Quality-Of-Service-Aware Green Bandwidth Allocation in Ethernet Passive Optical Network

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Abstract : Sleep mechanisms are commonly used to ensure the energy efficiency of each optical network unit (ONU) that concerns a single class delay constraint in the Ethernet Passive Optical Network (EPON). How long the ONUs can sleep without violating the delay constraint has become a research problem. Particularly, we can derive an analytical model to determine the optimal sleep time of ONUs in every cycle without violating the maximum class delay constraint. The bandwidth allocation considering such optimal sleep time is called Green Bandwidth Allocation (GBA). Although the GBA mechanism guarantees that the different class delay constraints do not violate the maximum class delay constraint, packets with a more relaxed delay constraint will be treated as those with the most stringent delay constraint and may be sent early. This means that the ONU will waste energy in active mode to send packets in advance which did not need to be sent at the current time. Accordingly, we proposed a QoS-aware GBA using a novel intra-ONU scheduling to control the packets to be sent according to their respective delay constraints, thereby enhancing energy efficiency without deteriorating delay performance. If packets are not explicitly classified but with different packet delay constraints, we can modify the intra-ONU scheduling to classify packets according to their packet delay constraints rather than their classes. Moreover, we propose the switchable ONU architecture in which the ONU can switch the architecture according to the sleep time length, thus improving energy efficiency in the QoS-aware GBA. The simulation results show that the QoS-aware GBA ensures that packets in different classes or with different delay constraints do not violate their respective delay constraints and consume less power than the original GBA.