The Packet ADM

Making Ethernet Services Economically Viable

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Agenda

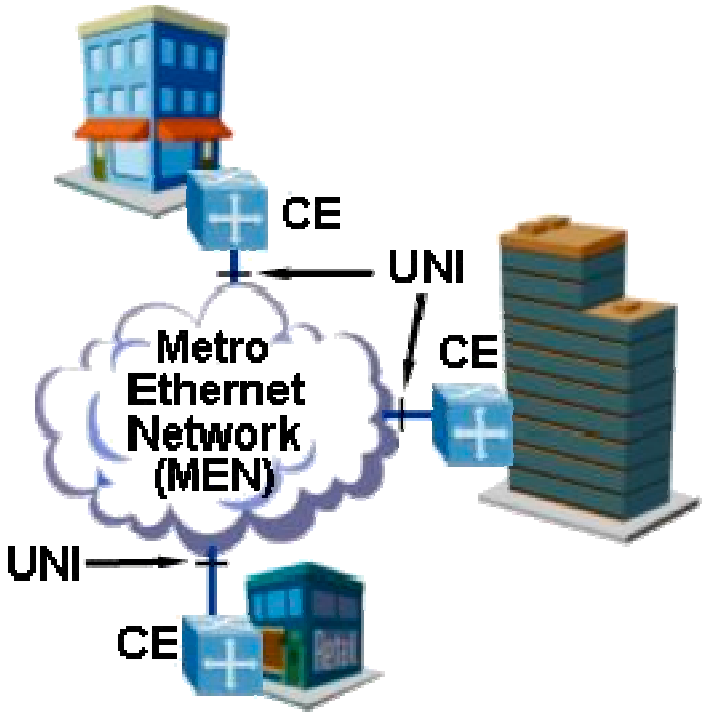
- **Why offer Ethernet as a service?**
- **How Ethernet services are defined**
- **Compelling economics for end-users**
- **Making Ethernet services economically viable for service providers**
  - Capex
  - Opex
- **The Packet ADM**
- **Sample Case Study**

Why Ethernet as a service?

- **Dominates the LAN**
  - Native interface
  - Plug-n-Play
- **Ease of use**
  - Widely available, well understood technology
  - Simplifies network operations to enterprises
- **Cost Effectiveness**
  - Widespread use of Ethernet interface
  - Purchase bandwidth only when needed
- **Flexibility**
  - Single interface can connect to multiple services
    - Internet, VPN, Extranet supplier, Storage Provider
  - Bandwidth can be added in 1Mbps increments

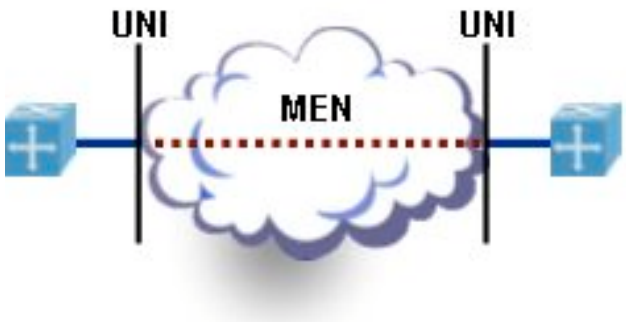
How Ethernet services are defined

- **CE attaches to UNI**
  - router
  - IEEE 802.1Q bridge (switch)
- **UNI (User Network Interface)**
  - Standard IEEE 802.3 Ethernet PHY and MAC
  - 10Mbps, 100Mbps, 1Gbps or 10Gbps
- **Metro Ethernet Network (MEN)**
  - May use different transport technologies, e.g., SONET, DWDM, MPLS, RPR, etc.

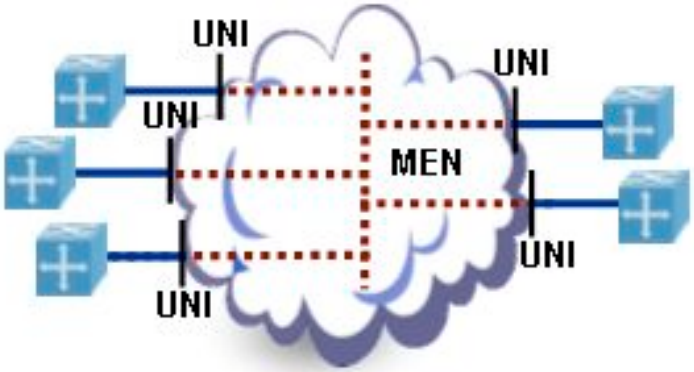


Ethernet Virtual Connection (EVC)

- **An EVC is "an association between 2 or more UNIs"**
- **MEF has defined 2 EVC types**
  - Point-to-Point
  - Multipoint-to-Multipoint
- **An EVC could carry traffic with multiple CoS**



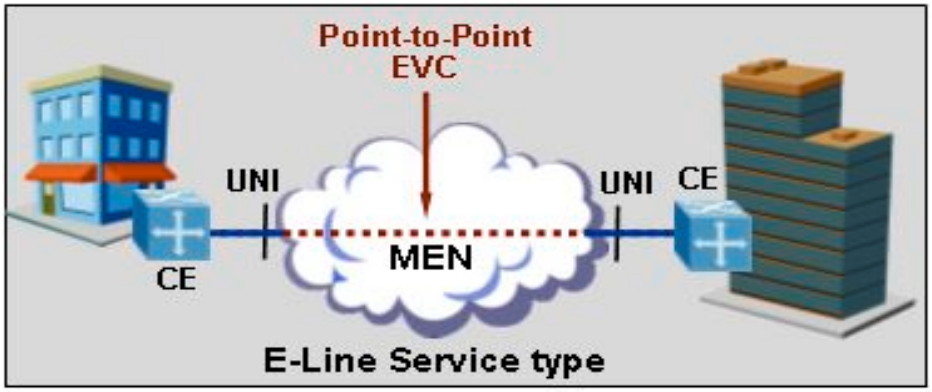
Point-to-Point EVC

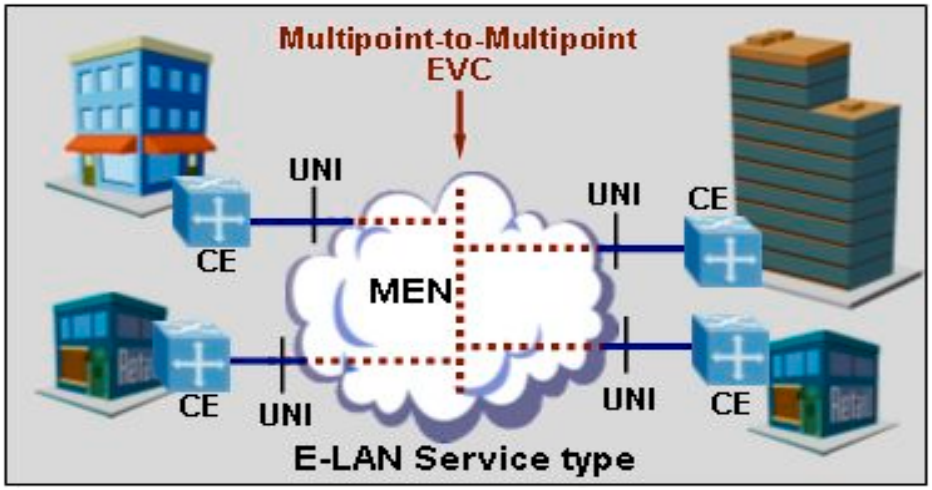


Multipoint-to-Multipoint EVC

E-Line and E-LAN Service Types

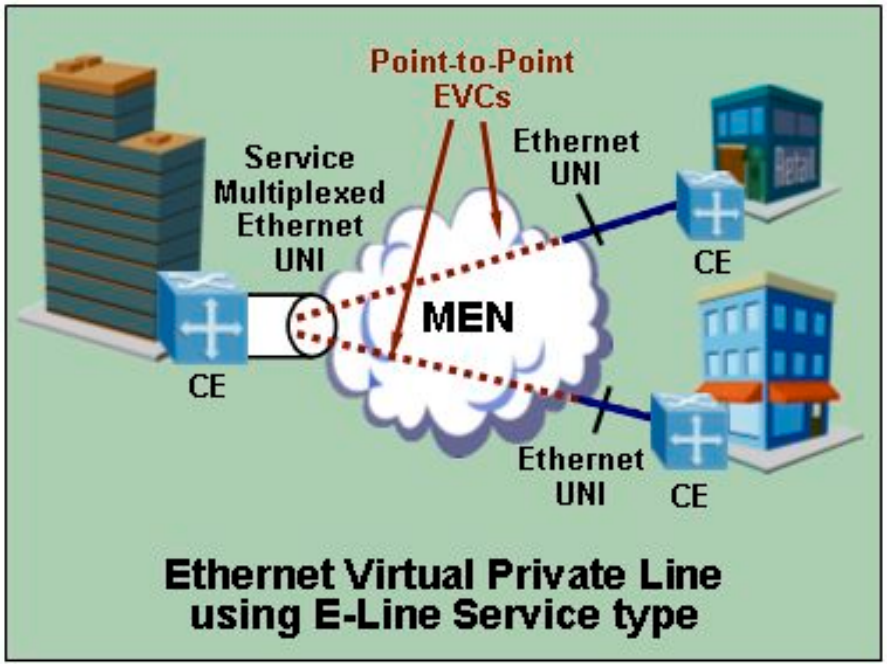
- **E-Line Service used to create**
  - Private Line Services
  - Direct Internet Access (DIA) Services
  - Point-to-Point VPNs
- **E-LAN Service used to create**
  - Multipoint VPNs

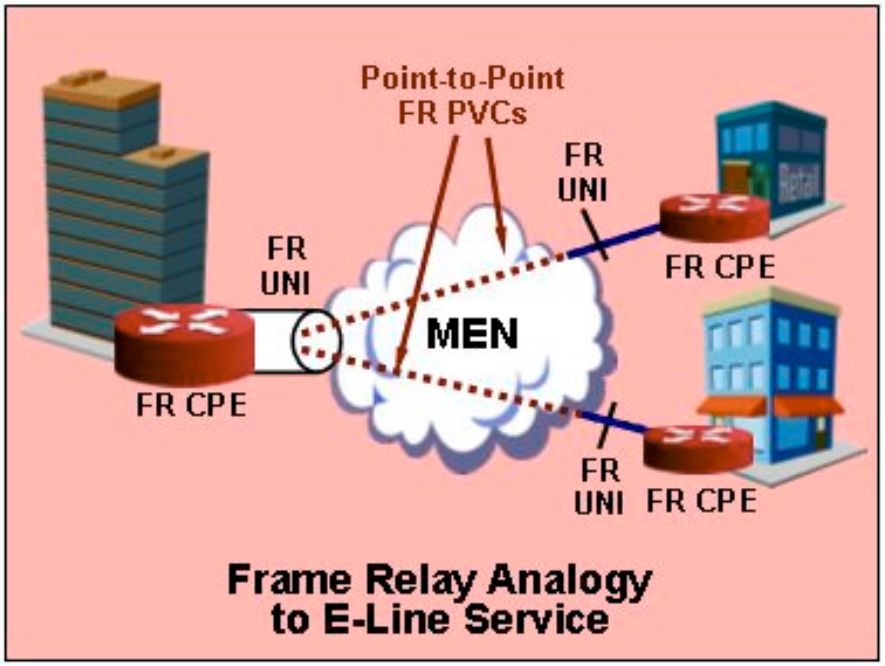




Example service using E-Line

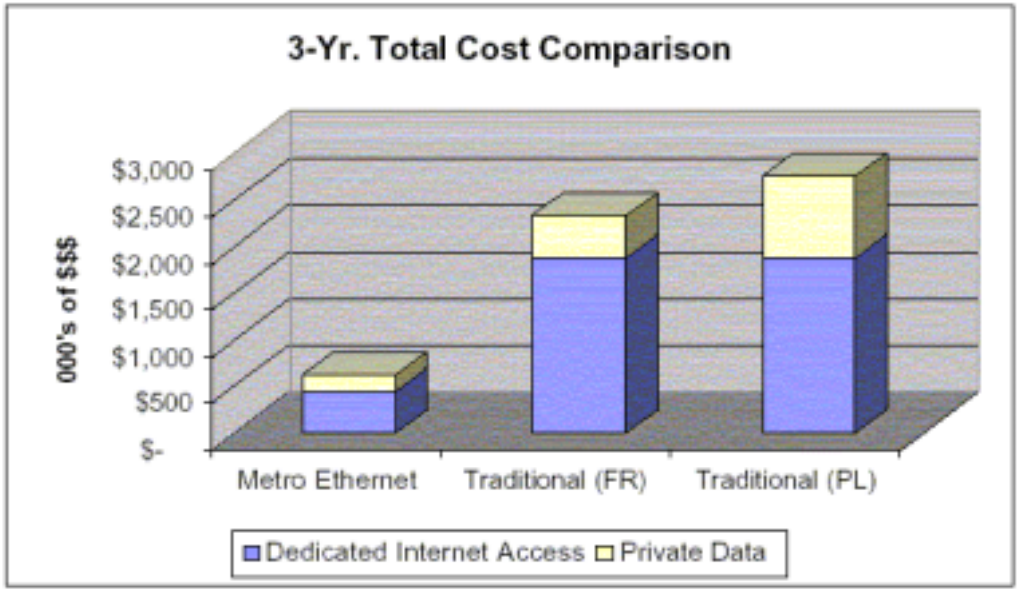
- **Ethernet Private Line**
  - Point-to-Point VPN for site interconnectivity





Compelling economics for end-users

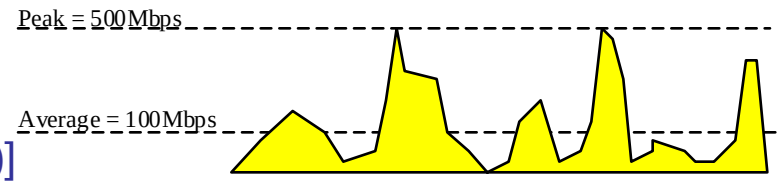
- **A detailed business case analyzed the cost benefits of Ethernet services to the end-user**
  - 73% 3-year saving compared to comparable Frame-Relay offering
  - 77% 3-year saving compared to comparable Private Line offering



What about carriers' economics?

- **Capital Expenditure**
  - Required network resources
  - Service Density
- **Operational Expenditure**
  - Provisioning
  - Adds, Moves and Changes
  - NOC

How is Ethernet different?



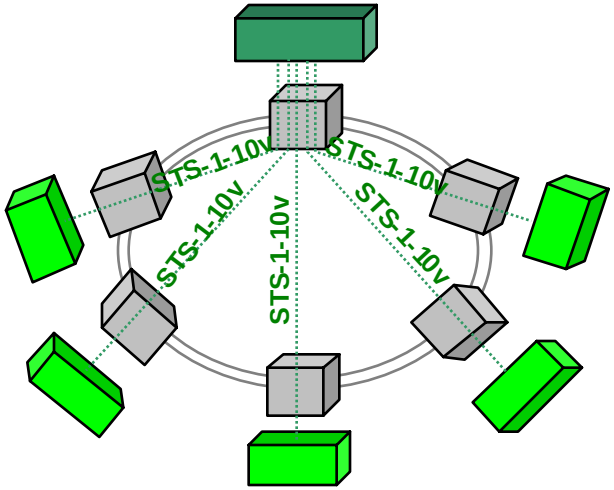
- **Many Ethernet services are bursty**
  - CIR/EIR service offering [CIR<<(CIR+EIR)]
  - On Ethernet "Private Line" Service – Actual average utilization may be low
- **Ethernet services can be highly granular**
- **If bursty Ethernet services are provisioned according to peak rate – they have no different cost point than today's Private Lines**
- **Demand for TLS services drives multipoint-to-multipoint as well as intra-metro connectivity for Ethernet services**

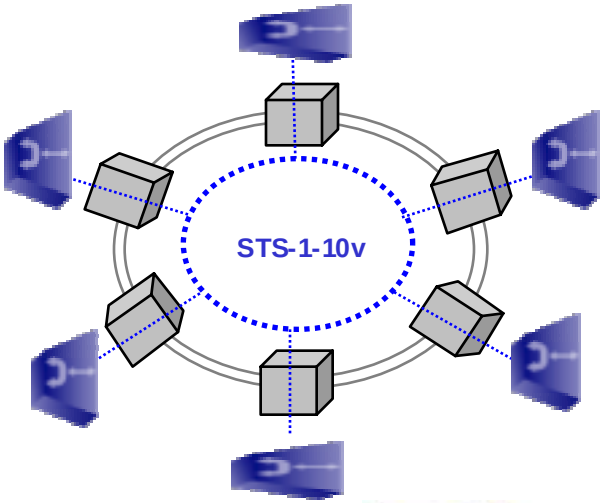
Just an analogy…

- We all use the highway infrastructure a few times a day (“bursty traffic”)
- Do we really expect to have a dedicated highway from our home to work???

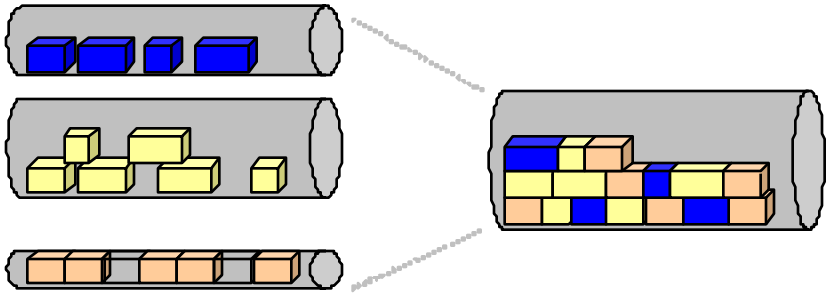
A Simple Case Study: Network Utilization

- **A 4-node ring with a hub. On each node a 500Mbps service with 20% average utilization (CIR/PIR = 100/500 Mbps)**
  - With VCAT alone – 5x STS-1-10v = 50x STS-1
  - With a shared media over VCAT – 1x STS-1-10v = 10x STS-1





So what's needed to reduce Capex?



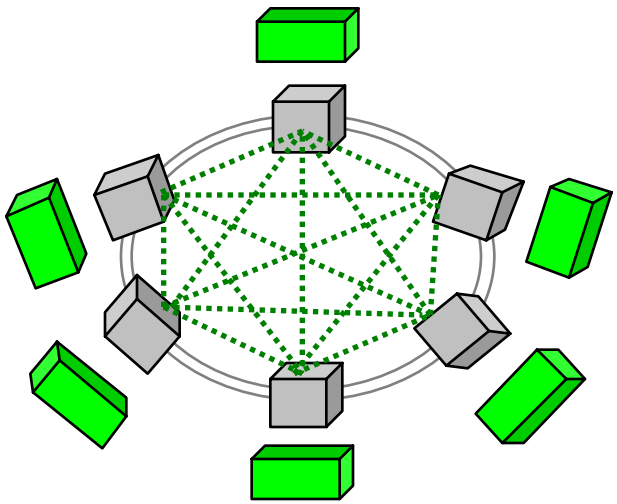
- **Traffic Management**
  - Support for multiple classes of service (H, M, L)
  - CIR/PIR policed to 1 Mbps
  - Fairness between traffic classes
- **Efficient Stat Muxing**
  - Thanks to highly efficient fairness algorithm
- **Congestion Control**
  - Usage Messages dynamically allocate bandwidth via Fairness Algorithm
- **Topology**
  - Shared Medium
  - Support for point to point, multicast and broadcast traffic

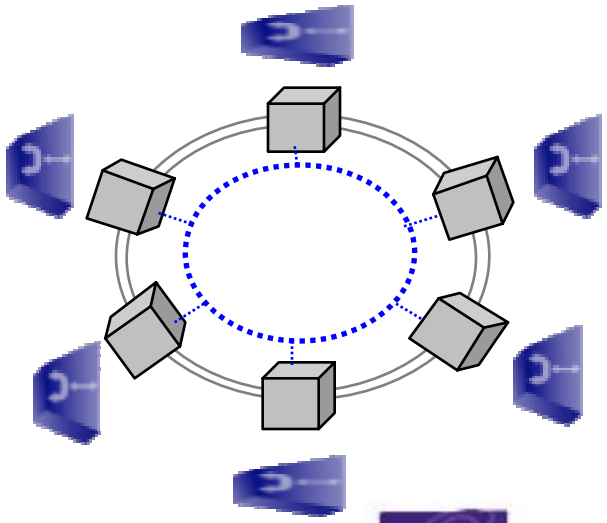
Operational Expenditure

- **Introducing new services and new equipment requires: planning, training, market development, …**
- **Once services are mature:**
  - Provisioning new services in new locations
  - Changing parameters of existing services, adding new services in existing locations, moving existing services to different locations
  - Controlling and troubleshooting existing services
- **New MEF-sponsored study shows that Ethernet has inherent advantages over legacy services in most of these areas**
- **BUT – It depends on HOW Ethernet services are delivered**

A(nother) Simple Case Study: Provisioning

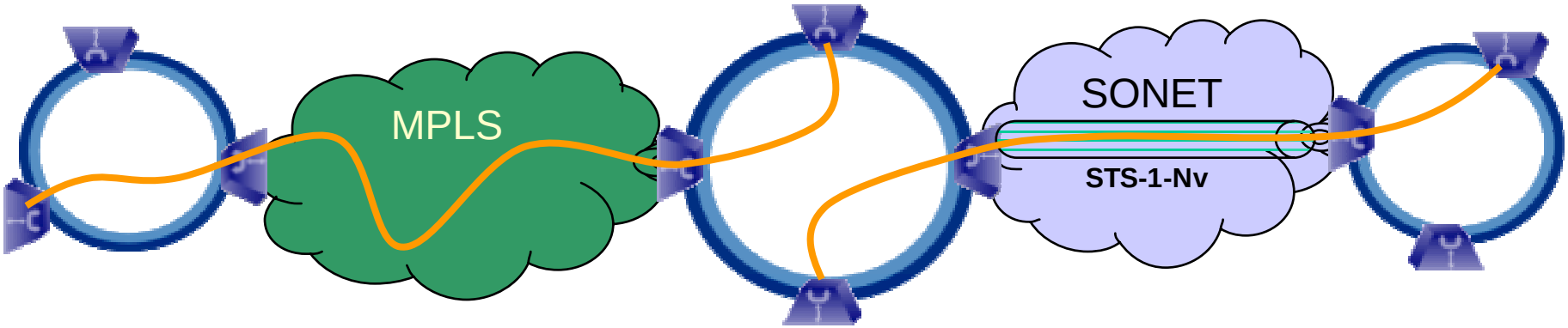
- **When Ethernet services are intra-metro – A mesh of SONET circuits has to be provisioned**
  - Provisioning a mesh of SONET circuits, with or w/o VCAT, is still a challenge
  - With VCAT alone – N*(N-1)/2 circuits
  - With a shared media over VCAT – N circuits





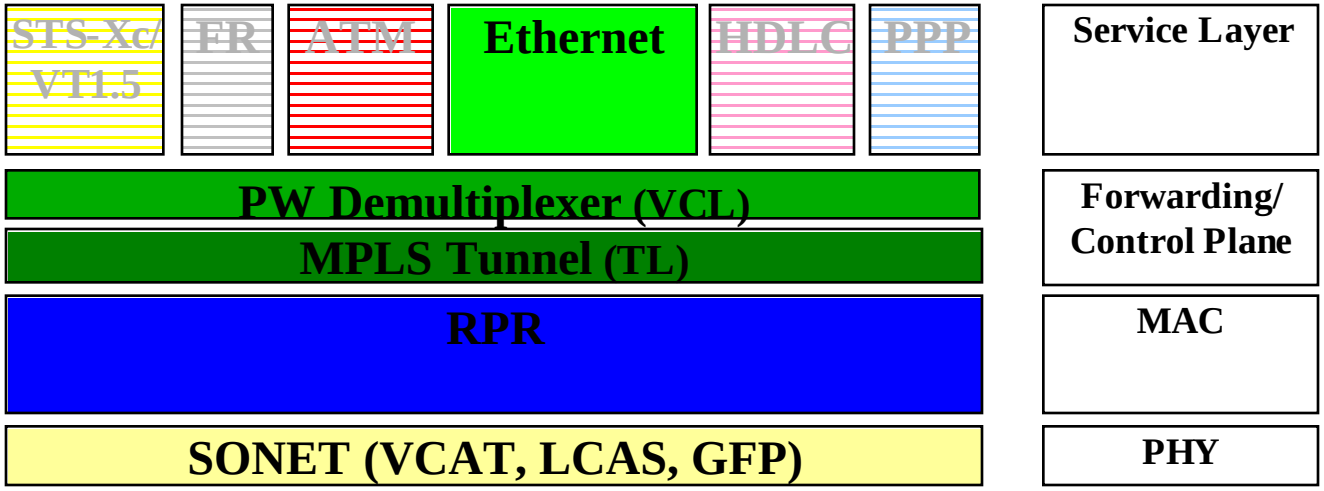
And what about end-to-end provisioning?

- **Services have to be provisioned across multi-vendor transport domains**
  - IP/MPLS domains
  - SONET/Optical domains
- **The "Martini" scheme can serve as the common interoperable bearer layer and control plane**



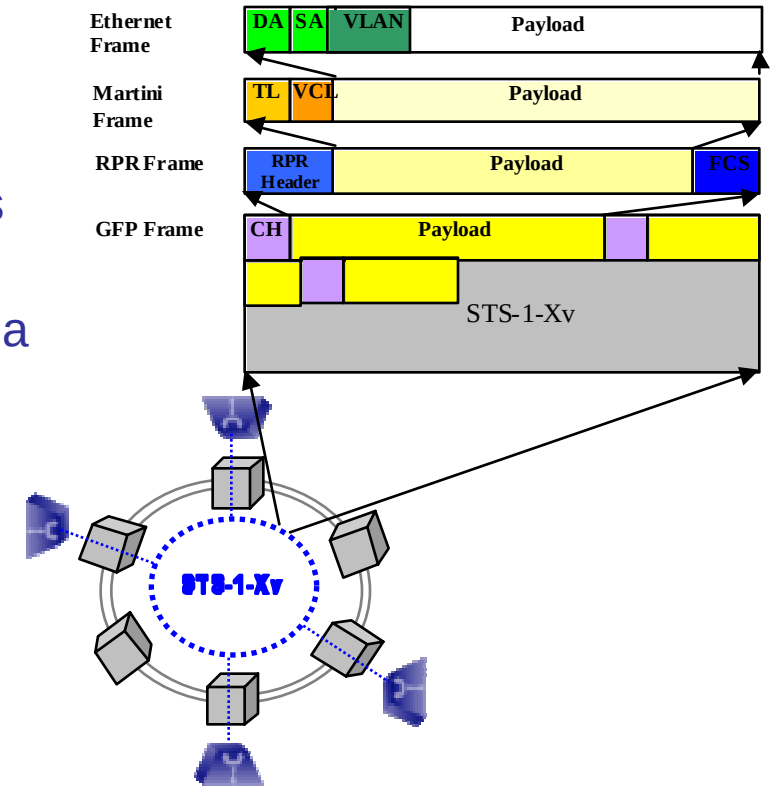
The Packet ADM

- Decoupling Services from physical facility
- Efficient data-aware traffic management
- Flexible bandwidth
- Automatic end-to-end provisioning and TE



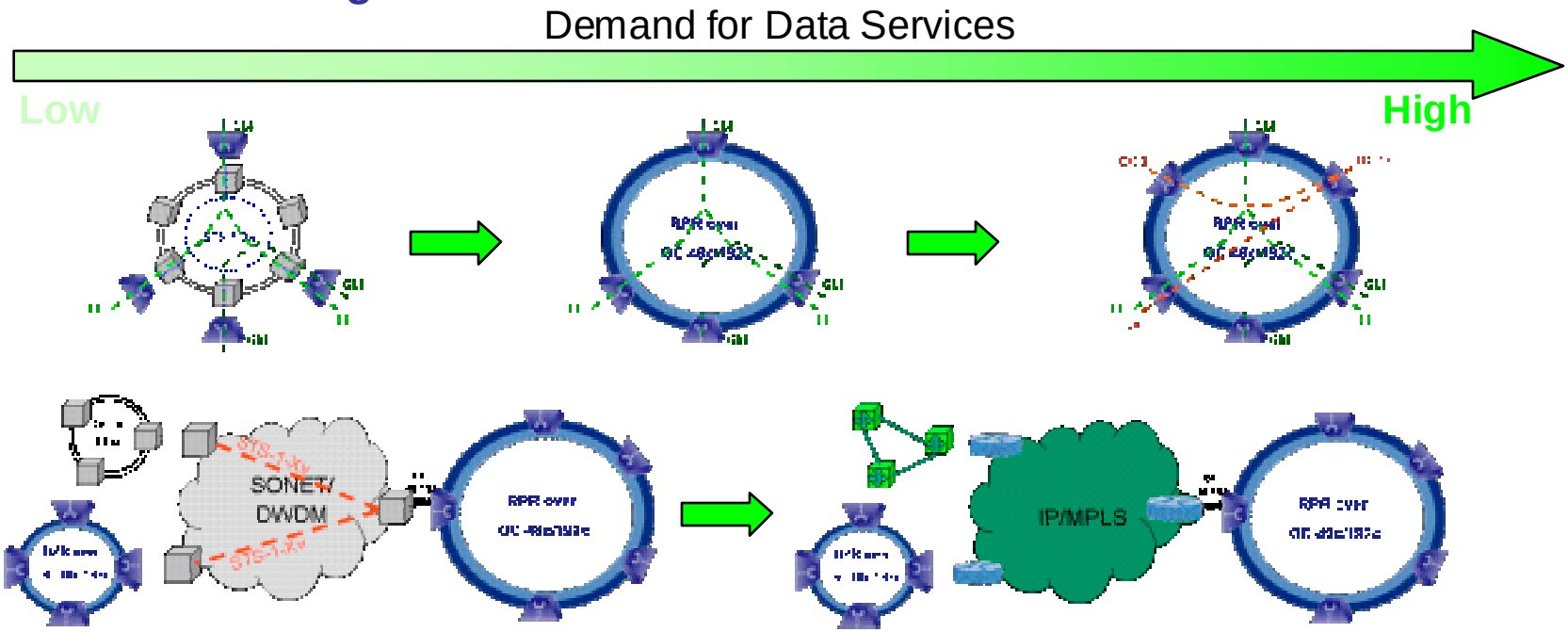
The Building Blocks

- **OC-48/192 Phy** provides OAM&P, synchronization and interworking with existing SONET
- **Virtual Concatenation** (G.707) and **GFP** (G.7041) to transparently provision a virtual ring or an interconnecting circuit (hub) across existing SONET Metro or Core
- **LCAS** (G.7042) to hitlessly adjust the size of a virtual ring or interconnecting circuit
- **RPR** (IEEE 802.17) for bandwidth management, fairness, and efficient stat-muxing and protection switching
- **MPLS** (IETF "Martini") for end-to-end provisioning, traffic engineering, and segregation between users



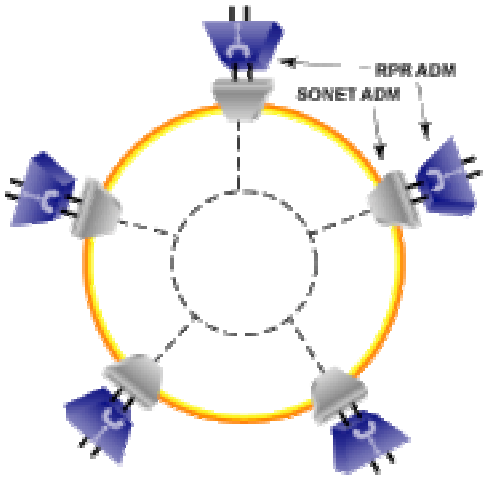
Evolution rather than Revolution

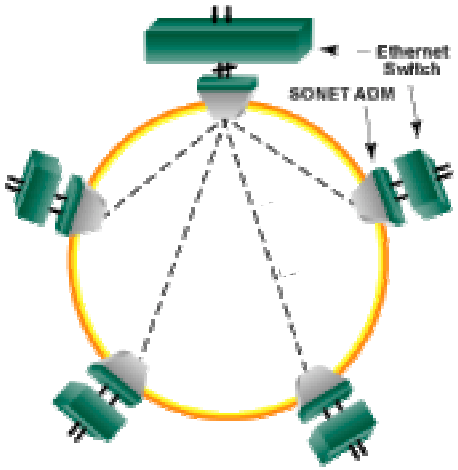
- **Start with packet ADMs on existing SONET capacity, and evolve to a standalone network as demand grows**
- **Interconnect on existing SONET long-haul, and evolve to MPLS core as demand grows**



A simple Business Case:

Adding Ethernet to existing SONET





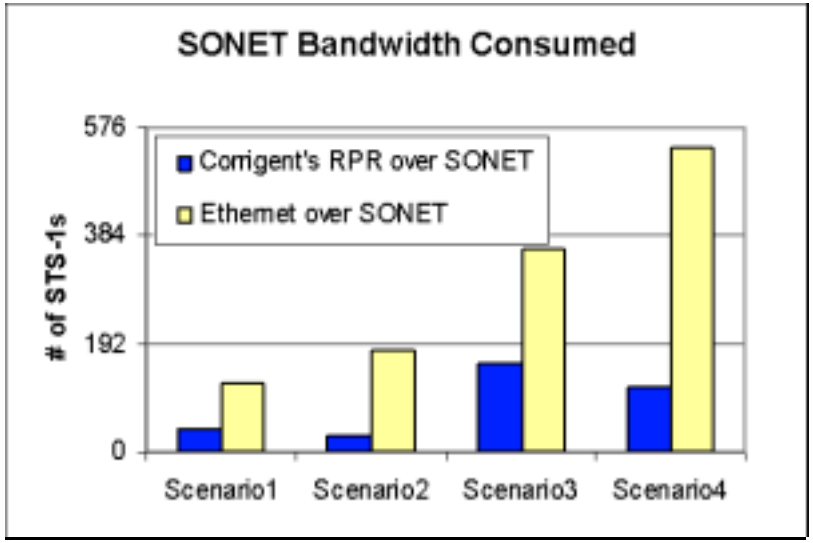
- Business case developed in conjunction with a major RBOC
- Application: Add support for Ethernet services over existing SONET rings

  Option A: Network based on an RPR-based shared media for traffic management

  Option B: Network based on adding Ethernet Switches
- 4 different traffic pattern scenarios considered

Results:

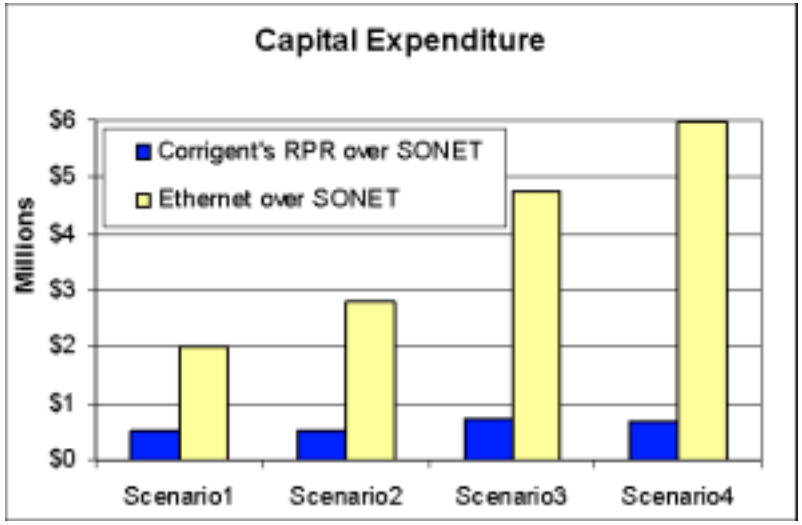
Network Utilization



- Upgrading existing SONET with a virtual shared media ring requires a fraction of the SONET bandwidth compared with alternative
- In many real-life scenarios, traditional Ethernet Switch based upgrade is non-feasible due to bandwidth limitations

Results:

Capital Expenditure



- Adding packet ADMs is a fraction of the cost of adding Ethernet switches and SONET ADMs
  - Existing capacity can be used w/o additional transport equipment
- Low additional capital expenditure is required as demand grows

Summary

- **Ethernet services offer compelling economics to end-users**
- **In order to maintain reasonable margins on Ethernet services, service providers have to:**
  - Introduce data-awareness to their transport network
  - Introduce fast provisioning mechanisms
  - Decouple service creation from physical facility
  - Do all that in a way that's compatible with the existing infrastructure
- **Packet ADMs are designed to address these issues exactly**

Questions?