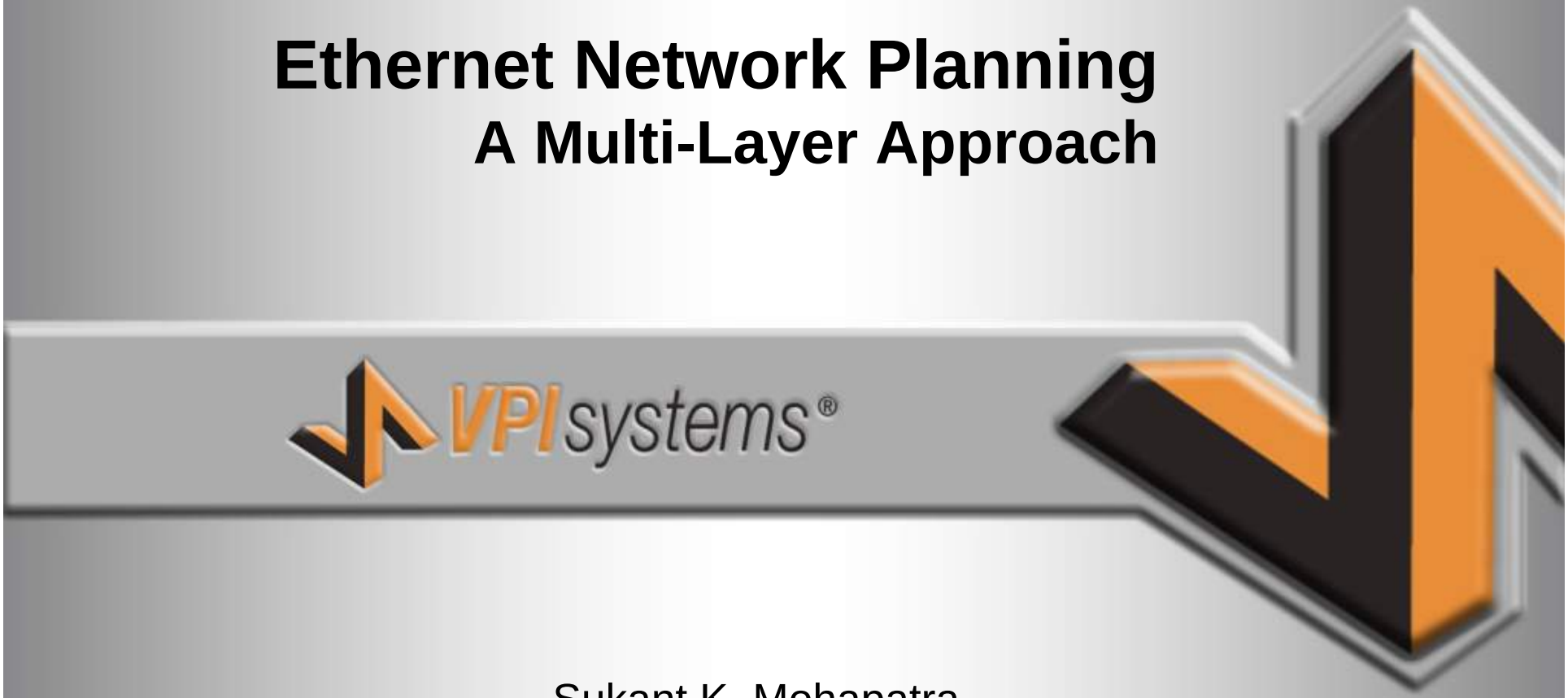
Ethernet Network Planning
A Multi-Layer Approach



Sukant K. Mohapatra

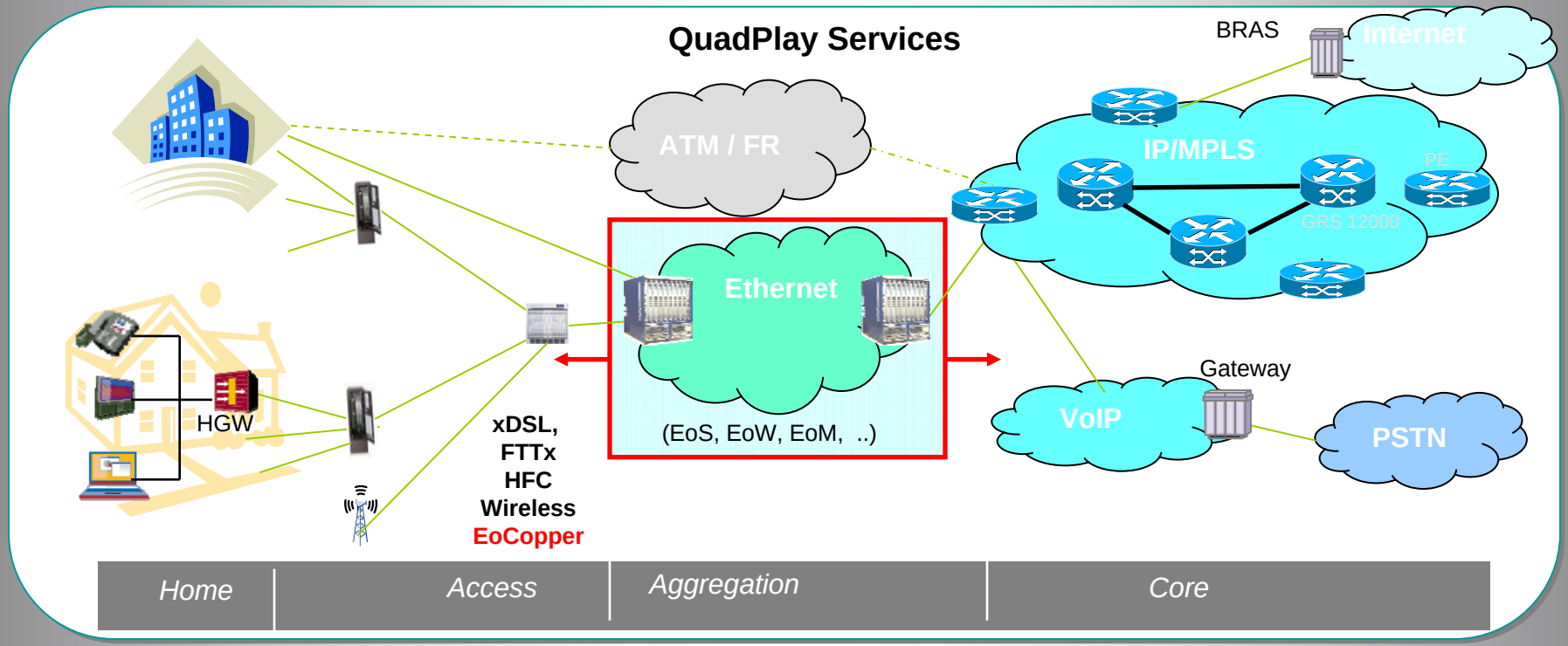
April 17, 2008

Outline

- Introduction
  - Ethernet Network – An Overview in Context of Next-generation Network
  - Ethernet Technology Options & Evolution
- Carrier Ethernet Network Planning Challenges
- A Multi-layer Approach in Ethernet Network Planning
- Conclusion

Ethernet Network

In Next-generation Network

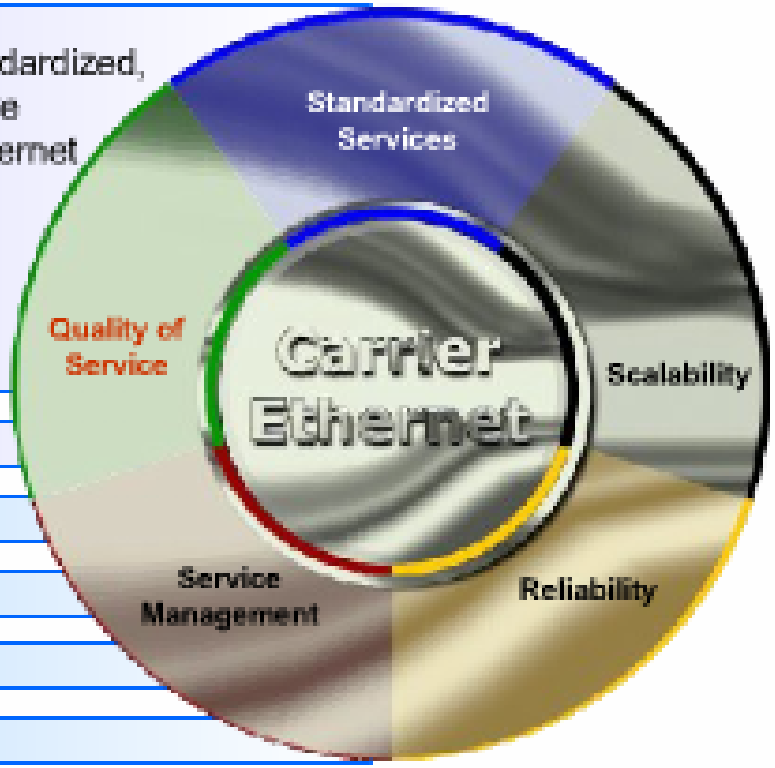


- Ethernet Network
  - Optical Ethernet (MEN/WAN)
  - Support over various Layer 1 & Technologies

Carrier Ethernet

Carrier Ethernet

- Carrier Ethernet is a ubiquitous, standardized, carrier-class **SERVICE** defined by five attributes that distinguish Carrier Ethernet from familiar LAN based Ethernet
- It brings the compelling business benefit of the Ethernet cost model to achieve significant savings

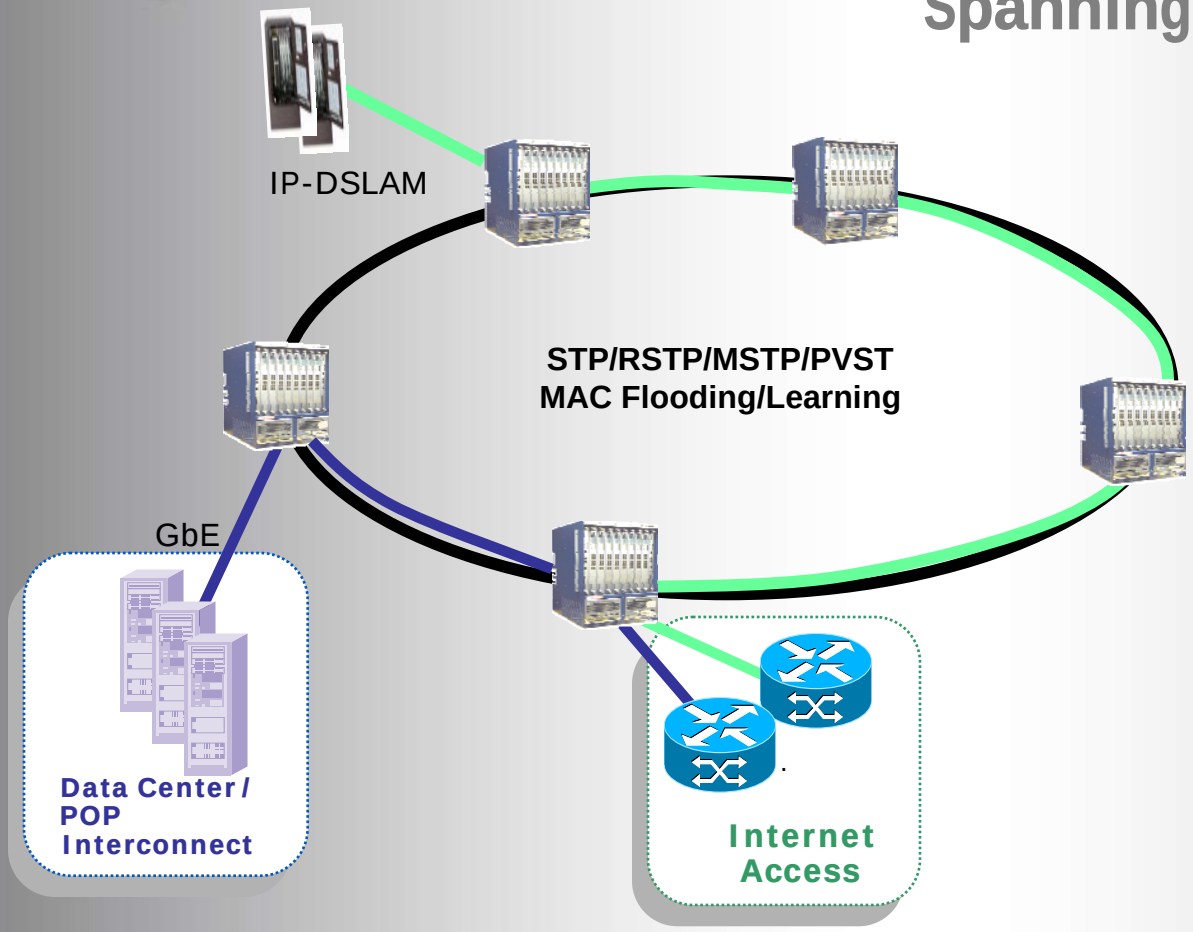


Carrier Ethernet Attributes

- **Standardized Services**
- **Scalability**
- **Service Management**
- **Reliability**
- **Quality of Service**

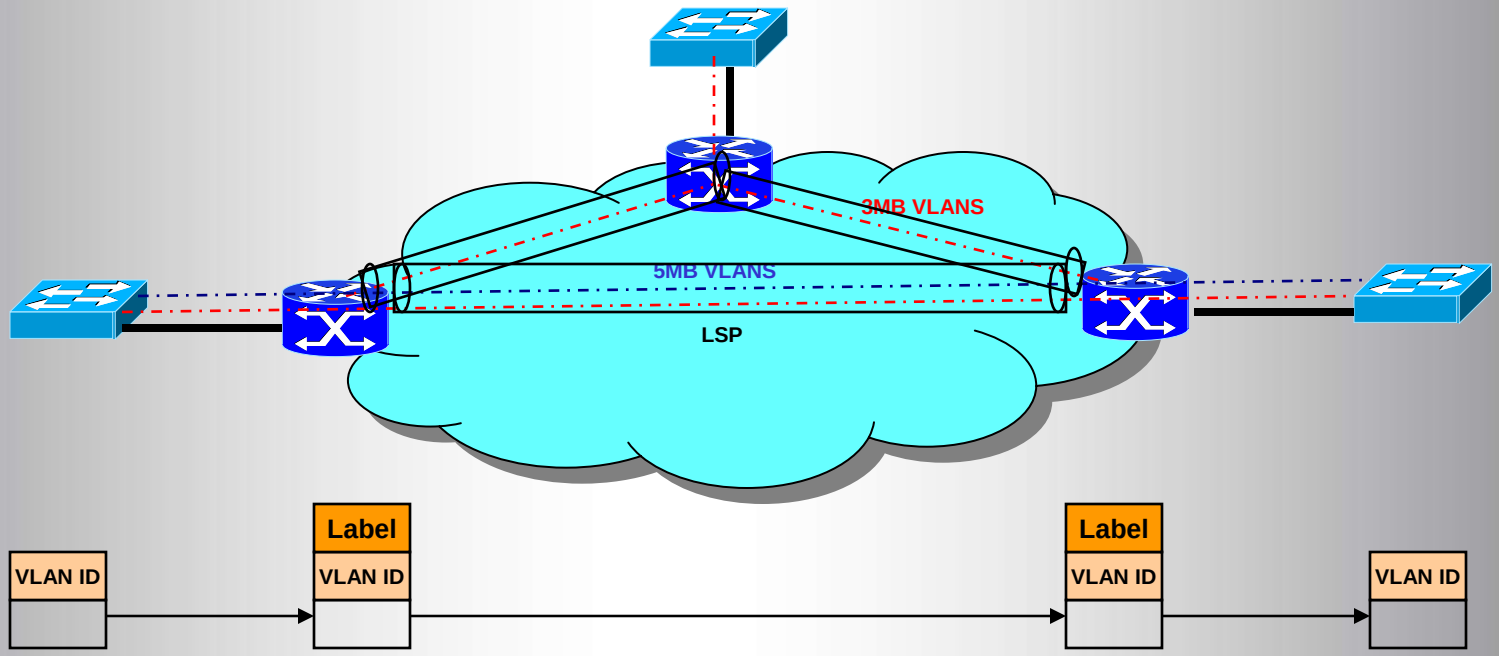
Native Ethernet

Spanning Tree Based



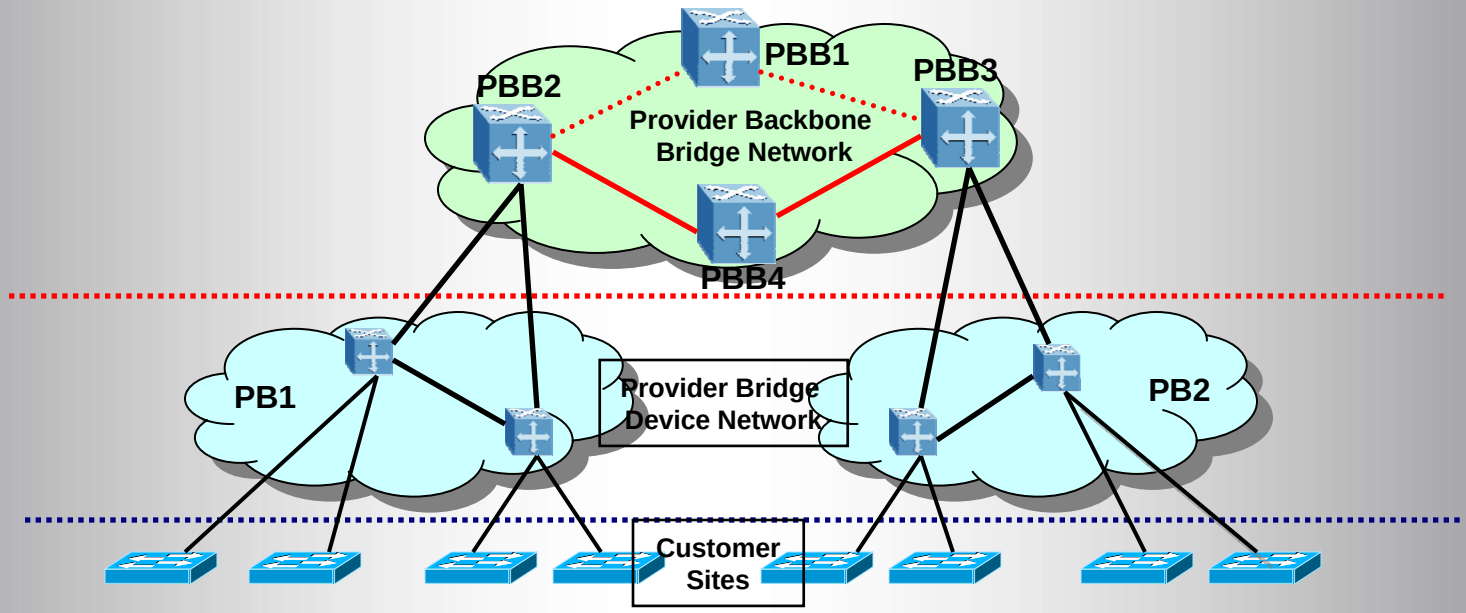
- STP – A Link Management Protocol to Prevent undesirable Loop in the Network
- Spanning Tree Protocols
  - (STP/RSPT)
    - IEEE 802.1D Standard
  - Per VLAN Spanning Tree Protocol (PVST)
    - Maintain STP per VLAN
  - Multiple Spanning Tree Protocol (MSTP)
- Issues
  - Convergence
  - Scalability

Ethernet over MPLS



- Ethernet over MPLS (EoM) uses Tunnel Mechanism to Carry Layer 2 Ethernet Traffic
- EoM Encapsulate MAC Frame in MPLS Packet and Forward across MPLS Network
- For Resiliency use MPLS Protection
- T-MPLS

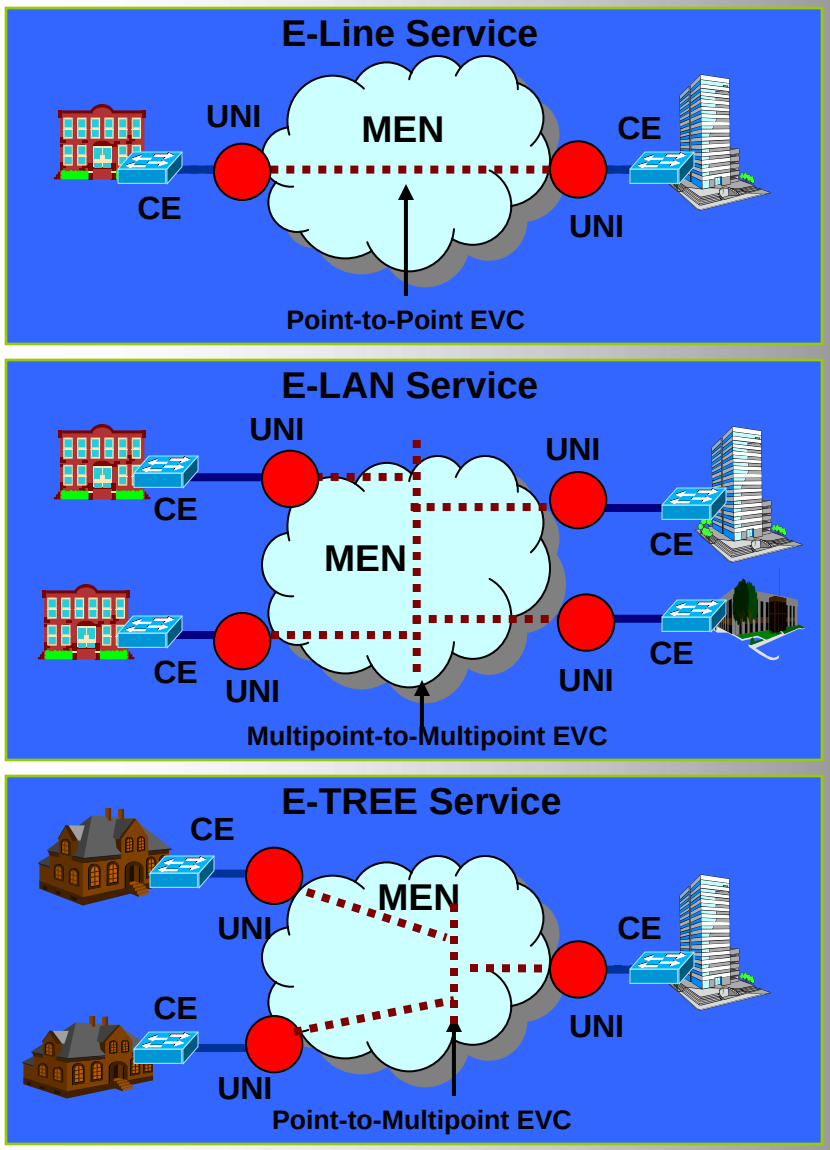
Ethernet PBT/PBB-TE



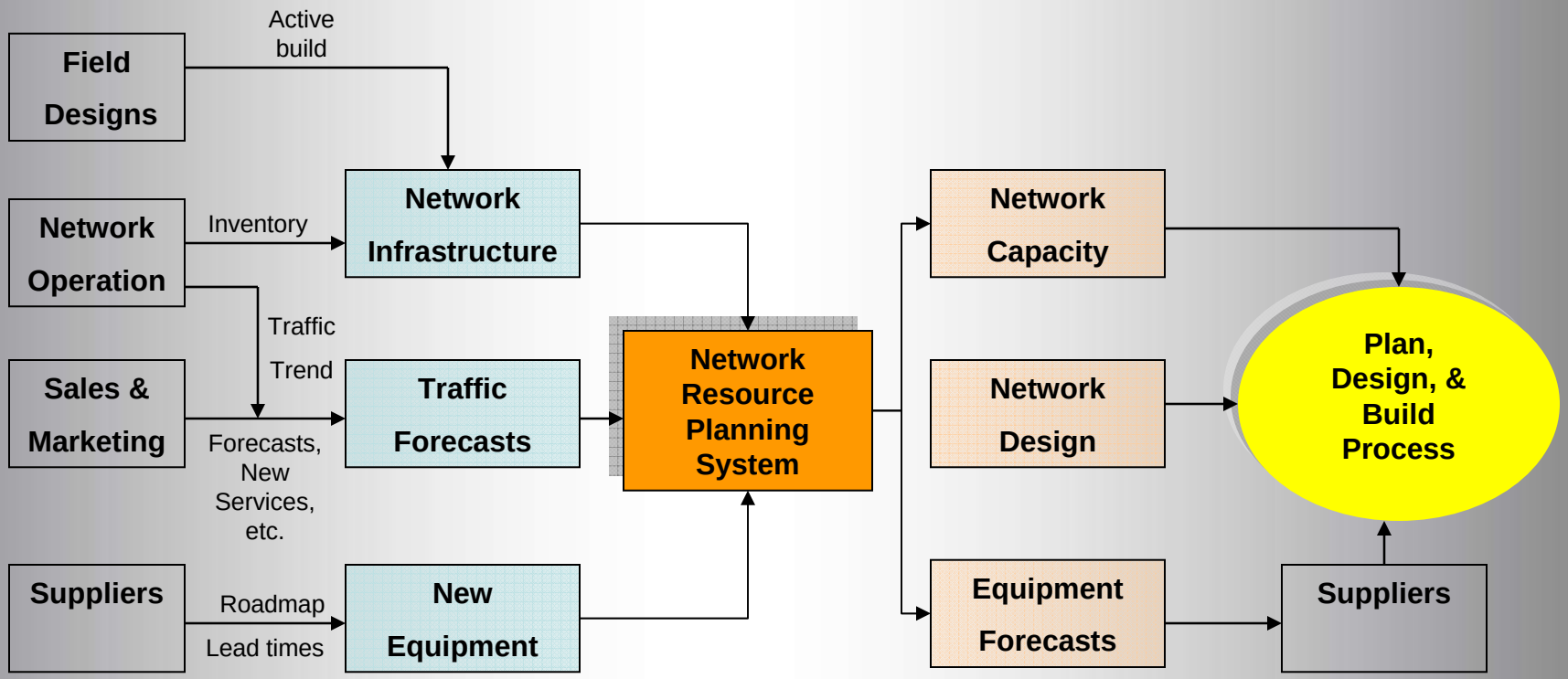
- Ethernet PBT = Deterministic Ethernet
- Distribute Bridging Tables using Control Plane
  - No Spanning Tree
- PBT Trunk can Carry Many Type of Services
- Protection Path

Ethernet Services

- E-Line Service (Pt-to-Pt)
  - Private Line Services
  - Point-to-Point VPNs
- E-LAN Service (Any-to-Any)
  - Multipoint VPNs
- E-TREE Service (Pt-to-Multipoint)
  - Rooted Multicast



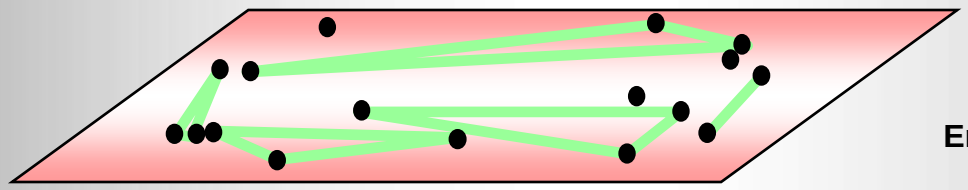
Network Planning Process



Ethernet Network
Planning Challenges

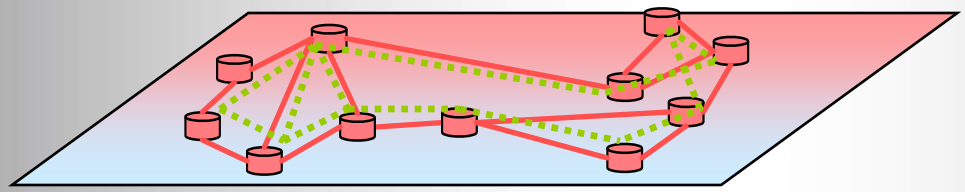
- **Converged service demand (with pt-pt, multi-point, and pt-multipoint services)**
- **Multiple technology deployed and its complexity**
  - **Native Ethernet (Ethernet over SONET/SDH), Ethernet over MPLS, PBT/PBB-TE**
  - **Protocols: STP/RSTP, MSTP, PVST ..**
  - **Equipment functionality and complexity**
- **Issues:**
  - **Accuracy in capturing service demand**
  - **Complexity in configuration set-up and protocol – sub-optimal use of network**
  - **Logical configuration changes – impact on balanced augmentation**
  - **Lack of analysis of network in failure scenario – worst case behavior of network capacity/utilization**
  - **Evolving technologies**
  - **Getting the right cost measure**
- **Consequence**: Sub-optimal network build and augmentation

Ethernet Services and Layers



Ethernet Services

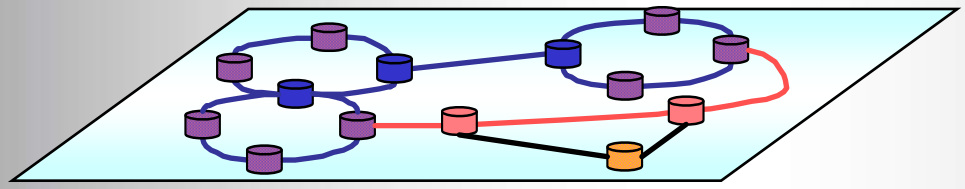
Enabled Service over Ethernet



Ethernet Network

Ethernet Routing & Connectivity

Routing



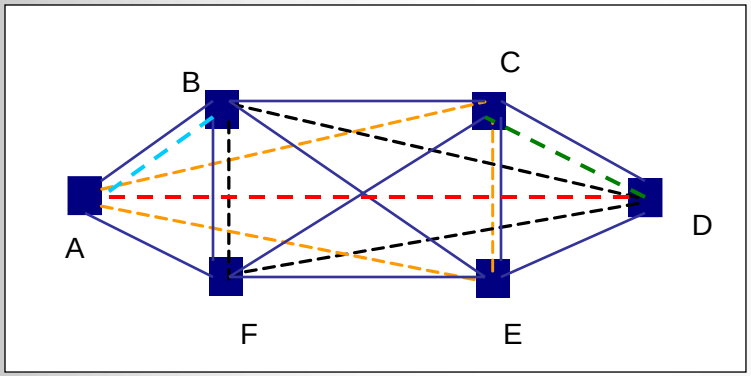
Transport Network

Service Delivery Transport

Planning Native Ethernet Network
Spanning Tree Based

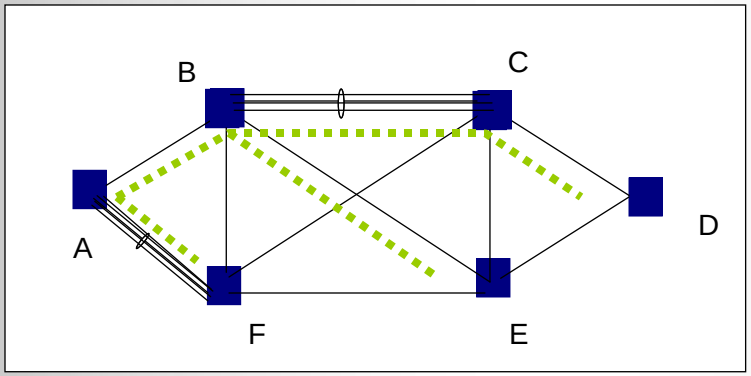
Ethernet Services

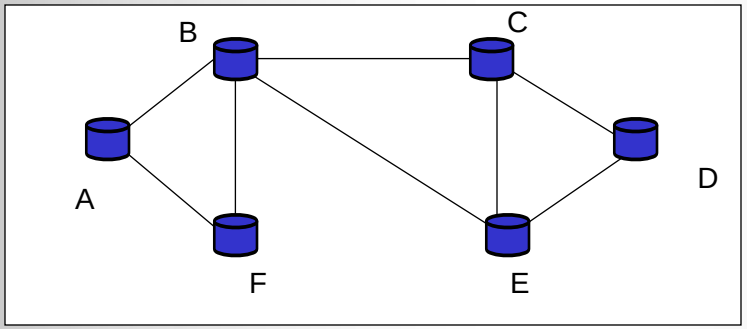
Topology & Config.



Spanning Tree

Augmentation





- Input
  - Service Demand (E-Line, E-LAN with Traffic Profile)
  - Ethernet Network Topology & Logical Configuration
- Routing and Design
  - Traffic Routing (STP/RSTP/PVST/MSTP)
  - Design & Augmentation

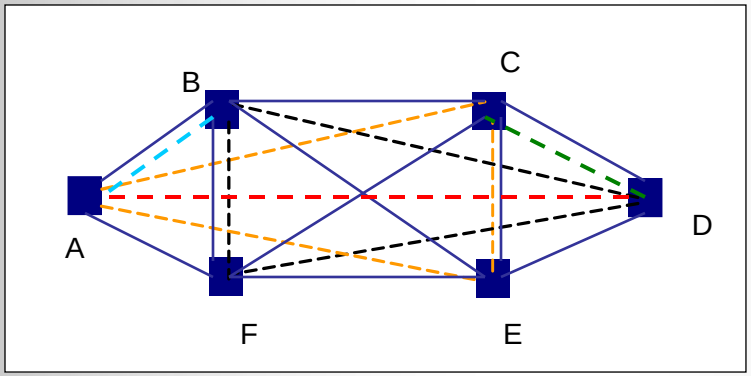
L2 Capacity Demand

- Transport Layer (SONET/SDH/..) Planning
  - VCG

Planning Ethernet over MPLS

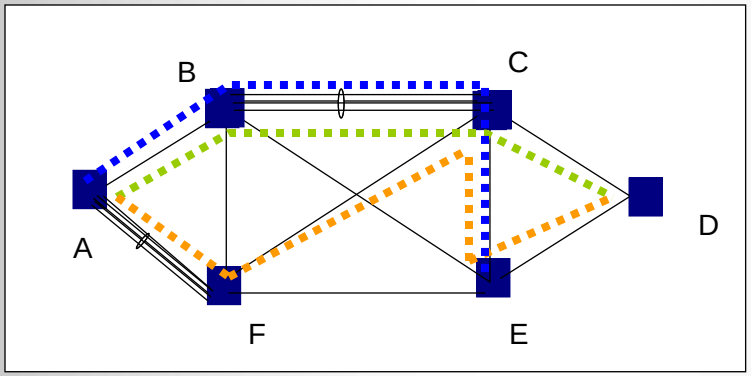
Ethernet Services

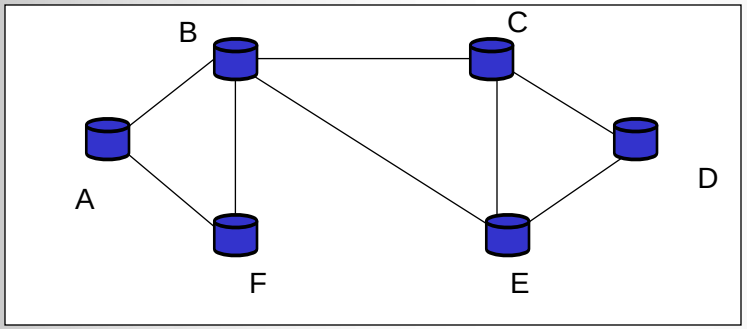
Topology & Config.



Label Switch Paths

Augmentation





- Input
  - Service Demand (E-Line, E-LAN with Traffic Profile)
  - Ethernet Network Topology & Configuration
- Routing and Design
  - Label Switch Path
    - Protection
  - Design & Augmentation

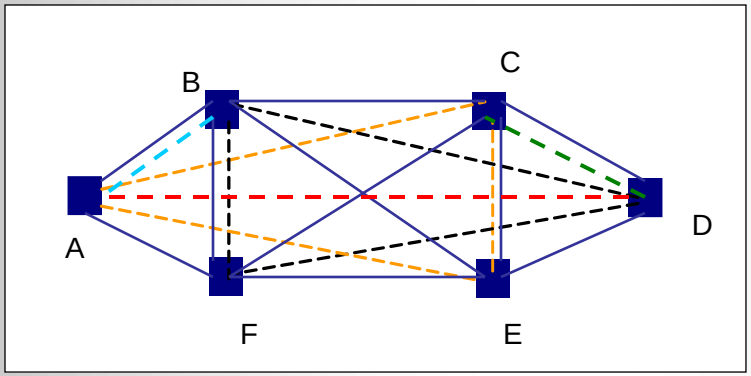
L2 Capacity Demand

- Transport Layer (SONET/SDH/..) Planning

Planning Ethernet PBB-TE

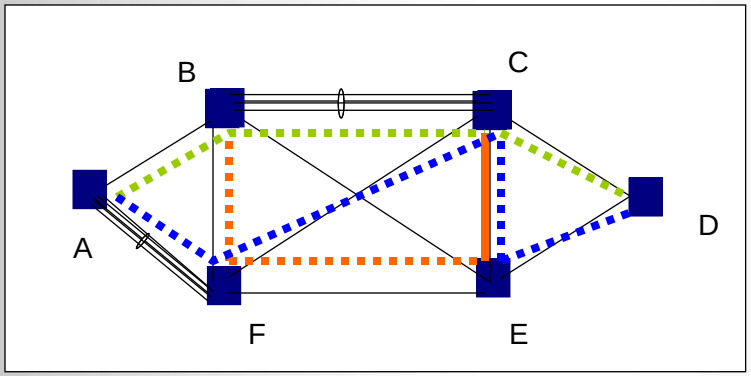
Ethernet Services

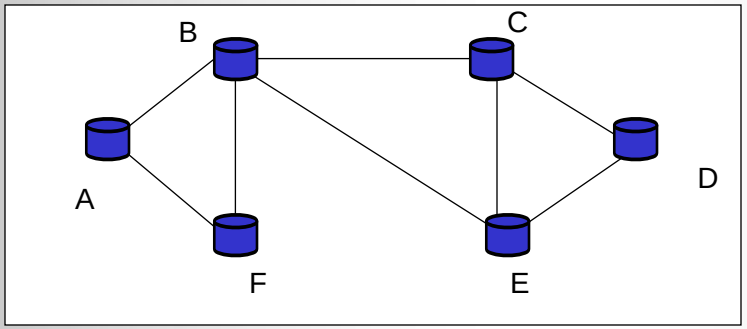
Topology & Config.



PBT Trunk

Augmentation



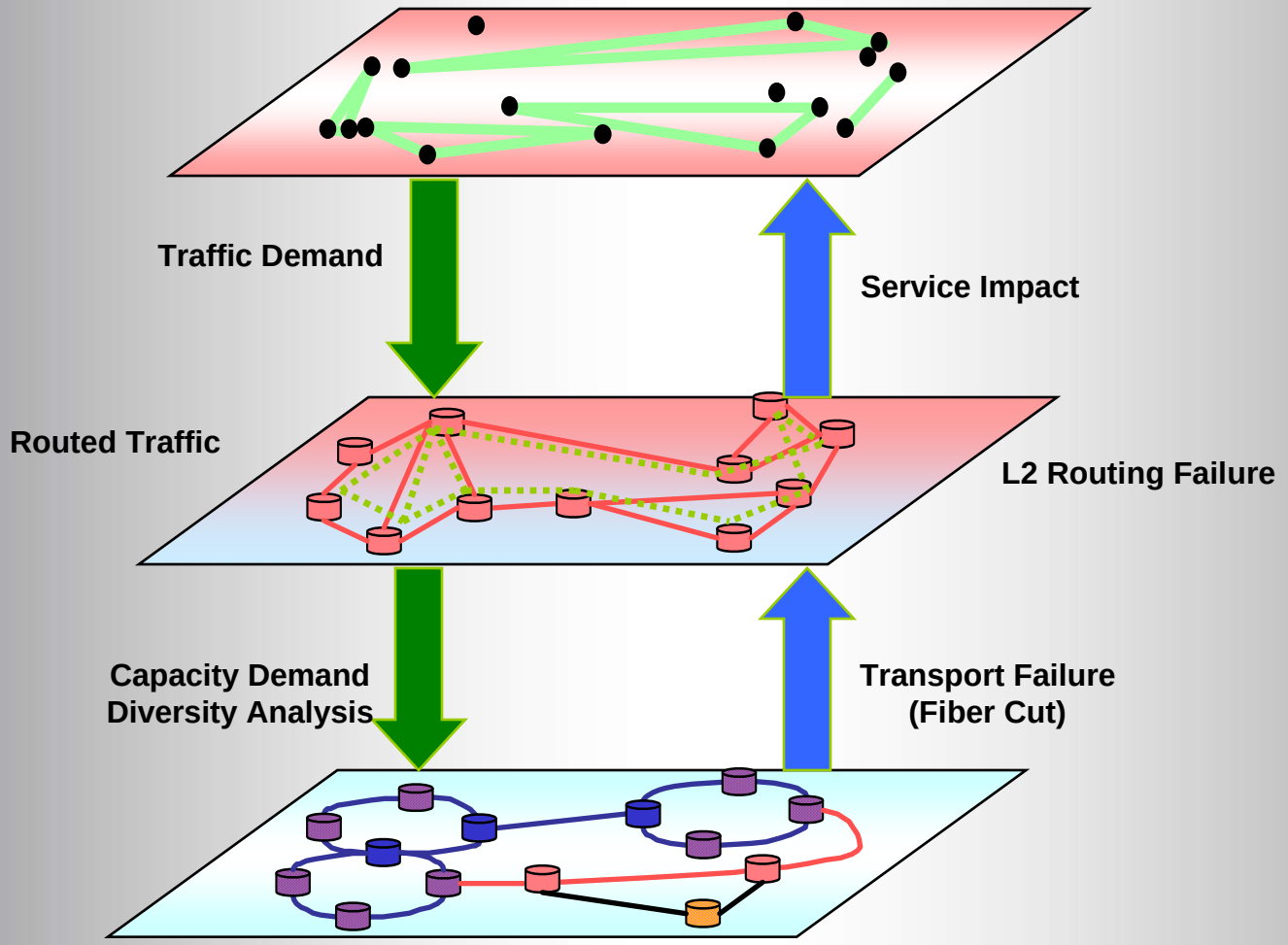


- Input
  - Service Demand (E-Line, E-LAN with Traffic Profile)
  - Ethernet Network Topology & Configuration
- Routing and Design
  - Centralized Path connection (PBT Trunk)
    - Protection
  - Design & Augmentation

L2 Capacity Demand

- Transport Layer (SONET/SDH/..) Planning

Multi-layer Analysis



Ethernet Network Planning System

Solving the Challenge

- Market Driven Network Build-out
  - Based on service forecast and existing infrastructure
- Capacity/Bottleneck Analysis & Augmentation Strategy
  - Equipment Model and Configuration
  - Analyze Potential Capacity Bottleneck and provide Augmentation Strategy
  - LoM (List of Materials) & BoM (Bill of Materials)
  - Equipment forecast
- Multi-layer Failure and Impact analysis
  - Analyze Network Behavior prior to Operation
- Layer Model – Supporting Multiple Technologies
  - Technology & Routing Complexity

Conclusion

- **What we Discussed**
  - Carrier Ethernet Technology Options
  - Ethernet Network Planning Challenges
  - A Layer Approach for Ethernet Network Planning
    - Handle Multiple Technology Options
    - Multi-layer Failure and Diversity Analysis
- **Q & A**

THANK YOU