Bridging Solution for the MAN: Service Separation

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Problem Context

- An Ethernet Service Provider supplies Ethernet Layer 2 services among customer sites

- IETF's Provider Provisioned Virtual Private Networks (PPVPN) WG is defining L2-VPNs
  - PPVPN drafts do not assume that bridges, as defined by 802.1, are essential to providing the service
  - They assume that devices which learn MAC addresses and forward packets based on that learned information are essential, but these are not bridges

- How can bridges supply these services?

Objective

- Proposal of an Ethernet bridging solution for the MAN

    - Carrier service separation

- Solution alignment with 802 and 802.1 Architecture

- Solution interworking with MPLS/IP/EoS network

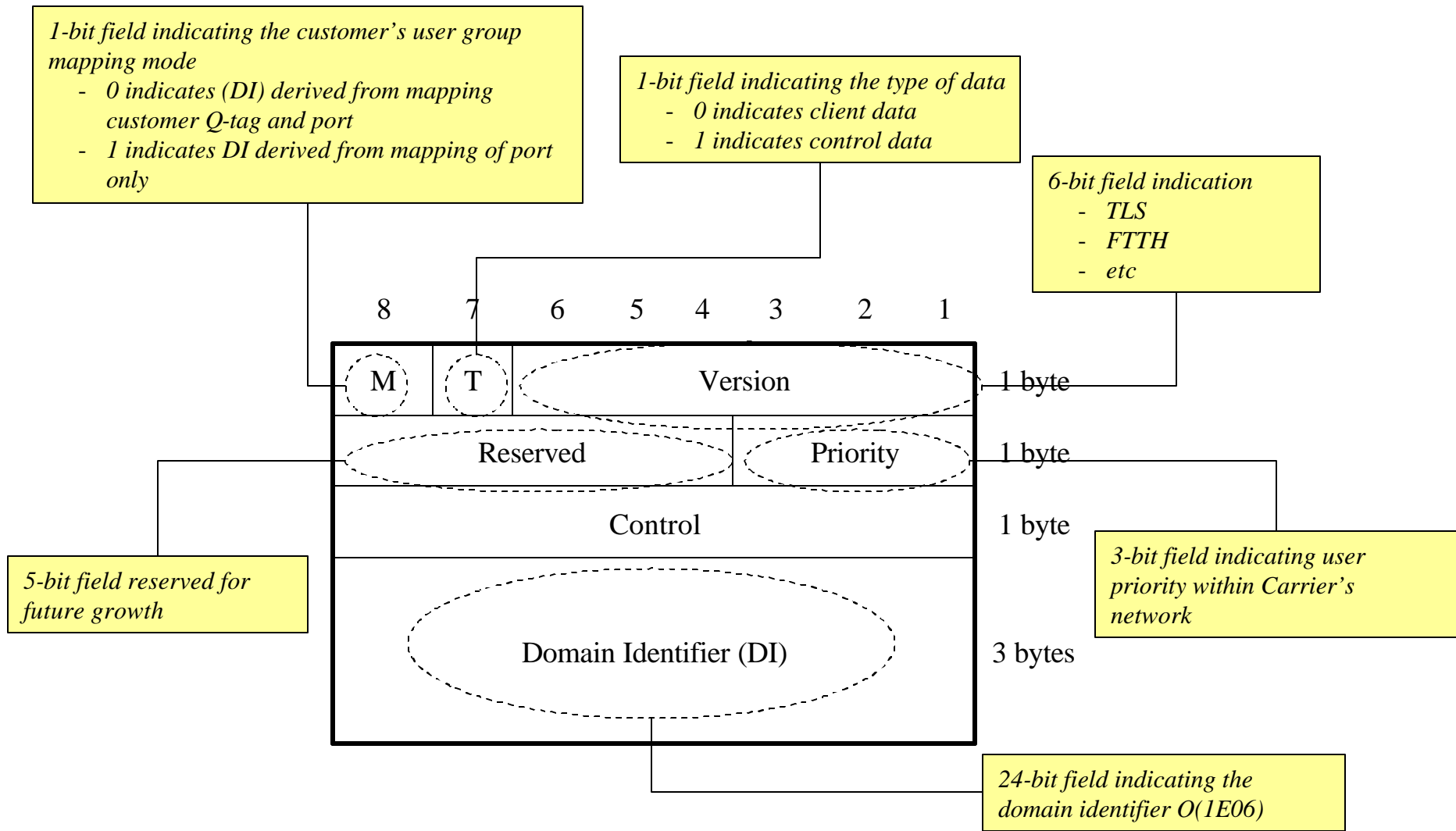# Carrier Grade Ethernet: Part II – Service Separation

Carrier Service Identifier

- A service instance represents a set of customer sites participating in a service

  - Forms a closed user group within the carrier's network

- A carrier's network can support multiple service instances

  - O(1E03) to O(1E06)

- Service identification is achieved by tagging the customer packet with a Carrier grade tag

Carrier Service Identification Tag

- Q-tag could provide 12 bits (4094) of domain identification. However

  - VLAN encapsulation is not currently a standard

  - 12 bits of domain identification does not support range partitioning in a way which allows a service provider to properly assign different layer 2 segments to more than 4K clients (especially in the context of a typical FTTH EFM deployment or TLS deployment)

- Define a service indicator tag with a space greater than 4K that can support realizable FTTH, TLS, etc deployments

Example Carrier Service ID Tag

1-bit field indicating the customer's user group mapping mode
- 0 indicates (DI) derived from mapping customer Q-tag and port
- 1 indicates DI derived from mapping of port only

1-bit field indicating the type of data
- 0 indicates client data
- 1 indicates control data

6-bit field indication
- TLS
- FTTH
- etc

8	7	6	5	4	3	2	1	
M	T	Version						1 byte
Reserved				Priority				1 byte
Control								1 byte
Domain Identifier (DI)								3 bytes

5-bit field reserved for future growth

3-bit field indicating user priority within Carrier's network

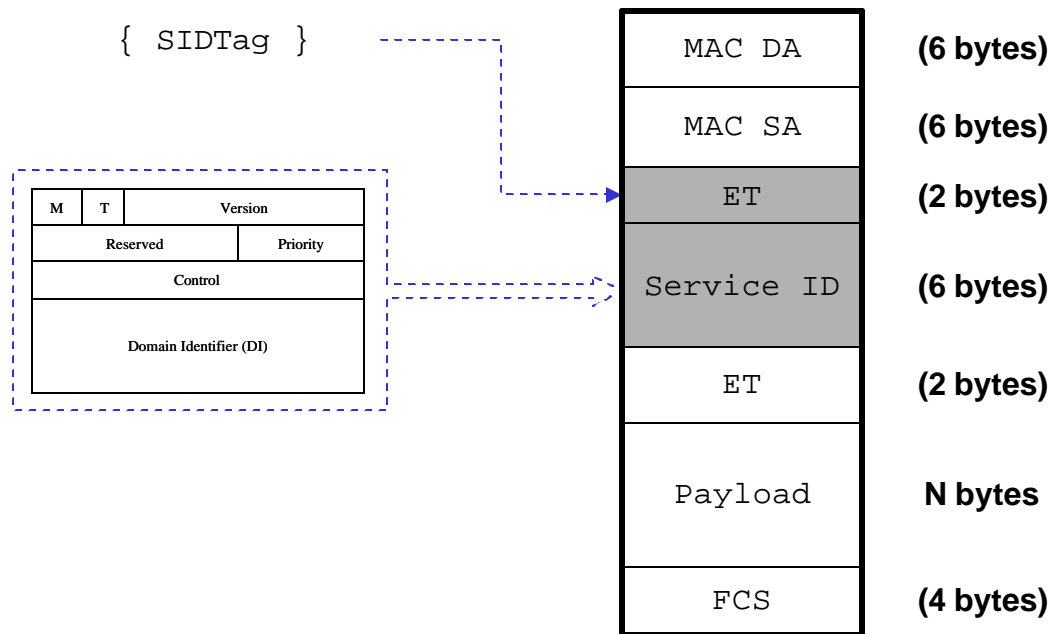24-bit field indicating the domain identifier O(1E06)

Carrier Service Tag Value Proposition

- Allows service providers to realize scalable Service identification within an IEEE 802 network
  - Does not require higher layer technologies to scale IEEE 802 solution
  - Removes dependency on higher layer protocols for VPN resolution

- Independence from control plane
  - No requirement for end-to-end control plane
  - Supports multiple networks running disparate control planes

- Enables cheap access devices that need not run complex protocols

802 Frame Format

- Use the EtherType (ET) field to indicate that a frame contains a Carrier service identification tag
  - Additional ET value is being proposed
  - New value that is being considered is `SIDTag`

{ SIDTag }		

	M	T	Version
	Reserved		Priority
	Control		
	Domain Identifier (DI)		

MAC DA	(6 bytes)
MAC SA	(6 bytes)
ET	(2 bytes)
Service ID	(6 bytes)
ET	(2 bytes)
Payload	N bytes
FCS	(4 bytes)

Carrier Grade Ethernet: Service Provider Network Applicability

Approach

- Build on top of Norm's "Bridge Based Ethernet Provisioned" proposal (rev 2.0)

- Use same reference model; concepts of Islands, Inter-Island Trunks, and Service Instances

Enlarging Provider Networks

• Same direction as Norm

• *Many* techniques have been implemented, and even more discussed, to expand the size of a bridged network.

— Separate spanning trees at edges which run on top of central spanning tree.

— Running two disconnected spanning trees in one bridge.

— Substituting hop count for Max Age in Rapid Spanning Tree. (Standardized by 802.1y: 64k hops allowed across network!)

— Enforce topology restrictions by some non-spanning tree means.

• We will look at just one: Topology restrictions.

— This also promises to interact well with the IETF solution(s).

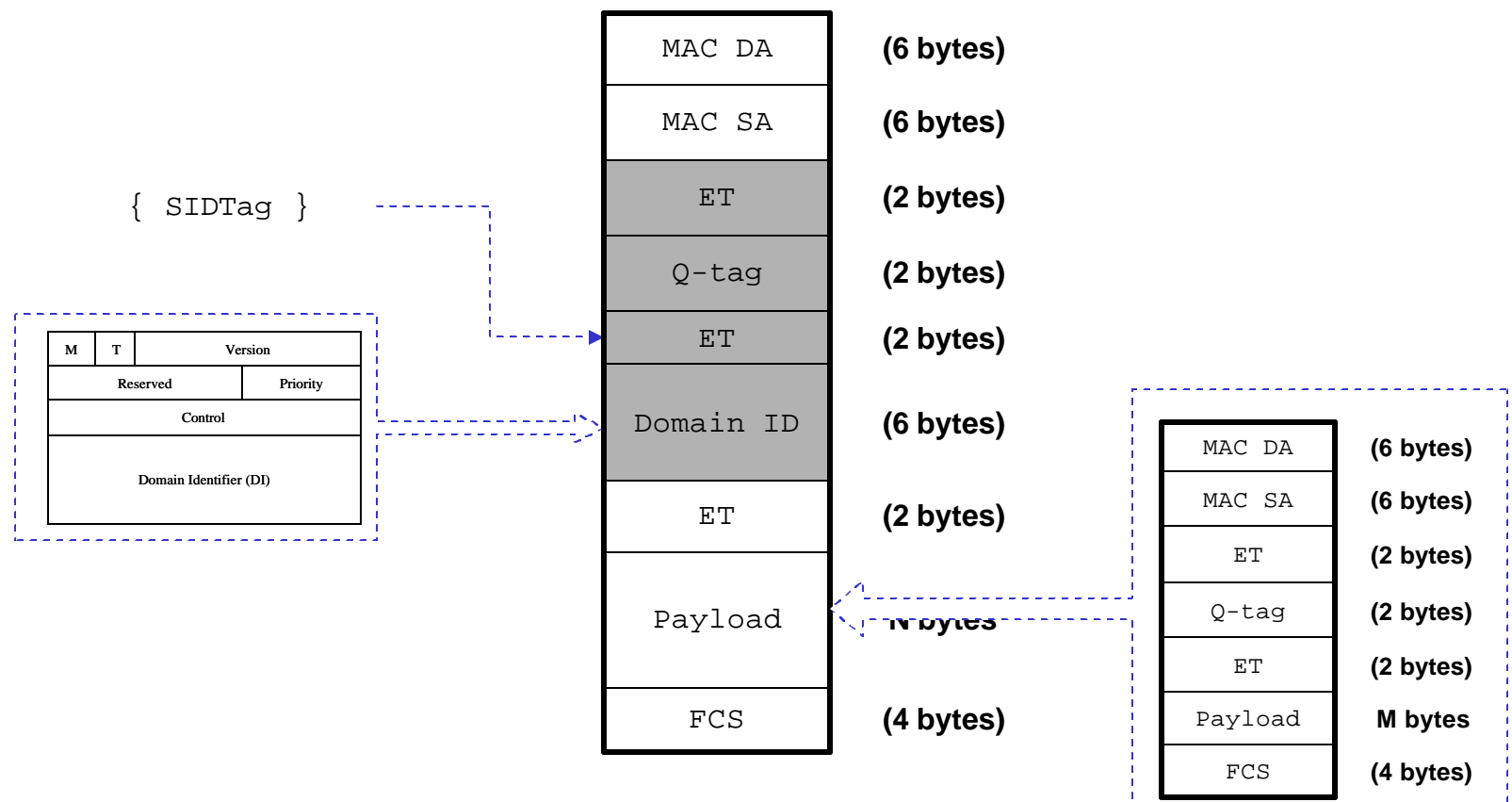# Service Instance, Islands and Inter-Island Trunks

- Same terminology used by Norm; subtle difference in definition however

    - A "Service Instance" is the carrier analog of a VLAN in an 802.1Q enterprise network
        - It is uniquely identified by the domain identifier in the domain tag
        - It can uniquely identify the Service provided by the Service Provider's network

    - The provider network carriers "Service Instances" via "Islands" connected by "Inter-Island Trunks"

    - Islands
        - An Island consists of one or more bridges connected by normal LAN segments and/or Inter-island Trunks
        - Different Islands must be connect only via Inter-Island Trunks

802 Specification Impacts – Step (1)

- Use service provider Q-tag along with Service ID tag within each island

  - Provider Q-tag dictates the connectivity associated with customer sites within an Island
    - Provider Q-tag is localized to an Island

  - Carrier service ID tag used to denote the service instance
    - Carrier service ID tag can be localized to an Island or can be used ubiquitously across Service Provider network (includes Islands and Inter-Island Trunking network)

802 Specification Impacts – Step (1)

- Outer Q-tag used by interior bridging devices to forward traffic and support Spanning Tree specifications within Islands

{ SIDTag }

M	T	Version
Reserved		Priority
Control		
Domain Identifier (DI)		

MAC DA	**(6 bytes)**
MAC SA	**(6 bytes)**
ET	**(2 bytes)**
Q-tag	**(2 bytes)**
ET	**(2 bytes)**
Domain ID	**(6 bytes)**
ET	**(2 bytes)**
Payload	**N bytes**
FCS	**(4 bytes)**

MAC DA	**(6 bytes)**
MAC SA	**(6 bytes)**
ET	**(2 bytes)**
Q-tag	**(2 bytes)**
ET	**(2 bytes)**
Payload	**M bytes**
FCS	**(4 bytes)**

Additional Value Proposition

- Full transparency is possible since carrier network elements do not have to deal with any flow identification process involving customer supplied information of any type

- End-to-end service identification is possible since the service tag can span the "Islands" and island inter-connecting network (e.g., IP, MPLS, etc.);

    - Minimizing service provider end-to-end service management costs

    - Facilitates end-to-end service management/control functions

Inter-Island Trunks

• Same as Norm with 1 notable exception:

- Inter-Island Trunks
  — An Inter-Island Trunk behaves, logically, like a Shared Medium LAN segment.
  — Among different Islands, a given Service Instance is carried over, at most, one Inter-Island Trunk.
  — The identification of a SI on an Inter-Island Trunk is dependent on the medium, e.g. Ethernet, or emulated Ethernet over layer 3 tunnels.
  — Any bridge port connected to an Inter-Island Trunk must make 1:1 translations between the P-VLAN IDs used within the bridge's Island and the SI identifiers used on the IIT.
- These rules prevent SI loops among Islands.
- Spanning trees prevent SI loops within an Island.

- Any bridge port connected to an Inter-Island Trunk must make 1:1 translations between the service identifier used on the Inter-Island Trunk

SIs, Islands, and IITs
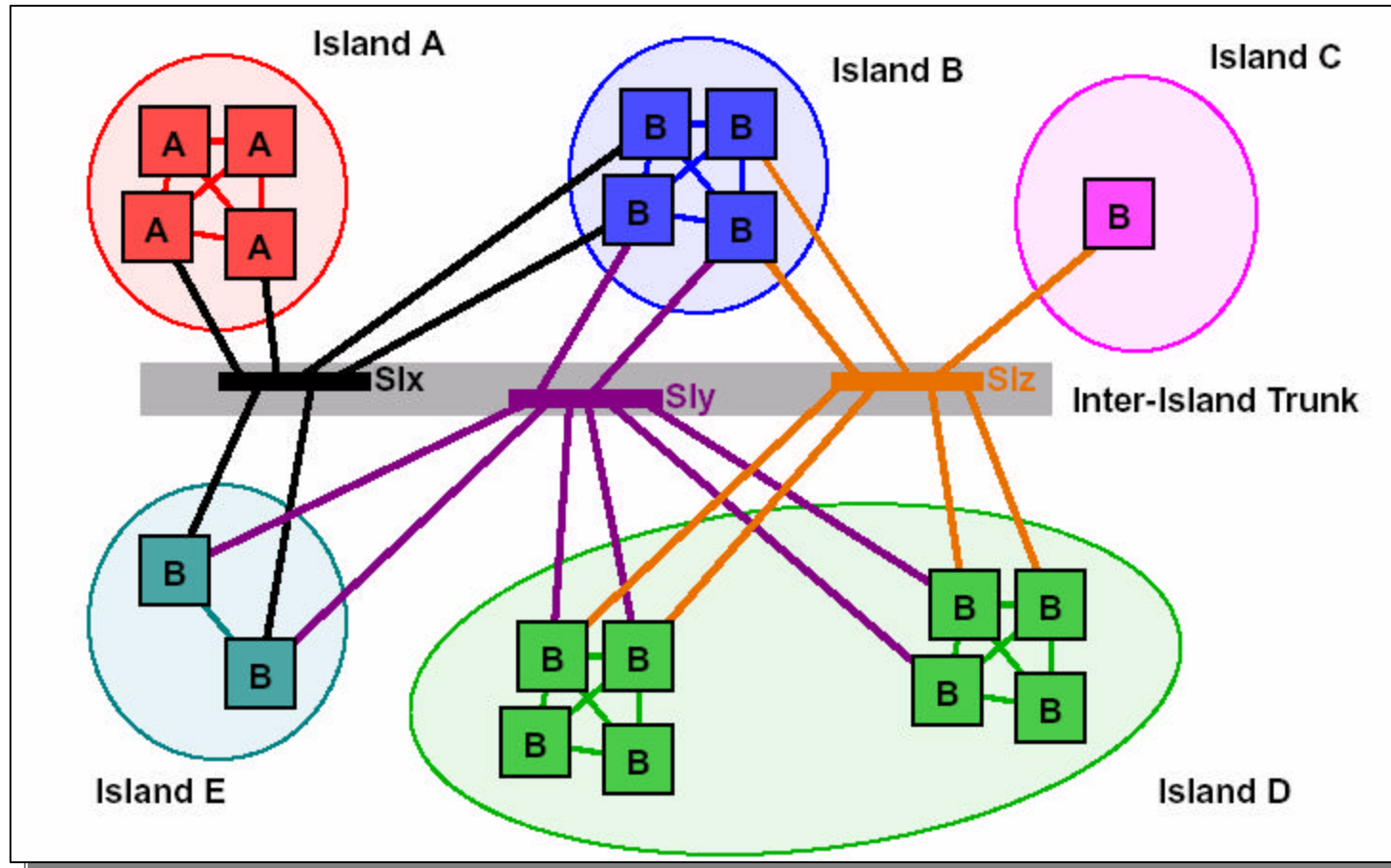
Interconnecting Islands

- ## Same direction as Norm

- **A separate MSTP Service Instance per Island carries MSTP BPDUs.**

  — **Bridges in the same Island interchange BPDUs and guarantee that, for any given frame on a P-VLAN, only one copy will be transmitted to the Inter-Island Trunk.**

  — **Similarly, by interchanging BPDUs, the bridges can guarantee that a frame on an Inter-Island Trunk will be delivered, at most, once to any LAN segment within the Island.**

  — **Since we are guaranteed (See Slide 51) that no SI exists on more than one Inter-Island Trunk, and that there are no back doors, failing to receive the BPDUs from bridges in other Islands cannot cause a loop, but does manage to limit the size of any one Spanning Tree Instance.**

- The outer tag (e.g., P-VLAN) is used to identify the connectivity between the PEBs and IIT per Island

Interconnection Islands and Topology Change Notification

- Same direction as Norm

- **A new Topology Change Notice is required.**
  - — Islands may have completely different MSTP configurations.
  - — Forgetting all addresses is too much, but we must forget some.
  - — The other "Island" may, in fact, be an IETF implementation.
  - — This new Topology Change Notice must signal topology changes based on Service Instance (Inter-Island Trunk).

Interconnection Islands Example
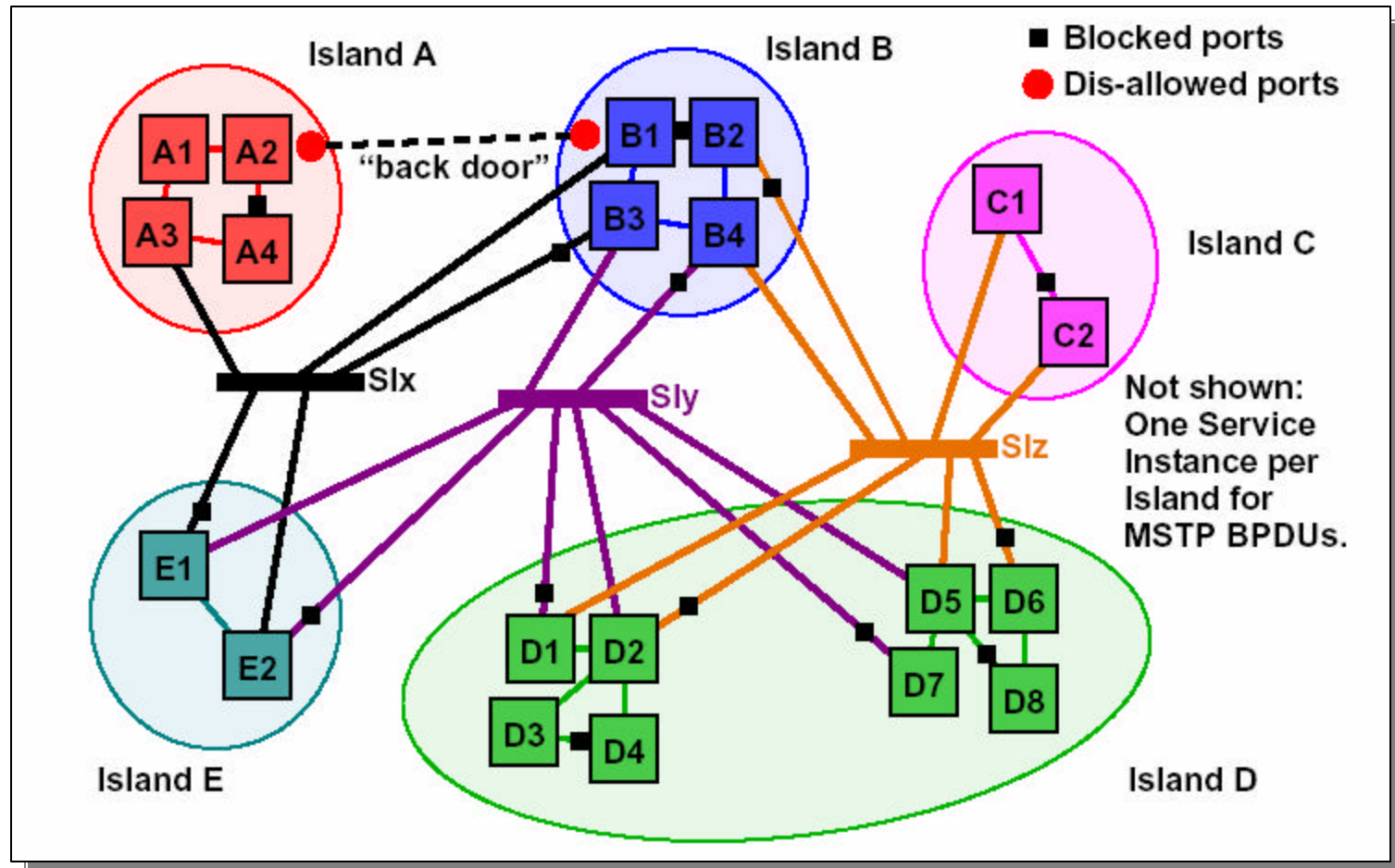
Observations

- Service identifier can uniquely identify the Service across the Service Provider's network

- The Service Provider's network can support O(1E06) services

- Islands can be composed of hierarchy bridges at the edge and transparent bridges* at the interior. Consequently, the Service Provider's interior devices per Island scale with the Service Providers network elements. In general, Islands have greater scaling properties

- Interworking with inter-island networks (e.g., IP, MPLS, Ethernet, etc.) can be supported using the service identifier tag

- Specification impact can be limited to the introduction of a service identifier tag