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IEEE Standard for Meshed Tree Bridging with Loop-Free Forwarding

IEEE Communications Society

Developed by the
Access and Core Networks Standards Committee

IEEE Std 1910.1™-2020

IEEE

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Access and Core Networks Standards Committee
of the
IEEE Communications Society

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Abstract: Meshed tree bridging protocol (MTBP) ensures that bridged network constituents receive high reliability in frame delivery in the event of link or bridge failures. MTBP is based on the meshed tree algorithm (MTA) that allows for simultaneous construction and maintenance of multiple trees or tree branches from a single root. In the event of tree branch failures due to link or bridge failures, another preconstructed and maintained branch exists as an immediate fallback. Recovery and tree pruning times in meshed tree bridging is minimal. Multiple roots should be pre-assigned to construct multiple distinguishable meshed trees from each root. In the event of a root bridge failure, the standby root and its meshed tree provides loop-free paths for frame forwarding with minimal recovery delays.

Keywords: IEEE 1910.1™, loop-free broadcast frame forwarding, meshed trees, multi-meshed trees, optimal unicast frame forwarding paths, path redundancy, root redundancy

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Introduction

This introduction is not part of IEEE Std 1910.1-2020, IEEE Standard for Meshed Tree Bridging with Loop-Free Forwarding.

This standard defines a *meshed tree bridging protocol* (MTBP) for bridged networks that forward frames as per specifications provided in IEEE Std 802.3™-2018 [B4].[1] Either *spanning tree protocol* as specified in IEEE Std 802.1D™-2004 [B2] or *rapid spanning tree protocol* as specified in IEEE Std 802.1w™-2001 [B3] is used for loop avoidance. The MTBP provides for computationally efficient loop-avoidance and recovery for topology changes including:

— Rapid tree and multiple overlapping branch construction from a single root that enables fast convergence and early broadcast frame forwarding in the event of topology changes.

— Multiple path establishment for unicast frame forwarding by leveraging several of the physical connections in the meshed topology normally used in bridged networks. The unicast frame forwarding paths are not constrained by the broadcast tree paths.

— Immediate failover to redundant paths or tree branches [established using the meshed tree algorithm (MTA)] upon detection of failed link(s) and or bridges.

— Unicast and broadcast frame forwarding on optimal paths between end stations and/or services where the optimal path is selected from the multiple forwarding paths that exist simultaneously.

— Unicast frame forwarding follows paths different from the multiple meshed tree paths constructed for broadcast frame forwarding.

Meshed trees do not follow the traditional single spanning tree from one root concept. In bridged networks based on MTA, multiple tree branches are preconstructed from a single root bridge and maintained in readiness. One of the multiple paths is designated for loop-free broadcast frame forwarding. All other preconstructed tree branches and paths are maintained in readiness to take over in the event of failure of a branch currently used for broadcast frame forwarding. Meshed trees thus address the path redundancy and quick recovery on network component failure in bridged networks. Failover to another path is almost immediate upon link failure detection as meshed trees allow several logical pathways to exist between any two bridging devices. This is a substantial improvement over previous efforts, where a single logical path existed between two bridges at any point in time resulting in longer delays when responding to topology transients. In some cases, though a single backup was permitted, the convergence process still required the new changed path information to be synchronized with bridges downstream from the point of failure.

[1] The numbers in brackets correspond to those of the bibliography in Annex B.

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IEEE Standard for Meshed Tree Bridging with Loop-Free Forwarding

1. Overview

1.1 Introduction

This standard defines a *meshed tree bridging protocol* (MTBP) for bridged networks. For this purpose, the standard specifies a *meshed tree algorithm* (MTA) and a technique for the generation of meshed trees from one root in a bridged network. A protocol based on this technique for forwarding unicast, multicast, and broadcast frames in a bridged network is specified. The protocol specifications focus on maintaining a readiness of multiple active topologies that can also share learned station information. The meshed trees provide multiple non-looping paths from any non-root bridge to the root bridge. To address the needs of root failure the multi-meshed tree (MMT) technique allows for construction of multiple meshed trees from several preselected root bridges. The specification describes a single protocol to construct multiple meshed trees from multiple predesignated root bridges.

The operation of the MTBP is based on the MTA. MTA describes a technique that allows for simultaneous construction and maintenance of multiple logical tree branches from a root. This feature allows for immediate fallback on preconstructed paths between the root bridge and the non-root bridges in the event of link or bridge failures. The fallback and thus convergence time are minimal.

1.2 Scope

The scope of this document is as follows:

a) In bridged networks running MTBP, ports shall be identified as either a meshed tree port that participates in the meshed tree resolution, or a host port, to which a local host is connected. Only meshed tree ports are allowed to participate in the meshed tree resolution.

b) MTBP provides superior fault tolerance by preconfiguring several logical trees from a root. One of these logical trees is considered the primary tree and is used for forwarding broadcast frames. In the event of a network component failure and immediately on failure detection of the primary branch, broadcast frame forwarding is taken over by any one of the other preconfigured tree branches. This is achieved with minimal message dissemination and delay.

c) The addition of a bridge configured to run MTBP will allow the bridge to send a request to join (via MT_JOIN message) message to all other bridges to which it is connected. The new bridge will join the bridges already in the topology. The new bridge then receives multiple invitations