20km PON Link with a 1:16 Split
What are the Possibilities?

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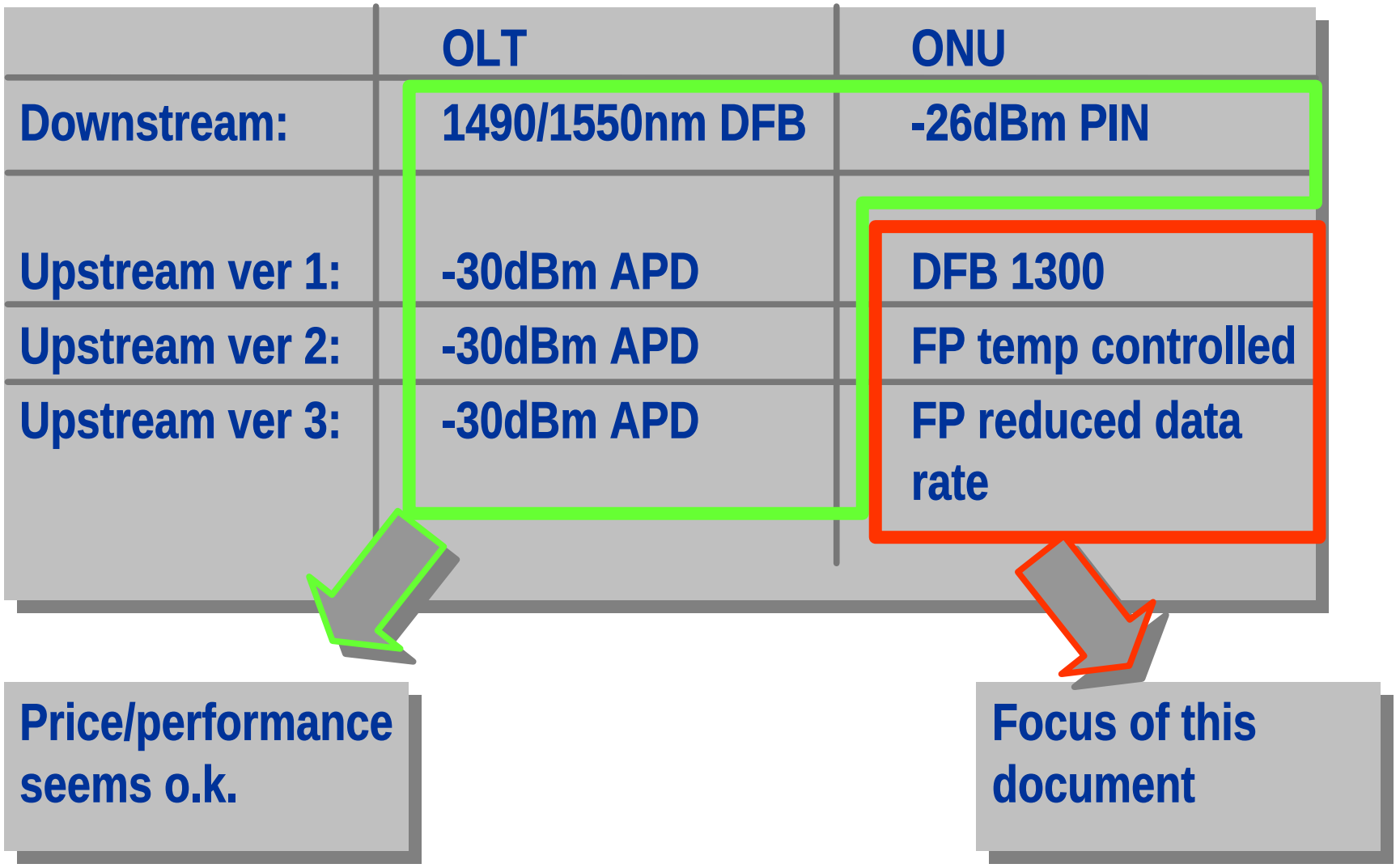
IEEE 802.3ah
Austin, TX. November 2001

Introduction

How to reach 20km link with 1:16 split. Cheap for the ONU side!



Overview options (only ONU Tx)

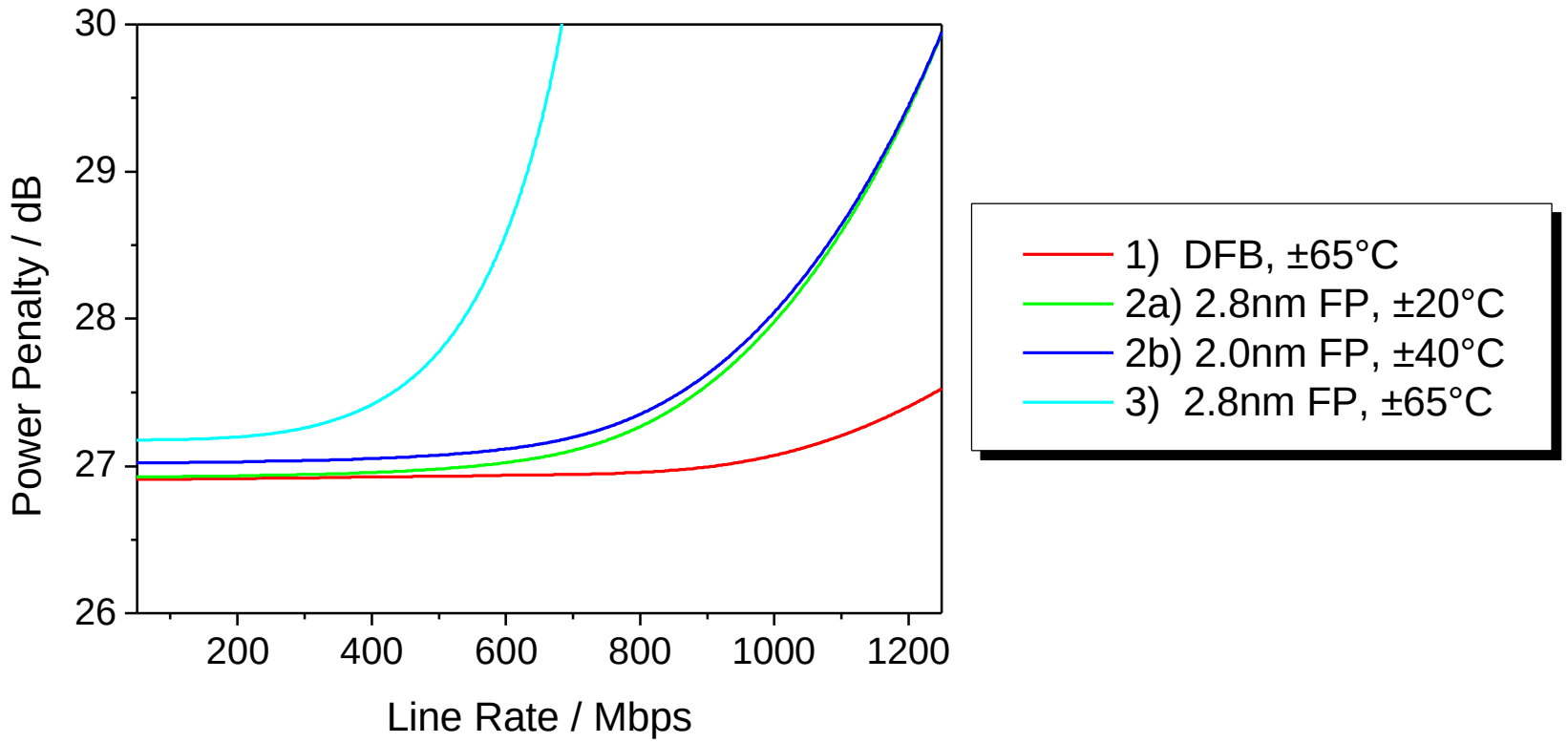
How to reach 20km

Upstream ver 1:	**DFB 1310nm**		
Upstream ver 2:	**Controlled temperature FP**		
	Two linewidths:	**2a)**	**2.8nm**
		2b)	**2.0nm**
Upstream ver 3:	**FP reduced data rate**		

Comparison of ONU Versions

1250Mbps link possible with ver 1&2, >622.5Mbps with ver 3

Power Penalty vs. Data Rate



Comparison of ONU Versions

	Advantages	Disadvantages
DFB	Reduced dispersion	Increased optics costs for ONU
Temp. Cont.	No extra optics costs	Need temperature controller[1]
Temp Cont.	Optics cheaper than DFB	Need temperature controller[1]
Lower US BW	No extra optics costs	Reduced bandwidth for user

[1]In low temperature regions, a simple heater may replace the controller, reducing costs

ONU Cost Comparison for Three Options

2.8nm FP laser used as base cost factor

Upstream Option	Increased ONU Optics Costs Factor	Additional Costs
1) DFB laser at 1310nm	2.5[1]	0
2a) 2.8nm FP with Temp. Controller	1	0.5
2b) 2.0nm FP with Temp. Controller	1→2	1
3) Reduced Upstream Line Rate	1	0

Reduced data rate most cost effective for end user

[1]Approx. 30% System Cost Increase

Summary

- Three different upstream options for 20km operation explored:
  - 1) DFB 1310nm laser
  - 2a) FP with 2.8nm linewidth, ±20°C
  - 2b) FP with 2.0nm linewidth, ±40°C
  - 3) FP with reduced data rate.
- Reduced data rate upstream the most cost effective for the end user
- Some open issues are:
  - ➢ 500Mbps Ethernet
  - ➢ Acceptance of lower bandwidth upstream