Single Fiber, Single wavelength, GbE / FE transceiver – Technical Issues

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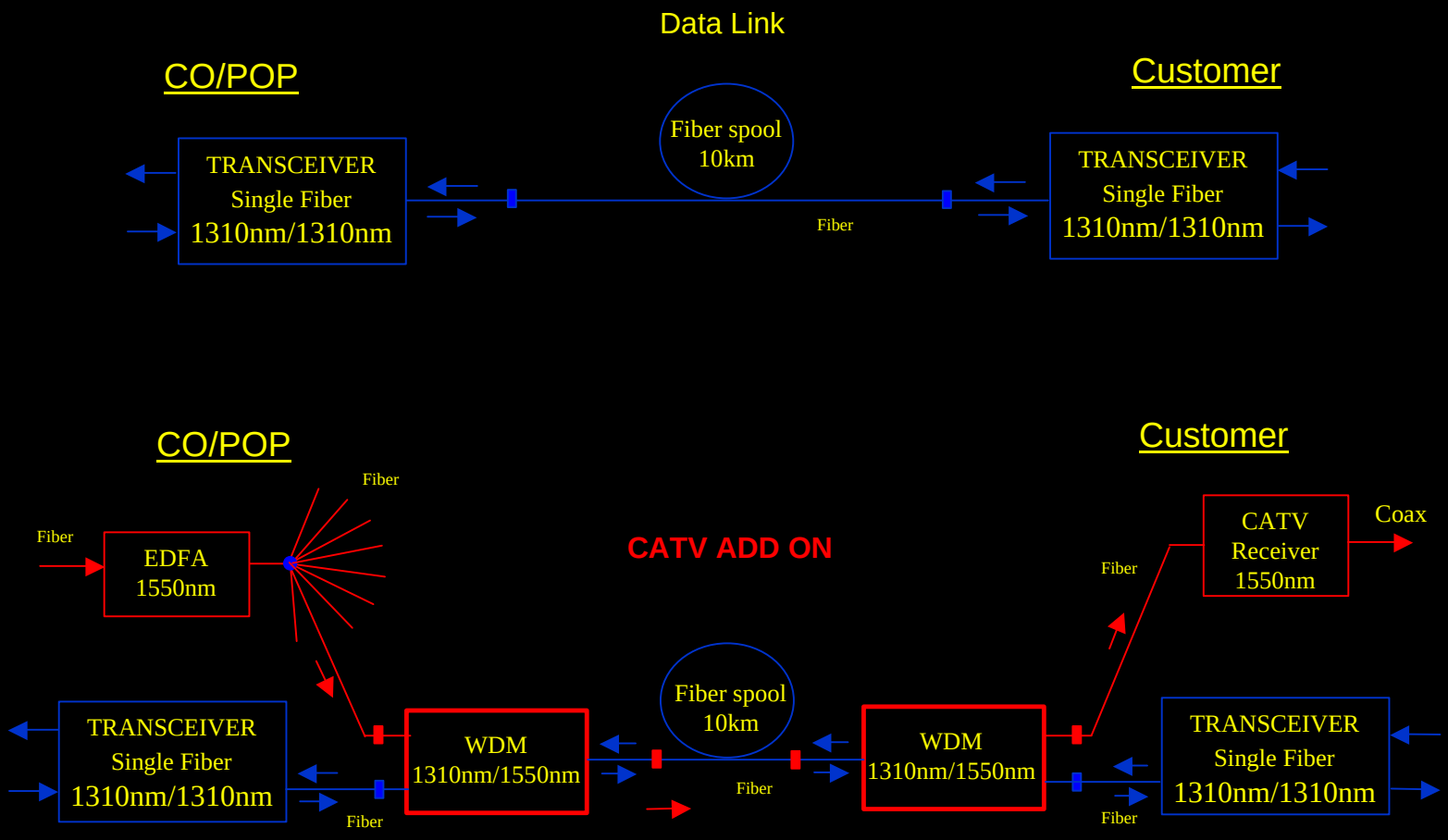
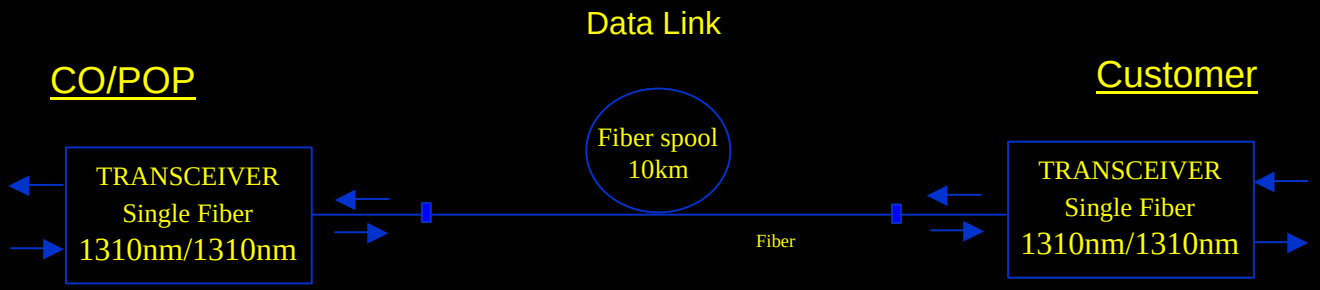
Table of Benefits

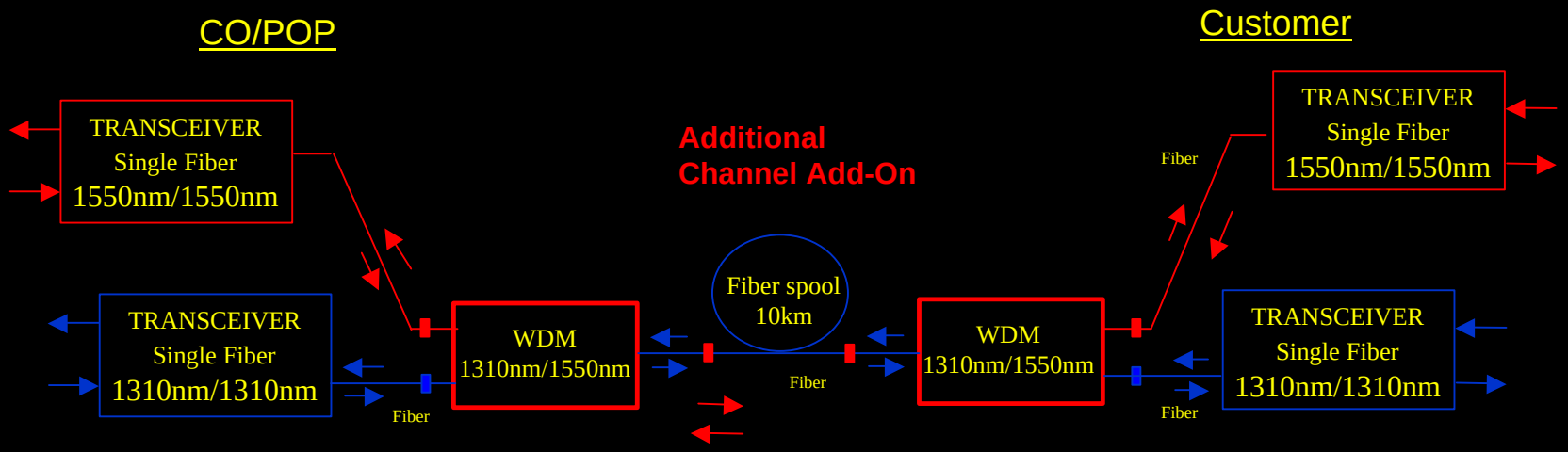
- Data Rate issues (see other presentation)
- Operation over worst-case cable plant (action item 4) (see other presentation)
- “Foreign ingress” light coming back into the laser – single wavelength (action item 3) (see other presentation)
- Compatibility with future CATV overlay AT NO UPFRONT COST
- Additional features
- DFB vs. FP – relative cost (action item 2)
- Ability to extend to longer distances (action item 5)
- Baseline

CATV add on for single wavelength bi-directional digital transmission

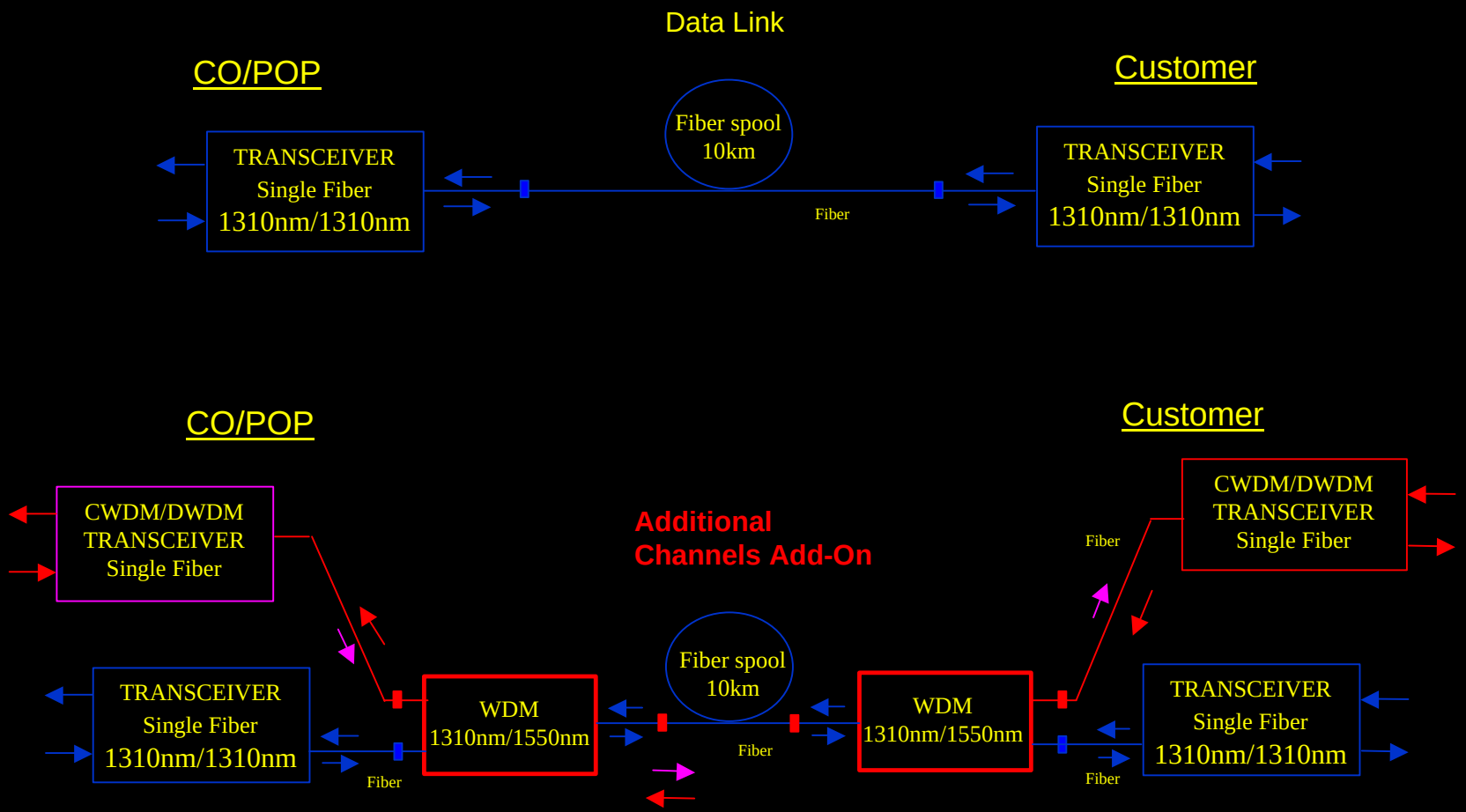


Channel add on for single wavelength bi-directional digital transmission





CWDM/DWDM Channels add on for single wavelength bi-directional digital transmission



Additional features UNIQUE for single wavelength

- Ability to recognize open connector
- Link quality monitoring for installer
  - Dummy lights provide link status (e.g. open local, open remote, LINK)
- Ability measure fiber break point (poor-man OTDR) communicate over IIC interface
  - Resolution of 100m demonstrated
  - No extra cost (only firmware)

DFB vs. FP – relative cost

- Major vendor relative costs (-40 to 85°C)

	Normalized to FP at same time/same volume [FP normalized to presntly @10K]				
Laser type	Volume (in thousands)	Presently	1 year later	2 year later	5 year later
FP-LD1310nm	10 per year	1.0	0.8	0.6	0.5
	100 per year	0.9	0.8	0.5	0.5
	1000 per year	0.9	0.7	0.5	0.5
HP-FP-LD1310nm (Aspheric lens)	10 per year	3.1	2.5	2.8	3.0
	100 per year	3.2	2.7	2.9	3.0
	1000 per year	3.0	2.9	2.8	3.0
DFB-LD1490nm	10 per year	**4.6**	**5.0**	**6.3**	**6.4**
	100 per year	**4.4**	**5.0**	**6.4**	**6.2**
	1000 per year	**3.9**	**4.4**	**5.7**	**5.7**
HP-DFB-LD1490nm,4dBm (Aspheric lens)	10 per year	6.7	7.3	9.8	10.0
	100 per year	6.6	7.2	10.0	10.0
	1000 per year	5.9	7.2	9.6	9.8

DFB vs. FP – relative cost

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HP-FP-LD1310nm (Aspheric lens)	10 per year	3.1	2.2	1.7	1.6
	100 per year	2.9	2.1	1.5	1.5
	1000 per year	2.7	2.0	1.4	1.4
DFB-LD1490nm	10 per year	**4.6**	**4.2**	**3.8**	**3.5**
	100 per year	**4.1**	**3.8**	**3.5**	**3.1**
	1000 per year	**3.5**	**3.1**	**2.8**	**2.6**
HP-DFB-LD1490nm,4dBm (Aspheric lens)	10 per year	6.7	6.2	6.0	5.4
	100 per year	6.1	5.5	5.4	5.0
	1000 per year	5.2	5.0	4.8	4.5

DFB vs. FP – reasons for relative cost

DFB cost vs. FP (for -40 to 85°C operation)

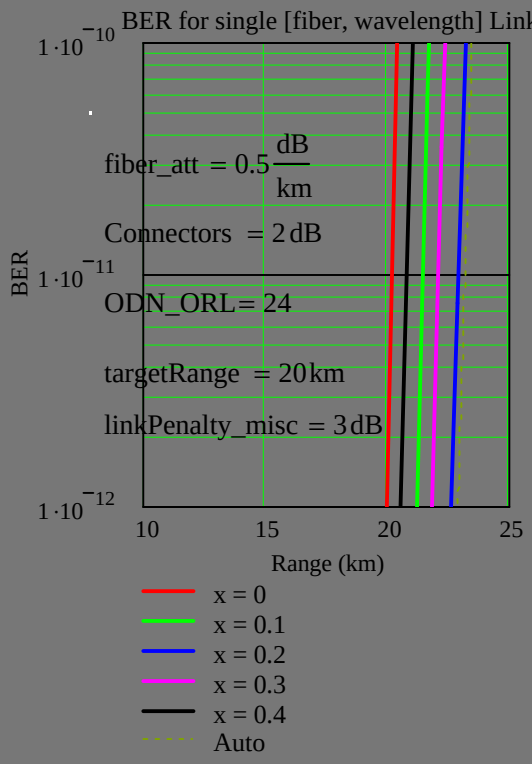
- Cost of DFB will ALWAYS be higher due to:
  - Extra step of fine lithography exposure
  - "delicate" etch
  - Higher test costs (more tests)
  - Test cost at temperature (must be done over -40 to 85C)
  - Yield issues (operating temp, SMSR)
- Also, DFB is more sensitive to ODN reflections than FP.

Ability to extend to longer distances 20km issues

- MPN limited to 2dB and treated separately
- ODN_ORL requirement 24dB
- Pmax – Pmin 4dBm
- Interoperability (mix 20km and 10km units for links <10km) Possible
- Specification can include 125Mb/s with same parameters
- ONE PMD IS POSSIBLE (20/10km,1250/125Mb/s)

20 km design example

Rdbm(20) = –20 dBm Signal Strength worst-case (Connectors=2dB)



ODNreturn_loss_test_db = –21

Sensitivity_Under_Test = –21.7

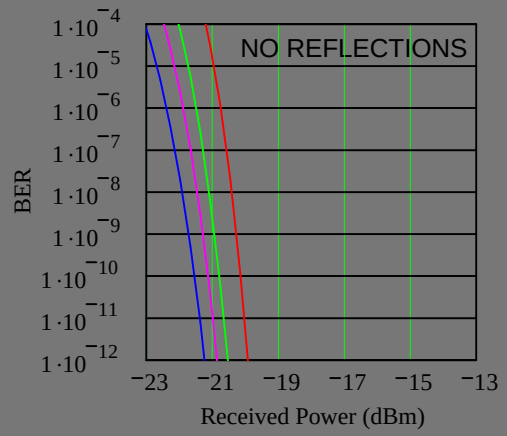
P_{AVGmax} = –4 dBm

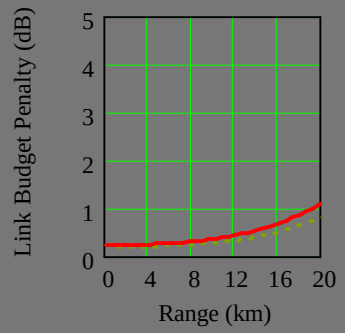
P_{AVGmin} = –8 dBm

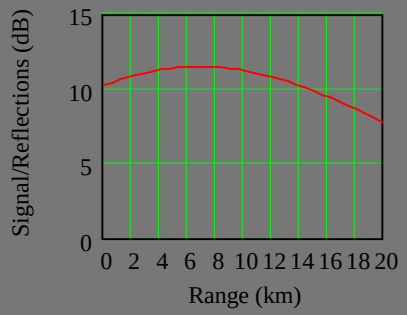
ORL = 17

I_{noise} = 0.2 µA R = 0.36

Cdbm(0) = –20.2dBm Reflections worst-case (Connectors=0dB)







x - Fixed Offset Threshold adjustment [Fraction of received signal at targetRange]

See http://grouper.ieee.org/groups/802/3/efm/public/jul01/presentations/bhatt_1_0701.pdf

PMD Specification

Description	ONU/OLT Module	Unit
Transmitter Type	Bi-directional, 1 fibre	
Signaling speed	1.25 / 0.125	GBd
Link length (range)	0.5 to 10,000	m
Power Budget	10	dB
Wavelength (range)	1270 to 1360	nm
T_{rise}/T_{fall} (Max, 20%-80% response time)	0.26	ns
RMS spectral width (max)	2.4	nm
Average launch power (min)	-9	dBm
Average launch power (max)	-4	dBm
Extinction ratio (min)	9	dB
RIN (max)	-120	dB/Hz
Receiver sensitivity (min)	-19	dBm
Return loss of ODN (min)	20	dB
Return Loss of module (min)	18	dB

SFSW Unique benefits

- Single PMD based on the lowest cost FP
- Future upgrades
  - Dual rate
  - CATV
  - CWDM/DWDM overlay