

"Dynamic Bandwidth Allocation for Integrated EPON and WiMAX"

Sheetal Krishna Jadhav
Department of Computer Science
University of Otago

Contents

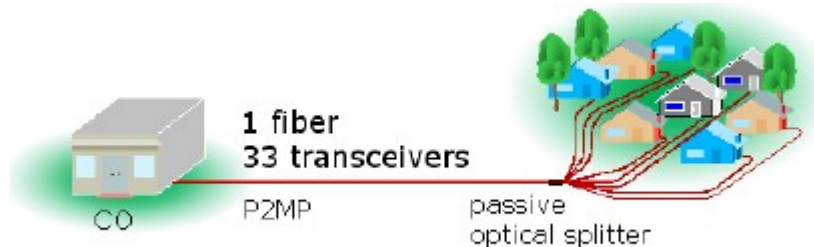
- Overview
- EPON(Ethernet Passive Optical Network) Architecture
- WiMAX(Worldwide Interoperability for Microwave access) Architecture
- Dynamic Bandwidth Allocation and Scheduling Scheme for EPON and WiMAX
- Future work
- Conclusion

Overview

- Ethernet Passive Optical Network (EPON) is regarded as a promising solution for the next generation fiber-based access technique because it is not only high speed and cost-effective but also scalable.
- The WiMAX technology which is based on the IEEE 802.16, has high bandwidth, low cost, deep coverage, support mobility, QoS support.
- The advantages of capacity, bandwidth benefit and mobility feature make the integrated EPON and WiMAX architecture as one of the best candidate solutions for next-generation broadband access networks.

EPON Architecture

- EPON is based on the Ethernet standard.



- An EPON network includes an optical line terminal(OLT) and an optical network unit (ONU).
- The OLT resides in the CO (Central Office).
- The ONU resides at or near the customer premise. It can be located at the subscriber residence or in a building.

Uplink and Downlink Transmission

- EPON provides bidirectional transmission.

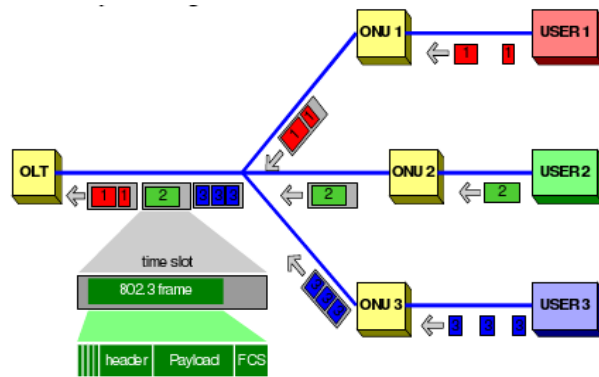


Figure 8: EPON Upstream Control

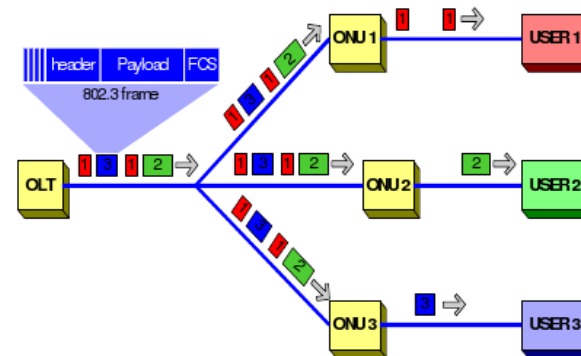
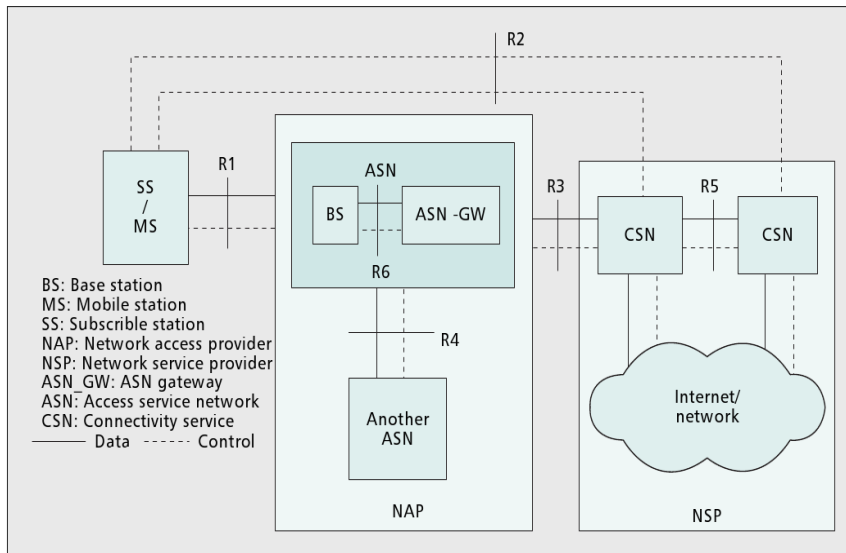


Figure 6: Downstream EPON Operation

- EPON supports differentiated services classified into
 1. Expedited Forwarding (EF) for delay sensitive (such as voice)
 2. Assured Forwarding (AF) for services that are not delay sensitive but require bandwidth guarantees.
 3. Best Effort (BE) for neither delay sensitive nor requires bandwidth guarantee.

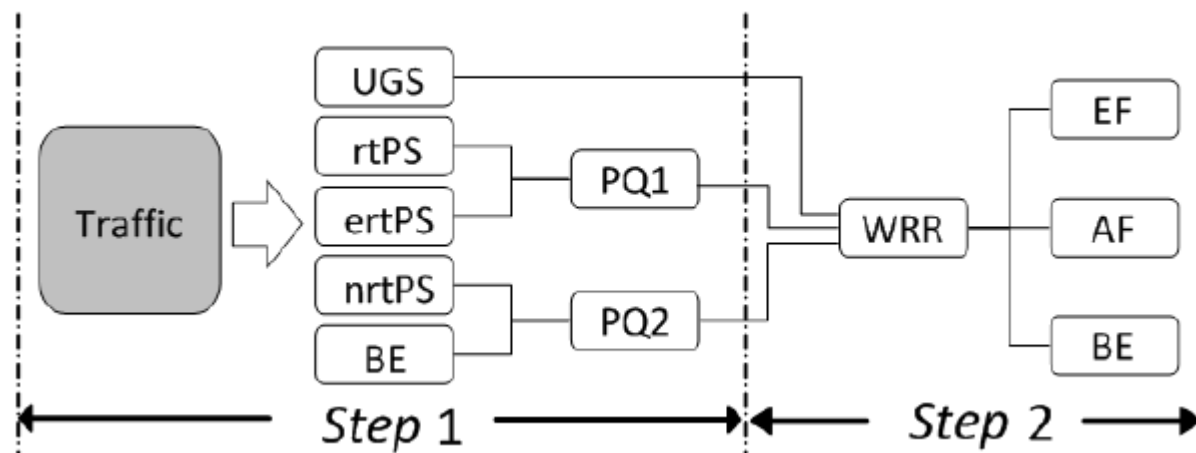
WiMAX Architecture

- WiMAX is a connection-oriented transmission technique. Each service flow is allowed with a unique connection ID.
- Required bandwidth for uplink request have to be scheduled and granted by BS.



Dynamic Bandwidth Allocation for Integrated Architecture of EPON and WiMAX

- The 802.16 protocol supports five types of QoS : UGS(Unsolicited Grant Service), rtPS (real time Polling Service),ertPS (extended real-time Polling Service), nrtPS (non-real-time Polling Service), and BE (Best Effort service).
- UGS has highest priority to transmit, rtPS has more high priority than ertPS, and based on this priority to assign the data packet into the Priority Queue 1 (PQ1).



- The data packets in UGS are transmitted into EF(expedited forwarding) queue of ONU.
- Data packets of PQ1 are transmitted into AF(Assured Forwarding) queue of ONU.
- Data packets in PQ2 are transmitted into BE queue of ONU.
- If the buffer of ONU is filled $< 40\%$, then configures the priority ratio 4:2:1 for UGS, PQ1, and PQ2. Between 40% and 80%, priority ratio 2:1:0. More than 80%, then priority ratio 1:0:0 for UGS, PQ1, and PQ2.

Future work and Challenges

- To meet the growing demand for broadband wireless, integrating 3G, 802.16, EPON is a good solution.
- The integration can significantly simplify network operation, e.g., user handover operation, and improve the reliability of network access.
- In future I will be working on Dynamic Bandwidth Allocation Integrating 3G, WiMAX and EPON for NGN.
- 3G, WiMAX and EPON have different characteristics in terms of data rates, coverage, deployment and they provide explicit support for QOS.

Future work and Challenges

- UMTS defines four class of QOS service:
 1. Conversational - Voice
 2. Streaming - Streaming video
 3. Interactive - Web browsing
 4. Background - Background download
- Providing end-to-end QOS is challenging since user is mobile and might switch network frequently.
- The access network must support features including traffic differentiation, policing, queuing, and scheduling in order to prioritise video and real-time interactive services, over best effort services.

Conclusion

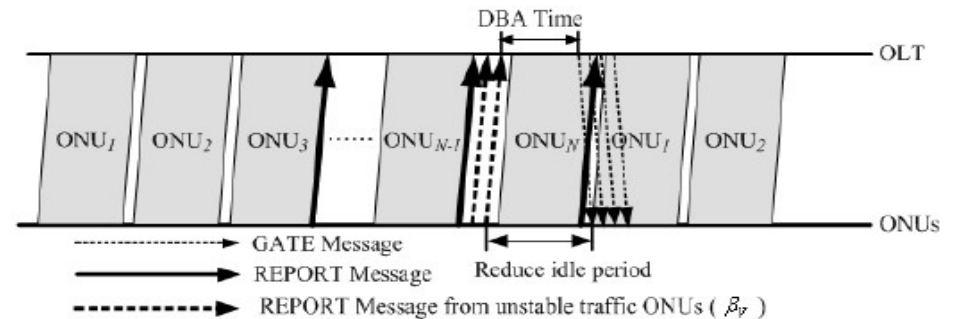
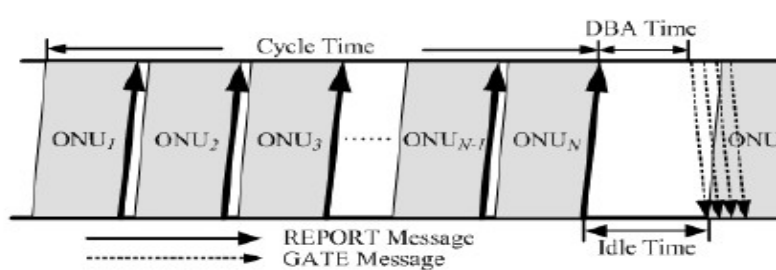
- Cost-effective, bandwidth benefit, mobility and scalable solution on the broadband access network.
- Integration of 3G, WiMAX and EPON architecture have the capability to deliver integrated broadband services by efficient fixed mobile convergence.
- The integration provide convenience for system operation and supports better QOS.
- Improves network throughput by employing packet scheduling strategies.

Thank You

Backup Slides

The Operation of Early DBA Mechanism

- EPON & WiMax have similarity in their bandwidth request/grant mechanism.
- Prediction-based fair excessive bandwidth allocation scheme executes the DBA mechanism after REPORT message from unstable traffic ONUs are received at the end of ONU_{N-1} instead of ONU_N .
- This reduces the idle period in the standard



- Divide frame in two parts, one is steady state part for P0 traffic which is always assigned first location.
- P0 sensitive to delay

