10/10 and 10/1 budgets

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10 Gb/s components

- NOTE: All values here use the ITU formalism, which assumes an ER~10 dB
- 10 Gb/s receivers (CW mode)
  - PIN-based: sensitivity around -18 dBm
  - APD-based: sensitivity around -24 dBm
- FEC
  - A pretty safe swag at FEC optical gain: 4 dB
- So, with FEC, the receivers can give us
  - PIN-based: sensitivity around -22 dBm
  - APD-based: sensitivity around -28 dBm

Budget, Loss, and Penalties

- Here, we use the following definition:
  - Budget = Loss + Penalty = Tx(min) – Sensitiv.
- Estimates of 10G penalty:
  - Upstream: 2 dB, assuming DM laser at 1310nm
  - Downstream: 1 dB, assuming EM laser at 1570nm
- Straw polls indicated an interest in defining three budgets:
  - “PX10” : 20 dB loss, 22+1 dB budget
  - “PX20” : 24 dB loss, 26 dB budget
  - “B++” : 29 dB loss, 31 dB budget
- Let’s assume a dynamic loss range of 15 dB

Our blessed single data point

- The 1GE-PON OLT sensitivity is -29.7 dBm (at an ER of 10 dB)
  - Let’s call it -30 dBm, between friends?
  - The following slide shows a best-effort at trying to reconstruct the whole budget(!)
- From the dual-rate burst mode analysis
  - Simple ‘parallel’ receiver will have a sensitivity delta of ~7 dB between 1.25G and 10G
- So, 10G sensitivity of -23 dBm is what we need
  - With FEC, that gives us -27 dBm

Upstream 1G Budgets (no FEC)

(dBm)	PX10		PX20		B++
OLT Rx Sens	-24	3	-27	3	-30
Budget (dB)	22+1	4-1	26	5	31
Tx Min	-1	0	-1	2	+1
Tx Max	+4		+4		+6
Rx Over	-3		-3		-10

Upstream 10G Budgets (FEC)

(dBm)	PX10		PX20		B++
OLT Rx Sens	-21	3 →	-24	3 →	-27
Budget (dB)	22+1	4-1 →	26	5 →	31
Tx Min	+2	0 →	+2	2 →	+4
Tx Max	+7		+7		+9
Rx Over	-1		-1		-7

Downstream 10G Budgets (FEC)

(dBm)	PX10		PX20		B++
ONU Rx Sens	-20	0 →	-20	2 →	-22
Budget (dB)	21	4 →	25	5 →	30
OLT Tx Min	+1	4 →	+5	3 →	+8
OLT Tx Max	+5		+9		+12
ONU Rx Over	-2		-2		-4

Port Types and Names

- 10G symmetric PON Designation: PR
- 10G/1G PON Designation: PRX
- Budget: 10, 20, 30(?)
  - ONU parts for 10 and 20 are common
- Direction: -D=OLT part, -U=ONU part
- We get 12 port types (10 distinct)
  - PR10-D, PR20-D, PR-30-D
  - PR10-U = PR20-U, PR30-U
  - PRX10-D, PRX20-D, PRX30-D
  - PRX10-U = PRX20-U, PRX30-U

Combination Ports

Downstream		Upstream		
10G	1G	10G	1G	Comments/Name
0	0	0	0	No downstream or upstream!
0	0	0	1	No downstream!
0	0	1	0	No downstream!
0	0	1	1	No downstream!
0	1	0	0	No upstream!
0	1	0	1	PX – Already exists
0	1	1	0	Kind of stupid – 1G down and 10G up?
0	1	1	1	Really stupid – 1G down and combo up?
1	0	0	0	No upstream!
1	0	0	1	10G down, 1G up: PRX
1	0	1	0	10G symmetric: PR
1	0	1	1	10G down, Both up: PRRX
1	1	0	0	No upstream!
1	1	0	1	Both down, 1G up: PRXX
1	1	1	0	Kind of stupid – 1G down and 10G up?
1	1	1	1	Both down, both up: PRXRX

The speed designation

- Gigabit is called “1000BASE”
- 10 Gigabit is called “10GBASE”
- The pure cases would reuse these
- Hybrid case could use “10/1GBASE”
- Dual downstream support could use “11GBASE”

Downstream		Upstream		
10G	1G	10G	1G	Comments/Name
0	1	0	1	1G down, 1G up: 1000BASE-PX – Already exists
1	0	0	1	10G down, 1G up: 10/1GBASE-PRX
1	0	1	0	10G symmetric: 10GBASE-PR
1	0	1	1	10G down, Both up: 10GBASE-PRRX
1	1	0	1	Both down, 1G up: 11GBASE-PRXX
1	1	1	1	Both down, both up: 11GBASE-PRXRX