Next Generation Ethernet

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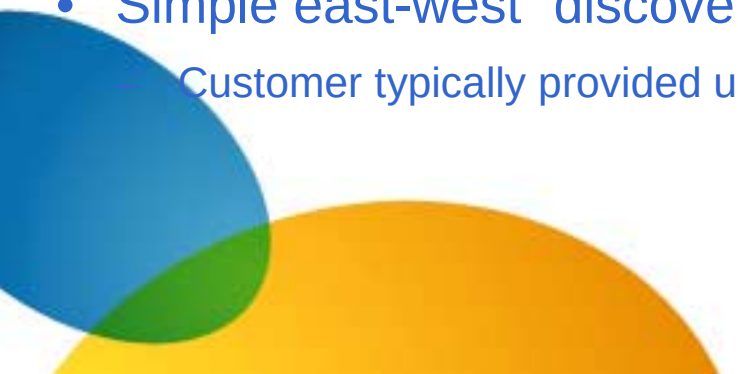
Enterprises

- Enterprises look to scale a single community of interest
  - They are their own customer
    - Which may range in size from a small number of desktops to an international corporate network
- Networks frequently constrained to geographically small and quite dense “islands”
  - Large networks have IT support in close proximity
- Controls on behavior of the community implemented within a single layer
  - Community is in general well behaved
  - IT has access to and control of all network components
- Simple east-west “discovery” sufficient for small networks to operate
  - Customer typically provided unfettered access to network



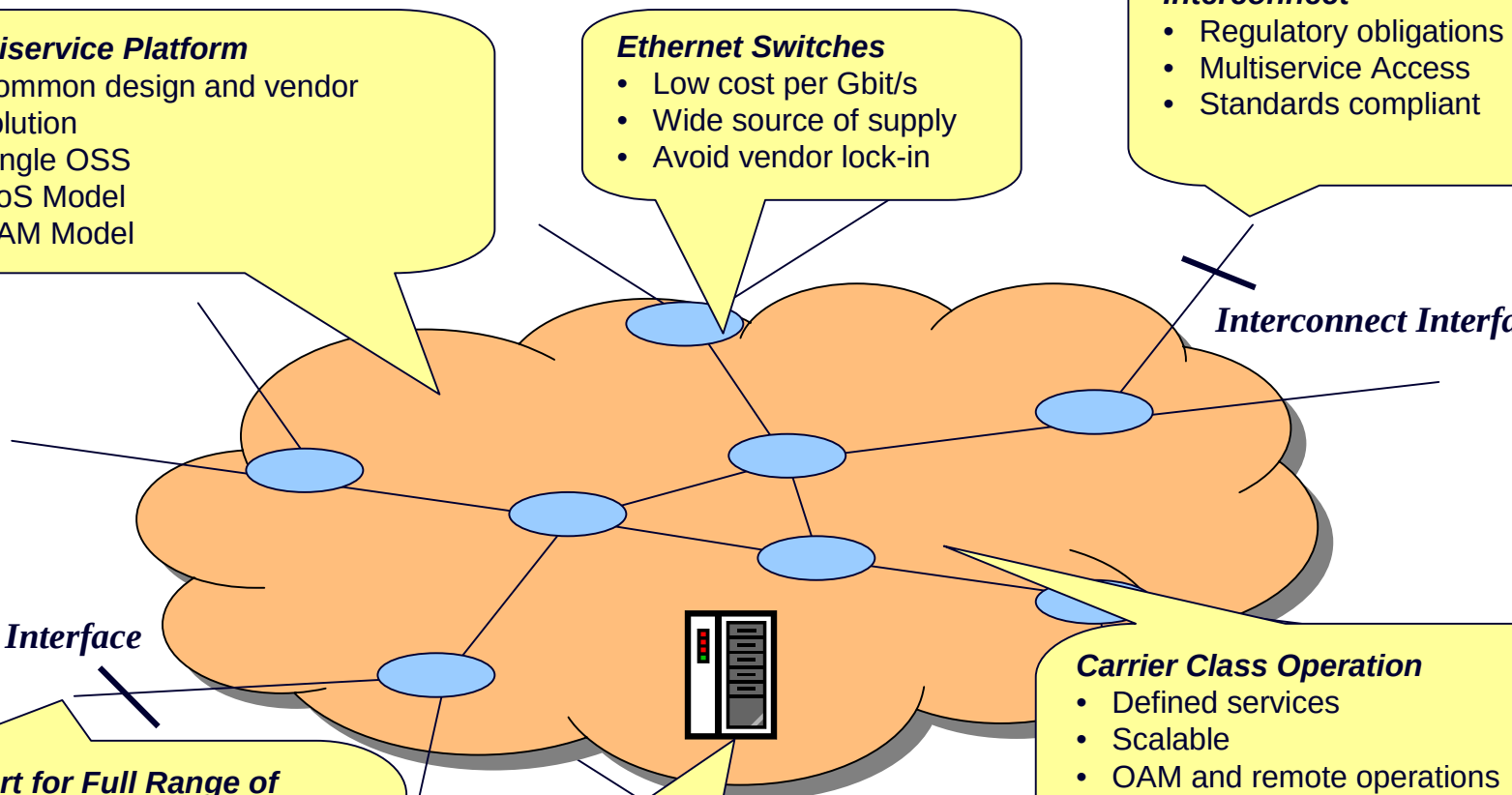
Carriers

- Carriers look to scale many small communities of interest
  - A carrier has many customers
  - “Small” is relative, customer networks can be quite large
- Customers need to be isolated from each other as well as the carrier’s network
  - Both with respect to connectivity, and with respect to resource consumption
  - This requires the carrier partition the network both vertically and horizontally
    - The network cannot have common failure modes
- Equipment rather sparsely geographically distributed
  - Outside plant, unattended offices etc.
  - Support frequently not in close proximity and expensive to dispatch
  - Carrier does not control, nor have access to all network components
    - Complicates addressing malicious or incompetent customers
- Carriers need reliable population of inventory
  - Relationship between carrier inventory and customer access is a business decision
  - Poor data fill for un-automated systems is a major barrier to service fulfillment
  - Nodal discovery, neighbor discovery and population of inventory is a much different problem than that of simple “east-west” flooding

Drive to commonality between Carriers and Enterprise

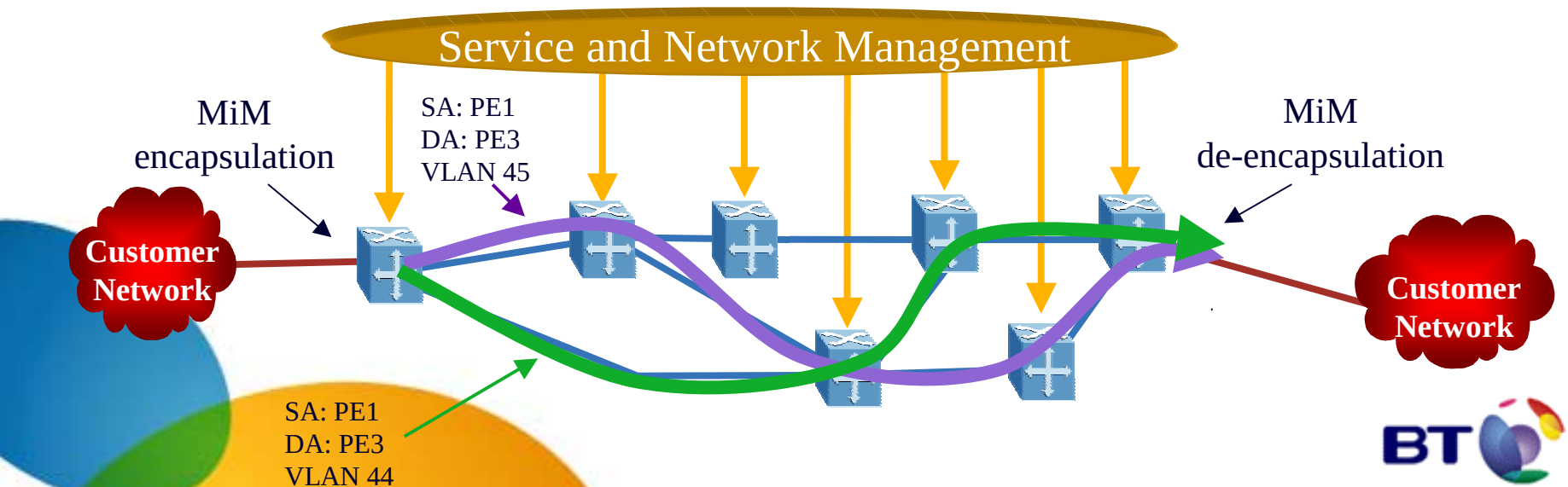
- Reach of optics
  - No dependency on line systems for reach in the LAN and MAN
- Leveraging economies of scale
  - Evolving to a common technology base
- Enterprise kit gradually gaining carrier functionality
  - Dataplane and management tools
- Ethernet
  - Ubiquity in Enterprise & the home
    - Wireless, LAN, MAN, WAN
  - Introduction of Ethernet Services (E-Line, E-LAN, E-VLAN,…..)
  - Interface of choice for many

General Requirements



PBT As A Carrier Grade Solution

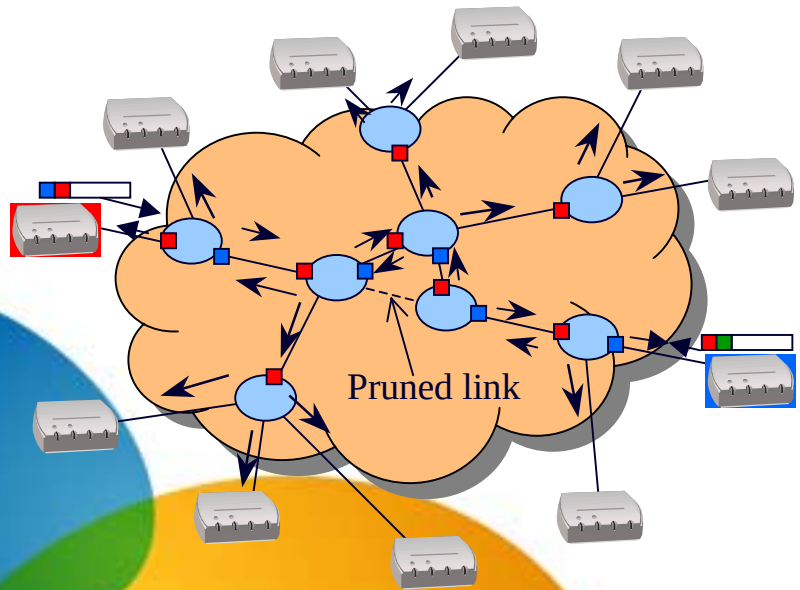
- Turn off MAC learning, Broadcast Unknown and STP
  - Use MAC-in-MAC hierarchy to separate customers from the carrier network,
  - and add hierarchical dataplane OAM for instrumentation and protection.
- Place under a Carrier-grade Management system
  - and introduce auto-discovery within the carrier network itself
- Management sets up connections, populating switch bridging tables :
  - Flows are separated using VLAN tags, which allows traffic management.
  - Tags **not** swapped, only significant per destination (not a scaling limitation)



Comparing Bridge Learning and PBT

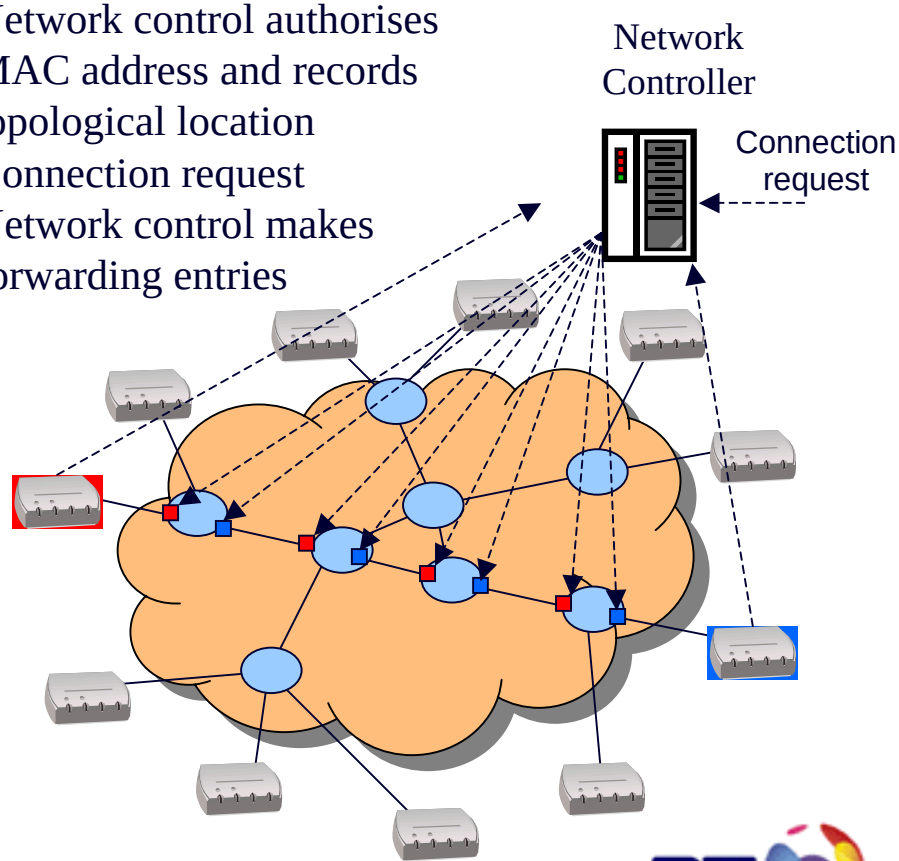
Bridge Learning

1. Spanning Tree Protocol prunes links to logical tree
2. Broadcast unknown destination address (blue) and learn port of unknown source address (red)
3. Forward to learnt destination address (red) learn port of unknown source address (blue)



PBT

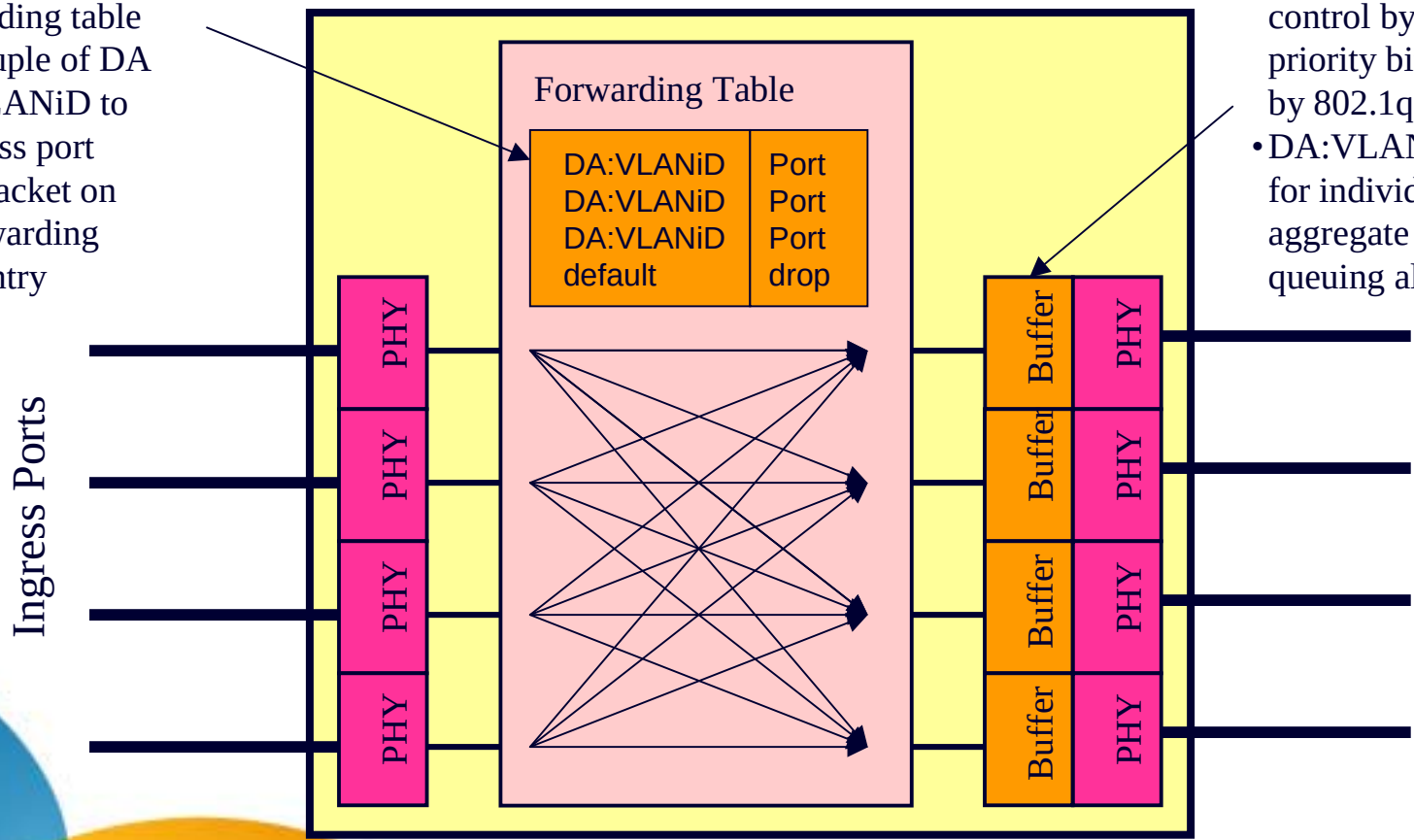
1. End points register MAC addresses with network control
2. Network control authorises MAC address and records topological location
3. Connection request
4. Network control makes forwarding entries



Forwarding Mode

- External population of forwarding table
- Forwarding table maps tuple of DA and VLANiD to an egress port
- Drop packet on no forwarding table entry

- Wide variety of buffering algorithms implemented by vendors
- 8 level priority queue control by VLAN priority bits required by 802.1q
- DA:VLAN available for individual flow or aggregate flow queuing algorithms

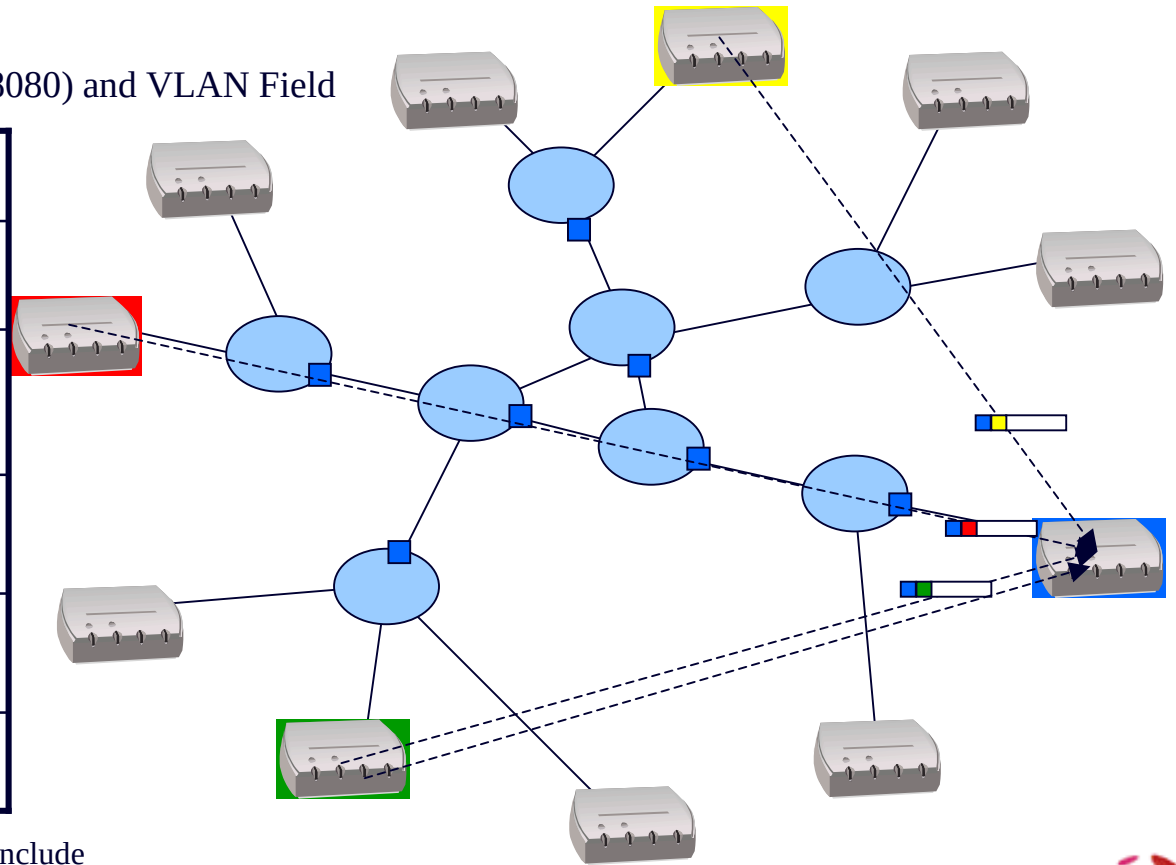


Transport Service Types

DA (6)	SA (6)	VLAN* (4)	ET/Len (2 or 4)	payload

*VLAN header is VLAN Ethertype (8080) and VLAN Field

Header Field	***Meaning in PBT***
Destination MAC Address (48 bits)	Provider unique label of destination
Source MAC Address (48 bits)	Provider unique label of source and (de-)multiplex label
VLAN Id (VLAN header) (12 bits)	Route/path/trail discriminator*
Priority (VLAN Header) (3 bits)	Forwarding priority marking
Ethertype (ET) (16 bits)	Protocol in payload



* Uses of the VLANId route discriminator include

- Distinguishing separated paths for protection
- Traffic engineering
- Multiplexing multiple channels between two end points

Conclusions

- Enterprise and Carrier worlds are colliding
  - Lots of commonalities but there are also big differences
  - Enterprise wants plug and play
  - Carriers require determinism
- Hierarchy and encapsulation allow both to exist
  - Mac-in-Mac from IEEE provides scalable solution
- PBT is an example of a technology that achieves this