IEEE P802.1CF
OMNIRAN

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| Data Path Establishment, Relocation and Teardown |
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Abstract

This contribution describes key concepts of data path establishment, relocation and teardown.

1. Data Path Establishment, Relocation and Teardown

Data path can be established on shared links or point-to-point links.

## 1.1 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.

### 1.1.2 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.

### 1.1.3 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

**Solution with a Controller**

A Controller, such as using the Software Defined Networking 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.]. Note that just PB bridges can also be used.

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). 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 along an Ethernet Switched Path (ESP) [802.1Q-2012 clause 8.9].

Initial Broadcasts

End nodes, e.g. AP and access gateway send broadcast frames. Usually such frames carry DHCP and ARP/IPv6 ARP/Unsolicited Neighbor Discovery (ND) requests (controller must be programmed for IPv6 multicast support), multicast address must be programmed by controller at the switches. Broadcast/multicast frames are sent to the controller over the ESP established in the previous step. Controller receives all broadcasts/multicasts 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/ARP/IPv6 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/multicast frame (ARP/IPv6 ND). Controller forms the reply to ARP/IPv6 ND. 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

In case of 802.15.4 or Low-Rate Wireless Personal Area Networks (LR-WPAN), point-to-point links can be supported in star topologies. In star topology, the communication is established between devices and a single central controller, called the PAN coordinator [IEEE 802.15.4].

In peer-to-peer topology, there is also PAN coordinator but the devices can communicate with other devices in radio range. So in this topology, point-to-point link establishment can not be achieved.

In case of 802.15.1 or Bluetooth has synchronous connection-oriented links and asynchronous connectionless links. Point-to-point links can be established in synchronous connection-oriented data channels [IEEE 802.15.1].

High rate wireless personal area networks (HR-WPAN) are organized in piconets where a number of independent data devices (DEVs) located within 10m of distance communicate with each other. One of the DEVs assumes the role of piconet coordinator (PNC) to control the piconet.

Devices establish point-to-point links to the piconet controller. Because of this, HR-WPANs enable point-to-point link establishment [IEEE 802.15.3].

**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] Controller controlling backbone bridges in order to configure a connection service

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

## 1.2 Shared Link Establishment

TBD.

**References:**

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