Tagging operations overview

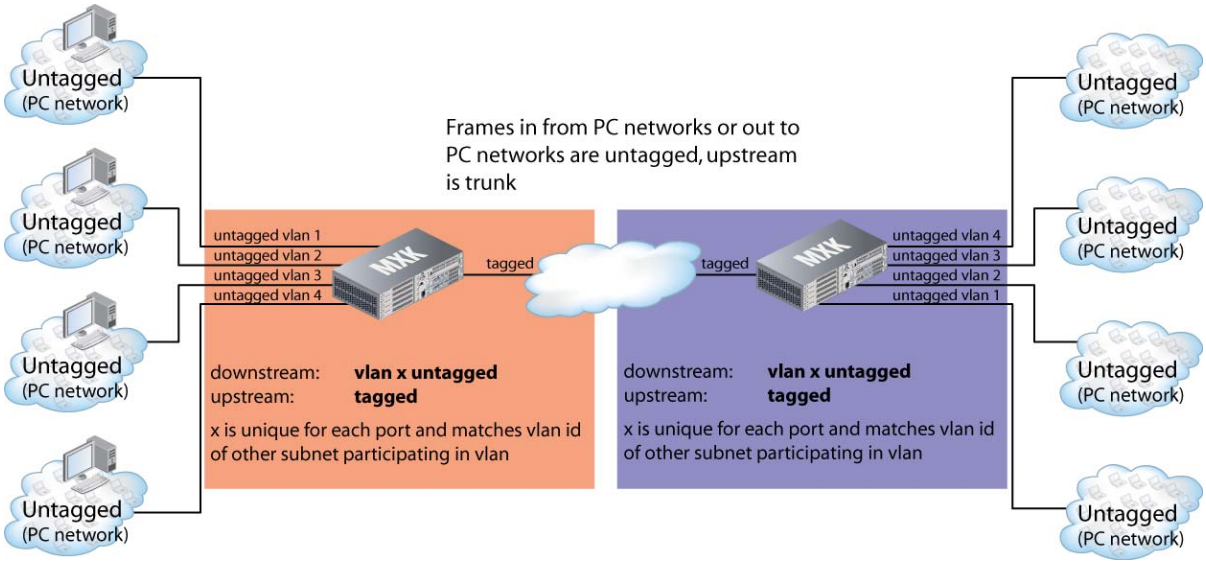
VLANs and SLANs (see VLANs and SLANs, untagged, tagged and stagged, page 205 for information about VLANs and SLANs) define the bridge to which an incoming frame belongs. The bridge type — as discussed in *Section 4, MXK bridge types* — determines the forwarding behavior for the bridge. In conjunction with the forwarding and learning characteristics from the bridge types, you can also configure tagging operations.

Tagging operations provide the ability to configure interfaces for ingress filtering, VLAN/SLAN promotion, egress, and/or stripping.

Usually these tagging operations — ingress filtering, promotion, egress and/or stripping — are configured on downstream interfaces. Defining whether a bridge interface should be untagged, tagged or stagged depends on what the devices connected to the interface are expecting.

Zhone uses an extremely flexible mechanism for configuring tagging operations. Before discussing the various combinations which are possible, it is important to understand common cases, including the most common case — VLAN tagging for PC networks.

Figure 17: VLAN tags can be used to organize subnets



You can add a VLAN tag to all frames coming in from a PC network which has untagged Ethernet frames. However you want the PC network to be part of a virtual LAN with another remote PC network, so you configure the downstream bridge interface to accept the untagged frames and add a tag. Zhone uses the term promotion to signify adding the tag. The frames are then tagged frames and are sent out the upstream bridge interface tagged and directed to the remote PC network. The upstream bridge is a trunk line.

Likewise on receiving a frame from the remote PC network (which has the same VLAN tag), the frame is received on the uplink and forwarded to the proper downstream link because the VLAN ID matches (and assuming the destination MAC address of the unicast frame matches a learned MAC

address). However the PC network does not accept tags, so the VLAN tag is removed and the frame is forwarded to the device with the proper MAC address. Zhone uses the term stripping to signify removing VLAN and/or SLAN IDs.

In Figure 17, the MXK is providing VLAN tags so on the other side of the cloud the frames may be forwarded to the proper VLANs as defined by the other MXK. In Figure 17, the cloud may just be the cabling between two MXKs connected back to back; the cloud could also be a whole network of subtending MALCs, MXKs, the Internet, but the basic VLAN tagging is being done at the MXK devices at the network edge.

In the example from Figure 17, the upstream interfaces are tagged with no VLAN ID designated. The downstream interfaces are untagged and given a VLAN ID which identifies which port (and hence which PC network) the frames received on these interfaces came from. This VLAN definition describes which VLAN tag to insert on ingress, and that VLAN ID upon receiving on the upstream interface on the remote MXK defines which downstream port to forward the frame. Since the downstream interface is untagged, the VLAN ID tag is stripped off and the frame sent out to the remote PC network.

Note: This example does not describe whether the bridges are asymmetric bridges or TLS bridges.

The four VLAN operations work together and are implied in the **bridge add** (**bridge modify**) command.

- Ingress filtering is the ability to have the bridge interface accept only frames with certain types of VLAN/SLAN tags.
- VLAN/SLAN promotion is the ability to add tags to a Ethernet frame. As with the example in Figure 17, the VLAN tag defines membership in a VLAN (VLAN/SLAN defines membership with two tags).
- Egress is the reciprocal of ingress filtering and designates where to forward the frame based on VLAN, SLAN, or VLAN/SLAN tags. If a frame is received into the device and possibly promoted, then needs to find the other bridge interface(s) for egress.
- Stripping is the reverse of promotion. Stripping is removing the VLAN, SLAN or VLAN/SLAN tags.

Promotion and stripping always occur together. Filtering on ingress assumes the incoming frames already have at least one tag; you may filter on VLAN and also promote an SLAN. Receiving the internally forwarded frame to the egress assumes that the frame either has been received with tags or has been promoted to have tags.

See *Common tagging operation scenarios* on page 212 using graphic representations to show the changes in frames as they are received on an interface forwarded to an egress interface and possibly promoted or stripped.

Zhone does not support stagged with known VLAN ID and unknown SLAN ID.

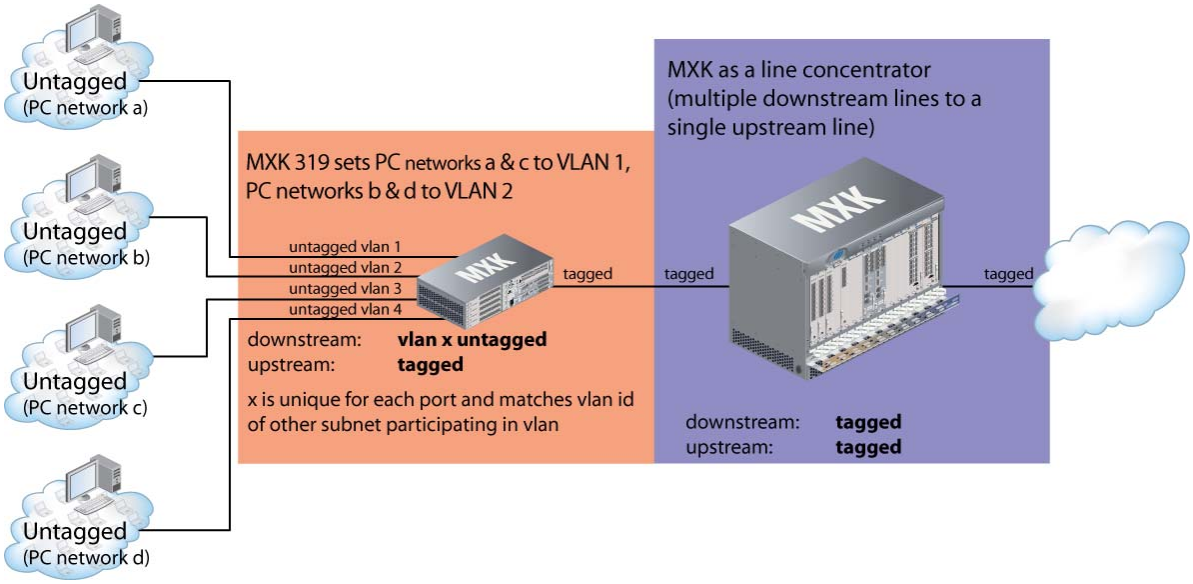
Note: The MXK does not support stagged frames with unknown VLAN and unknown SLAN.

The frames which come into the MXK are untagged, tagged and double tagged.

Common tagging operation scenarios

Figure 18 shows promoting untagged frames on the downstream interface (and so filtering to that interface when a frame with that VLAN ID is received on the upstream interface — given that the other bridging fundamentals are met, such as the MAC address as well as the VLAN ID match in the forwarding table if it is a downlink).

Figure 18: MXK 319 providing edge tagging, MXK as line concentrator



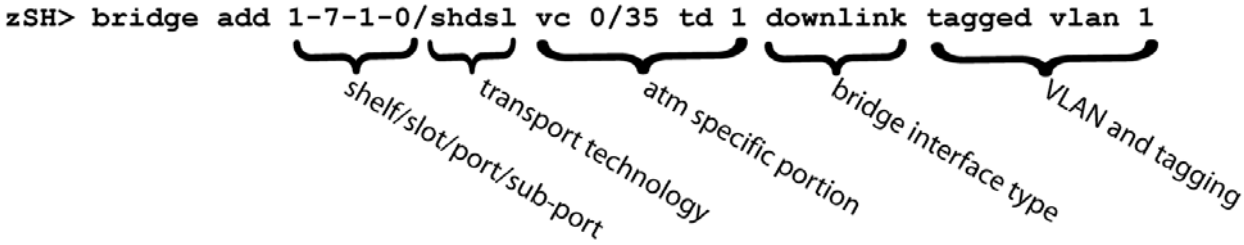
The untagged frame is accepted on the downstream interface, then it is promoted by inserting a VLAN ID. The upstream is tagged, so the tagged frame is sent out the upstream interface.

In order to complete the overlay with tagging and bridge types it helps to understand the following: the tagged frame will go out the uplink if part of an asymmetric bridge; if a TLS bridge, the frame will go where the forwarding table says it should go — the upstream interface if the MAC address matches. If the MAC address does not match addresses in the forwarding table the frame (an unknown unicast) would go out the upstream interface (along with the other participating bridge interfaces except the ingress bridge interface) since with TLS unknown unicasts are flooded out all member interfaces of the bridge

A good way to learn tagging fundamentals is by exploring some of the common scenarios. Figure 17 shows promoting (and stripping) VLAN tags at the network edge. Figure 18 shows that same promotion at the edge, but now a line concentrator (in the example a MXK) distributes access from many downstream lines to a trunk. These multiple downstream subscriber lines could be from different transport technologies. In Figure 18 the MXK uses Ethernet frames. For the next example, Figure 20, the downstream devices could also be ADSL based.

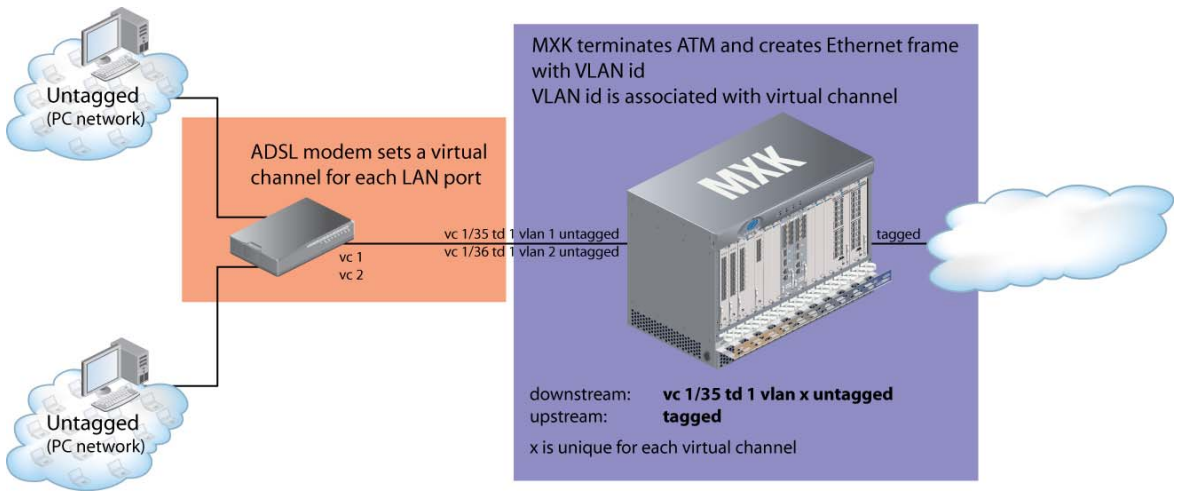
ADSL technologies are based on ATM virtual connections. Another example of VLANs is terminating ATM from an xDSL modem and creating an Ethernet frame. In this case, the VLAN id is associated with the virtual channel. The ATM virtual connections can then be terminated and the data put into Ethernet frames with VLAN tags corresponding to the ATM virtual channel.

Figure 19: Parts of the bridge add command



ADSL termination/Ethernet frame creation is a good example to show the parts of the **bridge add** command. Portions of the command define the bridging characteristics discussed in this chapter. The command also includes the transport technology and any associated information, such as the ATM specific portion for xDSL transport media.

Figure 20: ATM termination and Ethernet frame creation



Look at edge tagging in a tabular format to see that this same basic promotion concept works for different network.

The frame received on the downstream interface is untagged. Reading left to right, that frame is promoted to have a VLAN ID depending on the interface where the frame was received. The upstream interface is tagged, so a frame with a VLAN ID (but not double tagged) is forwarded to that interface. Since the bridge interface is tagged there is no stripping.

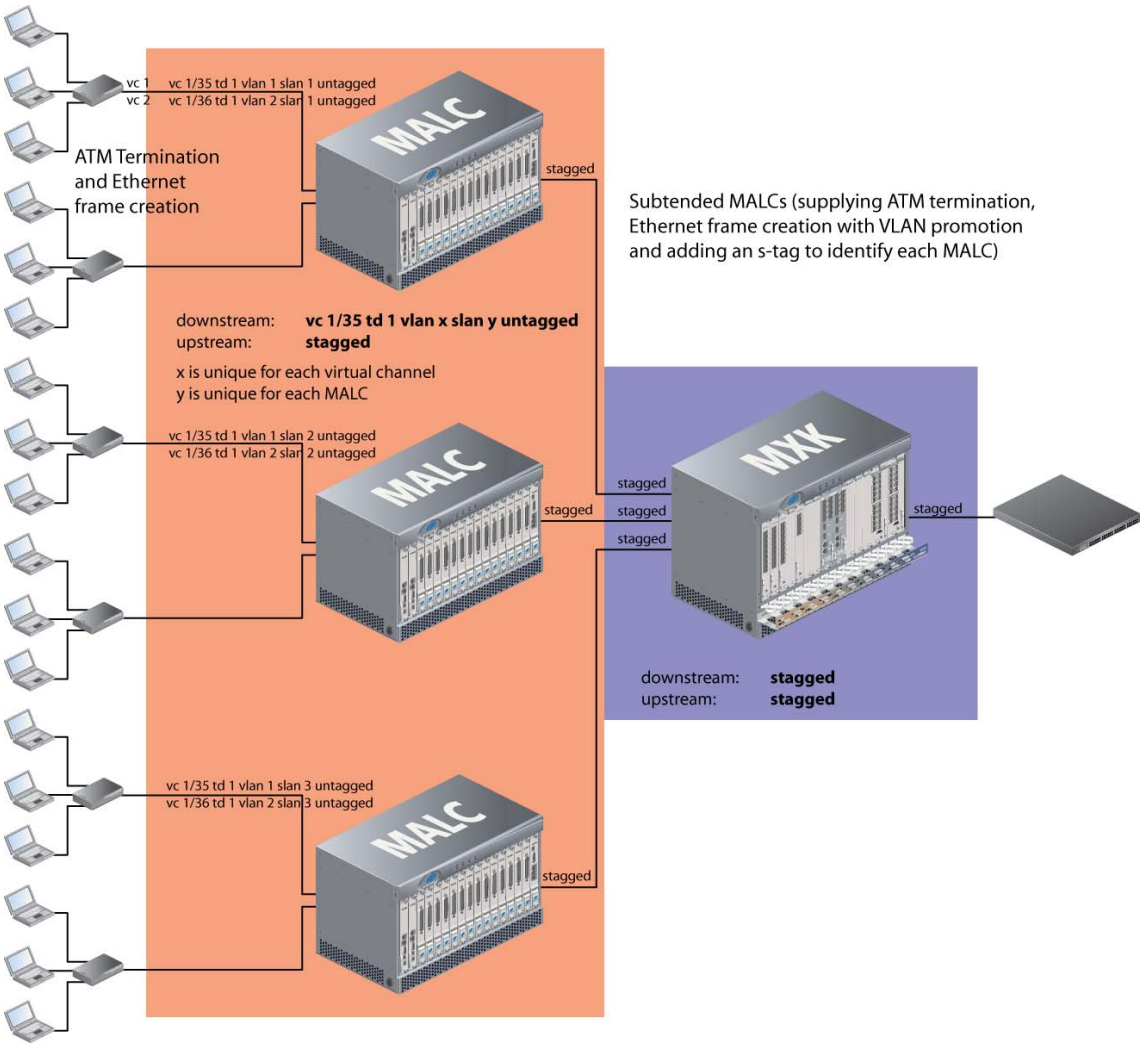
A frame on the upstream interface makes a reciprocal trip. A tagged frame is accepted on the upstream interface. Since no VLAN is defined it accepts all single tagged frames (so any VLAN ID). There is no promotion. The frame is forwarded to the bridge interface with the VLAN ID which matches the VLAN ID of the Ethernet frame. The egress interface is also untagged, so the VLAN ID is stripped out and the frame is sent to the network.

In this case multiple interfaces with the same VLAN are not being discussed, though that is a very common scenario.For the sake of discussion here, MAC addresses are found in the forwarding table for the egress interface.

All SLMS devices support tag promotion. How one defines the next level upstream from the edge of the network depends on the network architecture. In Figure 21, the MALC is the next level up from the EtherXtend and acts as line concentrator and the MXK is upstream from the MALC. The example shows only VLAN tagging, but any of the SLMS devices could promote an s-tag, depending on what is necessary in the application or the overall network architecture.

Figure 21 describes the next step upstream and describes double tags (the second tag are also called s-tags). In a subtended scenario you can add an s-tag for tracking the origination of the frame, perhaps by department. The example in Figure 21 shows the double promotion of tags. The example shows the MALC providing ATM termination and the linkage to a VLAN ID and the promotion of an s-tag as well.

Figure 21: Q in Q supports adding a second tag



In Figure 21 describing the subtended MALCs, ingress frames received on the downstream bridge interface have both VLAN and SLAN IDs promoted. In this case the VLAN ID defines the ATM virtual channel. The SLAN ID designates from which MALC the frame originated.

Uplinks are usually separated by VLAN IDs (see *VLANs and SLANs, untagged, tagged and stagged*). Normally a triple play scenario separates traffic by VLAN ID for video, data, and voice services in order to configure QoS prioritization bridging filters.