and MAN services