

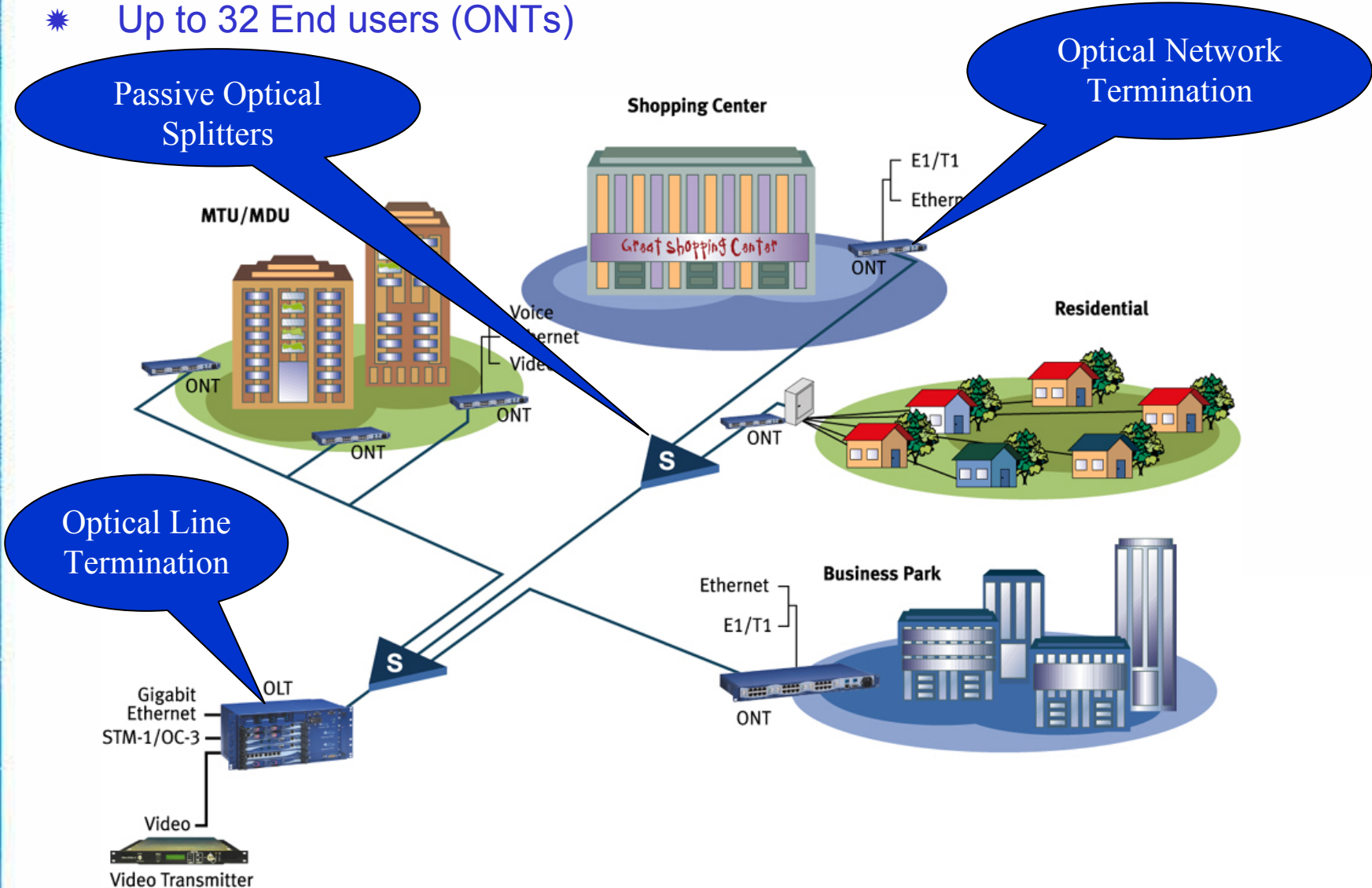
GPON – The Next Big Thing in Optical Access Networks

By FlexLight Networks

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What is a PON

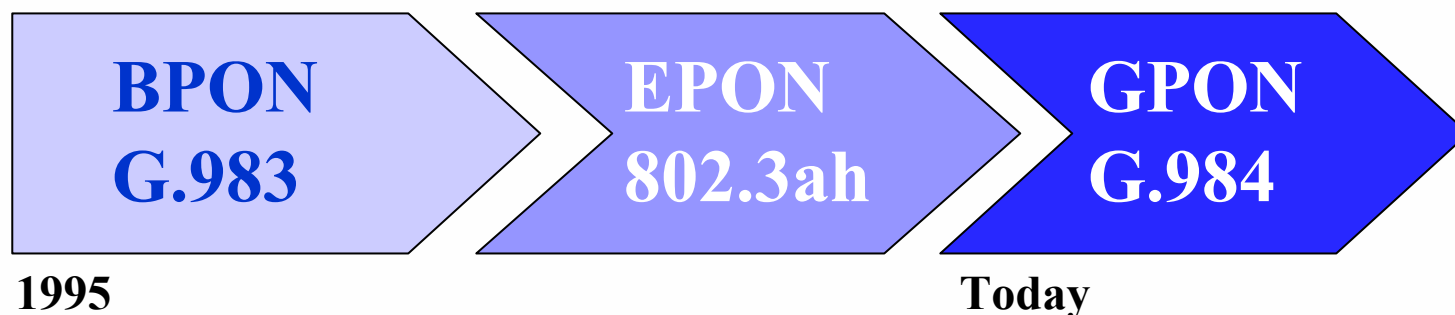
- ★ 1 OLT at the Central Office
- ★ Up to 32 End users (ONTs)



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PON Standards

-PON Evolution Timeline-



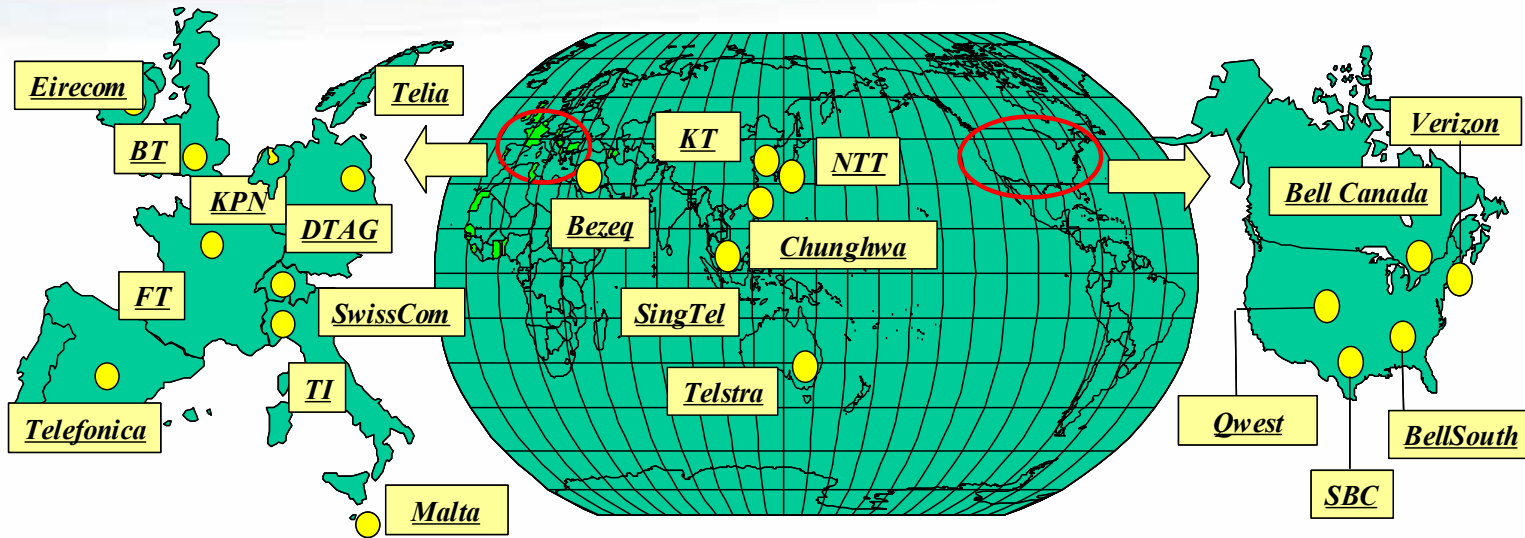
- * ATM-based PONs
- * Early BPON products tested and installed in limited quantities by carriers
- * Supports Voice and Data
- * 622 Mbps bandwidth ~70% Efficiency
- * Adopted as ITU standard in 1999

- + EPON = Ethernet-based PONs
- + Emerging market, especially for Metro Ethernet
- + Efficiency (for voice and data services) - ~ 49%
- + 1Gbps bandwidth
- + IEEE acceptance expected only in **2004**

- + GPON = Gigabit PON
- + Evolution in FSAN Committee for Voice and Data in their native format
- + Efficiency (for voice and data services) - ~ 92%
- + 2.5Gbps+ of bandwidth at 92% Efficiency
- + ITU ratification based on FlexLight's proposal in **2003**

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FSAN/ITU supporting GPON



21 operators and 29 vendors, as of Nov. 2003

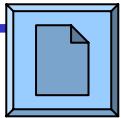
| | | | | | | |
|---------------------|-----------|-------------------|-------------------|------------|----------|-------------|
| AFC | Agere | Alcatel | Broadcom | BroadLight | Cisco | Entrisphere |
| Ericsson | FlexLight | Fujitsu | Hitachi | Iamba | Infineon | INOVIA/ECI |
| Intel | Lucent | Marconi | Mitsubishi/Paceon | Motorola | NEC | |
| Nortel | OFN/Oki | Optical Solutions | Quantum Bridge | | | |
| ST Microelectronics | Samsung | Terawave | Vinci | Zonu | | |

- * FSAN selected FlexLight's proposal for GPON standard in September 2002
- * FSAN proposal to ITU January 2003

What's GPON

- ✦ In early 2001, the FSAN group initiated a new effort for standardizing PON networks operating at bit rates above 1 Gb/s.
- ✦ The FSAN consortium initiated a GPON Task Group:
 - ✦ G.GPON.GSR – Gigabit Service Requirements
 - ✦ G.GPON.GPM – Gigabit Physical Media
 - ✦ **G.GPON.GTC** – Gigabit Transmission Convergence
- ✦ There were 3 leading TC candidates
 - ✦ ATM Based Enhanced BPON
 - ✦ Ethernet based EMCPC (Modified EPON)
 - ✦ PMFTC
- ✦ FlexLight Led the PMF-TC team:
 - ✦ Supported by **6** PON Vendors: Quantum Bridge, Optical Solutions, FlexLight, Agere, Marconi, Infineon.
 - ✦ PMF-TC protocol is **similar** to FlexLight's *FlexWin* TC protocol

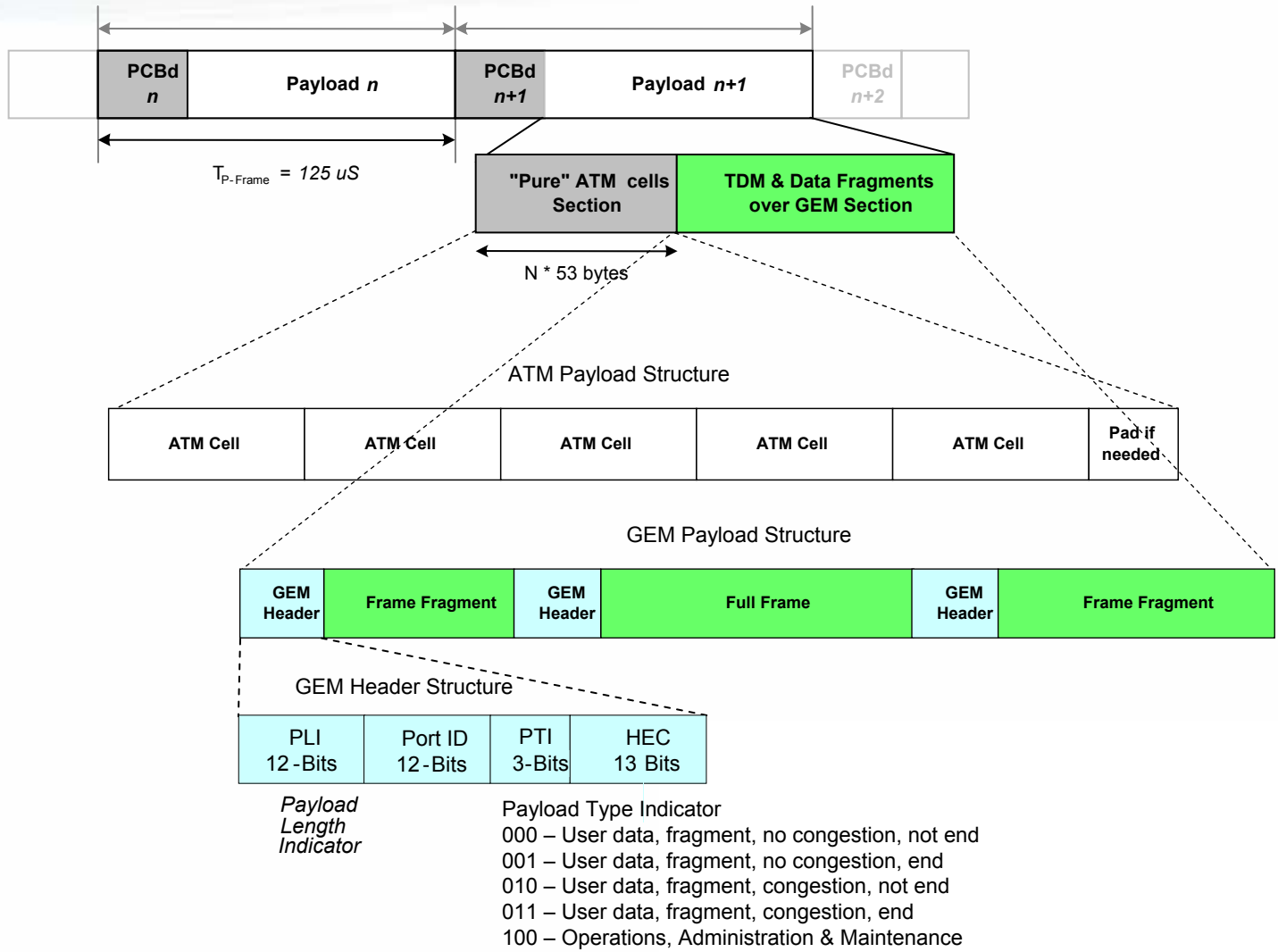
GPON Status

- ✦ In Sep 2002 PMFTC was selected as the GPON TC frame because of its high efficiency for all services
- ✦ In January 2003, ITU-T SG15 accepted the 3 main GPON documents
 - ✦ G.984.1 – GSR - Done
 - ✦ G.984.2 – GPM - Done
 - ✦ G.984.3 – GTC – Done
- ✦ ITU official Announcement . 
 - GPON will be standardized 1 year before EPON
 - FlexLight is and will be the 1st GPON compliant vendor

GPON TC main features

- ✦ 125us, frame based transmission;
 - ✦ Scalable framing structure for 622 Mbps to 2.488 Gbps and beyond
 - ◆ 2.488 Gbps = 38880 bytes per frame.
 - ✦ Asymmetric rates supported
- ✦ **GEM** (Similar to GFP ITU-T G.7041) encapsulation of any type of Service (Both TDM and packet)
 - ✦ Highly efficient, no overhead transport of native TDM traffic
 - ✦ Supports pure ATM transmission mode
- ✦ Use of Pointers to allocate U/S bandwidth
 - ✦ Minimizes number of transmission switch-overs between ONTs
 - ✦ Allows for **variable** guard time allocation by OLT
- ✦ Maximal reuse of G.983 concepts
 - ✦ DBA, Protection, Ranging, PLOAM Message set, etc.
- ✦ Exceptionally High BW Utilization for any type of service
- ✦ Native transport of TDM traffic

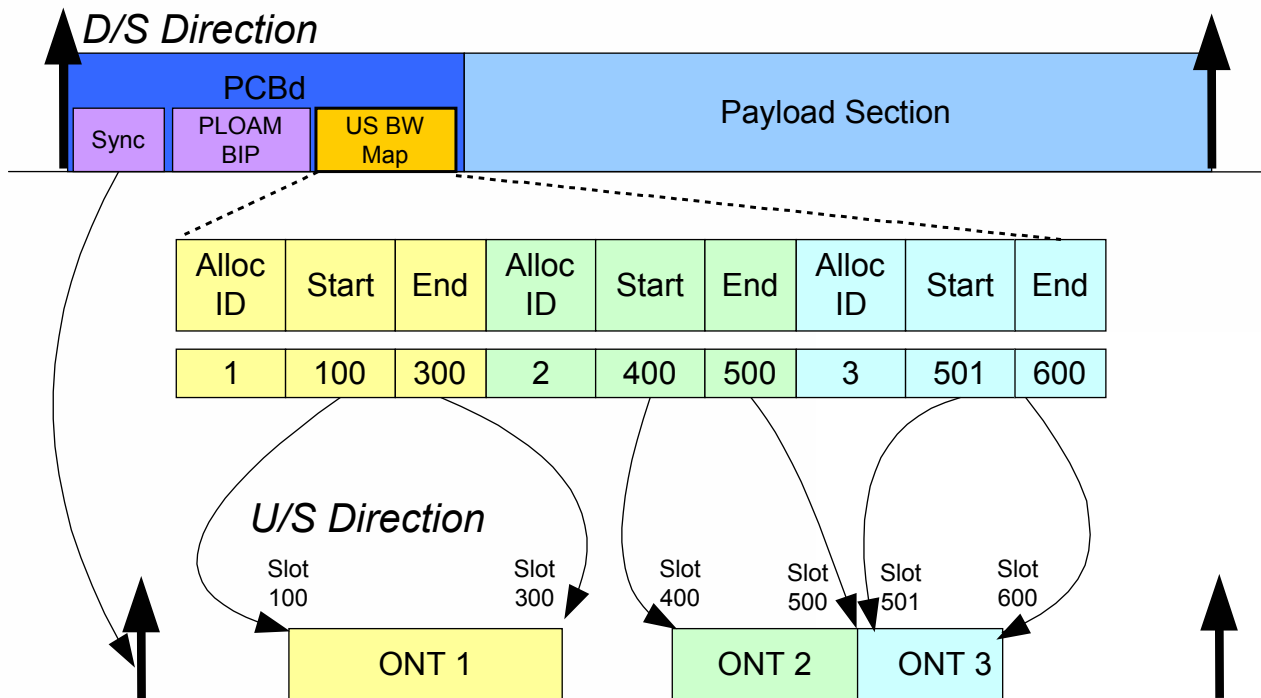
GPON Payload Structure



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Pointer Mechanism

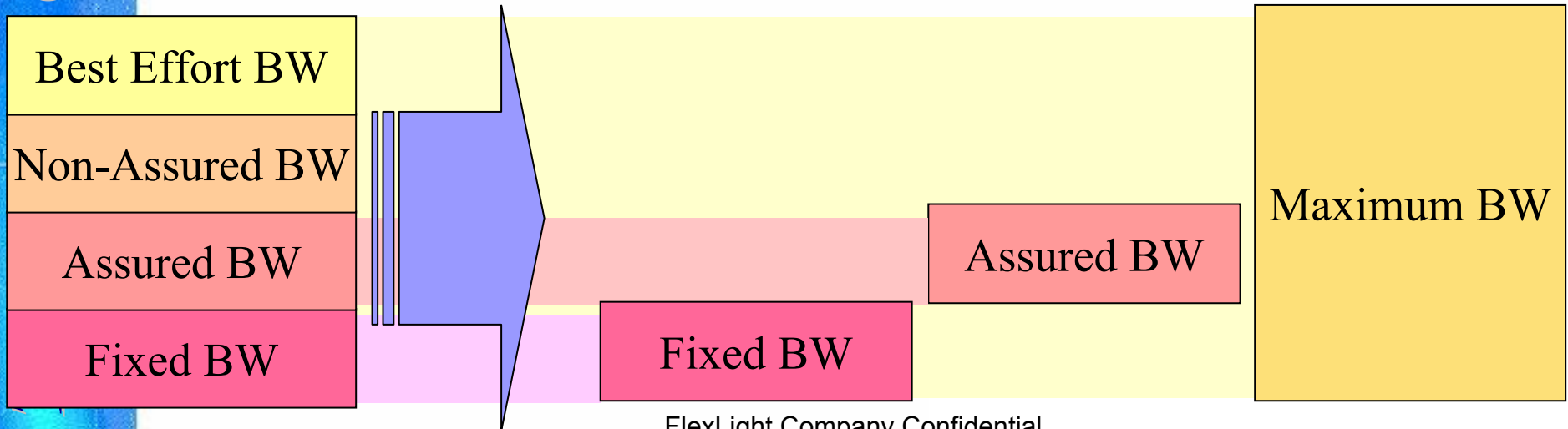
- ✦ Pointers mechanism controls ONT U/S transmission.
- ✦ The U/S Frame is divided into multiple small slots
 - ✦ TS size is 4 bytes. 125us & 1.24 Gbps yields 4860 TS
 - ◆ 1.244Gbps = 19440 bytes per frame
- ✦ Pointer structure:
 - ✦ Start Pointer: ONT Start TX at the Start-Pointer timeslot
 - ✦ End Pointer: ONT Stop TX at the End-Pointer timeslot



Ethernet: DBA

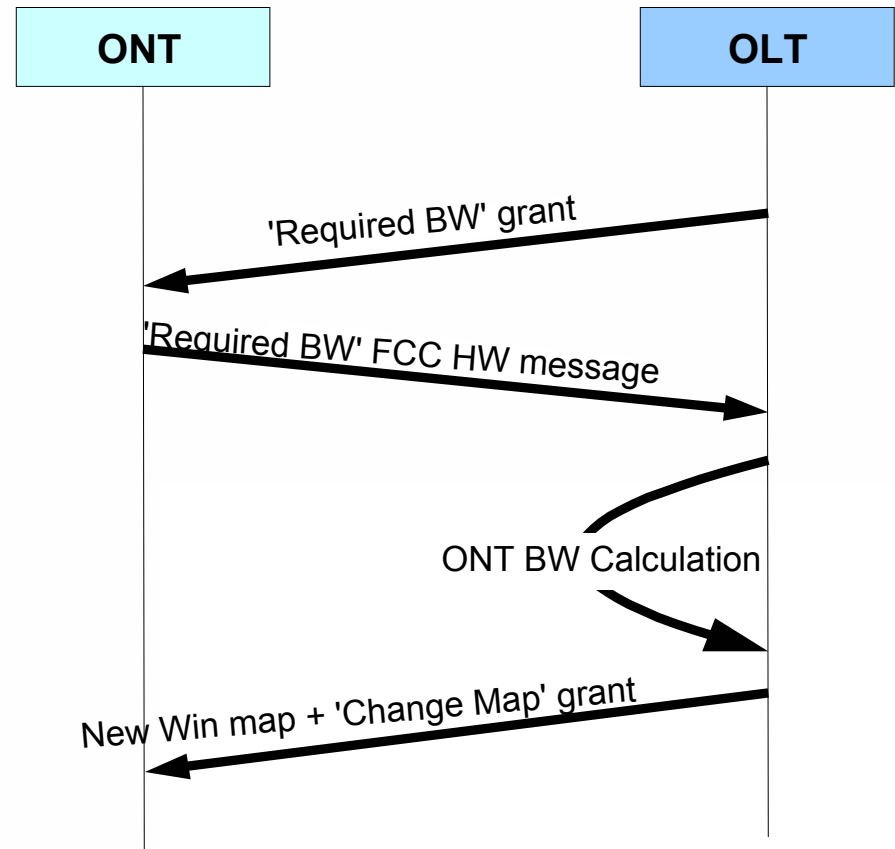
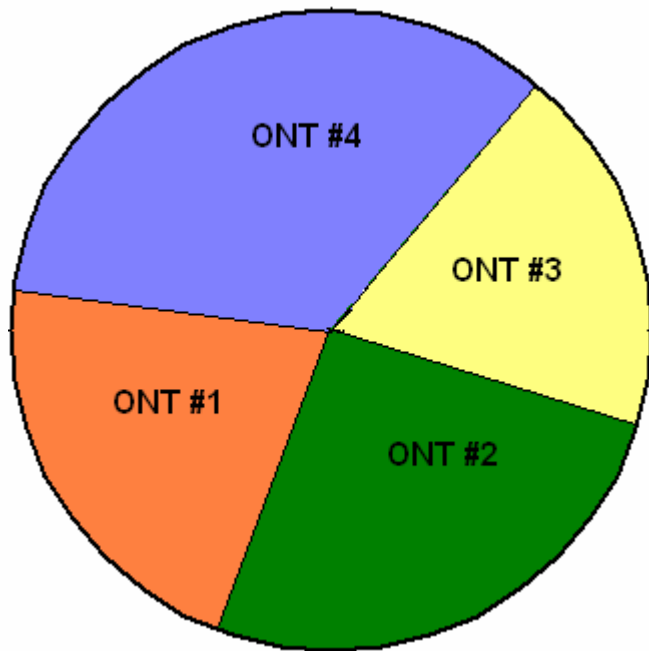
- ✦ Per Port/Channel, a Traffic Descriptor is assigned
- ✦ The Traffic Descriptor defines/provisions the following traffic parameters:
 - ✦ Fixed bandwidth
 - ✦ Guaranteed (Assured in G.984) bandwidth
 - ✦ Maximum bandwidth

GPON



DBA Flow

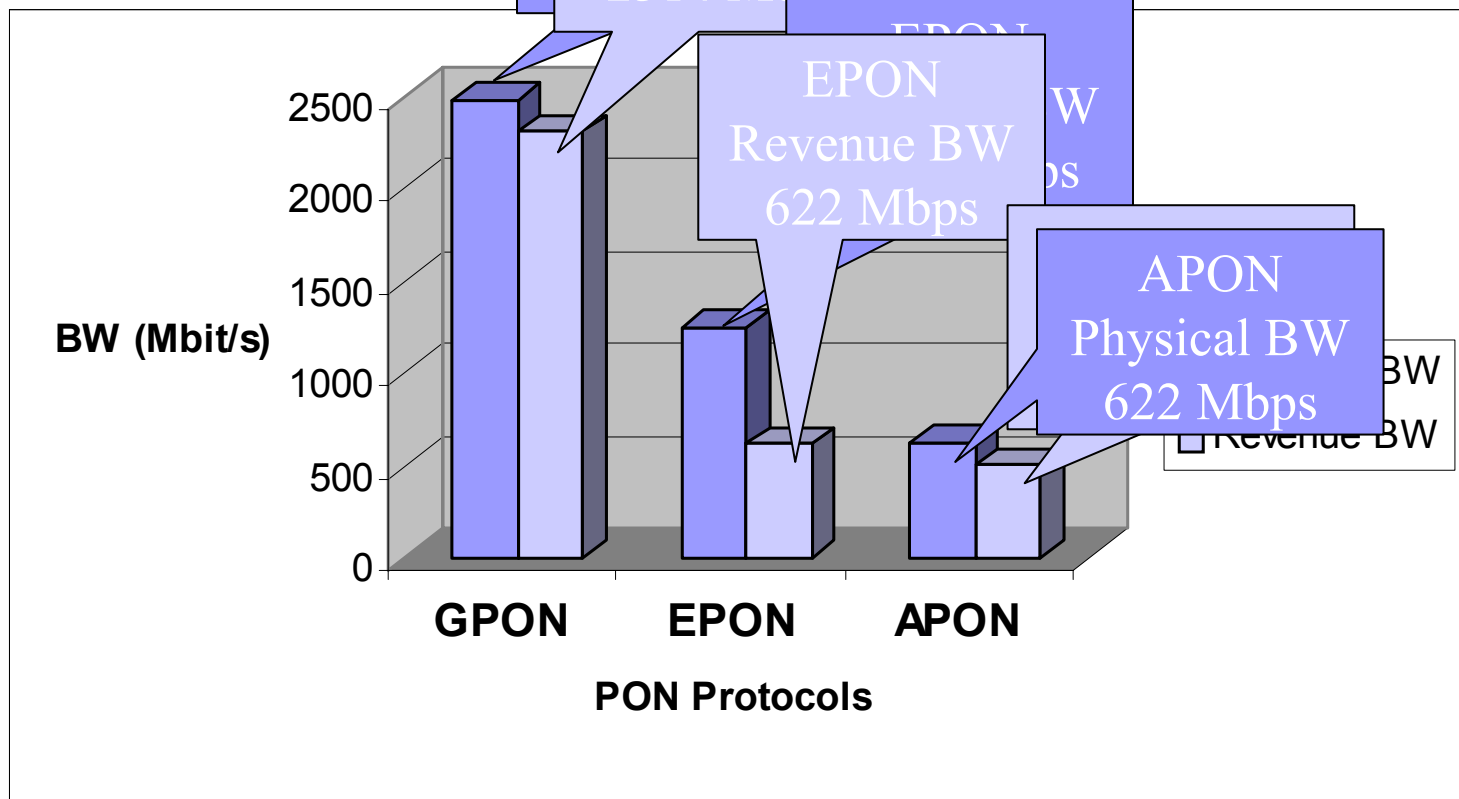
- ⊕ The ONTs dynamically request U/S BW.
- ⊕ OLT reassigns the U/S BW, when available, accordingly.



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Efficiency Considerations

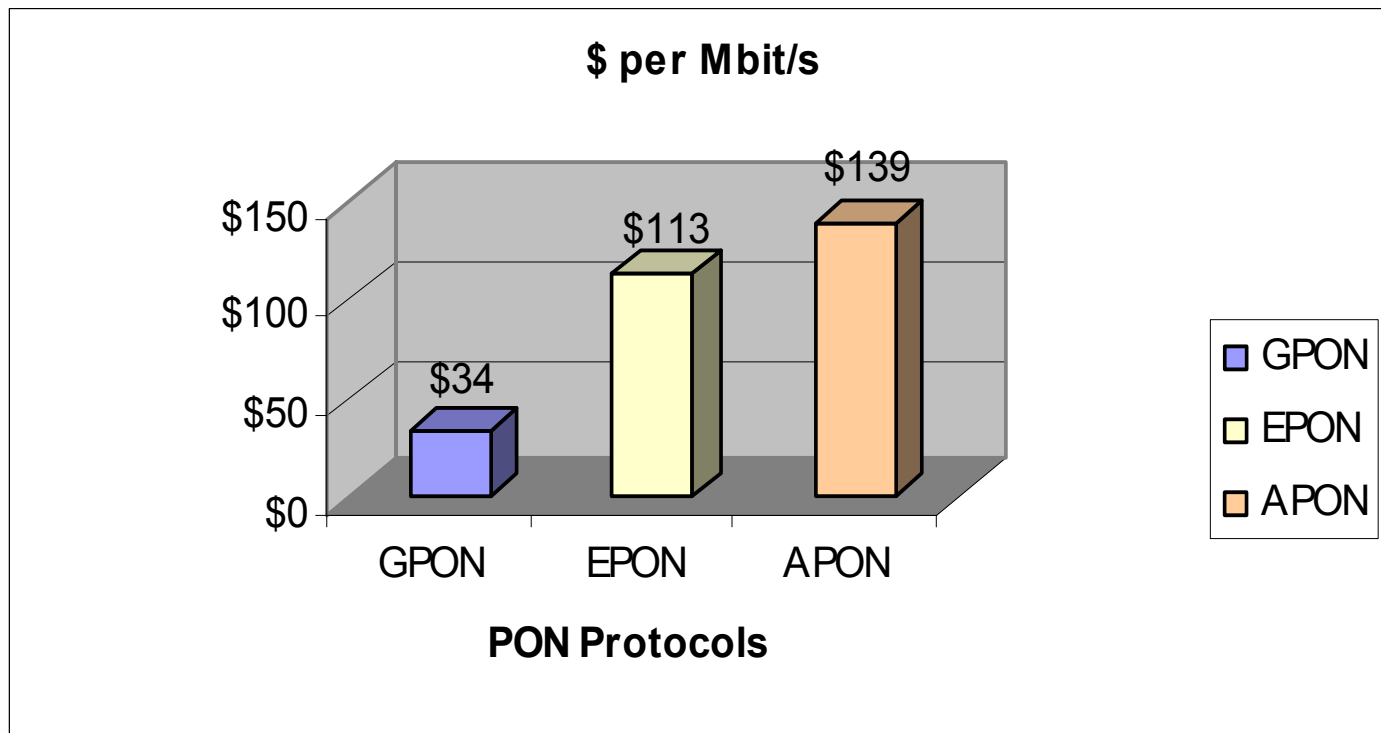
- ★ GPON has the highest bit rates & efficiency
- ★ More BW can be used for revenue services. GPON has the lowest price



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Model 1: \$ per Mbit/s

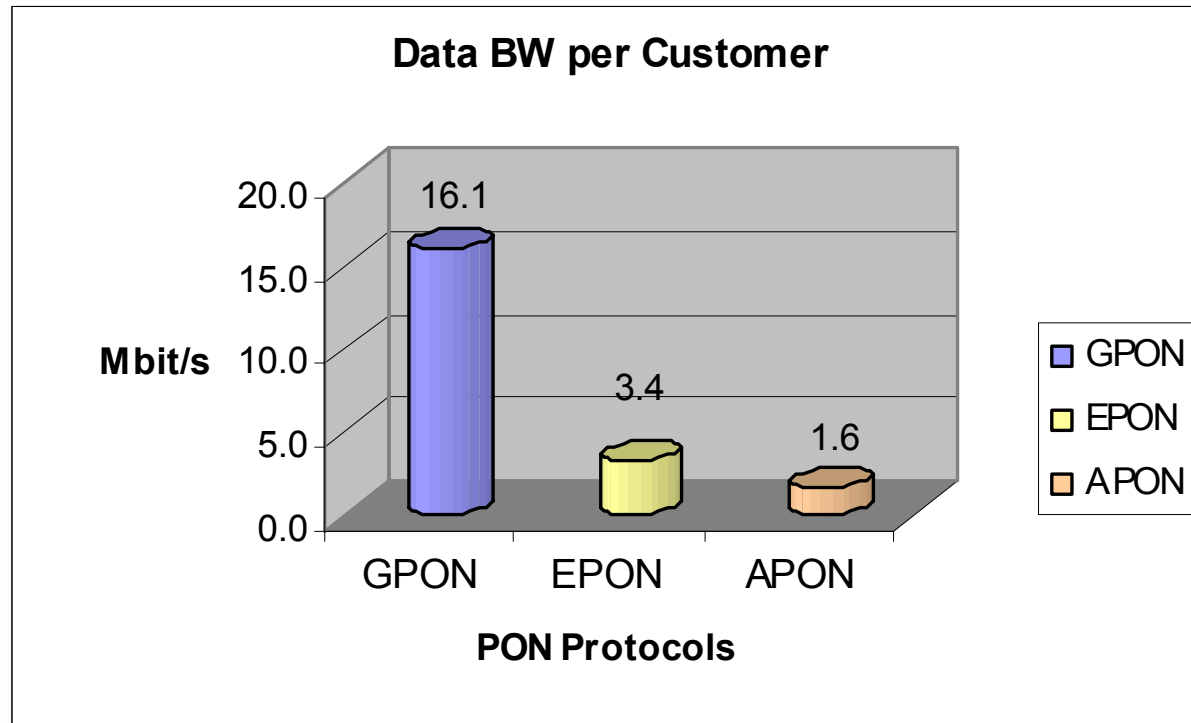
- * 1 OLT and 16 ONTs
- * GPON & EPON Equipment Prices are similar
- * APON price is lower (Slower optics)



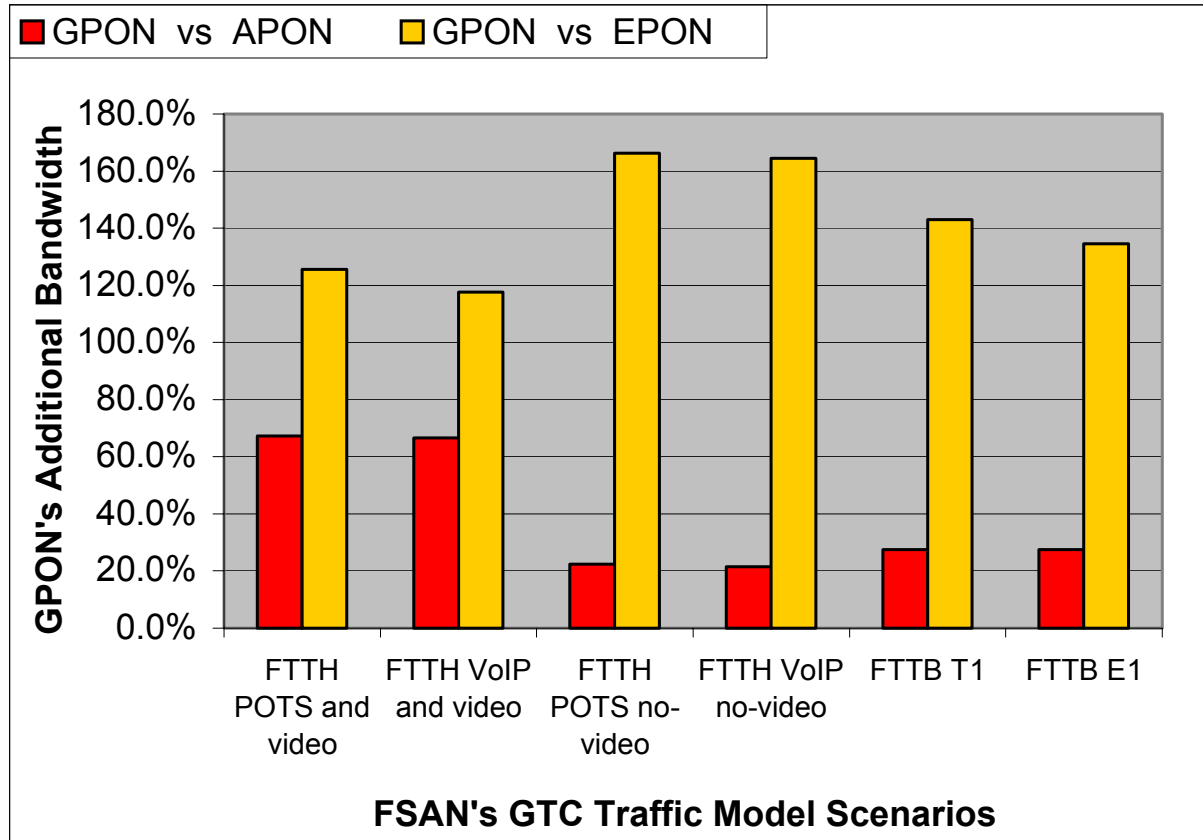
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Model 2: Data BW per user

- ✦ How much BW is left for each Customer
- ✦ 32 Buildings. 4 Customers/Building
- ✦ Each Customer requires 1 E1/T1 and 1 10/100 Ports

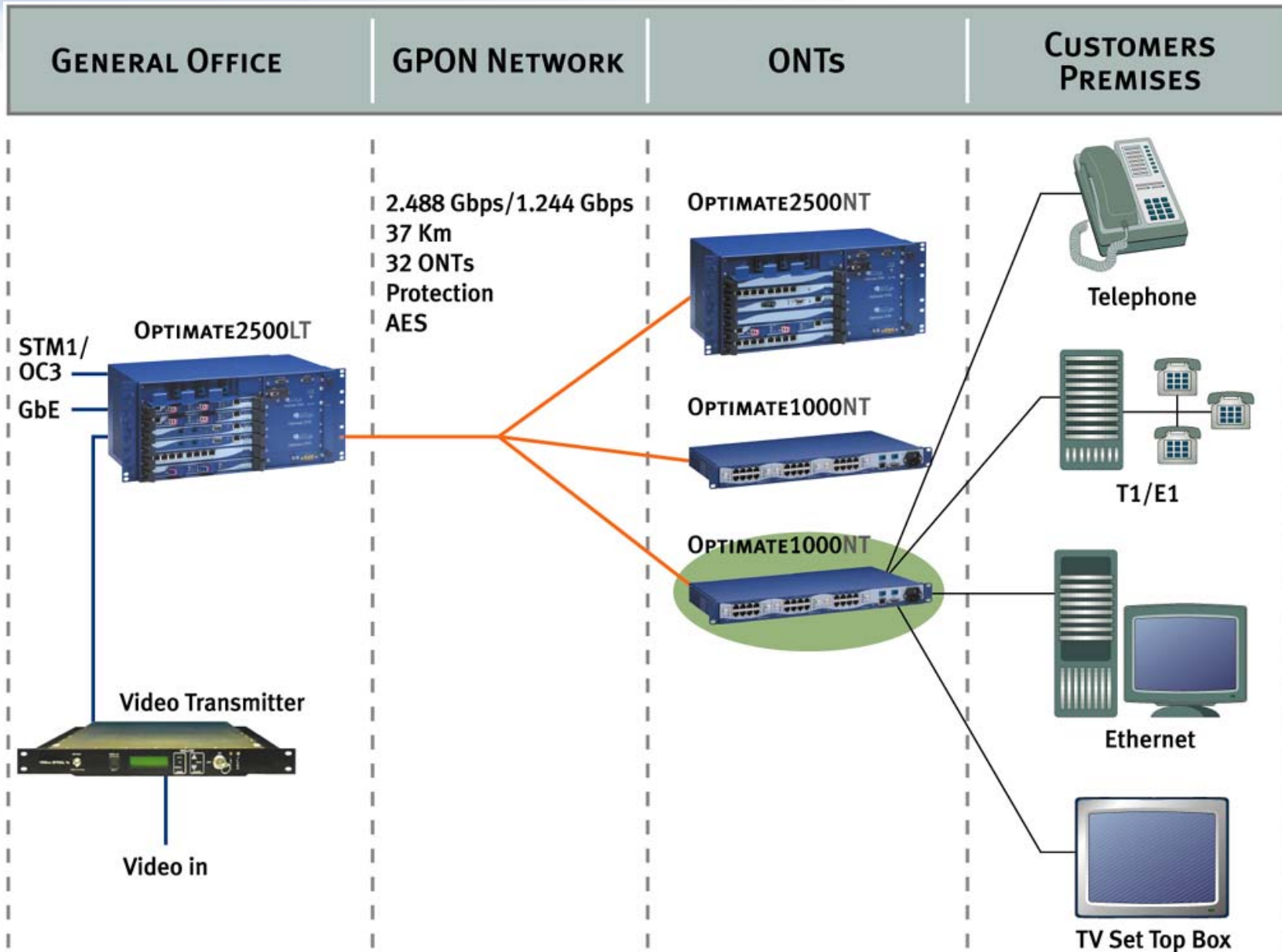


System Performance



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FlexLight's Revolutionary PON System



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