Extended EPON Power Budget Feasibility

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802.3av PR30

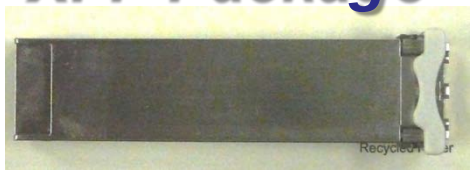
- Generally, IEEE specifies numbers focusing cost and interoperability
  - Occasionally, additional user/vender-specific requests are applied
- 10G-EPON PR30 (29dB ChIL symmetric) was a challenge
  - 802.3av TF specifies the practically optimum solution for PR30
    - 10G top-power lasers (EML/DML) are to be equipped
    - Optics supply reality reflected (product deviation, TDP, penalty, etc.)
    - PON parameter considered (burst, interoperability, volume, cost, etc.)
  - 1G/10G co-existence option enables smooth system upgrades

ChIL	20dB	24dB	29dB	32dB ??	?? dB
802.3ah	PX10	PX20	Missing	Maybe	Maybe
802.3av	PR10	PR20	PR30	??	Difficult
	PRX10	PRX20	PRX30	?	?

PR30 Optimum Solution

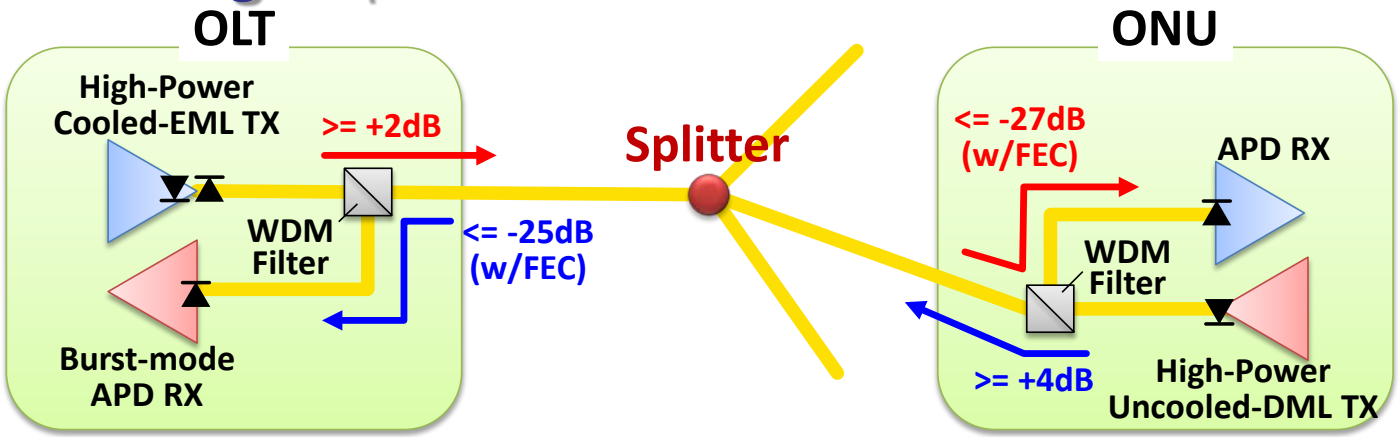
- Top-power EML/DML are to be equipped in OLT/ONU
  - Significant power increase is not possible
- Optical Amp.-less structure (OLT)
  - XFP-type OLT, using simple triplexer optics, is commonly designed by transceiver suppliers

XFP Package



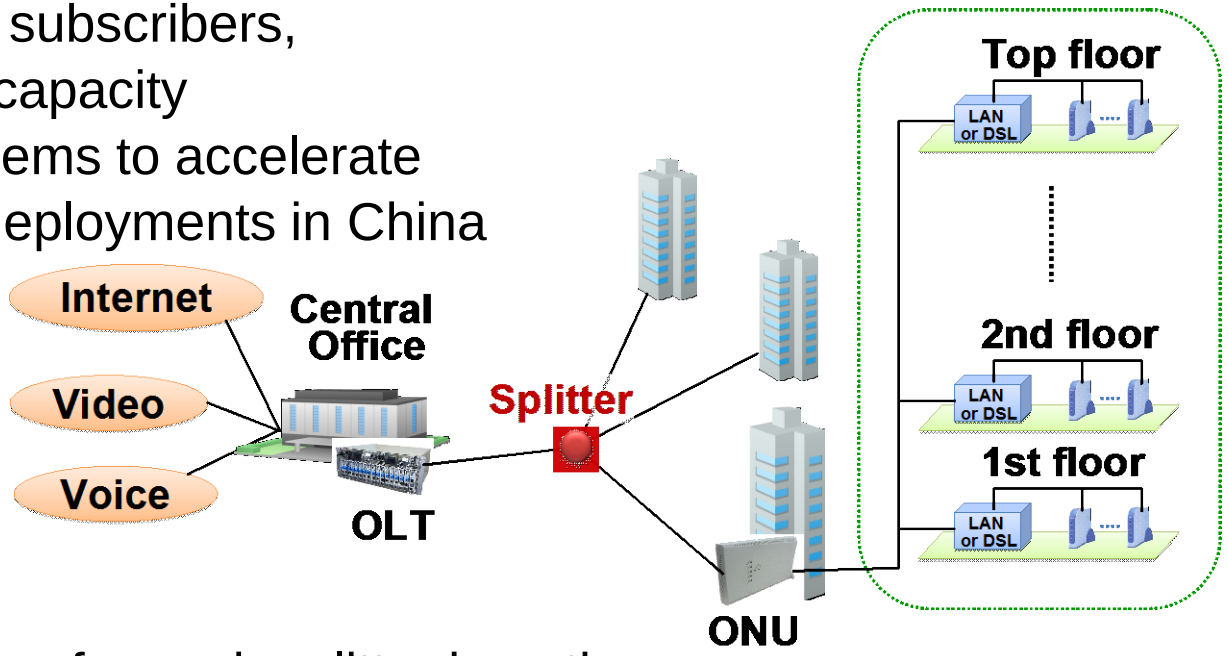
- Sufficient and flexible APD-RX sensitivity margin
  - Stressed RX sensitivity was defined mandatory, not RX sensitivity
  - Yield free production, multi-source availability, and smooth OLT/ONU interoperability, will reduce the real 10G TRX cost

PR30 Budget (TX Launch Power / RX Stressed Sensitivity)



Splits, Range, or Capacity ??

- Capacity targets per subscriber??
  - FTTB + LAN/DSL structure enables a PON to support multiple subscribers, but limits average capacity
  - Capacity desire seems to accelerate early 10G-EPON deployments in China

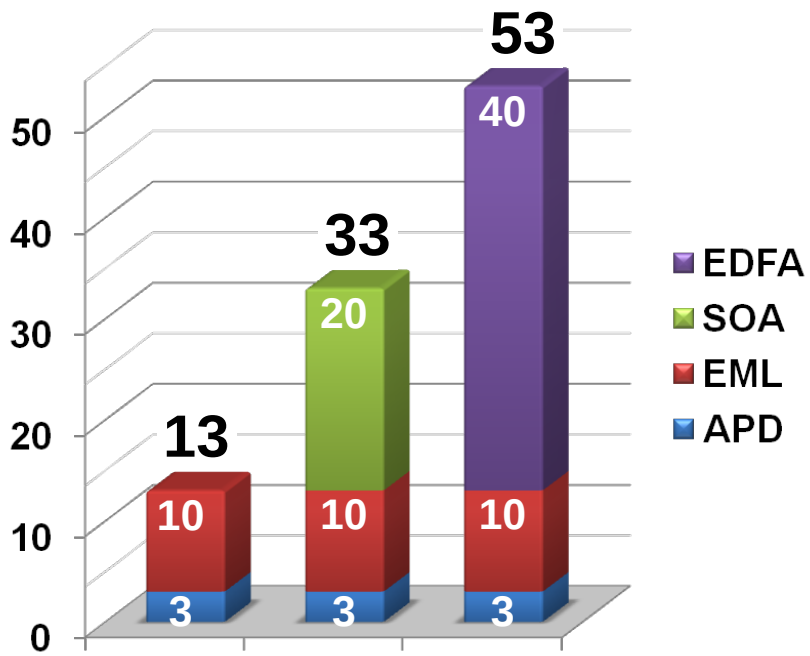


- More splits??
  - >3dB loss necessary for each splitter insertion
  - Tradeoff between splits vs average capacity
- Longer Reach??
  - Fiber loss & Penalty allocation necessary
  - Reach Extender (RE) to be a discussion focus??

10G OLT Enhancement

- ONU should stay PR30 compliant, no change preferred for cost
  - 10G-EPON (asymmetric) already starts volume deployments
  - ONU 10G DFB power increase seems difficult
- 10G OLT Downstream power enhancement :
  - Optical Amplifier (OA) booster necessary
  - EML/SOA integration (hybrid, or rather, monolithic) ??

OLT Cost with Discrete OA Booster



Relative Cost

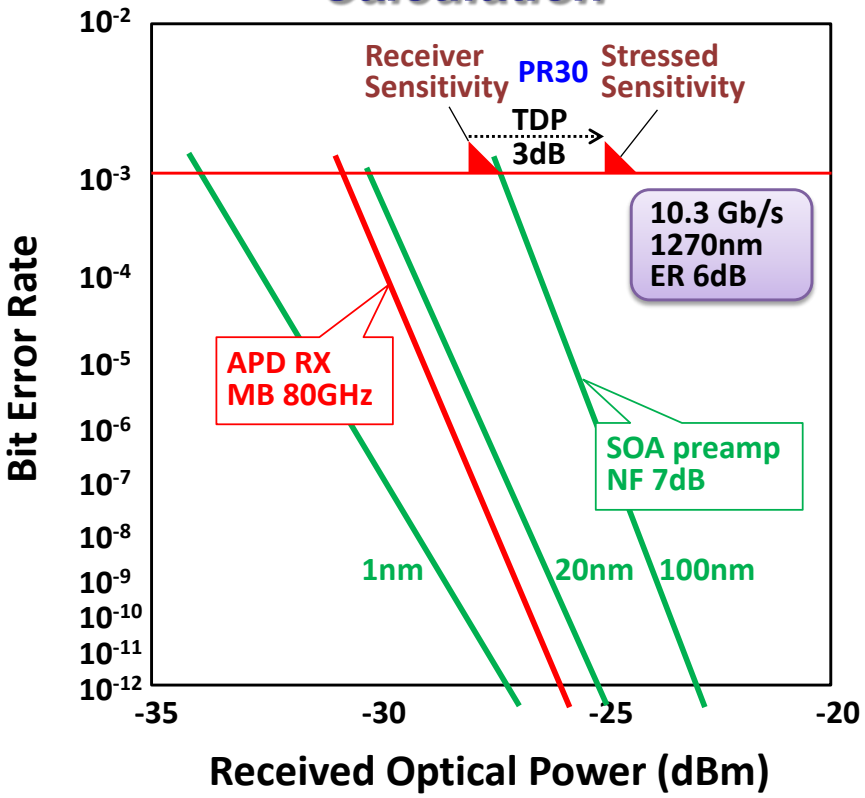
	Lee/ Schrans
PIN ROSA	1
APD ROSA	3
EML TOSA	10
SOA	20
EDFA	40

10G 32dB Upstream

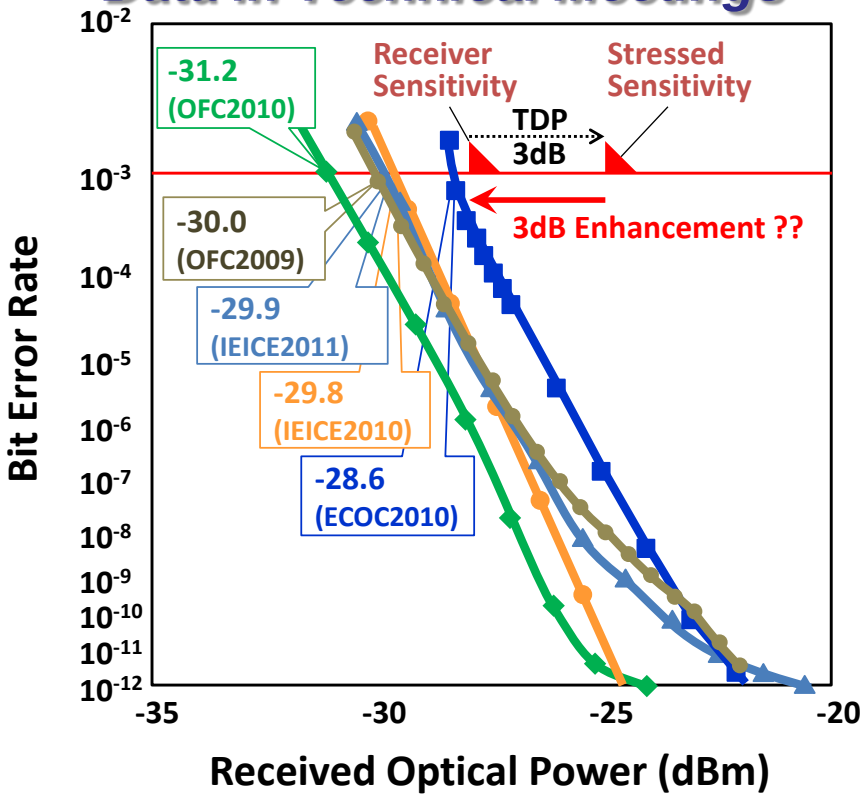
- 10G OLT Upstream RX sensitivity enhancement:
  - SOA preamplifier does not improve RX sensitivity
  - Penalty/margin reduction only helps, but yield raises TRX cost

10G RX Sensitivity

Calculation



Data in Technical Meetings



Conclusion

- 10G 32dB budget class can be defined theoretically,
  but its cost reduction may be a long-term target
  - Downstream :
    New development for OA-integrated high-power source
  - Upstream :
    Precise penalty assumption and optics selection for production cost and interoperability
- G-EPON PX30 is missing and should be specified
  - Further 1G extension may also be possible:
    ONU/OLT power increase, FEC introduction
- Current 10G PR30/PRX30 volume market penetration is the KEY
  - User/venders strong and continuous 10G PR30/PRX30 supports are definitely necessary, for real 10G TRX cost reduction and also its budget enhancement

Thank You !!