Converged Optical-Wireless Access Networks

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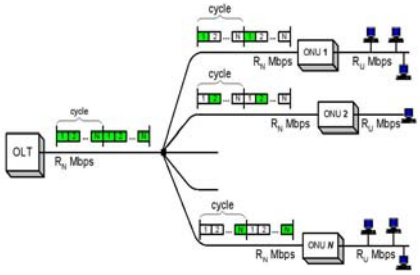
Rapid developments in broadband access technologies for both fixed and mobile network infrastructures are pushing the need for converged optical-wireless access networks that combine mobility with high-capacity. These networks can then deliver high-capacity services with quality-of-service to different types of end users.

Passive Optical Networks

- **Multipoint topologies with tree, tree-and-branch, ring and bus architectures.**
- **Transmission in a PON: between an optical line terminal (OLT) and optical network units (ONUs).**
- **OLT resides in the central office, connecting the optical access network to the metro network.**
- **ONU is located at either the curb (FTTC) or the end-user location (FTTH and FTTB).**
- **In the downstream (from OLT to ONUs) a PON is a point-to-multipoint network, and in the upstream direction it is a multipoint-to-point network.**

EPON - Model Architecture



PARAMETER	DESCRIPTION	VALUE
N	Number of ONUs	16
R_U	Line rate of user-to-ONU link	100Mbps
R_N	EPON line rate	1000Mbps
Q	Buffer Size in ONU	1Mbyte
G	Guard Interval	1μs
T	Cycle time	2ms
W	Timeslot size $W=R_N(\frac{T}{N} - G)$	15500 bytes

- The packet generator generates Ethernet bursts.
- **Pareto Distribution** is the most appropriate choice for traffic generation.

Pareto Distribution

- Pareto Distribution is a heavy-tailored distribution with the probability density function (pdf):

$$f(x) = \frac{ab^a}{x^{a+1}} \qquad x \geq b$$

α is a shape parameter with bounds 1< α <2, and b is a location parameter.

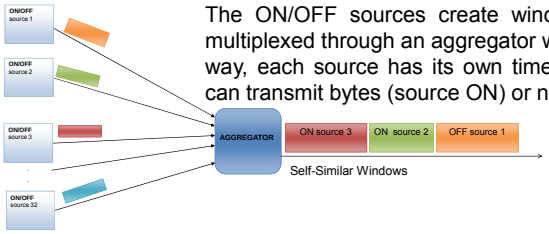
- The generation of self-similar traffic is an aggregation of multiple streams, each consisting of alternating Pareto-distributed ON/OFF periods.
- To generate the Pareto-distributed values, we used the formula :

$$Xpareto = \frac{b}{U^{\frac{1}{a}}}$$

where U is a uniform random variable (0<U≤1) .

- Each one of these sources generates windows of bytes which later are going to be filled with multiple Ethernet packets of size 64 to 1518 bytes.

Packet Generator for generating Self-Similar traffic



The ON/OFF sources create windows and then the windows are multiplexed through an aggregator which acts like a multiplexer. In this way, each source has its own time (byte) window (TDM) in which it can transmit bytes (source ON) or not (source OFF).

Fixed DBA

- Use static slot assignment (SSA)
- Static size which remains unchanged throughout the transmission process.
- Static time interval of 124μs is used corresponding to a frame size of 15500 bytes for each one (of the timeslots).
- Constant cycle time Tcycle, which is 2ms in our case.

Limited DBA

- Does not use SSA.
- Grants the requested number of bytes.
- If the requested number of bytes exceed the maximum transmission window it just grants the maximum transmission window (15500 bytes).
- Time cycle is not fixed, cannot exceed the 2ms (max).
- It has the shortest cycle of all the implemented schemes.

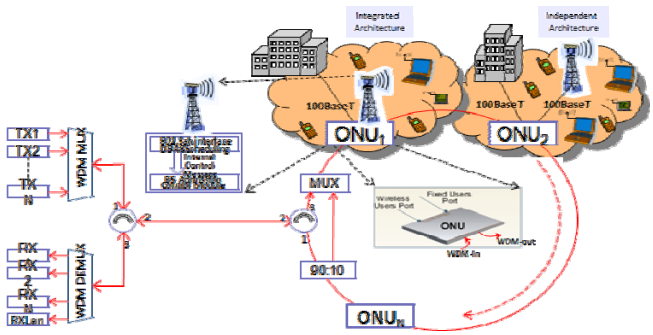
Gated DBA

- Does not place any limits on the cycle time or the granted window size.
- A limiting factor is the buffer size Q. An ONU cannot store more than Q bytes in the buffer and thus it will never request more than Q bytes.

Integration of Next-Generation PON with 4G mobile broadband access technologies

- Integration of next-Generation PON (NG-PON) with the 4G mobile broadband access technologies into a fixed-mobile platform utilizing an innovative ring-based WDM-PON.

- **Provides:**
  - The best overall system performance
  - Cost-effectiveness
  - Bandwidth utilization
  - Better QoS
  - Speedy handoff schemes for the mobile nodes.



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This work is funded by the European Regional Development Fund and the Republic of Cyprus through the Research Promotion Foundation (TPE/EPOIK/0609(BIE)/07).