

Managed FDB Algorithm and Protection in Ethernet Ring Topology

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Abstract — We propose an Ethernet ring protection technique introducing a managed forwarding database scheme (FDB). The major benefit of the proposed FDB scheme is provisioning with a cost-optimized path that eliminates an unnecessary overprovision requirement.

I. INTRODUCTION

Ethernet ring protection is gaining its importance as Ethernet technology is being aggressively deployed in the carrier networks. IEEE 802.17 RPR standard, i.e. resilient packet ring, specifies a variant of Ethernet ring and protection. A newer technology that utilizes the generic feature of the Ethernet MAC standard is being standardized at ITU-T as G.8032. The main idea is to utilize the APS (Automatic Protection Signal) and AIS (Alarm Indication Signal) frames defined by ITU-T Y.1731 and G.8031 standard for Ethernet OAM (operation, administration, and maintenance). These protocols provide Ethernet ring protection with a simple algorithm where managing a blocking port to prevent forming a loop in Ethernet ring topology. However, this scheme maximizes peak traffics in links of the ring, which makes leads the network utilization poor: Making blocking port results more than 2 times overprovision. In this paper, we suggest a managed FDB (Forwarding Data Base) scheme in the framework of MEG (Maintenance Entity Group) defined at Y.1732. The proposed Ethernet ring provides cost-effective path and protection.

II. MANAGED FDB ALGORITHM

We assume that an Ethernet ring manager or an OAM function of the ring network determines Ethernet nodes of which a ring topology consists and then informs to each node. In addition, we assume that each Ethernet ring node has bridge function defined by IEEE 802.1D and IEEE 802.1Q. An Ethernet ring is assigned to a unique virtual network number, for example by use of VLAN for a ring node group, thus ring OAM protocol data units (PDU) are distributed only within the ring. These ring nodes receive information of all ports that belong to the virtual network.

Each node in the ring topology multicasts MAC learning frame bi-directionally within the ring. This MAC learning frame contains the source address (SA) and payload information which contains information from which the transmission cost or comparable time delay can be determined at the receiving nodes. Each ring node which received a pair of MAC learning frames from east and west

ports compares transmission cost or time delay, so as to determine the port with minimum cost or delay. And then, the node writes a new entry of the SA and port in FDB. We call this FDB a managed FDB without a blocking port. If one node transmits the MAC learning frame in the ring topology, other nodes in the ring can write cost-effective path in FDB. A node FDB point of view flow chart is shown in Fig. 1.

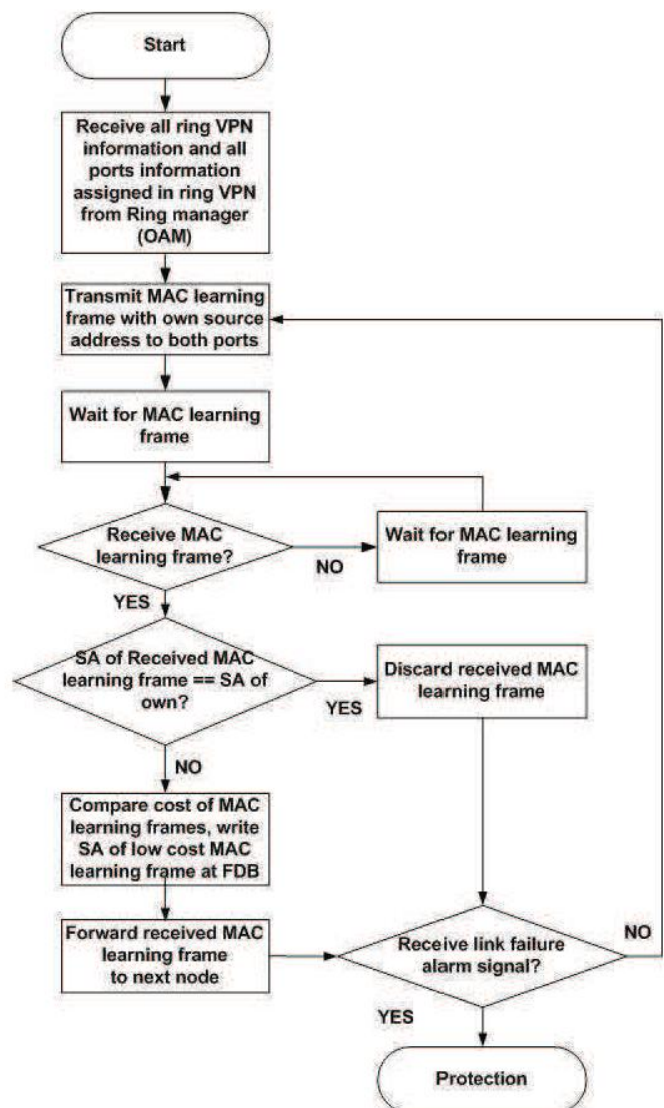


Fig. 1. A node FDB point of view flow chart

As shown Fig.1, we can terminate FDB MAC learning process after receiving link failure alarm signal like AIS protocol.

The main point of managed FDB is fixed time. When a failure occurs in an Ethernet ring link, only one MAC protection frame will be generated and multicast to repair the FDB of each node. Because of this case, we can guarantee a fixed time to settle in the protection mode.

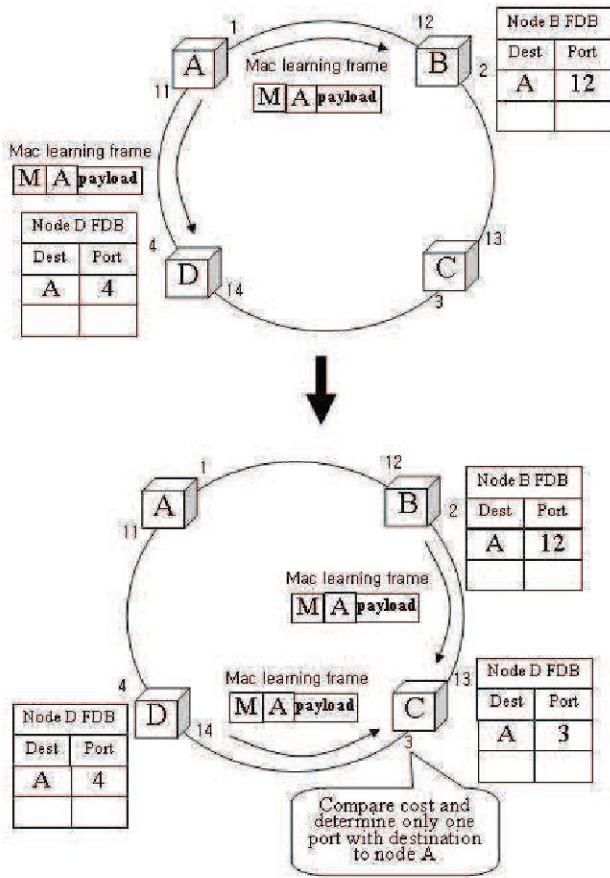


Fig. 2. MAC learning with managed FDB example

The overall MAC learning example with managed FDB is shown in Fig.2. Node A transmits MAC learning frames with own information to both ports. Then, B, C and D node receive a pair of MAC learning frames arrived from both ports in the east and west. Then, each Ethernet ring node which has a bridge function where we can implement a function that can compare the cost from the information in the MAC learning frame payload, then writes the destination and port number which has low cost. This is simple example of managed FDB algorithm.

III. PROTECTION WITH MANAGED FDB

CC (Continuity Check) frame defined by ITU-T Y.1731 is transmitted from each port to the link periodically. If a defect occurs in a link, both ports which terminate the link can detect the failure with CC frame loss. The node that has

detected the failure transmits link failure alarm frame to the opposite port. An AIS PDU of Ethernet OAM is one of examples of link failure alarm frames. After all nodes receive the link failure alarm frame, the two nodes which are associated with the link failure multicast ring protection frame to the opposite port. APS PDU in Ethernet OAM is one of examples of ring protection frames. Ring protection frame payload contains the destination MAC address information which is assigned to link failure direction. In our proposal, we use an extended protection frame which contains all destination addresses (DA) that are assigned to the port associated with the link or port failure. After receiving the ring protection frame, each node compares the protection frame payload information and the FDB of port received protection frame. If the same DAs exist, then the entries of such DAs are transferred to the FDB of the opposite port in the same node. Such process is progressed to every nodes, the managed FDB provides protection function. The flow chart can be divided two types; a node protection point of view and whole network protection point of view. The flow chart in the node-protection point of view is shown in Fig.3.

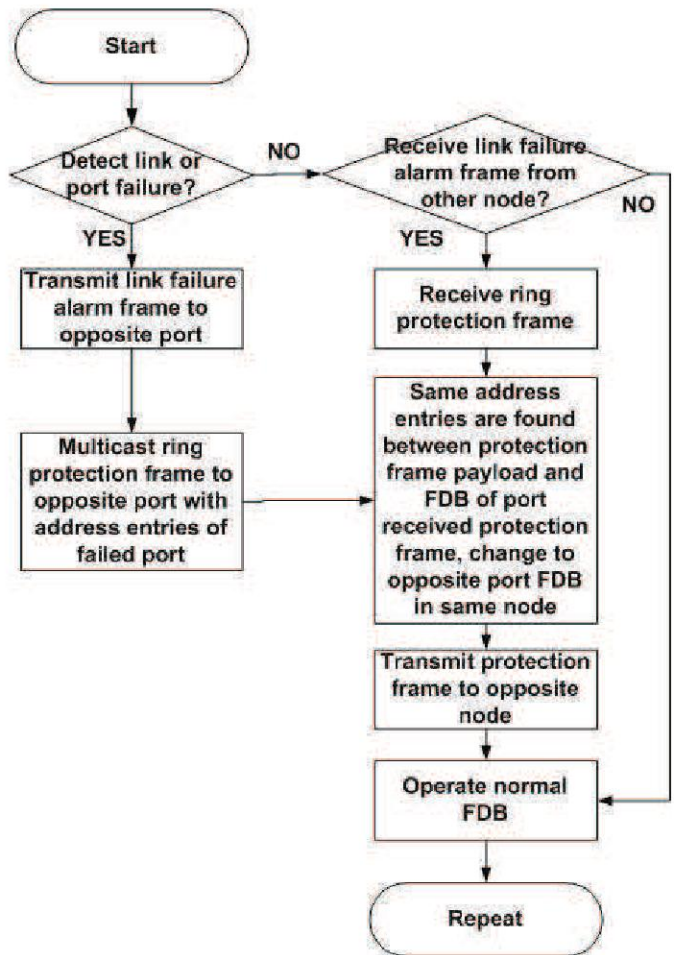


Fig. 3. A node protection point of view flow chart.

The flow chart in the whole-network-protection point of view is shown in Fig. 4.

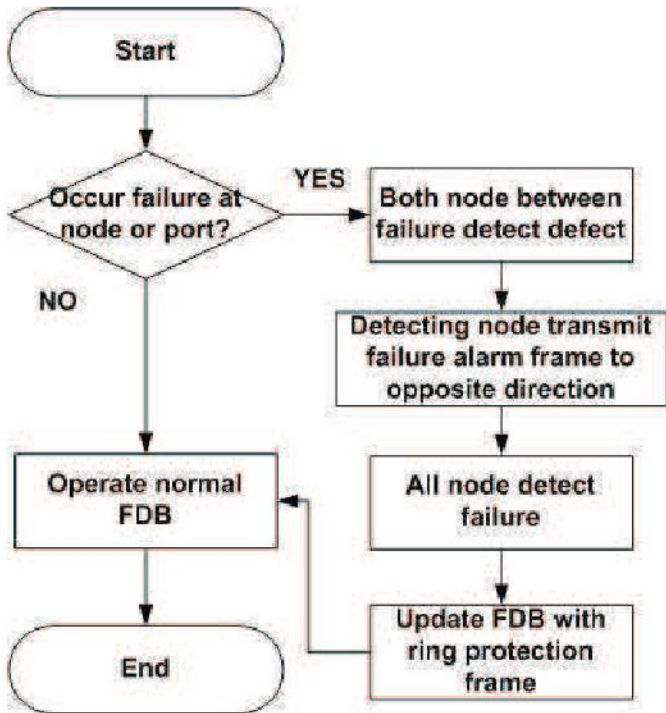


Fig. 4. A whole network protection point of view flow chart

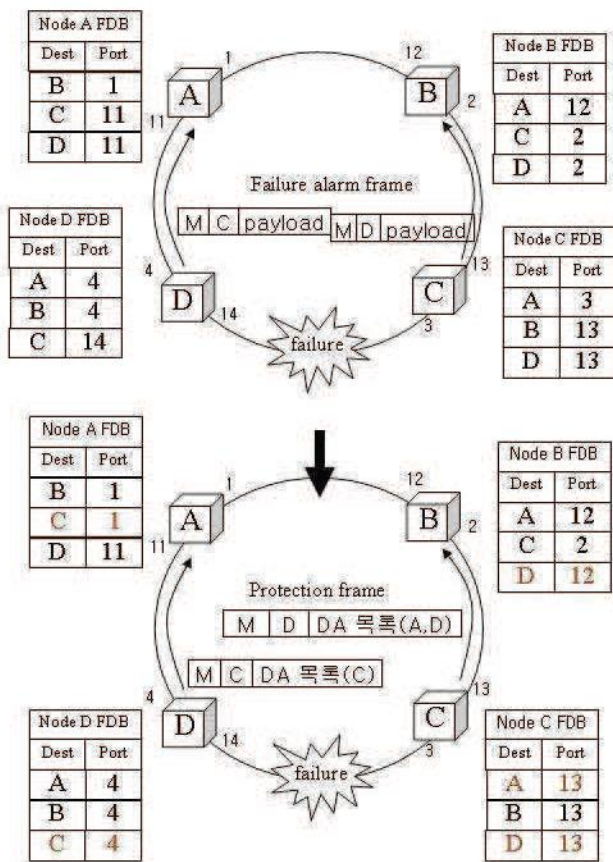


Fig.5. Protection with managed FDB example

The overall protection example with managed FDB is shown in Fig.5. The link between nodes C and D occurs failure. Then, nodes C and D detect the failure, and transmit failure alarm frame and ring protection frame. After changing FDB DA lists by above flow chart algorithm, managed FDB provides Ethernet ring protection without blocking port. This scheme prevents from network traffic overshoot that is observed in the port-blocking protection scheme.

IV. CONCLUSIONS

In this paper we suggest a managed FDB scheme which prevents from Ethernet loop formation and provides cost-effective path and protection. This managed FDB increases network utilization more than 2 times because all links are optimized. Also, overprovision effect is decreased compared with the blocking port technology. Managed FDB with high efficiency in multi-ring topology can lead future Ethernet ring technology.

ACKNOWLEDGEMENT

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