Loops Detection OAM for Provider Bridged Networks

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Problem Statement

- Loops fatally affect Bridged LANs
- Users can cause loops through Provider Bridged Networks, whether the providers take precaution
    - Use of Bridge that violates the standards
    - Miss configuration of user network
- User loops through Provider Bridged Network waste resources, thus the other users are fatally affected
- Therefore, Providers must protect the other users from customer loops through the attached networks
- Development of user loops detection OAM for Provider Bridged Networks is indispensable

Loops through Provider Network
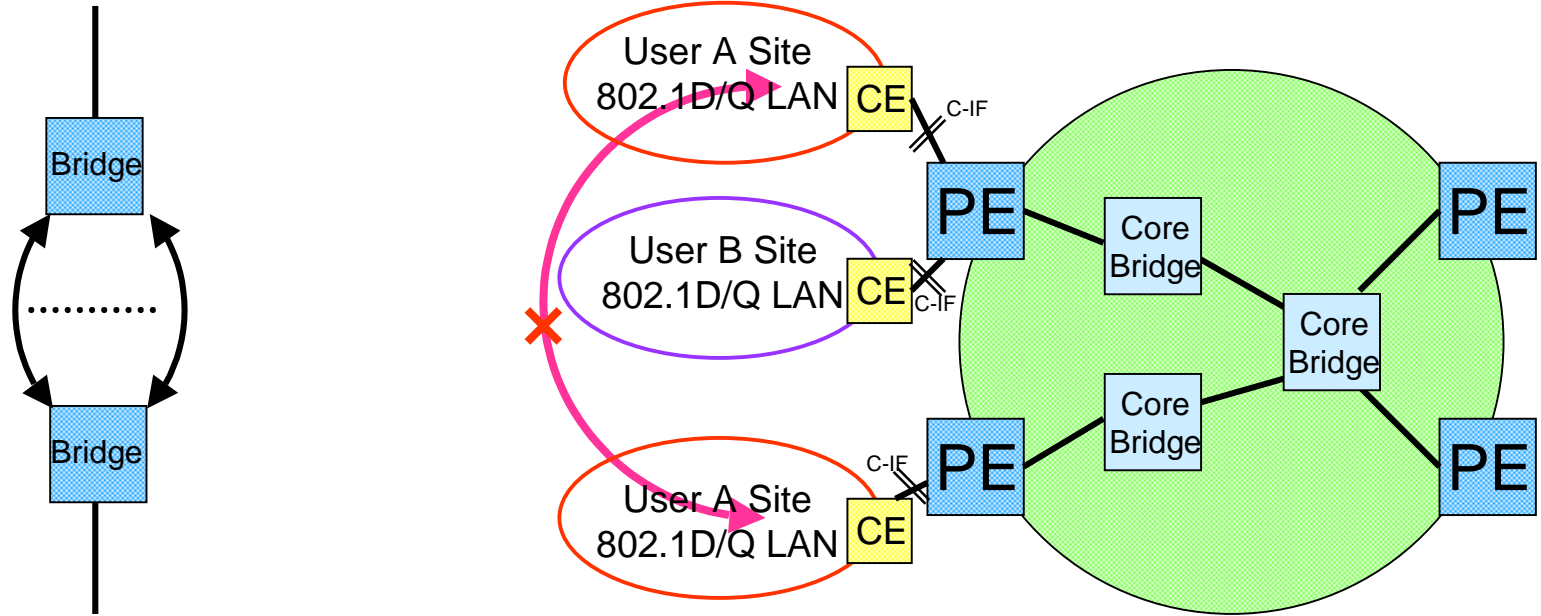
- Loops: Multiple active paths between two Bridges
- Provider Bridged Network provides connectivity among Customer IFs with tree topology S-VLANs
- Therefore, user sites must not provide connectivity between Customer IFs while the S-VLAN is working
- If there is connectivity between Customer IFs, it is equivalent with an user loop that through the Provider Bridged Network while the S-VLAN is working

Principles of Operation
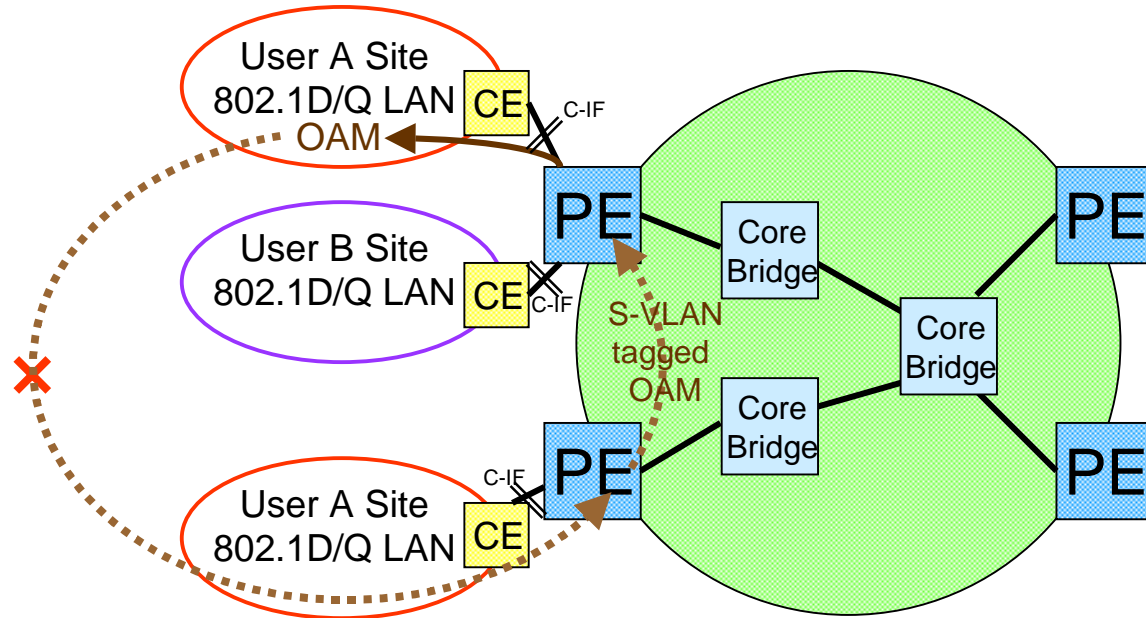
- Loops detection OAM frame is periodically created and sent from a Customer IF to an user site

- When a PE receives the OAM frame which is generated by the PE from a Network or Customer IF, it detects a loop

- Therefore, it contains a PE ID which identifies the PE that creates the OAM frame
  - Real port address (e.g., Bridge ID) may be un-secure for PE ID

- Limitation: If Loops detection OAM frames are discarded in an user site, loops may not be discovered

- However, it is much better than providers don't have any loops detection tools

Issue: Relationship between user and S-VLANs

- A single user may subscribe multiple S-VLANs in a single or multiple Providers
- For an S-VLAN, another S-VLAN's paths for an user are regarded as the user's paths
- Port-based VLAN:
    - A single Customer IF is related to a single S-VLAN
    - Customer IF forwards user frames to the S-VLAN
        - User frame may contain an C-VID, but it is not concerned
    - Therefore, Loops detection OAM frame must contain an S-VID to identify the S-VLAN for the user
- Delimiter-based VLAN:
    - A single Customer IF is related to a single or multiple S-VLANs
    - A single S-VLAN is related to a single or multiple C-VLANs
    - An S-VLAN for an user frame is selected by the tagged C-VID
        - Note: Some Customer IFs for an user may have partial relationship between S-VLANs and C-VLANs for the user
    - Therefore, Loops detection OAM frame must be tagged with an C-VID and contain an S-VID
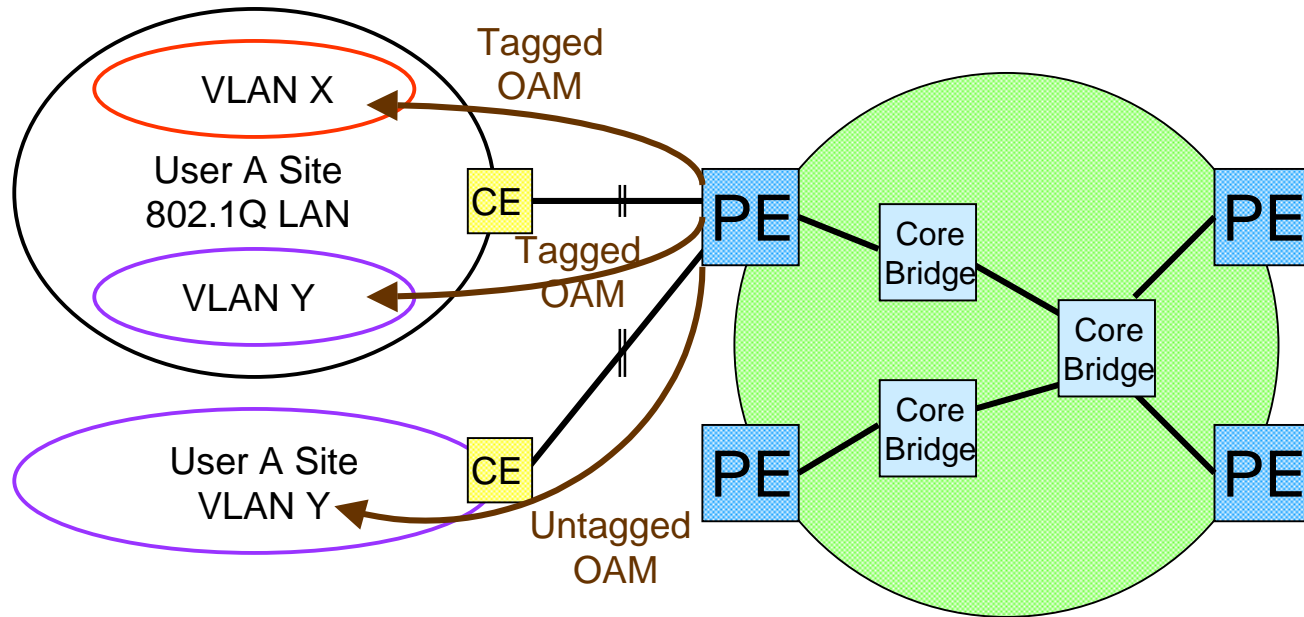
Port-based VLAN Case

- Loops detection OAM frame contains PE ID and S-VID
- When a Network IF of a PE receives a Loops detection OAM frame, if PE IDs in the frame and assigned to the PE are the same, it compares S-VID in the frame and tagged S-VID
  - If S-VIDs are the same, a loop is detected; thus the OAM frame is discarded
    - Note: In this case, the PE must have single or multiple Customer IFs related to the S-VID; otherwise, it is an unexpected error
  - Otherwise, the PE handles the frame as an user frame
    - Forward, discard, tagging, un-tagging, etc
- When a Customer IF of a PE receives a Loops detection OAM frame, if PE IDs in the frame and assigned to the PE are the same, it compares S-VID in the frame and the S-VID related to the IF
  - If S-VIDs are the same, a loop is detected; thus the OAM frame is discarded
  - Otherwise, the PE handles the frame as an user frame

Delimiter-based VLAN Case

- PE creates and sends tagged Loops detection OAM frames from a Customer IF to all C-VLANs that are related to the IF
- Loops detection OAM frame is tagged with an C-VID and contains PE ID and S-VID
- When a Network IF of a PE receives a Loops detection OAM frame, if PE IDs in the frame and assigned to the PE are the same, it compares S-VID in the frame and tagged S-VID
  - If S-VIDs are the same, a loop is detected; thus the OAM frame is discarded
    - Note: In this case, the PE must have single or multiple Customer IFs related to the S-VID and tagged C-VID; otherwise, it is an unexpected error
  - Otherwise, the PE handles the frame as an user frame
- When a Customer IF of a PE receives a Loops detection OAM frame, if PE IDs in the frame and assigned to the PE are the same and if an S-VID that is related to the tagged C-VID exists, it compares S-VID in the frame and the related S-VID
  - If S-VIDs are the same, a loop is detected; thus the OAM frame is discarded
  - Otherwise, the PE handles the frame as an user frame

Mingler Case

- Port-based and Delimiter-based Customer IFs for an user may coexist in a single PE
- Customer IF that supports port-based VLAN may receive tagged Loops detection OAM frame
  - If S-VID in the frame and the S-VID related to the IF are the same, a loop is detected regardless tagged C-VID value
- Customer IF that supports delimiter-based VLAN may receive untagged Loops detection OAM frame
  - If S-VID in the frame and one of S-VIDs related to the IF are the same, a loop is detected

Proposed Solution

- Loops detection OAM frame is periodically generated and sent from a Customer IF
  - It contains PE ID and S-VID
  - Delimiter-based VLAN case, it is tagged with an C-VID
- When a Network IF of a PE receives a Loops detection OAM frame:
  - If PE IDs in the frame and assigned to the PE are the same, it compares S-VID in the frame and tagged S-VID
- When a Customer IF of a PE receives a Loops detection OAM frame:
  - Port-based VLAN case: If PE IDs in the frame and assigned to the PE are the same, it compares S-VID in the frame and the S-VID related to the IF
    - C-VID value is not concerned however it exists
  - Delimiter-based VLAN case: If PE IDs in the frame and assigned to the PE are the same and if an S-VID that is related to the tagged C-VID exists, it compares S-VID in the frame and the related S-VID
    - If the OAM frame is untagged, it compares S-VID in the frame and S-VIDs related to the IF
- If S-VIDs are the same, a loop is detected; thus the OAM frame is discarded
- Otherwise, the PE handles the frame as an user frame

Further Issues

- Addressing and frame format
  - Destination address
    - Reserved multicast address
    - Reserved unicast address
    - Customer IF address that creates the OAM frame
  - Source Address
    - Customer IF address that creates the OAM frame
    - PE ID
- Efficiency, security, and etc...

Motions to 802.1 WG

- Proposed Loops detection OAM solution needs customers understanding because it uses customer's resources

- Therefore, it should be clearly stated in Clause 16.8 of 802.1ad that the providers can send Loops detection OAM frames from PEs to customers in order to detect user loops that through Provider Bridged Networks and protect the other users

- Technical details of Loops detection OAM solution should be discussed in Connectivity Fault Management Project to be approved (or 802.1ad)