Address Scopes

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This note reviews address scoping and its use in 802.1 standards, and documents the proposed additional address scopes for P802.1AEcg (Ethernet Data Encryption devices).

Table 1 summarizes the filtering of reserved destination group addresses by C-VLAN, MAC Bridge, S-VLAN, and TPMR components specified in 802.1Q-2014 Tables 8-1, 8-2, and 8-3. Figure 1 looks at the same information from the point of view of a port transmitting a frame—which other bridge types does the frame reach, and which of these relay the frame. Figure 2 looks at it from the point of view of peer protocol entities—which address(es) might be used to communicate between entities associated with ports of the same bridge type.

Table 1—Reserved Address filtering

Address assignment	Address value	MAC Bridge & C-VLAN components (Customer Bridges, PEB w/multiple PEPs[1])	PEB C-VLAN components w/ single PEP[1]	S-VLAN components (Provider Bridges, Provider Backbone Bridges, PEBs)	TPMR components
Bridge Group Address, Nearest Customer Bridge group address	01-80-C2-00-00-00	Y[2]			
IEEE MAC-specific Control Protocols group address[3]	01-80-C2-00-00-01	Y	Y	Y	Y
IEEE 802.3 Slow_Protocols_Multicast address	01-80-C2-00-00-02	Y	Y	Y	Y
Nearest non-TPMR Bridge group address, IEEE Std 802.1X PAE address[4]	01-80-C2-00-00-03	Y	Y	Y	
IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-04	Y	Y	Y	Y
Reserved for future standardization	01-80-C2-00-00-05	Y	Y	Y	
Reserved for future standardization	01-80-C2-00-00-06	Y	Y	Y	
Metro Ethernet Forum ELMI protocol group address[5]	01-80-C2-00-00-07	Y	Y	Y	
Provider Bridge Group Address	01-80-C2-00-00-08	Y	Y	Y	
Reserved for future standardization	01-80-C2-00-00-09	Y	Y	Y	
Reserved for future standardization	01-80-C2-00-00-0A	Y	Y	Y	
Reserved for future standardization	01-80-C2-00-00-0B	Y	Y		
Reserved for future standardization	01-80-C2-00-00-0C	Y	Y		
Provider Bridge MVRP Address	01-80-C2-00-00-0D	Y	Y	[6]	
Individual LAN Scope group address, Nearest Bridge group address[7,8]	01-80-C2-00-00-0E	Y	Y	Y	Y
Reserved for future standardization	01-80-C2-00-00-0F	Y	Y		

[1]A PEB's C-VLAN component has a single Customer Edge Port, if it has multiple PEPs it supports more than one provider network service instance.
[2]Y indicates, Yes, this address is filtered by the compoenent.
[3]Assigned to 'Clause 31 (MAC Control) of IEEE Std 802.3' in 802.1Q-2005, and to 'IEEE Std 802.3, 1998 Edition, Full Duplex PAUSE operation' in 802.1Q-2003.
[4]This address was identified as the 802.1X PAE address in IEEE 802.1Q-2003 and 802.1Q-2005, that name is still used in IEEE 802.1X-2010.
[5]This address is not exclusively reserved for this purpose; other uses are reserved for future standardization.
[6].This address is filtered by S-VLAN components supporting MVRP
[7]It is intended that no IEEE 802.1 relay device will be defined that will forward frames that carry this destination address.
[8]This address was identified IEEE Std. 802.1AB Link Layer Discovery Protocol multicast address in 802.1Q-2005. IEEE 802.1AB now discusses its use in multiple scopes.

A 'from first principles' look at the use of reserved addresses in a sub-layered network architecture follows. Finally Table 2, Figure 3, and Figure 4, show the proposed use of reserved addresses with EDEs (P802.1AEcg Ethernet Data Encryption devices) as discussed in the September 2015 802.1 interim meeting (see ae-seaman-ede-reserved-addresses-1115-v03.pdf and ae-seaman-ede-interop-1115-v05.pdf for additional detail and rationale, these updated documents also improve and correct the presentation of some details).

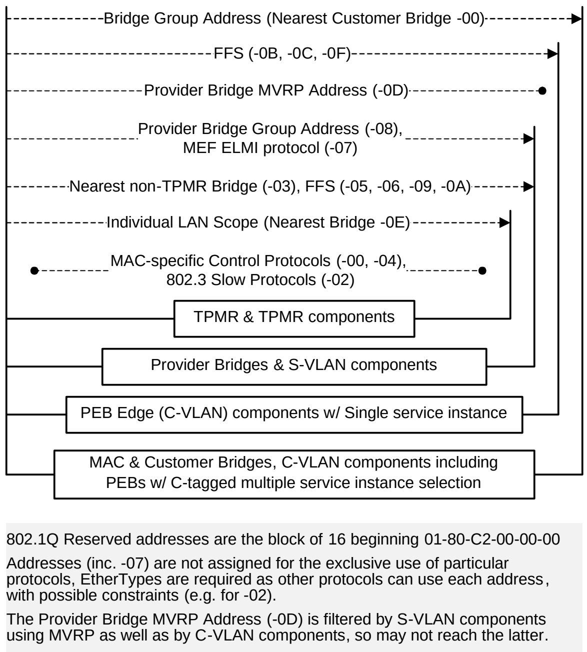

Figure 1—Reserved address scopes

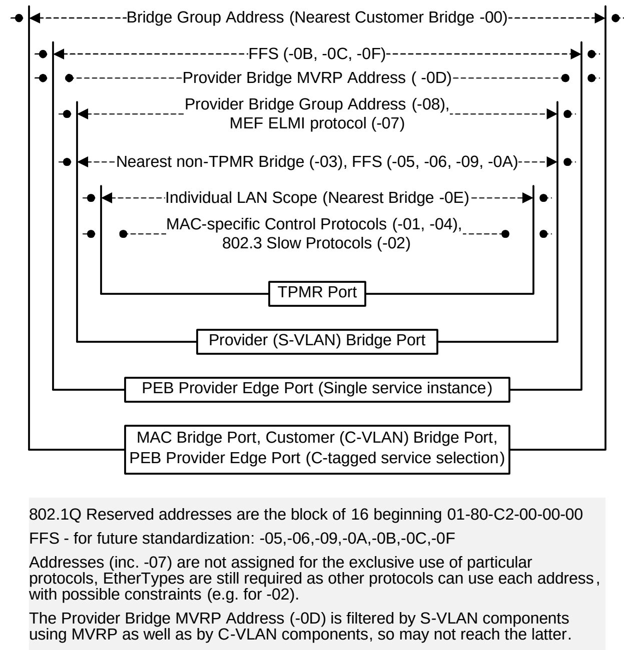

Figure 2—Bridge ports and reserved addresses

1. Background

The OSI Reference Model introduced the valuable notion of a service as a description of the interaction between two or more communicating participants that focuses on primitives (the notionally indivisible actions and events) that express the interaction between the users of the service and its provider, and on the parameters associated with each primitive. Primitives are naturally paired, a request (for example) made by one user of the service results (with reasonable probability) in an indication at one or more other peer users - that is to say users of the same service. In its purest form, the reference model requires that the parameters delivered by the service with an indication have the same values as those associated with the original request.

Services defined in this way facilitate the definition of user protocols. Their state machines and associated procedures can be specified in terms of the primitives and parameters, and the semantics of the latter are well known and unmodified by the service provider. Equally the mechanics of service provision, which may vary between providers of the same service, can be ignored in the user protocol specification unless they significantly impact the quality of the service; as can issues that are purely local to one service user or another.

The Reference Model, as originally conceived, made little provision for the definition of relaying devices. In a sense they did not need to appear. Routers were part of the internal operation of network layer, not of the end to end service it provided. Only when paying attention to network layer operation was an internal service was needed[1]. This provided the basis for the development of the 802.1 Internal Sublayer Service (ISS) and EISS, each adding parameters to the MAC Service. The relays (bridges) on a path between peer users of the MAC Service are in a sense also peers of the requesting MAC Service user. They receive and use the destination and source address parameters, and can both use and modify other parameters such as ‘drop eligible’, they are constrained to forward the address and data parameters unchanged to their peers and eventually to the MAC Service destination.

2. Nested peers

In the context of sub-layered services, where a service is typically realized by encoding some or all of its parameters in the data of an underlying sub(network) service, the notion of peers comes close to subsuming that of primitives and their parameters. In contrast to earlier networking philosophies where almost arbitrary transforms might be invoked as data moved from its source to its destination, the simplifying principle is

[1]ISO 8648

that if a protocol entity (in system A, say) produces a parameter that is to be conveyed by a service then only a peer of A (in system B, say) can consume that parameter. Naming A's protocol entity as 'bra' — usually represented by the symbol '('—and B's as 'ket'—')', the essence of network sublayering is that the brackets match.

Consider a protocol entity that simply encapsulates the parameters of a protocol in the data of a further copy of that protocol. Externally the PDUs look the same (if we don't or can't look into the data) so we can denote the two nested encoders (for left to right transmission) by '((' and their peer recipients (for right from left reception) by '))', and show the resulting network path as:

```
(  (     )  )
```

and, either by considering the detail of protocol operation or by simply matching brackets, arrive at the only possible sublayering, i.e.:

```
(           )
   (     )
```

This simple notation can be extended by the addition of '+' to identify a service user that, like a simple bridge using instances of the ISS provided by two bridge ports, just relays the (significant) service parameters unchanged from one service supporting entity to another. A path between two MAC service users (end stations), through three bridges might then be shown as:

```
((    )+(    )+(    )+(    ))
```

or equivalently as:

```
(                           )
 (    )+(    )+(    )+(    )
```

showing the sublayering corresponding to the matched brackets. Here the end station protocol components '((' and '))' show an explicit decomposition into a mapping from the MAC Service to the ISS, and from the ISS to the underlying media.

Differing, and readily distinguishable, protocol entities can be shown by using different brackets. On one of individual LANs in our example we might decide to encode EtherTypes behind a SNAP SAP, using '[' and ']' to show that[2], then:

```
((    )+[    ]+(    )+(    ))
```

is a viable network path, whereas:

```
((    )+[    )+(    ]+(    ))
```

is not, as it will unexpectedly remove functionality.

3. Finding peers (or not

If a given protocol entity ('A', say) uses group addressed frames to advertise its presence to (or to solicit responses from) potential peers, and the addresses used are filtered by relays associated with higher (sub)layered protocol entities[3], they can be sure they can communicate with the peers they discover. Any encoding/addition to/transformation of the data that 'A' performs to realize the service that it offers will be decoded/removed/used by a peer 'B' (say) before being delivered to a higher (sub) layered entity —so that higher entity uses strictly the service that is to be provided and is neither mystified by receiving data mangled by 'A', nor mangles[4] the data in a way that would make it unintelligible to 'B'.

If 'A' does not find a peer or peers, as a result of discovery/advertisement group address filtering (or perhaps because there are no such peers to be found), it knows that it should not provide its particular service. It may substitute a null transform on the data, or may not support connectivity at all—the choice depends on what 'A' is meant to achieve. Some protocols may instantiate multiple protocol entities within a given interface stack, each using a different discovery/advertisement group address and functioning at a different sublayer. LLDP (Link Layer Discovery Protocol, LLDP) entities may, for example, attempt to find the following (amongst other possibilities): any device immediately connected to an Individual LAN; the nearest Provider Bridge Port; or the nearest Customer Bridge Port, each of which potentially relays LLDP frames to find more distant higher (sub)layer entities.

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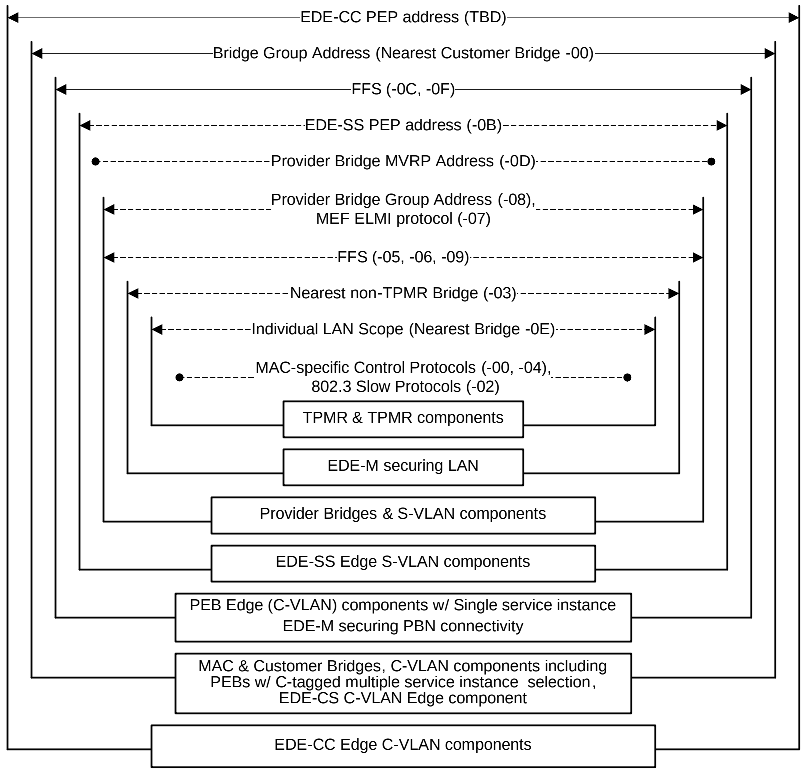
[2]This makes a change from using MAC Security as the device for making frames unintelligible.
[3]And not used by those higher-layer entities themselves.
[4]'Mangling' should be understood to also cover adding additional frames/procedures that are part of 'A's cooperation with 'B'.



802.1Q Reserved addresses are the block of 16 beginning 01-80-C2-00-00-00

Addresses (inc. -07) are not assigned for the exclusive use of particular protocols, EtherTypes are required, as other protocols can use each address, with possible constraints (e.g. for -02).

The Provider Bridge MVRP Address (-0D) is filtered by S-VLAN components using MVRP as well as by C-VLAN components, so may not reach the latter.

EDE's also enforce frame scoping—discarding all frames that are not sent by CA participants, both when connectivity is secured and when not (unless unsecured connectivity is permitted).

Figure 3—Scopes w/ proposed EDE addresses

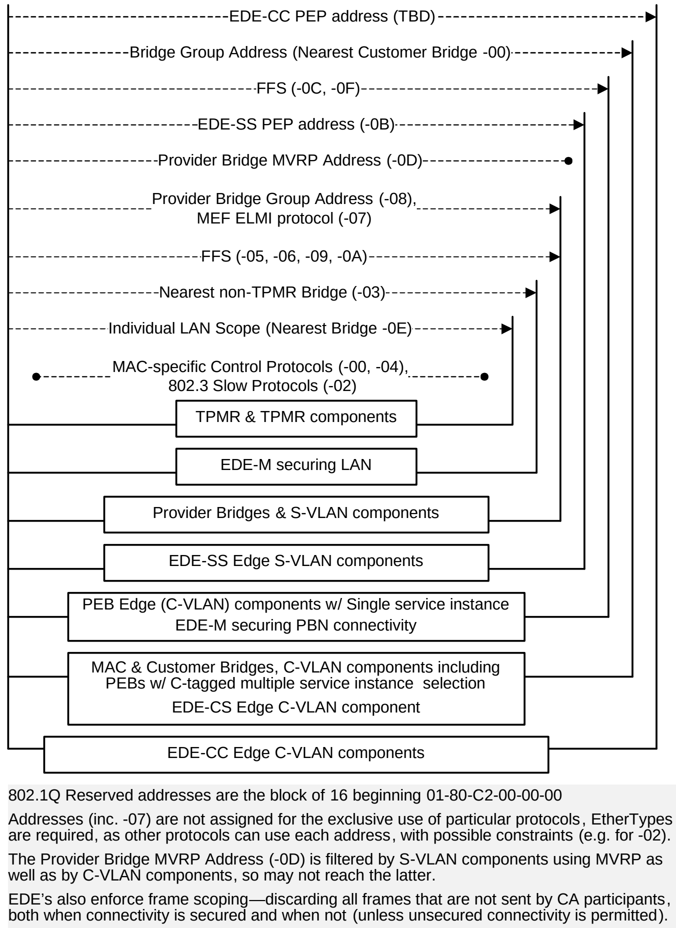


Figure 4—Bridge ports w/ EDE addresses

Table 2—Reserved Address filtering w/ proposed EDE addresses

Address assignment	Address value	MAC Bridge & C-VLAN components (Customer Bridges, PEB w/multiple PEPs[1])	PEB C-VLAN components w/ single PEP[1] EDE-M securing PBN connectivity	S-VLAN components (Provider Bridges, Provider Backbone Bridges, PEBs)	EDE-M securing LAN	TPMR components
Bridge Group Address, Nearest Customer Bridge group address	01-80-C2-00-00-00	Y[2]				
IEEE MAC-specific Control Protocols group address[3]	01-80-C2-00-00-01	Y	Y	Y	Y	Y
IEEE 802.3 Slow_Protocols_Multicast address	01-80-C2-00-00-02	Y	Y	Y	Y	Y
Nearest non-TPMR Bridge group address, IEEE Std 802.1X PAE address[4]	01-80-C2-00-00-03	Y	Y	Y	Y	
IEEE MAC-specific Control Protocols group address	01-80-C2-00-00-04	Y	Y	Y	Y	Y
Reserved for future standardization	01-80-C2-00-00-05	Y	Y	Y		
Reserved for future standardization	01-80-C2-00-00-06	Y	Y	Y		
Metro Ethernet Forum ELMI protocol group address[5]	01-80-C2-00-00-07	Y	Y	Y		
Provider Bridge Group Address	01-80-C2-00-00-08	Y	Y	Y		
Reserved for future standardization	01-80-C2-00-00-09	Y	Y	Y		
Reserved for future standardization	01-80-C2-00-00-0A	Y	Y	Y		
EDE-SS PAE address	01-80-C2-00-00-0B	Y	Y			
Reserved for future standardization	01-80-C2-00-00-0C	Y	Y			
Provider Bridge MVRP Address	01-80-C2-00-00-0D	Y	Y	[6]		
Individual LAN Scope group address, Nearest Bridge group address[7,8]	01-80-C2-00-00-0E	Y	Y	Y	Y	Y
Reserved for future standardization	01-80-C2-00-00-0F	Y	Y			

[1]A PEB's C-VLAN component has a single Customer Edge Port, if it has multiple PEPs it supports more than one provider network service instances.
[2]Y indicates, Yes, this address is filtered by the compoenent.
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[4]This address was identified as the 802.1X PAE address in IEEE 802.1Q-2003 and 802.1Q-2005, that name is still used in IEEE 802.1X-2010.
[5]This address is not exclusively reserved for this purpose; other uses are reserved for future standardization. Needs to be forwarded by EDE-CCs.
[6].This address is filtered by S-VLAN components supporting MVRP
[7]It is intended that no IEEE 802.1 relay device will be defined that will forward frames that carry this destination address.
[8]This address was identified IEEE Std. 802.1AB Link Layer Discovery Protocol multicast address in 802.1Q-2005. IEEE 802.1AB now discusses its use in multiple scopes.