IEEE P802.1CF
OMNIRAN

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| Point to Point Link Establishment |
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Abstract

This contribution describes point to point link establishment in 802 technologies.

1. Point-to-Point Link Establishment

The 802.1CF network reference model enables point-to-point link establishment between the terminal and termination point. The termination point is the access network (AN) gateway, i.e. the link is established between the terminal and the gateway.

* 1. Layer 2 Operation Basics

Point-to-point link requires that the terminal does not have direct bi-directional connectivity at the link layer to any other terminal. This needs to be enforced by the access network nodes such as Access Points or Residential Gateways.

Layer 2 operation is shown pictorially in Figure 1. Terminals establish a link with the base station, access point, switch, etc. depending on the access technology. This link is extended to the access gateway which is the egress point of the access network. The frames flow in these sets of links which eventually enables the Internet communication.



1. —Point-to-Point Link Operation

Access technology may allow broadcast or multicast communication as most access technologies do. Point-to-Point link establishment should not prevent such communication to take place.

* 1. Access Technology Specific Procedures

## IEEE 802.3

IEEE 802.3 point-to-point link can be established in several ways which are described next.

Home Network Solution

If the home network residential gateway operates in bridged mode there is a transport tunnel and in the tunnel the terminal’s MAC address is the source address in Ethernet frames and this can be easily detected in each frame. The transport tunnel establishes the terminal’s isolation from the other terminals.

If the home network residential gateway operates in routed mode the transport tunnel is established using IP level technologies which are out-of-scope. Therefore the terminal’s isolation is still enabled in routed mode.



1. —Point-to-Point Link on Ethernet

**SDN Solution**

SDN Controller can be used to configure a connection service between the access switch, e.g. 802.11 Access Point, Provider Backbone Bridge (PBB) switches and the access gateway. This solution based on Provider Backbone Bridge Traffic Engineering (PBB-TE) [IEEE 802.1Qay] will be explained step-by-step [OmniRAN Cont.].

In PBB-TE there is no flooding. Only provisioned filtering entries are used, so frames are dropped unless there is a provisioned filtering entry to forward the frame’s destination address or VLAN identifier. B-VID stands for Backbone VLAN identifier and it is a B-Tag which is the same as the S-Tag, i.e. same Ethertype, but named differently to indicate role in network architecture.

Initial Configuration.

Initially switches exchange control frames using Link Layer Discovery Protocol (LLDP). SDN Controller discovers all bridges using e.g. LLDP. Controller configures all switch ports to use a default B-VID, e.g. 100. This is the first step in establishing a PBB-TE trunk. PBB-TE trunks are identified by [B-SA, B-DA, B-VID] where B-SA and B-DA identify the source and destination endpoint bridges of the trunk and B-VID is a backbone VLAN identifier that is used to distinguish different trunks to the same destination. This way the controller configures all switches to forward any broadcast frames to the controller. This is called Ethernet Switched Path (ESP). This ESP is unidirectional from each bridge to the controller.

Initial Broadcasts

End nodes, e.g. AP and access gateway send broadcast frames. Usually such frames carry DHCP requests. Braodcast frames are sent to the controller over the ESP established in the previous step. Controller intercepts all broadcasts and identifies the end point MAC addresses. Controller configures the endpoint MAC addresses into the two bridges to which the endpoints are connected. Using these ESPs, controller can send responses to the request, e.g. DHCP requests.

Connection Establishment

Based on the terminal request, the end station connected to the terminal, e.g. AP requests a connection to the other end station, e.g. the access gateway using a broadcast frame. The controller configures the forwarding databases of the bridges in the path. Controller configures two point-to-point ESPs with the end point MAC addresses on all the bridges in the path (Figure 2). These two ESPs establish a point-to-point TE service instance (TESI). There could be two or more bridges in the path.The controller then responds to the AP its connection request giving B-VID and destination MAC address information into AP’s access table. Similarly, the other endpoint, after receiving the first frame, uses the controller to receive B-VID and AP MAC address and record it into its access table.

## IEEE 802.11

In order to assure point-to-point operation, IEEE 802.11 Access Point or Residential Gateway with the Access Point must not route frames coming from the terminal downstream to other terminals. Instead such a routing should come from the gateway.

## IEEE 802.15

For further study.

**IEEE 802.16**

IEEE 802.16 is point-to-point and connection oriented at the MAC layer. The details on how IP subnet can be structured using IP Convergence Sublayer (CS) or Ethernet CS are described in [IETF RFC 5692].

Requirements for OmniRAN

[Req1] Provider Backbone Bridging Traffic Engineering support in the bridges

[Req2] SDN Controller controlling backbone bridges in order to configure a connection service

[Req3] SDN Controller controlling the endpoints of the connection service, i.e. the access node and the access gateway

**References:**

IETF RFC5692 (October 2009) Transmission of IP over Ethernet over IEEE 802.16 Networks.

IEEE 802.1Qay-2009. Provider Backbone Bridge Traffic Engineering, July 2009.

OmniRAN Contribution, Paul Ostroff, Ethernet Connection Service, May 2014, omniran-14-0040-00-CF00-ethernet-connection-service.pdf