xx Connectivity Fault Management in an SPT Region

The original CFM protocol in IEEE 802.1ag-2007 specifies the monitoring of VLAN services, thus it can be used for the monitoring of Shortest Path Trees identified by SPVIDs in SPB. Application of CFM in SPB is discussed below in subclause xx.1.
However, the CFM extensions defined by IEEE 802.1Qay are needed for the monitoring of services in SPBB since SPBB does not rely on simple VLAN services. The operation of CFM protocols in SPBB is described below for both Formats in sublcauses xx.2 and xx.3.

xx.1 Application of CFM in SPB

SPTs are identified by SPVID and MAC learning operates in data plane in SBP. Therefore, monitoring of VLAN services can be applied as defined in IEEE 802.1ag-2007. Nonetheless, reply messages require some extensions as described below.

xx.1.1 Continuity Check Protocol in an SPB MA

Continuity Check Protocol can be applied as described in Clause 20.1, no extensions are required. That is, CCMs monitor an SPT distinguished by an SPVID; the destination_address parameter is set according to the Group MAC addresses listed in Table 8-9. The vlan_identifier parameter is the SPVID that corresponds to the bridge in which the originator MEP resides. Thus, CCMs sent by a MEP follow the paths span by the corresponding SPT and reach all the leaf bridges.

xx.1.2 Loopback Protocol in an SPB MA

The Loopback protocol is described in Clause 20.2. Loopback Message transmission in an SPB MA operates as specified in Clause 20.2. That is, a unicast LBM is initiated by a MEP and the destination_address parameter being the Individual MAC address of another MP within the same SPB MA as the transmitting MEP. The receiving MP responds to the LBM with a unicast Loopback Reply. The enhancement required for the LBR in an SPB MA is described below.

SPTs are unidirectional in an SPT Region, i.e. the SPVID assigned to an SPT can only be used in one direction (from the Root Bridge to the leaves). Therefore, reply messages have to be transmitted on a different tree. The CIST is suitable for the transmission of the reply messages. Thus, the vlan_identifier parameter of an LBR issued by an SPB MD has to be set to a VID assigned to the CIST, e.g. to the Base VID corresponding to the vlan_identifier parameter of the received LBM.

All other Loopback processes are the same as those for a VLAN based MA.

xx.1.3 Linktrace Protocol in an SPB MA

The Linktrace protocol is described in Clause 20.3. Linktrace Message transmission operates as specified in Clause 20.3. That is, LTM is carried in a multicast frame, with a destination_address taken from Table 8-10 according to the MD Level of the transmitting MEP. The LTM carries a target MAC address and the MAC address of the originator MP as part of its payload. Receiving MPs that respond to the LTM send a unicast Linktrace Reply (LTR) to the originator of the LTM. The enhancement required for the LBR in an SPB MA is described below.

As pointed out in Clause xx.1.2, the VID used in LTM and LTR are different due to the unidirectional SPTs. The responder MP sets the vlan_identifier parameter of the LTR to a VID assigned to the CIST, e.g. to the Base VID corresponding to the vlan_identifier parameter of the received LTM.

All other Linktrace processes are the same as those for a VLAN based MA.

xx.2 Application of CFM in SPBB Format A

All addresses are managed in SPBB hence MAC learning is invoked by IS-IS in the control plane instead of the traditional data plane MAC learning. SPVIDs identify SPTs in Format A (28.2.1), thus VIDs need to be monitored, which is similar to the application of CFM in SPB. Furthermore, ingress filtering is also based on SPVIDs in Format A. 802.1Qay PBB-TE extensions to CFM have to be used for the proper operation of reply messages. The operation of CFM protocols is described below.

xx.2.1 Continuity Check Protocol in a Format A SPBB MA

Continuity Check Protocol can be applied as described in Clause 20.1, the only extension defined in 802.1Qay that need to be applied in an SPBB MA is that the destination address of a CCM PDU maybe an Individual MAC address. That is the destination_address parameter of CCM PDUs is set according to the monitored connectivity. Thus, the destination_address parameter is an Individual MAC address of a BEB in case of monitoring a unicast connectivity; and the destination_address parameter is the corresponding Group MAC address if a multicast tree is monitored, i.e. it is not taken from Table 8-9. The vlan_identifier parameter is the corresponding SPVID that belongs to the originator bridge with respect to the monitored service. Thus, CCMs always follow the corresponding SPT both in unicast and multicast services.

All other Continuity Check processes are the same as those for a VLAN based MA.

xx.2.2 Loopback Protocol in a Format A SPBB MA

The Loopback protocol is described in Clause 20.2. The PBB-TE MIP TLV specified in Clause 21.7.5 in 802.1Qay has to be applied for the addressing of MIPs and for the proper operation of Loopback Reply messages as summarized below.

a) The destination_address parameter of LBMs issued by a MEP associated with an SPBB MA is set to the Individual MAC address of another MEP residing in a BEB. As the MAC address of intermediate MIPs may not be included in the FDBs, the PBB-TE MIP TLV (21.7.5) is inserted as the first TLV in an LBM in order to enable intermediate MIPs to selectively intercept LBMs that are targeting them. The PBB-TE MIP TLV is not included if a MEP is targeted by the LBM. The PBB-TE MIP TLV is constructed as follows:
    1. The MIP MAC address field is the MAC address of the MIP to which the LBM is targeted;
    2. The reverse VID field contains an SPVID that belongs to the destination MEP of the LBM in the corresponding VLAN.
b) Forwarding of LBM operates as specified in Clause 26.9.6.2.b.
c) The destination_address parameter of LBRs issued by Format A SPBB MPs is the Individual MAC address of the originator MEP of the LBM.
d) The source_address parameter of LBRs issued by Format A SPBB MPs is their own individual MAC address.
e) The vlan_identifier parameter used by LBRs issued by Format A SPBB MEPs is their own SPVID belonging to the corresponding VLAN or otherwise;
f) The vlan_identifier parameter used by LBRs issued by Format A SPBB MHFs is set to the Reverse VID field contained in the PBB-TE MIP TLV of the received LBM. As the Reverse VID belongs to the destination MEP of the LBM, the Reverse VID is associated with the shortest path from the destination of the LBM to the originator of the LBM, thus, LBRs having the Reverse VID are able to reach the originator MEP of the LBM.

All other Loopback processes are the same as those for a VLAN based MA.

xx.2.3 Linktrace Protocol in a Format A SPBB MA

The Linktrace protocol is described in Clause 20.3. The PBB-TE MIP TLV specified in Clause 21.7.5 in 802.1Qay has to be applied for addressing the proper operation of Linktrace Reply messages as summarized below.

a) According to the monitored service, the LTMs issued by a MEP associated with a Format A SPBB MA may use an Individual MAC address or a Group MAC address as the destination_address parameter of an LTM. The PBB-TE MIP TLV of LTMs is constructed as follows
    1. The MIP MAC address field is null;
    2. The Reverse VID field contains an SPVID belonging to the destination MEP if the destination_address parameter of the LTM is an Individual MAC address, or otherwise;
    3. The Reverse VID field contains a VID assigned to the CIST (e.g. the Base VID of the corresponding VLAN) if the destination_address parameter of the LTM is a Group MAC address.
b) The process to identify possible egress ports by an intermediate bridge that implements a MIP associated with a Format A SPBB MA operates as specified in Clause 26.9.6.3 for PBB-TE MAs.
c) An LTR issued by a Format A SPBB MA
    1. uses as destination_address the source_address of the received LTM;
    2. uses as vlan_identifier the value carried in the Reverse VID field contained in the PBB-TE MIP TLV of the received LTM. Thus the LTR is transmitted along the shortest path to the originator of the LTM if its destination_address parameter was an Individual MAC address or otherwise sent on the CIST.

All other Linktrace processes are the same as those for a VLAN based MA.

xx.3 Application of CFM in SPBB Format B

SPTs are identified by the MAC address of the Root Bridge of the tree, which is incorporated into Group MAC addresses in a nickname format in SPBB Format B (28.2.2). Thus SPT identification only operates for multicast connections but not taken into account for unicast connections. Ingress filtering also operates relying on the source address, i.e. on the MAC address of the Root Bridge. 802.1Qay PBB-TE extensions need to be applied for Format B SPBB MAs as summarized below.

xx.3.1 Continuity Check Protocol in a Format A SPBB MA

Continuity Check Protocol can be applied as described in Clause 20.1, however, the destination_address parameter can be either an Individual MAC address or a Group MAC address of a corresponding service but it is not taken from Table 8-9. Thus CCMs follow the SPTs that they monitor. The vlan_identifier parameter is a VID that belongs to the monitored VLAN, i.e. it is either the single VID or one of the multiple ECMT VIDs, which depends on the SPTs aimed to be monitored.

All other Continuity Check processes are the same as those for a VLAN based MA.

xx.3.2 Loopback Protocol in a Format A SPBB MA

The Loopback protocol is described in Clause 20.2. The PBB-TE MIP TLV specified in Clause 21.7.5 in 802.1Qay has to be applied for the addressing of MIPs and for the proper operation of Loopback Reply messages as summarized below.

a) The destination_address parameter of LBMs issued by a MEP associated with an SPBB MA is set to the Individual MAC address of another MEP residing in a BEB. As the MAC address of intermediate MIPs may not be included in the FDBs, the PBB-TE MIP TLV (21.7.5) is inserted as

the first TLV in an LBM in order to enable intermediate MIPs to selectively intercept LBMs that are targeting them. The PBB-TE MIP TLV is not included if a MEP is targeted by the LBM. The PBB-TE MIP TLV is constructed as follows:

1. The MIP MAC address field is the MAC address of the MIP to which the LBM is targeted;
2. Reverse MAC field contains the same value as the destination_address parameter of the LBM.

b) Forwarding of LBM operates as specified in Clause 26.9.6.2.b.
c) The destination_address parameter of LBRs issued by SPBB MPs is the Individual MAC address of the originator MEP of the LBM.
d) The source_address parameter of LBRs issued by Format B SPBB MPs is the destination_address parameter of the received LBM.
e) The vlan_identifier parameter used by LBRs issued by Format B SPBB MPs is the vlan_identifier parameter of the received LBM.
f) An LBR issued by an MHF of a Format B SPBB MA either carries Reply Ingress TLV (21.9.8) or carries PBB-TE MIP TLV in order to identify the responder MIP. If PBB-TE MIP TLV is applied then the Reverse MAC field contains the MAC address of the MIP that issued the LBR.

All other Loopback processes are the same as those for a VLAN based MA.

xx.3.3 Linktrace Protocol in a Format A SPBB MA

The Linktrace protocol is described in Clause 20.3. The PBB-TE MIP TLV specified in Clause 21.7.5 in 802.1Qay has to be applied for addressing the proper operation of Linktrace Reply messages as summarized below.

d) According to the monitored service the LTMs issued by a MEP associated with a Format B SPBB MA may use an Individual MAC address or a Group MAC address as the destination_address parameter of an LTM. The PBB-TE MIP TLV of LTMs is constructed as follows
    1. The MIP MAC address field is null;
    2. The Reverse VID field contains an SPVID belonging to the monitored VLAN if the destination_address parameter is an Individual MAC address, or otherwise;
    3. The Reverse VID field contains the VID assigned to the CIST if the destination_address parameter of the LTM is a Group MAC address.
    4. The Reverse MAC field contains the value of the destination_address parameter of the LTM if it is an Individual MAC address, or otherwise,
    5. If the destination_address parameter of the LTM is a Group MAC address, then the Reverse MAC field contains an Individual MAC address assigned to the CIST, which ensures that the LTR is transmitted on the CIST thus able to reach its destination. Note that this Individual MAC address is not defined yet.
e) The process to identify possible egress ports by an intermediate bridge that implements a MIP associated with a Format B SPBB MA operates as specified in Clause 26.9.6.3 for PBB-TE MAs.
f) An LTR issued by a Format B SPBB MA
    1. uses as destination_address the source_address of the received LTM;
    2. uses as source address the Reverse MAC field carried in the PBB-TE MIP TLV of the received LTM;
    3. uses as vlan_identifier the value carried in the Reverse VID field contained in the PBB-TE MIP TLV of the received LTM. Thus the LTR is transmitted along the shortest path to the originator of the LTM if its destination_address parameter was an Individual MAC address or otherwise sent on the CIST.

All other Linktrace processes are the same as those for a VLAN based MA.