



10GE Economic Feasibility

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Agenda

- **Encode (review)**
- **Optics**
- **Cost Summary**

Encode

- **Scrambled encode presentation showed no cost issue for:**
 - data recovery
 - clock recovery
 - jitter tolerance
 - digital processing (similar to 8B/10B)
- **The encode proposal has significant performance advantages:**
 - robust delineation
 - extended reach/relaxed link budget
- **Scrambling at 10G has been field proven since 1995**
 - parts readily available now
- **Scrambling can operate over serial/parallel optics, MMF/SMF**

Optics

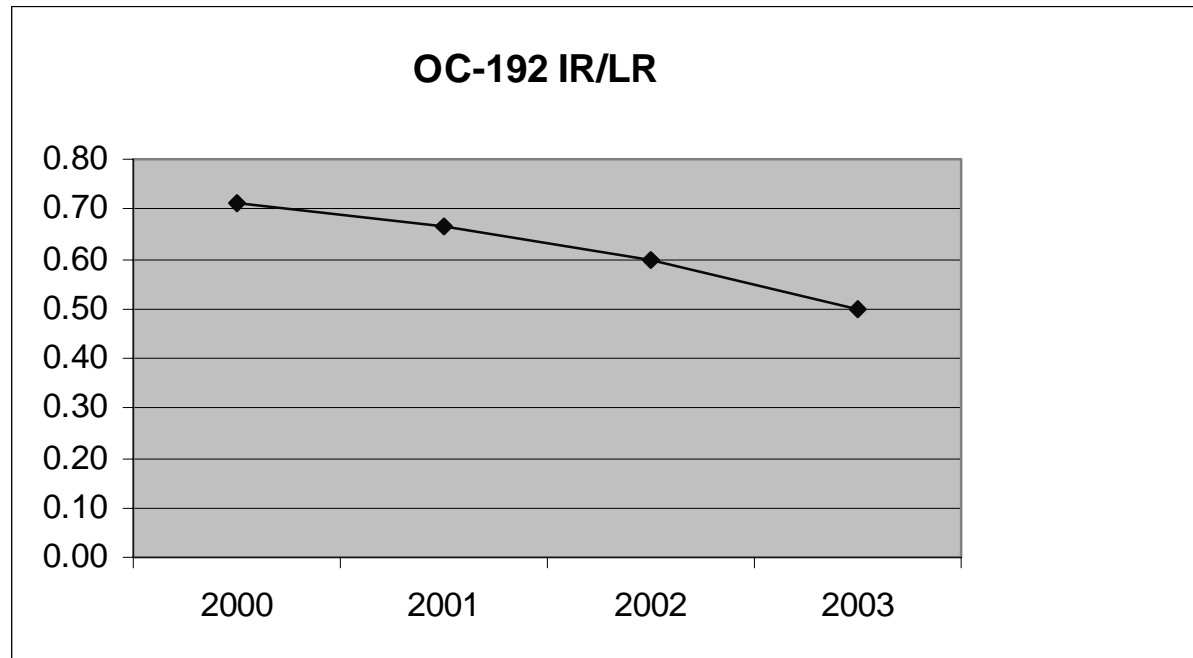
- **Agree with following WAN distance/technology breakpoints:**

Distance	Laser	Link Budget	RX E/O	Notes
<2km	FP uncooled	8dB	PIN, pre-amp	dispersion limited
<10km	DFB uncooled	8dB	PIN, pre-amp, AGC	>0dBm launch, high gain AGC
			APD, pre-amp, AGC	<0dBm launch, low gain AGC
<40km	DFB cooled	18dB	APD, pre-amp, AGC	>0dBm launch, high gain AGC

Notes

- serial transmission
- SMF
- 1310nm band

OC-192 IR vs LR Relative Cost

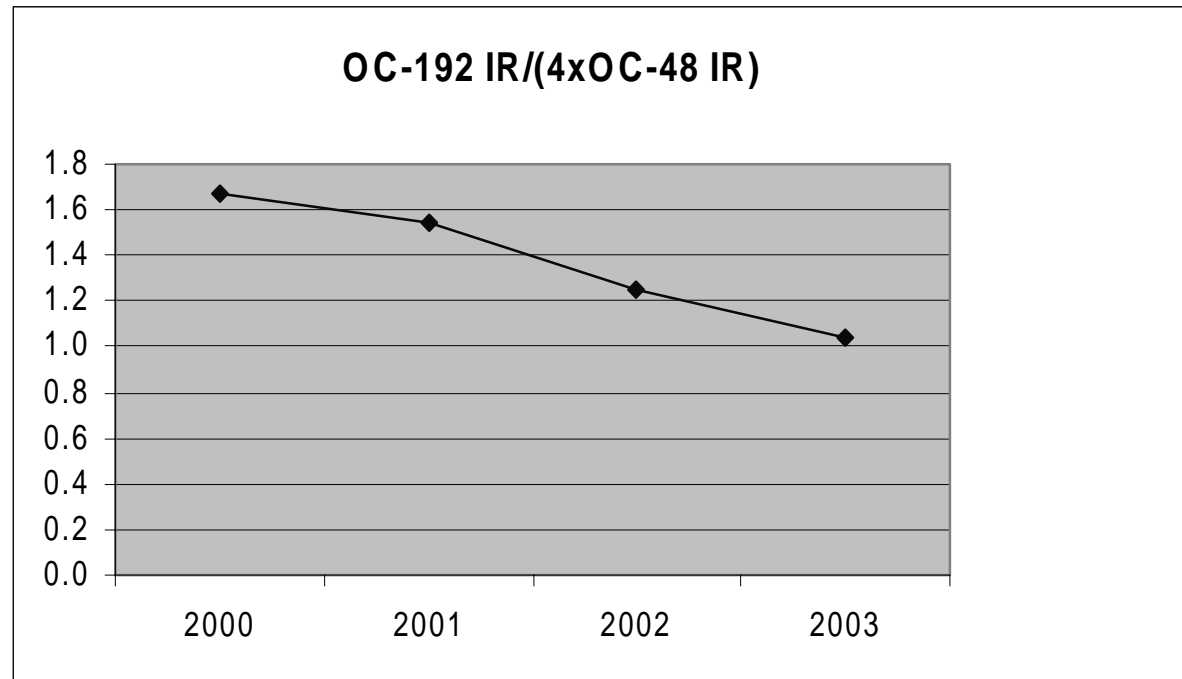


Notes

- OC-192 LR: M-Z modulator, CW laser, PIN, pre-amp, 155x nm (10k->100k volume)
- OC-192 IR: DM cooled DFB, PIN, pre-amp, 1310nm (1k->25k volume)

- **Expect OC-192 IR cost to drop further with intro of uncooled DFB**

OC-192 IR vs OC-48 IR Relative Cost



Notes

- OC-192 IR: DM cooled DFB, PIN, pre-amp, 1310nm (1k->25k volume)
- OC-48 IR: DM cooled DFB, PIN, pre-amp, 1310nm (25k->125k volume)

- **OC-192 IR (even at 1/5 volume) equals 4xOC-48 IR**

10G vs 12.5G

- **Concern with low yield for direct mod lasers at 12.5G rate:**
 - for the same reach/BER, the laser drive current for 12.5G operation must be ~1.5x that for 10G (e.g. 40mA->60mA)

$$\Delta I_L = (\Delta BW)^2$$

- **10G-rate direct mod lasers available from at least 3 suppliers**

Cost Summary

- **Scrambled encode**
 - similar complexity/cost as 8B/10B
 - extended reach/relaxed link budget
 - parts available now
- **OC-192 IR optics**
 - will be less than half the cost of OC-192 LR
 - will equal 4xOC-48 IR, even at 1/5 volume
 - parts available from at least 3 suppliers