



Enhancing IPACT with Limited Service for Multi-thread DBA in Long-reach EPON

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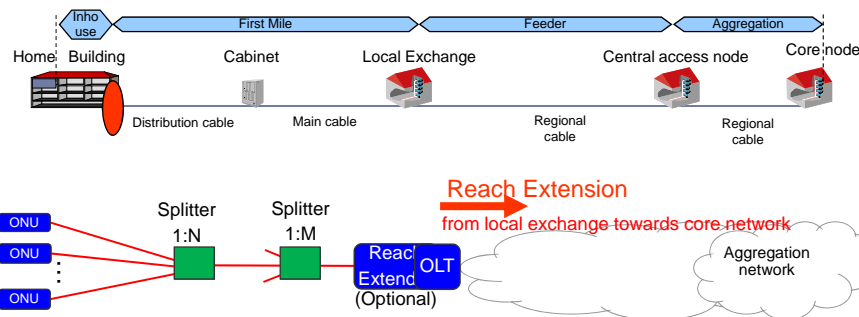
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Outline

- ▶ **Introduction**
 - ▶ Long reach EPON
 - ▶ Multi-thread dynamic bandwidth allocation (DBA)
 - ▶ Interleaved polling with adaptive cycle time (IPACT) with limited service
- ▶ **Enhanced IPACT with Limited Service**
 - ▶ Efficiently apply to multi-thread DBA
 - ▶ Completely overcome unused time slot
- ▶ **Performance Evaluation**
- ▶ **Conclusion**

Long reach EPON



- ▶ Reach extension beyond 20km
 - ▶ has been ratified in IEEE 802.3av for EPON
 - ▶ enables replacing multiple central offices (COs) by a single CO, and therefore has the potential to offer significant capital and operational savings.

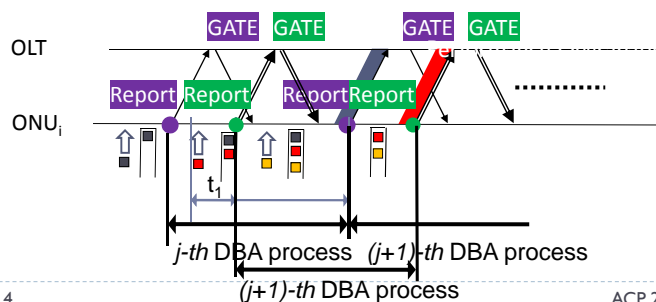
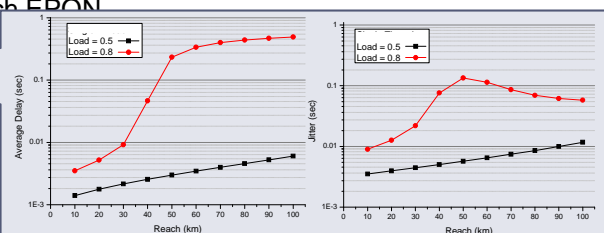
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Multi-thread dynamic bandwidth allocation (DBA)

EPON vs. Long-reach EPON

- ▶ 20km to 100km
- ▶ 1ms (and less)
- ▶ Increased performance.
- ▶ To address the challenge of bandwidth allocation for long-reach



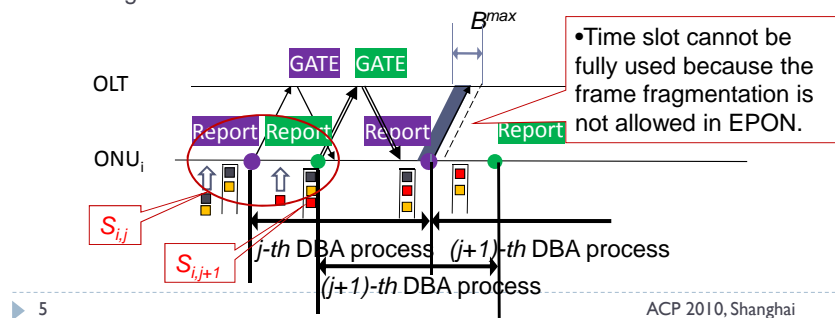
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IPACT with limited service

- Steps of one DBA process

- ONU_i Sending a REPORT with information regarding the amount of required bandwidth $R_{i,j}$, which is typically set as the buffer occupancy $S_{i,j}$
- OLT calculating bandwidth grant $B_{i,j} = \min(B^{max}, S_{i,j})$
 - B^{max} : predefined maximum limit, which is imposed in order to avoid bandwidth hogging by greedy ONUs.
- OLT sending a GATE with information on the start time and length ($B_{i,j}$) of the granted slot



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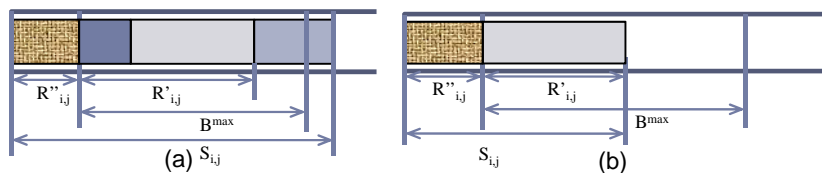
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Enhanced IPACT with limited service

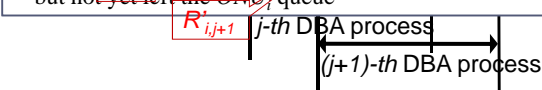
- Steps of one DBA process

- ONU_i Sending a REPORT with information regarding the amount of required bandwidth $R_{i,j}$, which is set as $R'_{i,j}$
 - the adjusted bandwidth demand reported by ONU_i in the *j*-th DBA process

Buffer at ONU_i at the time of reporting for the *j*-th DBA process



$R''_{i,j}$: the bandwidth required by the traffic that has previously been reported to the OLT but not yet left the ONU_i queue



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Simulation parameters

▶ C++ based discrete-event-driven Simulator

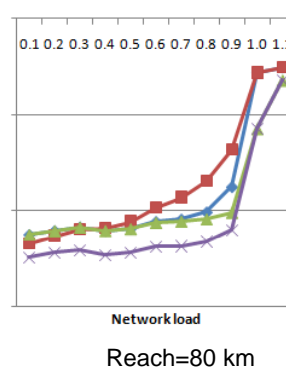
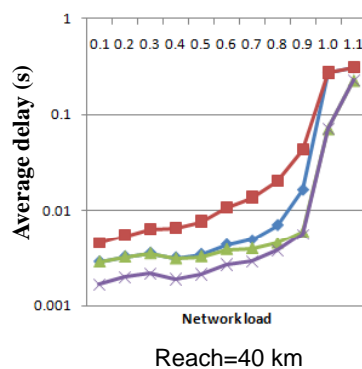
Description	value
Bit rate before line coding	1Gbps
Number of ONUs	32
B^{\max}	1/32 portion of 2-ms polling cycle
Maximum buffer size for each ONU	10 Mbits
Guard bandwidth between two neighboring slots	125 bytes (~ 1 us)
Length of control messages (i.e. GATE and REPORT) in bytes	64 bytes

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Average delay

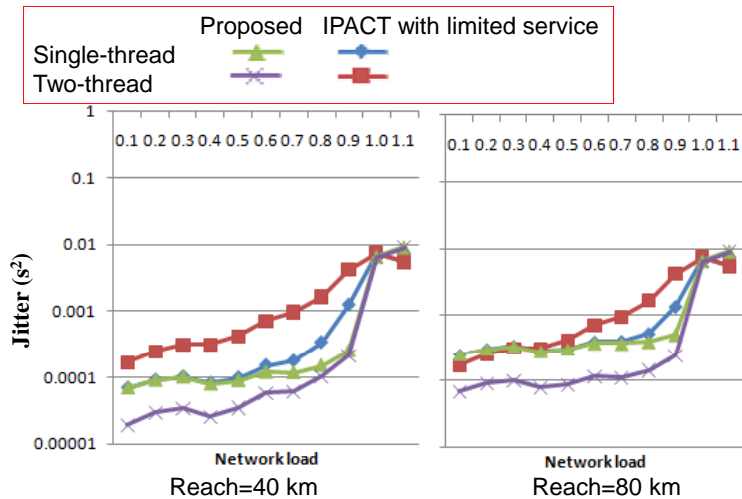
Proposed
IPACT with limited service
Single-thread ▲ ◆
Two-thread × ■



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Jitter



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Conclusion

- ▶ Two main advantages of our proposed enhanced IPACT with limited service:
 1. every frame in the buffer is correctly reported once and only once so that over granting by the OLT is avoided.
 2. the bandwidth assigned by the OLT is always equal to the bandwidth reported. This enables eliminating unused time slots which may occur in the conventional scheme due to the absence of frame fragmentation.
- ▶ Simulation results confirmed that for both single-thread and multi-thread DBA the proposed scheme outperforms the conventional IPACT with limited service in terms of delay and jitter performance.

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Thank you very much!!

