

Advanced Fiber Optics

Or

Please Don't Look Into the Laser
With Your Remaining Good Eye

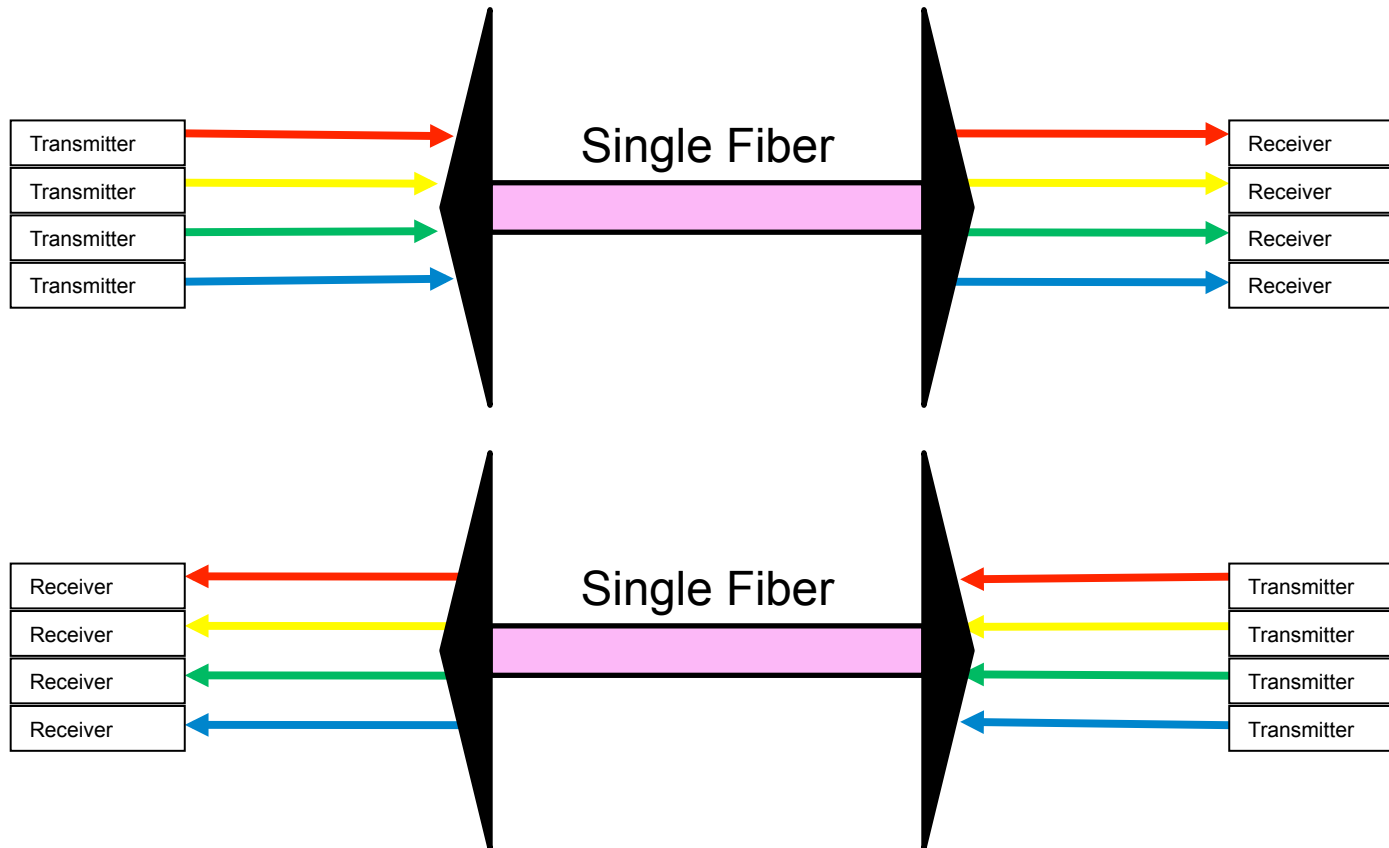
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WDM Basics

- WDM (Wavelength-Division Multiplexing)
- Multiplexes multiple wavelengths of light (colors) into a composite signal on a single fiber pair
- Each wavelength is an independent carrier signal
- Carrier signal is framing agnostic (STM-X, 1GE , 10GE...)

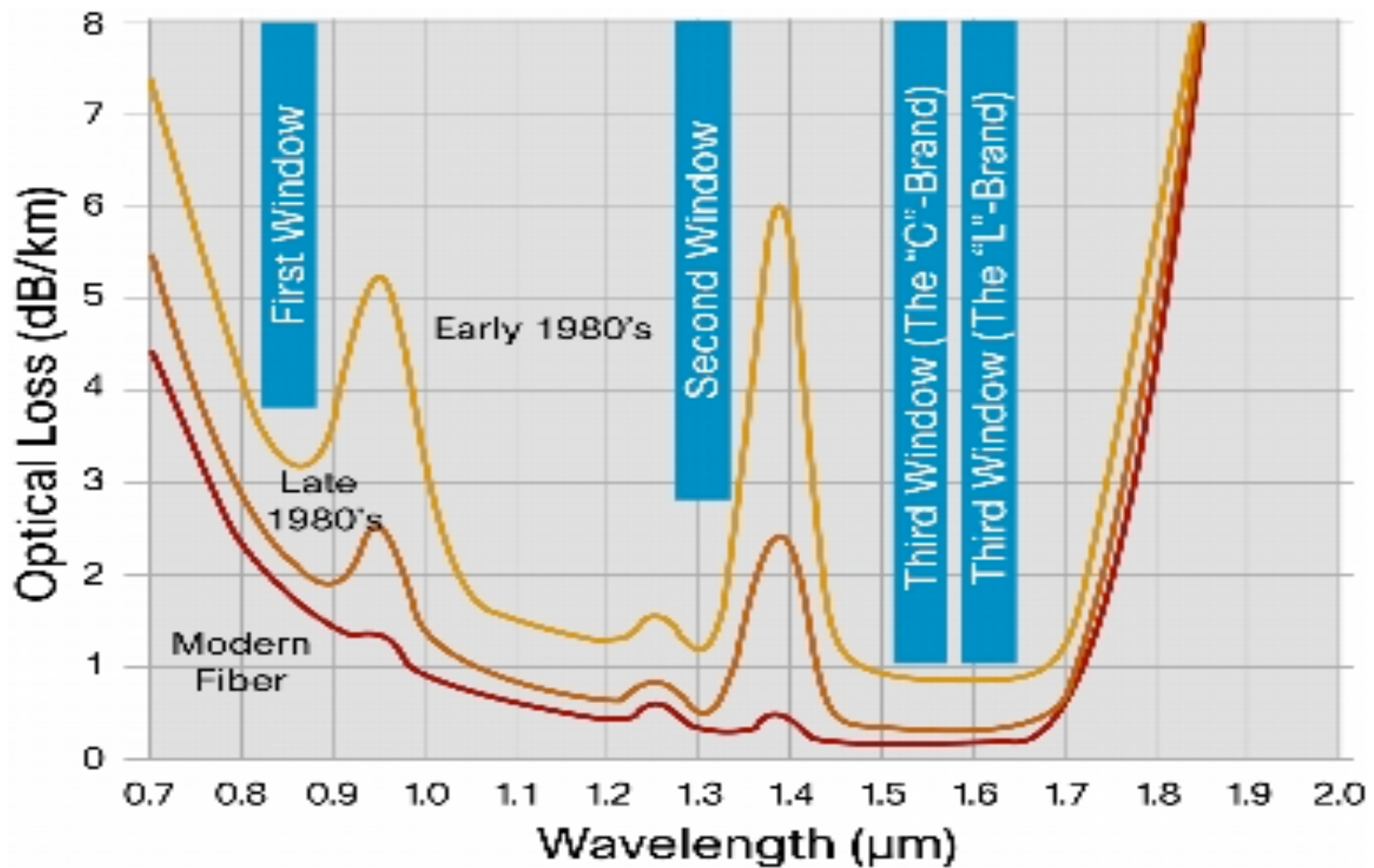
WDM Simple Single Span



ITU Wavelength Grid

- A set of standardized wavelengths based on Attenuation characteristics of fiber.
- DWDM
 - S-Band - 1491nm to 1529nm
 - C-Band - 1530nm to 1569nm
 - L-Band - 1570nm to 1611nm
- Other Ranges
 - 800nm - 900nm
 - 1250nm - 1350nm

ITU Wavelength Grid



Ethernet Client Optics

http://www.cisco.com/en/US/customer/products/hw/modules/ps5455/products_data_sheet09186a008014cb5e.html

GBIC Device	Type	Wavelength (nm)	Fiber Type	Core Size (Micron)	Modal Bandwidth (MHz/km)	Cable Distance	Transmit (dBm)		Receive (dBm)	
							Max	Min	Max	Min
WS-G5484	1000BASE-SX	850	MMF	62.5	160	722ft (220m)	-3.0	-9.5	0.0	-17.0
				62.5	200	902ft (275m)				
				50.0	400	1640ft (500m)				
				50.0	500	1804ft (550m)				
WS-G5486	1000BASE-LX/LH	1310	MMF*	62.5	500	1804ft (550m)	-3.0	-9.5	-3.0	-19.0
				50.0	400	1804ft (550m)				
				50.0	500	1804ft (550m)				
			SMF	9/10	n/a	6.2 miles (10km)				
WS-G5487	1000BASE-ZX	1550	SMF	9/10	n/a	43.4 to 62 miles (70 to 100km)**	5.0	0.0	-3.0	-23***

NOTE: See url above for notes

http://www.cisco.com/en/US/customer/products/hw/modules/ps5455/products_data_sheet0900aecd8033f885.html

SFP Product	Type	Wavelength (nm)	Fiber Type	Core Size (µm)	Modal Bandwidth (MHz* Km)	Operating Distance (m)	Transmit (dBm)		Receive (dBm)	
							Max	Min	Max	Min
GLC-SX-MM	1000BASE-SX	850	MMF	62.5	160	220 (722 ft)	-3.0	-9.5	0.0	-17.0
				62.5	200	275 (902 ft)				
				50	400	500 (1,640 ft)				
				50	500	550 (1,804 ft)				
GLC-LH-SM	1000BASE-LX/LH	1310	MMF*	62.5	500	550 (1,804 ft)	-3.0	-9.5	-3.0	-20.0
				50	400	550 (1,804 ft)				
				50	500	550 (1,804 ft)				
			SMF	**	-	10,000 (32,821 ft)				
GLC-ZX-SM	1000BASE-ZX	1550	SMF	-	-	Approximately 70 km depending on link loss	5.0	0.0	0.0	-23.0
GLC-BX-D	1000BASE-BX-D	1310	SMF	**	-	10,000 (32,821 ft)	-3.0	-9.0	-3.0	-19.5
GLC-BX-U	1000BASE-BX-U	1490	SMF	**	-	10,000 (32,821 ft)	-3.0	-9.0	-3.0	-19.5

More Ethernet Client Optics

http://www.cisco.com/en/US/prod/collateral/modules/ps2797/ps5138/product_data_sheet09186a008007cd00_ps708_Products_Data_Sheet.html

XENPAK Product	Type	Wavelength (nm)	Fiber Type	Core Size (µm)	Modal Bandwidth (MHz* Km)	Operating Distance (m)	Transmit (dBm)		Receive (dBm)	
							Max	Min	Max	Min
XENPAK-10GB-SR	10GBASE-SR	850	MMF	62.5	160	26m	-1.2	-7.3	-1.0	-9.9
				62.5	200	33m				
				50	400	66m				
				50	500	82m				
				50	2000	300m				
XENPAK-10GB-LR/LR+ **	10GBASE-LR	1310	SMF	G.652 *		10km	0.5	-8.2	0.5	-14.4
XENPAK-10GB-ER/ER+ ***	10GBASE-ER	1550	SMF	G.652 *		40km ****	4.0	-4.7	-1.0	-15.8
XENPAK-10GB-ZR	10GBASE-ZR	1550	SMF				4	0	-7	-24

http://www.hp.com/rnd/accessories/J4858C/accessory.htm?jumpid=reg_R1002_USEN

http://www.hp.com/rnd/accessories/J4859B/accessory.htm?jumpid=reg_R1002_USEN

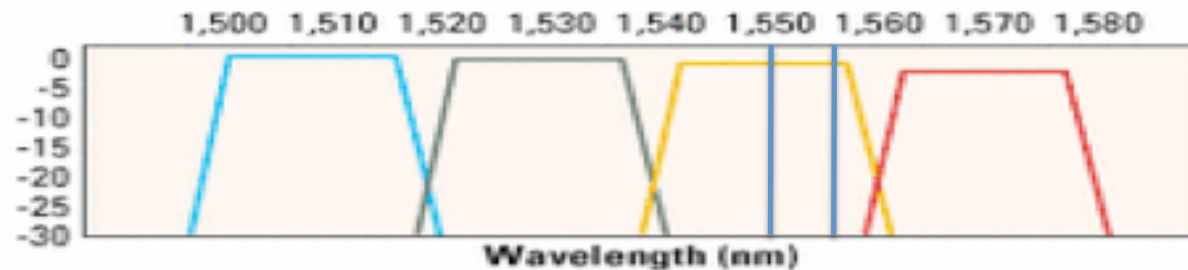
http://www.hp.com/rnd/accessories/J4859B/accessory.htm?jumpid=reg_R1002_USEN

mini-GBIC Product	Type	Wavelength (nm)	Fiber Type	Core Size (µm)	Modal Bandwidth (MHz* Km)	Operating Distance (m)	Transmit (dBm)		Receive (dBm)	
							Max	Min	Max	Min
ProCurve Gigabit-SX-LC	1000Base-SX	850	MMF	62.5	160	2220m				
				62.5	200	2275m				
				50	400	2500m				
				50	500	2550m				
ProCurve Gigabit-LX-LC	1000Base-LX	1310	SMF	G.652		10km				
ProCurve Gigabit-LH-LC	1000Base-LH	1550	SMF	G.652		70km				

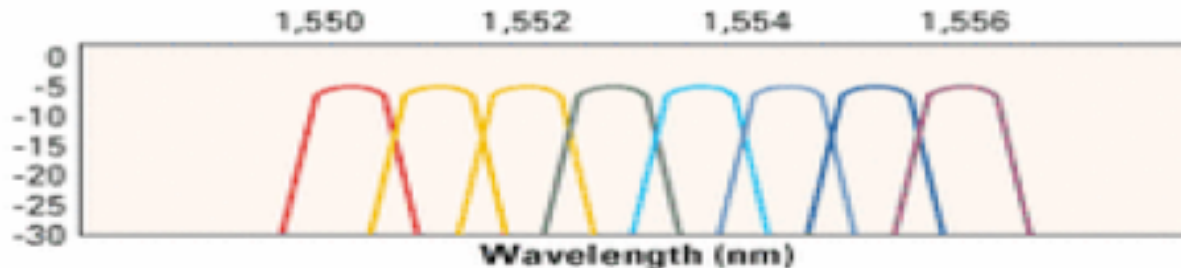
Channel Spacing

- DWDM – 100GHz (.78nm) or 50GHz (.39nm)
- CWDM – Wider spacing 2.5Thz (20nm) channel spacing from 1271nm to 1611nm

CWDM 20nm Spacing



DWDM 100GHz Spacing



ITU Grid Specification

	L-Band				C-Band				S-Band			
	100 GHz Grid		50 GHz Offset		100 GHz Grid		50 GHz Offset		100 GHz Grid		50 GHz Offset	
	THz	nm	THz	nm	THz	nm	THz	nm	THz	nm	THz	nm
1	186.00	1611.79	186.05	1611.35	191.00	1569.59	191.05	1569.18	196.00	1529.55	196.05	1529.16
2	186.10	1610.92	186.15	1610.49	191.10	1568.77	191.15	1568.36	196.10	1528.77	196.15	1528.38
3	186.20	1610.06	186.25	1609.62	191.20	1567.95	191.25	1567.54	196.20	1527.99	196.25	1527.60
4	186.30	1609.19	186.35	1608.76	191.30	1567.13	191.35	1566.72	196.30	1527.22	196.35	1526.83
5	186.40	1608.33	186.45	1607.90	191.40	1566.31	191.45	1565.90	196.40	1526.44	196.45	1526.05
6	186.50	1607.47	186.55	1607.04	191.50	1565.50	191.55	1565.09	196.50	1525.66	196.55	1525.27
7	186.60	1606.60	186.65	1606.17	191.60	1564.68	191.65	1564.27	196.60	1524.89	196.65	1524.50
8	186.70	1605.74	186.75	1605.31	191.70	1563.86	191.75	1563.45	196.70	1524.11	196.75	1523.72
9	186.80	1604.88	186.85	1604.46	191.80	1563.05	191.85	1562.64	196.80	1523.34	196.85	1522.95
10	186.90	1604.03	186.95	1603.60	191.90	1562.23	191.95	1561.83	196.90	1522.56	196.95	1522.18
11	187.00	1603.17	187.05	1602.74	192.00	1561.42	192.05	1561.01	197.00	1521.79	197.05	1521.40
12	187.10	1602.31	187.15	1601.88	192.10	1560.61	192.15	1560.20	197.10	1521.02	197.15	1520.63
13	187.20	1601.46	187.25	1601.03	192.20	1559.79	192.25	1559.39	197.20	1520.25	197.25	1519.86
14	187.30	1600.60	187.35	1600.17	192.30	1558.98	192.35	1558.58	197.30	1519.48	197.35	1519.09
15	187.40	1599.75	187.45	1599.32	192.40	1558.17	192.45	1557.77	197.40	1518.71	197.45	1518.32
16	187.50	1598.89	187.55	1598.47	192.50	1557.36	192.55	1556.96	197.50	1517.94	197.55	1517.55
17	187.60	1598.04	187.65	1597.62	192.60	1556.55	192.65	1556.15	197.60	1517.17	197.65	1516.78
18	187.70	1597.19	187.75	1596.76	192.70	1555.75	192.75	1555.34	197.70	1516.40	197.75	1516.02
19	187.80	1596.34	187.85	1595.91	192.80	1554.94	192.85	1554.54	197.80	1515.63	197.85	1515.25
20	187.90	1595.49	187.95	1595.06	192.90	1554.13	192.95	1553.73	197.90	1514.87	197.95	1514.49
21	188.00	1594.64	188.05	1594.22	193.00	1553.33	193.05	1552.93	198.00	1514.10	198.05	1513.72
22	188.10	1593.79	188.15	1593.37	193.10	1552.52	193.15	1552.12	198.10	1513.34	198.15	1512.96
23	188.20	1592.95	188.25	1592.52	193.20	1551.72	193.25	1551.32	198.20	1512.58	198.25	1512.19
24	188.30	1592.10	188.35	1591.68	193.30	1550.92	193.35	1550.52	198.30	1511.81	198.35	1511.43
25	188.40	1591.26	188.45	1590.83	193.40	1550.12	193.45	1549.72	198.40	1511.05	198.45	1510.67
26	188.50	1590.41	188.55	1589.99	193.50	1549.32	193.55	1548.91	198.50	1510.29	198.55	1509.91
27	188.60	1589.57	188.65	1589.15	193.60	1548.51	193.65	1548.11	198.60	1509.53	198.65	1509.15
28	188.70	1588.73	188.75	1588.30	193.70	1547.72	193.75	1547.32	198.70	1508.77	198.75	1508.39
29	188.80	1587.88	188.85	1587.46	193.80	1546.92	193.85	1546.52	198.80	1508.01	198.85	1507.63
30	188.90	1587.04	188.95	1586.62	193.90	1546.12	193.95	1545.72	198.90	1507.25	198.95	1506.87
31	189.00	1586.20	189.05	1585.78	194.00	1545.32	194.05	1544.92	199.00	1506.49	199.05	1506.12
32	189.10	1585.36	189.15	1584.95	194.10	1544.53	194.15	1544.13	199.10	1505.74	199.15	1505.36
33	189.20	1584.53	189.25	1584.11	194.20	1543.73	194.25	1543.33	199.20	1504.98	199.25	1504.60
34	189.30	1583.69	189.35	1583.27	194.30	1542.94	194.35	1542.54	199.30	1504.23	199.35	1503.85
35	189.40	1582.85	189.45	1582.44	194.40	1542.14	194.45	1541.75	199.40	1503.47	199.45	1503.10
36	189.50	1582.02	189.55	1581.60	194.50	1541.35	194.55	1540.95	199.50	1502.72	199.55	1502.34
37	189.60	1581.18	189.65	1580.77	194.60	1540.56	194.65	1540.16	199.60	1501.97	199.65	1501.59
38	189.70	1580.35	189.75	1579.93	194.70	1539.77	194.75	1539.37	199.70	1501.21	199.75	1500.84
39	189.80	1579.52	189.85	1579.10	194.80	1538.98	194.85	1538.58	199.80	1500.46	199.85	1500.09
40	189.90	1578.69	189.95	1578.27	194.90	1538.19	194.95	1537.79	199.90	1499.71	199.95	1499.34
41	190.00	1577.86	190.05	1577.44	195.00	1537.40	195.05	1537.00	200.00	1498.96	200.05	1498.59
42	190.10	1577.03	190.15	1576.61	195.10	1536.61	195.15	1536.22	200.10	1498.21	200.15	1497.84
43	190.20	1576.20	190.25	1575.78	195.20	1535.82	195.25	1535.43	200.20	1497.46	200.25	1497.09
44	190.30	1575.37	190.35	1574.95	195.30	1535.04	195.35	1534.64	200.30	1496.72	200.35	1496.34
45	190.40	1574.54	190.45	1574.13	195.40	1534.25	195.45	1533.86	200.40	1495.97	200.45	1495.60
46	190.50	1573.71	190.55	1573.30	195.50	1533.47	195.55	1533.07	200.50	1495.22	200.55	1494.85
47	190.60	1572.89	190.65	1572.48	195.60	1532.68	195.65	1532.29	200.60	1494.48	200.65	1494.11
48	190.70	1572.06	190.75	1571.65	195.70	1531.90	195.75	1531.51	200.70	1493.73	200.75	1493.36
49	190.80	1571.24	190.85	1570.83	195.80	1531.12	195.85	1530.72	200.80	1492.99	200.85	1492.62
50	190.90	1570.42	190.95	1570.01	195.90	1530.33	195.95	1529.94	200.90	1492.25	200.95	1491.88

15454 Channel Numbering

15454 32 Ch	15454 40 Ch	WaveLength (nm)	15454 32 Ch	15454 40 Ch	WaveLength (nm)
1	1	1530.33	17	21	1546.12
2	2	1531.12	18	22	1546.92
3	3	1531.9	19	23	1547.72
4	4	1532.68	20	24	1548.51
	5	1533.47		25	1549.32
5	6	1534.25	21	26	1550.12
6	7	1535.04	22	27	1550.92
7	8	1535.82	23	28	1551.72
8	9	1536.61	24	29	1552.52
	10	1537.4		30	1553.33
9	11	1538.19	25	31	1554.13
10	12	1538.98	26	32	1554.94
11	13	1539.77	27	33	1555.75
12	14	1540.56	28	34	1556.55
	15	1541.35		35	1557.36
13	16	1542.14	29	36	1558.17
14	17	1542.94	30	37	1558.98
15	18	1543.73	31	38	1559.79
16	19	1544.53	32	39	1560.61
	20	1545.32		40	1561.42

Fujitsu Channel Numbering

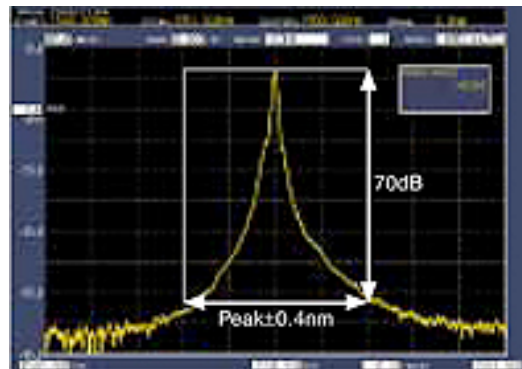
Fujitsu Ch #	ITU Ch #	Frequency (GHz)	Wavelength (nm)	Fujitsu Ch #	ITU Ch #	Frequency (GHz)	Wavelength (nm)
40	18	191800	1563.05	20	38	193800	1546.92
39	19	191900	1562.23	19	39	193900	1546.12
38	20	192000	1561.42	18	40	194000	1545.32
37	21	192100	1560.61	17	41	194100	1544.53
36	22	192200	1559.79	16	42	194200	1543.73
35	23	192300	1558.98	15	43	194300	1542.94
34	24	192400	1558.17	14	44	194400	1542.14
33	25	192500	1557.36	13	45	194500	1541.35
32	26	192600	1556.56	12	46	194600	1540.56
31	27	192700	1555.75	11	47	194700	1539.77
30	28	192800	1554.94	10	48	194800	1538.98
29	29	192900	1554.13	9	49	194900	1538.19
28	30	193000	1553.33	8	50	195000	1537.4
27	31	193100	1552.52	7	51	195100	1536.61
26	32	193200	1551.72	6	52	195200	1535.82
25	33	193300	1550.92	5	53	195300	1535.04
24	34	193400	1550.12	4	54	195400	1534.25
23	35	193500	1549.32	3	55	195500	1533.47
22	36	193600	1548.52	2	56	195600	1532.68
21	37	193700	1547.72	1	57	195700	1531.9

Composite Signal



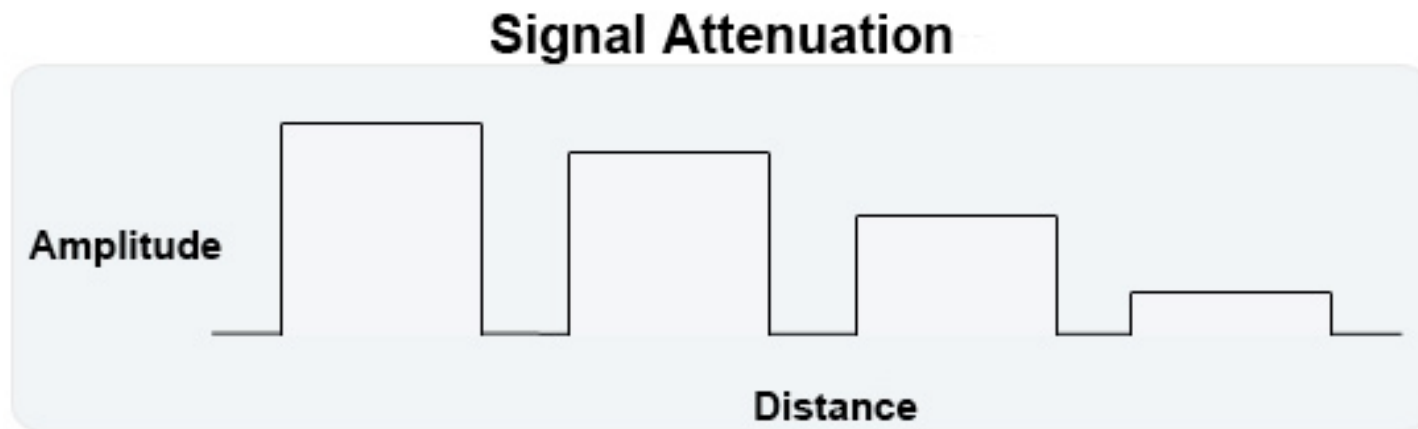
OSNR

- OSNR – Optical Signal to Noise Ratio
 - The ultimate value in decibels (dB) that indicates signal quality. Higher = Better
 - Degrades over distance due to cumulative linear and non-linear effects
 - Amplification reduces
 - Must Regenerate when it becomes too low



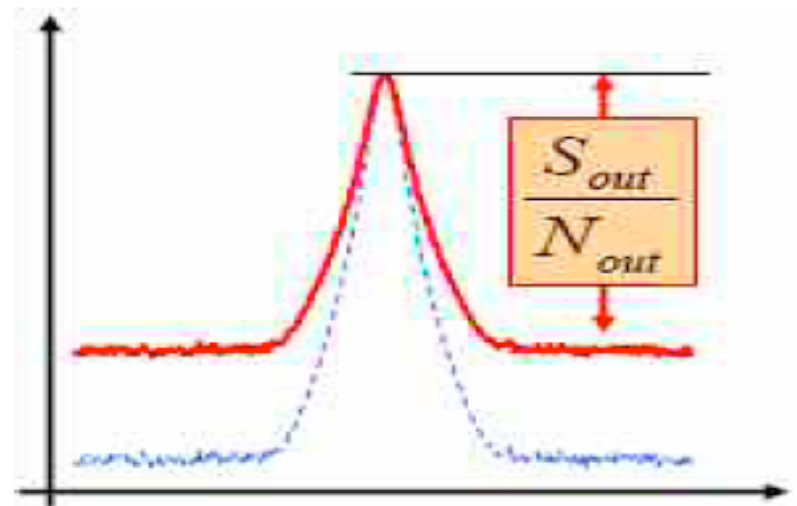
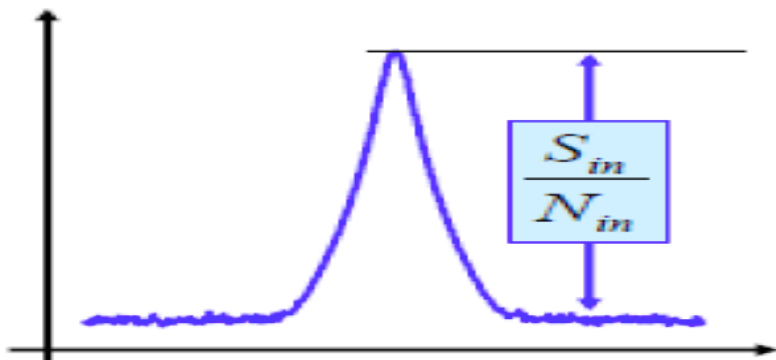
Fiber - Linear Effects

- Attenuation – The power level of the signal is reduced linearly over distance.
 - Intrinsic Causes
 - Fiber impurities
 - Material absorption
 - Rayleigh Scattering
 - Extrinsic Causes
 - Macrobending – Visible bend that exceeds recommended bend radius
 - Microbending – Usually not visible, may be temperature or stress related



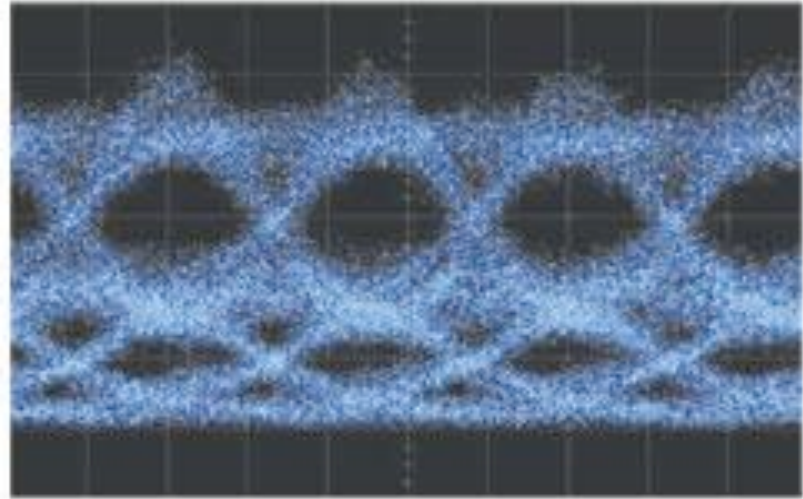
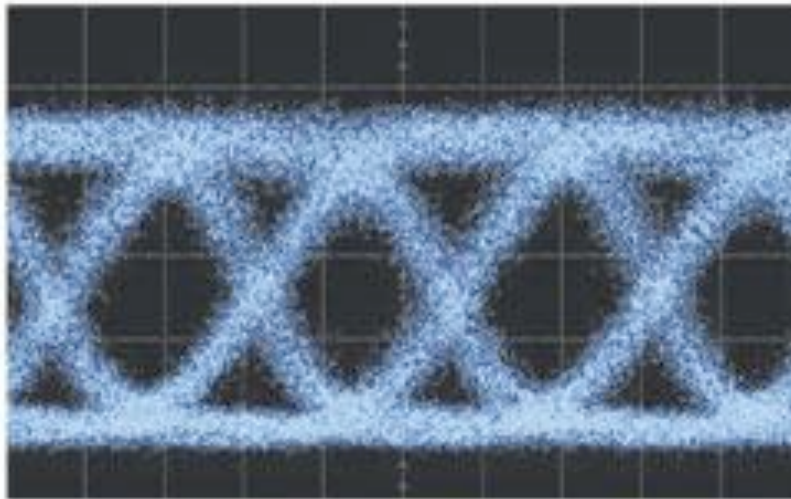
Amplification

- Attenuation can be corrected using amplifiers
- Signal must be amplified every 70 ~ 120km
- Most common EDFA amplifiers Amplify signal and noise equally which decreases OSNR value



Fiber - Linear Effects - Dispersion

- Dispersion - The widening of a light pulse as it travels through fiber.



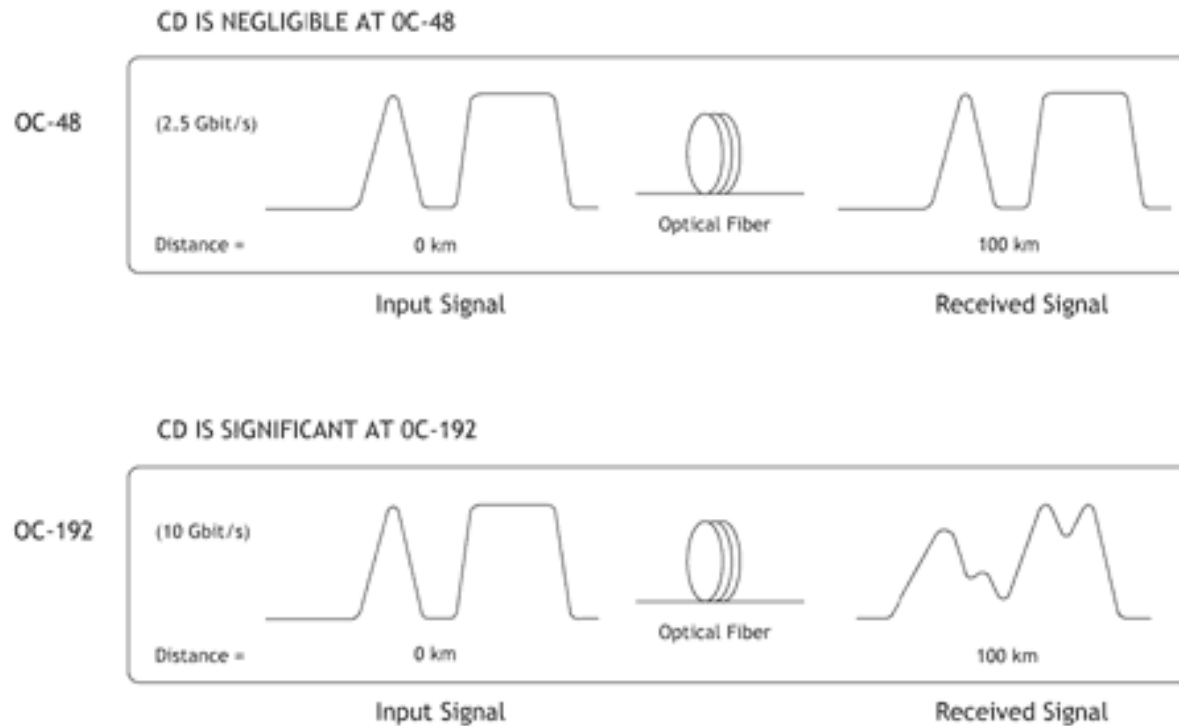
Fiber - Linear Effects - CD

- Chromatic Dispersion (CD) –Each wavelength travels at a slightly different speed.
 - Varies by type of fiber and bit rate



Fiber - Linear Effects - CD

- Effects increase with bandwidth

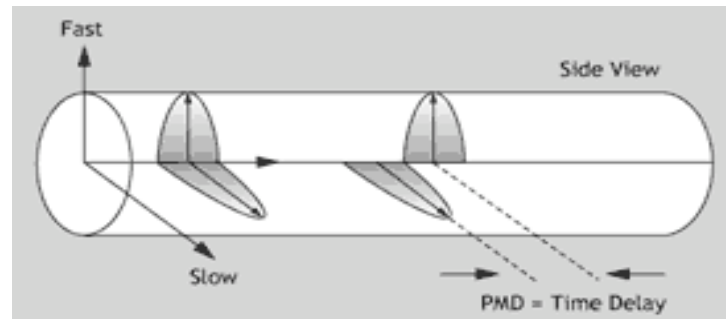
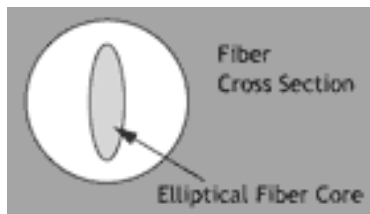


Dispersion Compensation

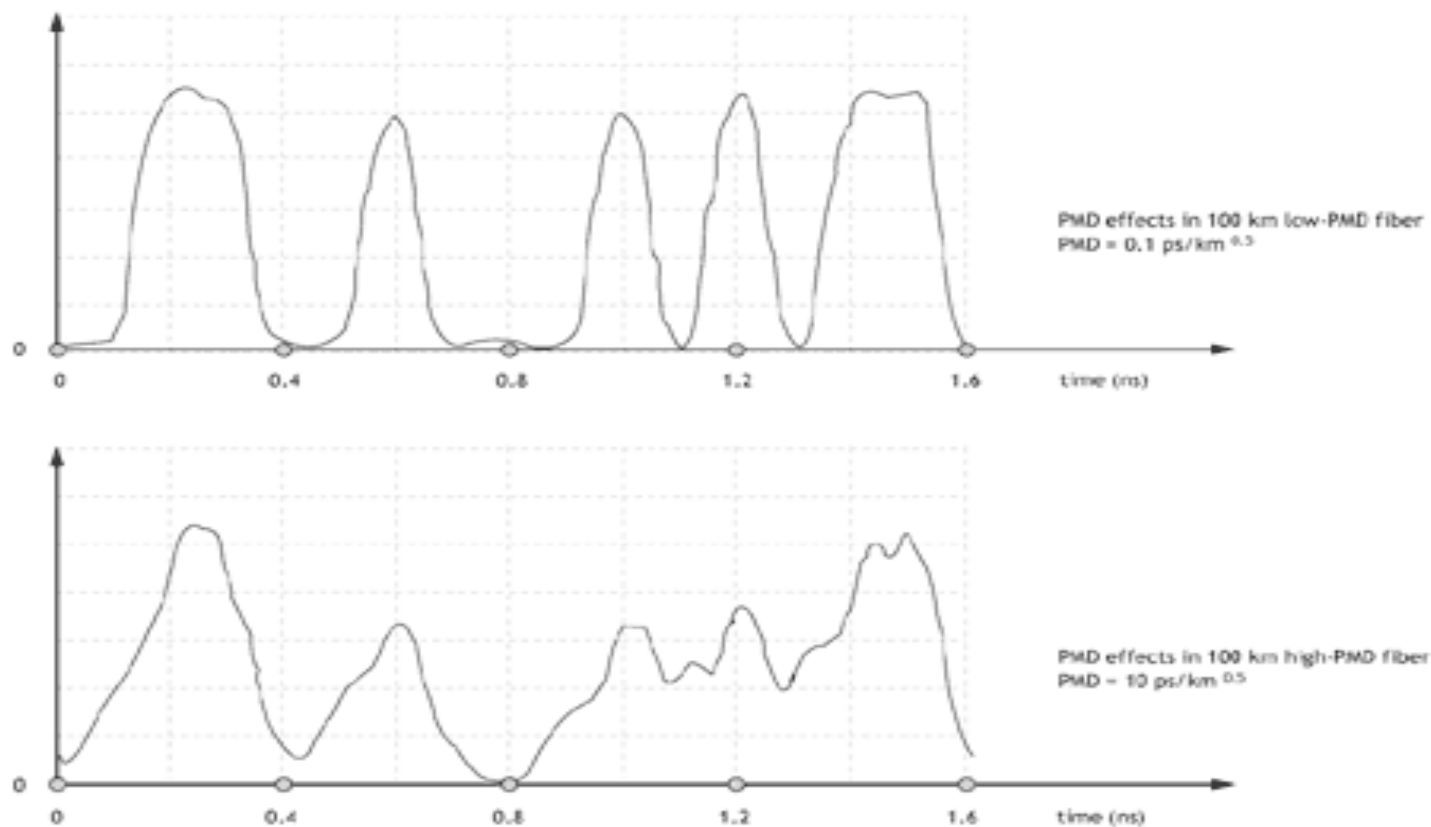
- DCUs (Dispersion Compensation Units) can reduce effects. DCUs are spools of dispersion compensating fiber placed at intervals along the fiber path
 - Use different lengths to based on amount of dispersion to compensate
- Electronic Dispersion Compensation can be done in Transponders.
 - Negative dispersion added when signal transmitted
 - Normal positive dispersion of fiber corrects

Fiber - Linear Effects - PMD

- PMD – Polarization Mode Dispersion – Different polarizations (Axis) of light travel at different speeds
 - Caused by irregularities in the shape of the fiber. Not a perfect cylinder or a constant shape.
 - Varies by type of Fiber
 - More significant at higher transmission rates >10GE
 - DCUs do not address PMD.
 - Must Regenerate more frequently with higher PMD



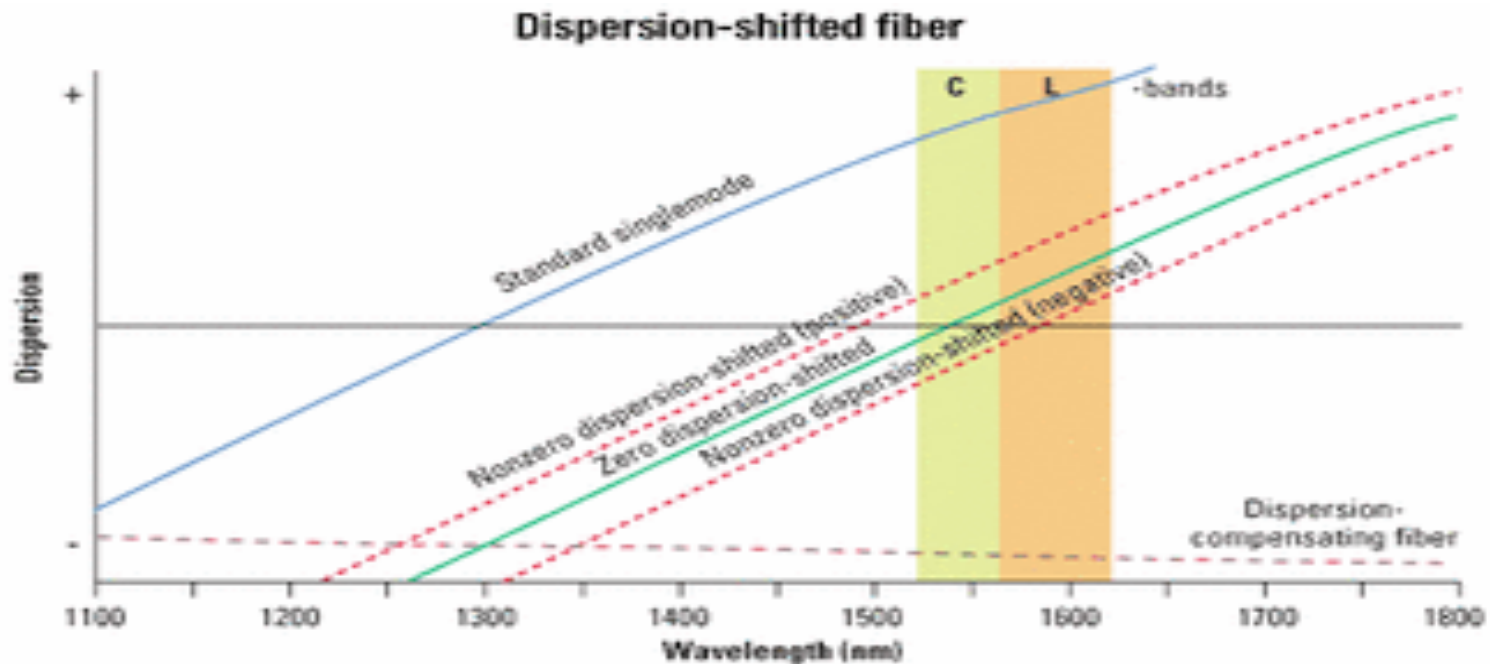
Fiber - Linear Effects - PMD



PMD CHANGES RANDOMLY WITH ENVIRONMENTAL CONDITIONS, REQUIRING ADAPTIVE COMPENSATION.

Fiber Characteristics

<i>Type</i>	<i>Dispersion @1550</i>	<i>Vintages</i>
SMF	17 ps/nm/km	1980-
E-LEAF	4 ps/nm/km	1996-
TrueWave RS	4.5 ps/nm/km	1996-
TrueWave Classic	2 ps/nm/km	1992-1996
DSF	0 ps/nm/km	1990-1992
SMF-LS	-1 ps/nm/km	1992-1995



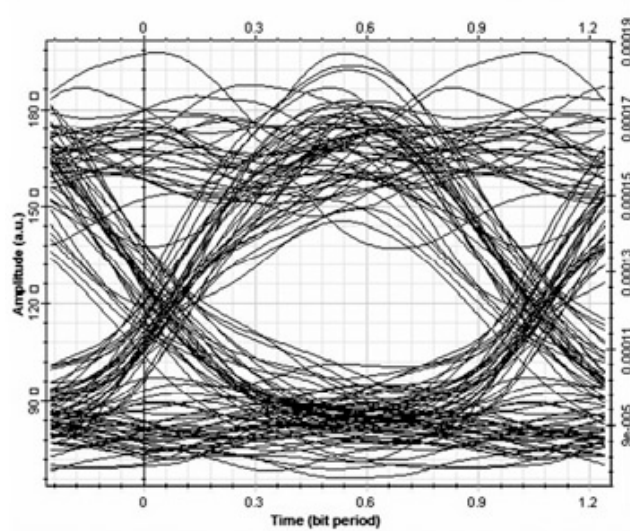
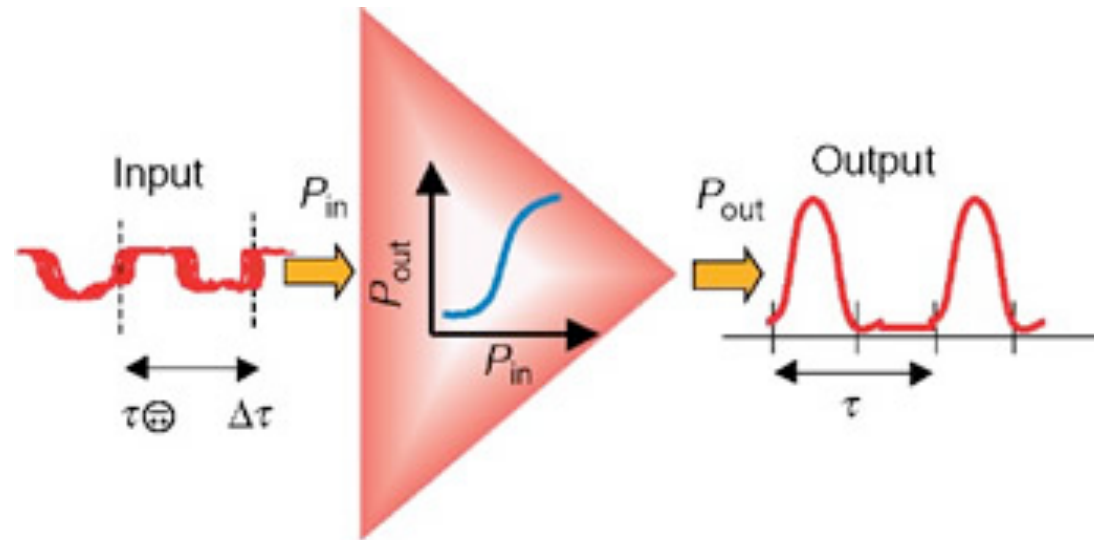
Fiber Nonlinear Effects

- Light in optical fiber exhibits nonlinear effects when under the influence of electrical and magnetic fields
- Scattering - Photons interact with themselves and the medium they are traveling through causing scattering effects
 - Stimulated Raman Scattering (SRS) scatters in forward and reverse direction
 - Stimulated Brillouin Scattering (SBS) scatters in forward direction only
- Four-Wave Mixing - 3 optical frequencies interact in a nonlinear medium giving rise to a fourth frequency.

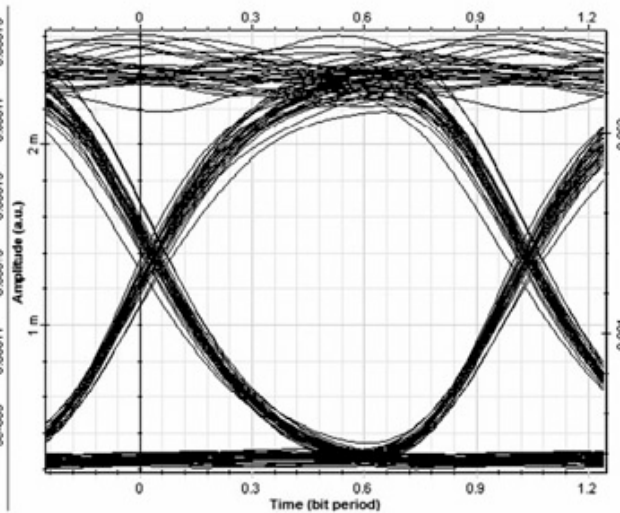
OEO (3R) Regeneration

- OSNR will continue to degrade
- The optical signal will need to be converted back to an electrical/digital signal before it becomes unrecoverable.
- Regenerate with back to back transponders

Signal Regeneration



(a)



(b)

Additional References

- http://www.iec.org/online/tutorials/light_limit/index.asp
- <http://www.scribd.com/doc/9038/cisco-systems-dwdm-primer-oct03>

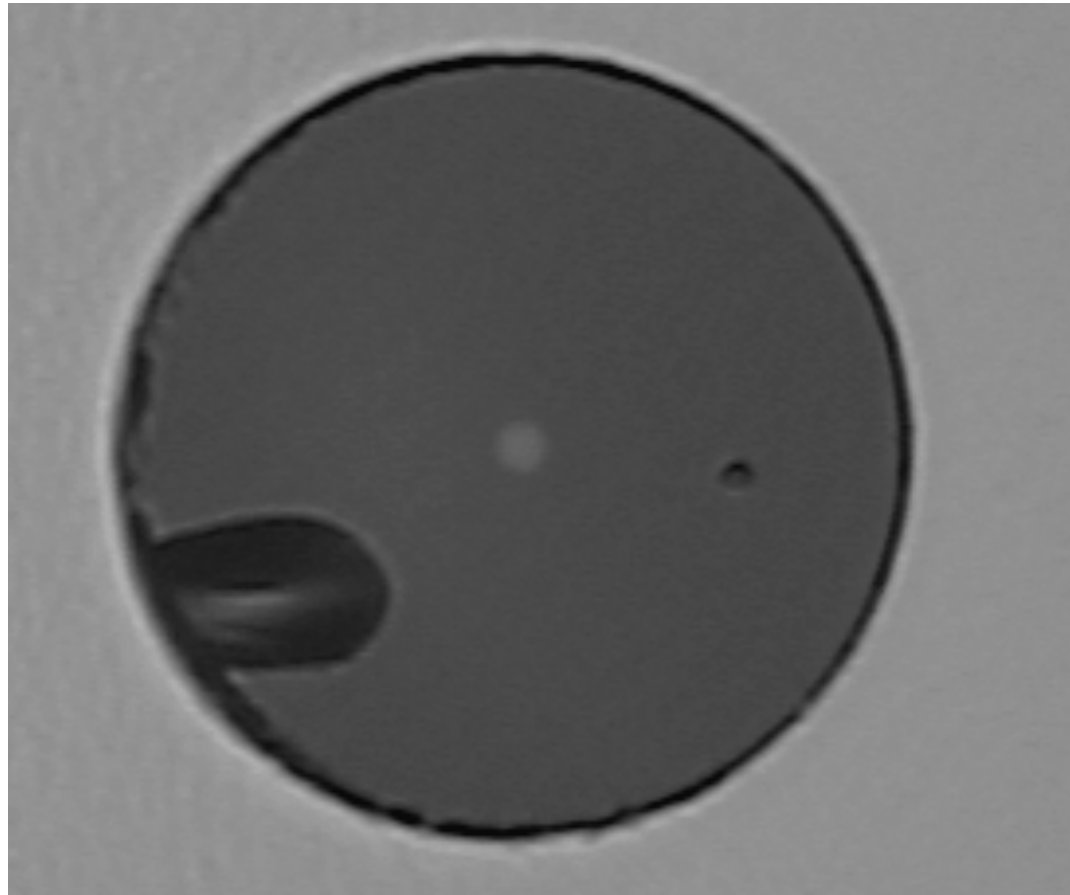


Fiber Cleaning 101

- Higher speeds less tolerant of dirty Fiber
- Equipment
 - CLETOP
 - Fiber Scope
 - Port Swabs
 - Alcohol pads
- NLR's fiber cleaning procedures
 - Clean both front and back connectors at Patch Panels.
 - Use swab and aerosol to clean bulkhead connector
 - Dry clean fibers with CLETOP
 - Use scope and if still dirty use alcohol wipe
 - Insert in bulkhead, wait 1 min, remove & scope
 - Repeated as necessary



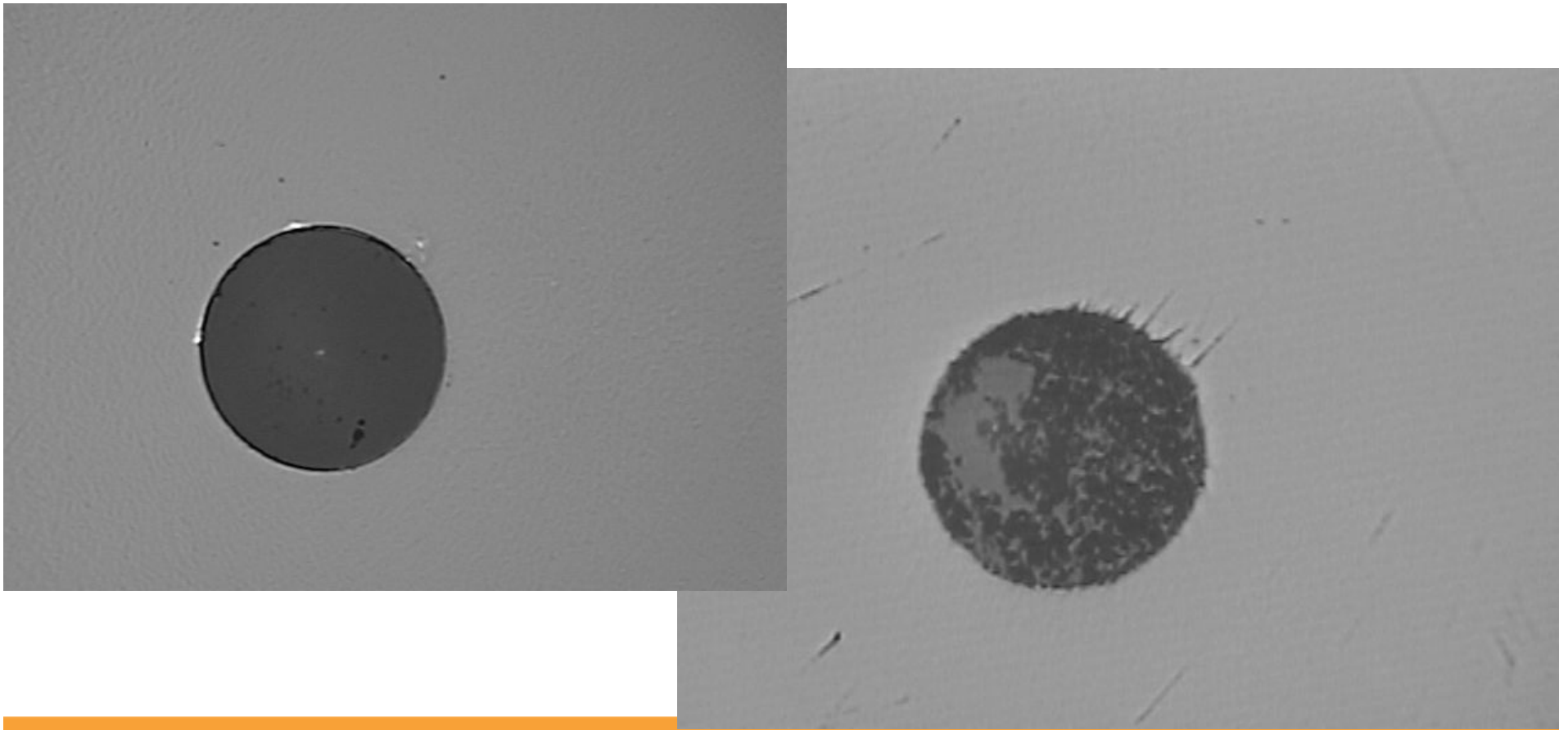
Fiber Issues





How Not to Clean Fiber

- Don't count on your telco to clean the fiber properly

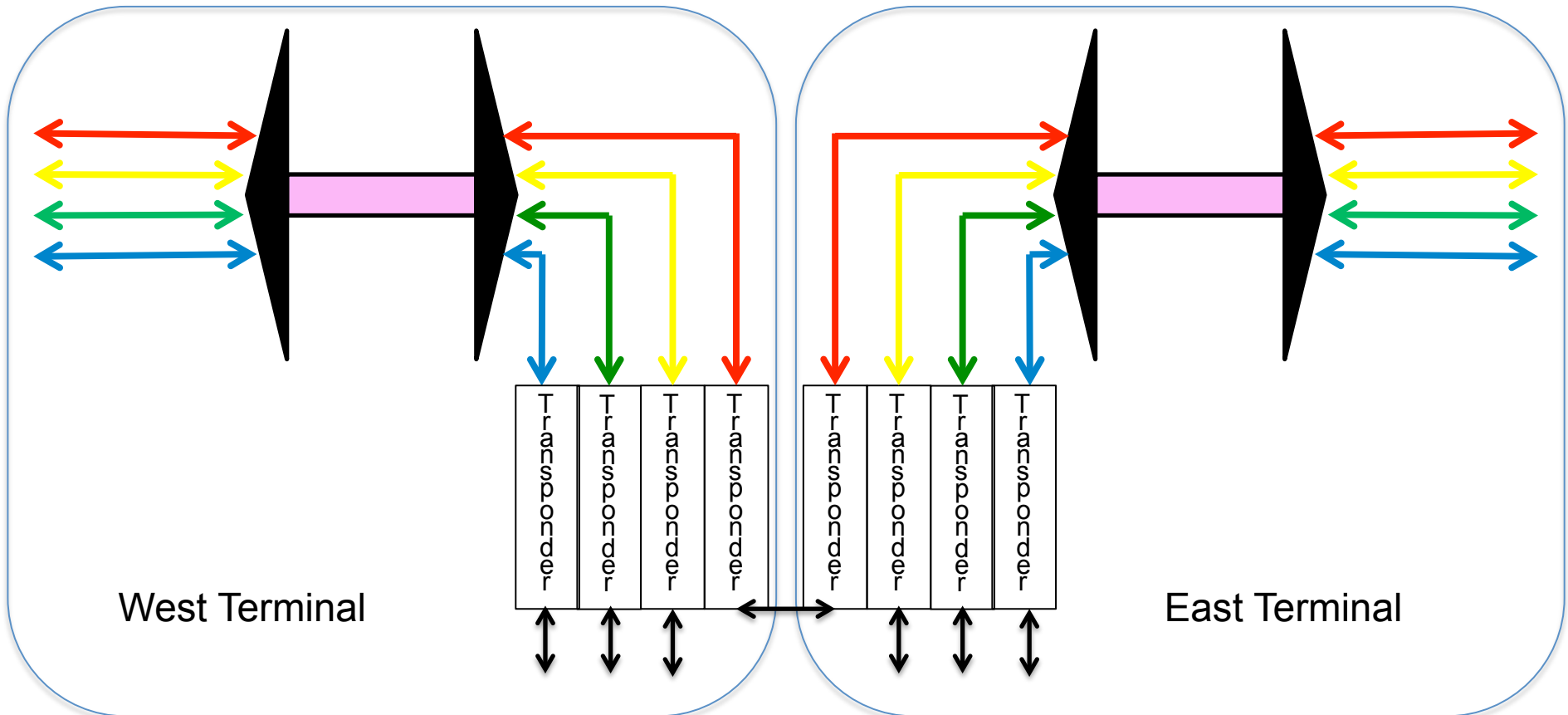


The Equipment

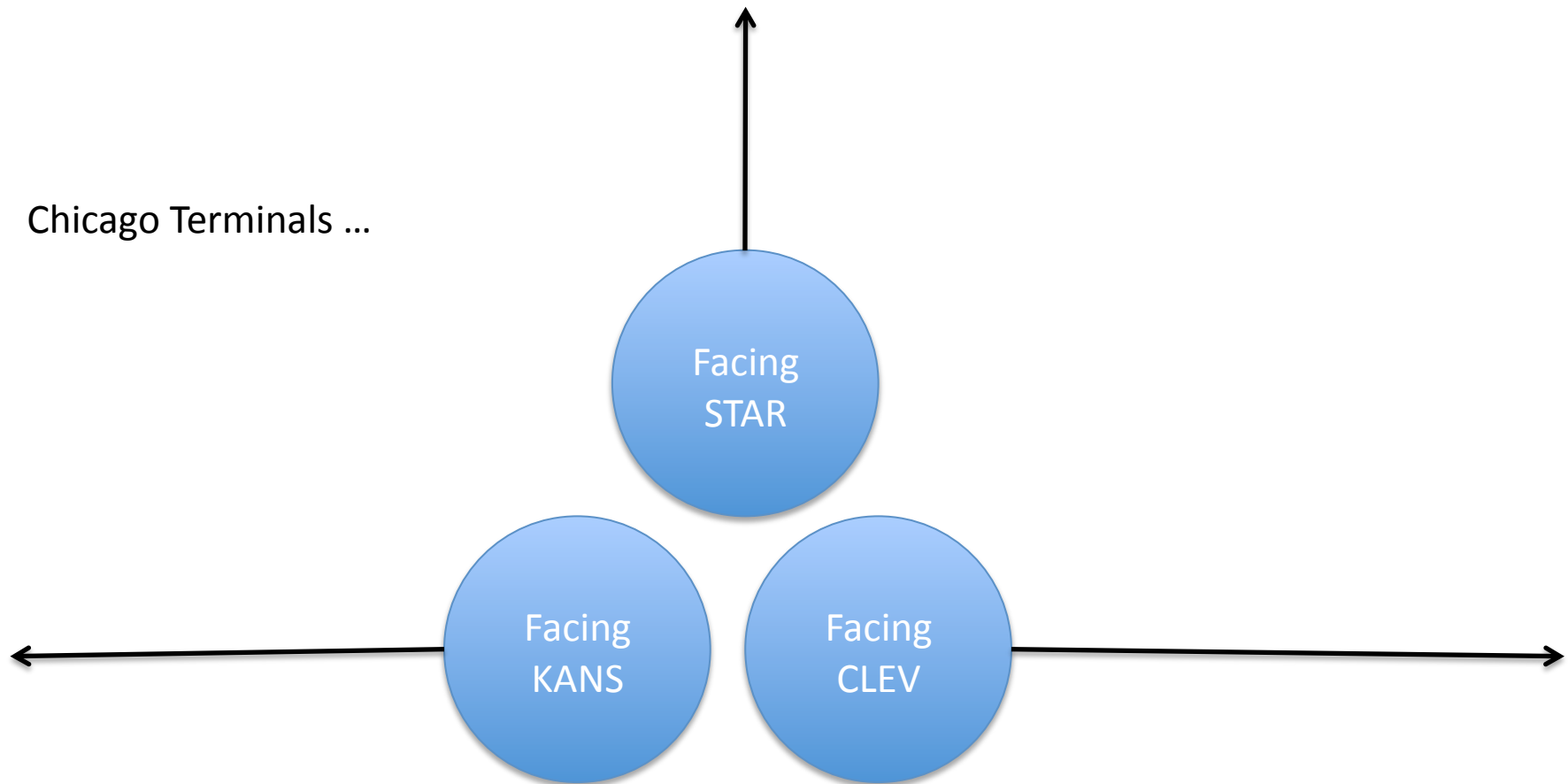
- Transponder – Converts a framed electrical signal (10GE OC192) into an optical signal at a specific wavelength.
- Mux – Multiplexes multiple discrete wavelength signals into a composite signal.
- DeMux – De-Multiplexes the Composite signal back into the individual wavelengths
- DCU (Dispersion Compensation Unit) - Uses coils of Dispersion Compensating Fiber to reverse effects of Dispersion
- Amplifiers
 - EDFA (Erbium Doped Fiber Amplifier)
 - RAMAN
- Management Cards

Terminal Node

- All wavelengths must drop and terminate on a TXP
- Use MUX/DMX to add or drop
- May continue circuit by cross-connecting to other terminal



Terminals ...



Terminal Node

CHCGIL39A

SummaryNetwork Explorer

CHCGIL39A

0 CR

0 MJ

0 MN

Node Addr : 152.49.50.1

IPv6 Address : unknown

Booted : 2/10/09 4:34 PM

User : NAGIOS

Authority : Retrieve

SW Version: 09.00-008I-17.17

Defaults : Factory Defaults

APC state : Side A - Enabled

Side : A In (Shelf 1 - Slot 1)

Out (Shelf 1 - Slot 1)

Rack 1

123567811121314151617

Shelf 1

123456711121314151617

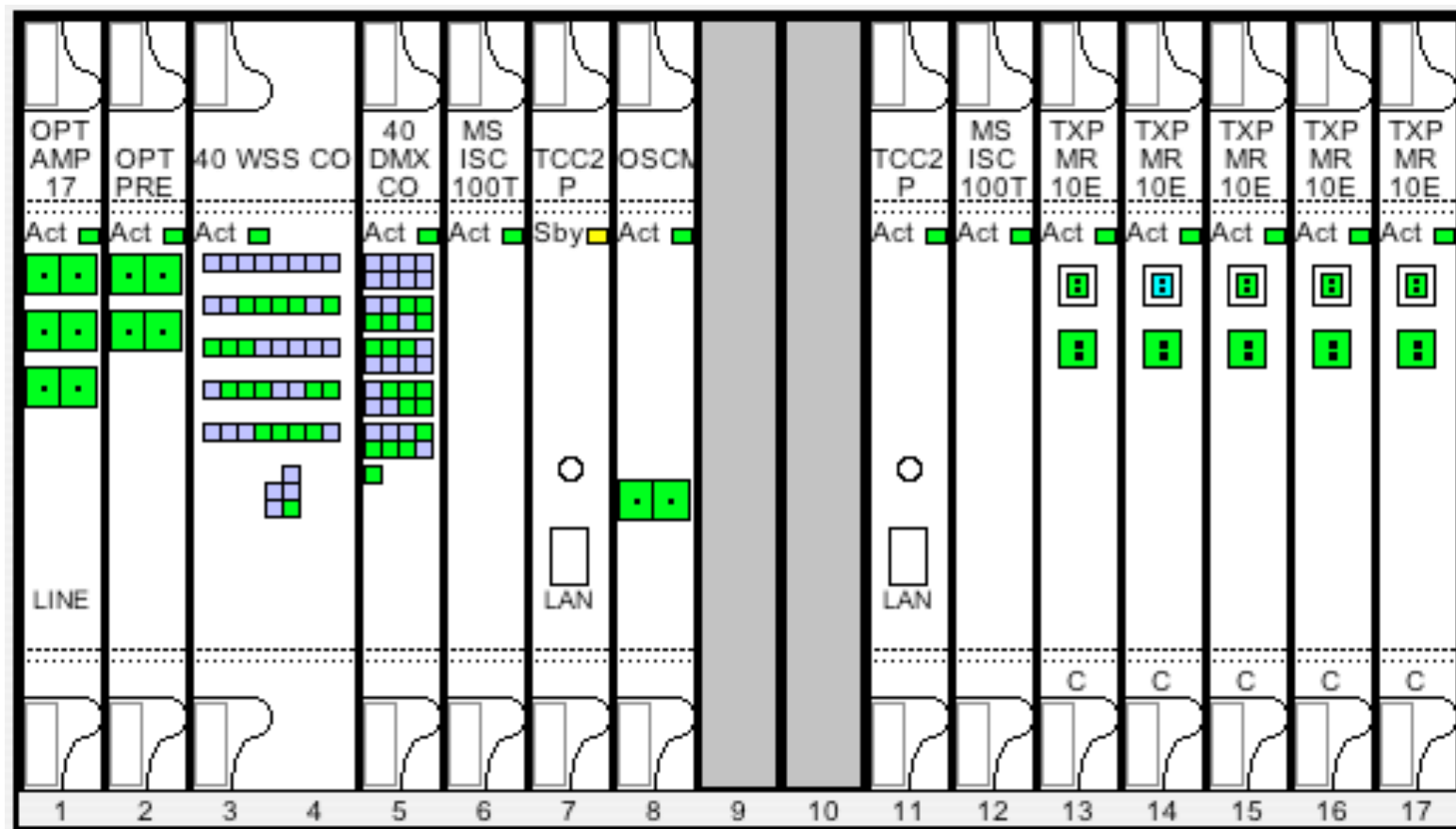
Shelf 2

711

Shelf 3

Terminal Node

CHCGIL39A

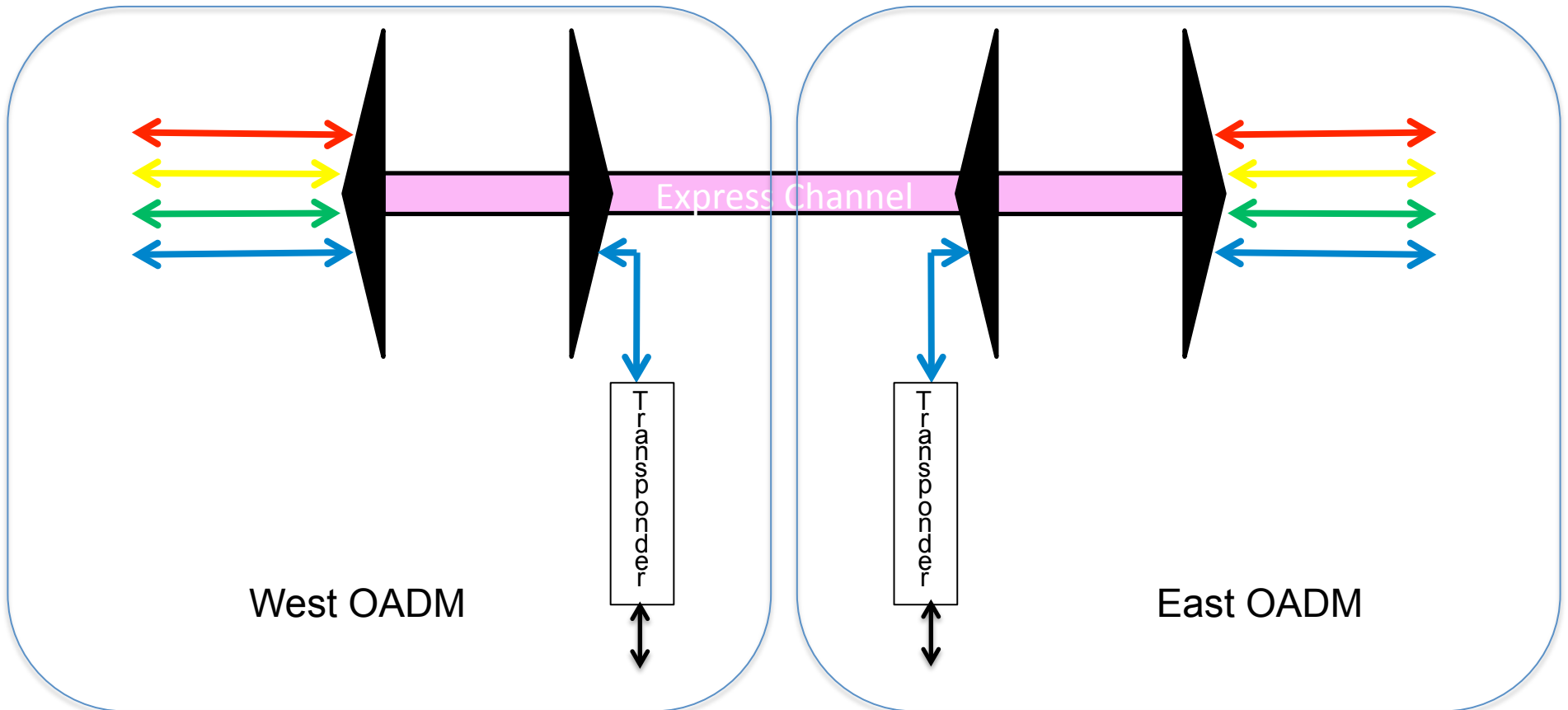






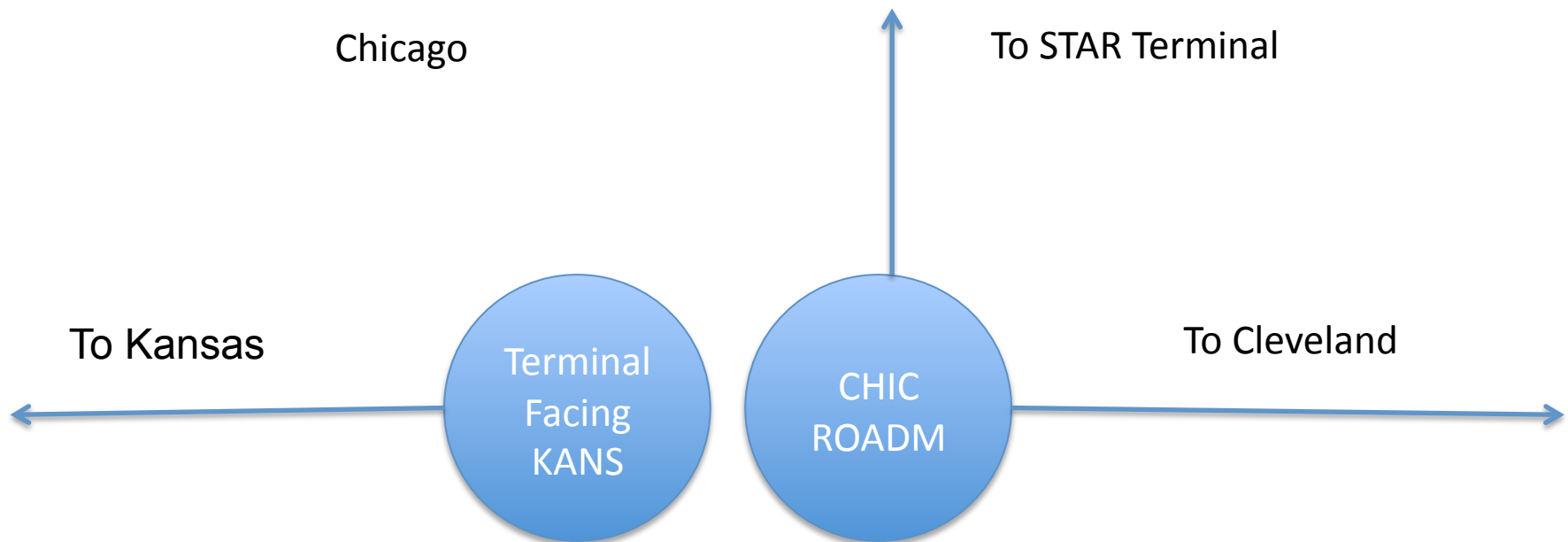
OADM -Optical Add Drop Multiplexor

- Selected wavelengths may drop and terminate on a TXP
- Use Band Filter or ROADM to add or drop
- Other circuits continue through express/pass-through



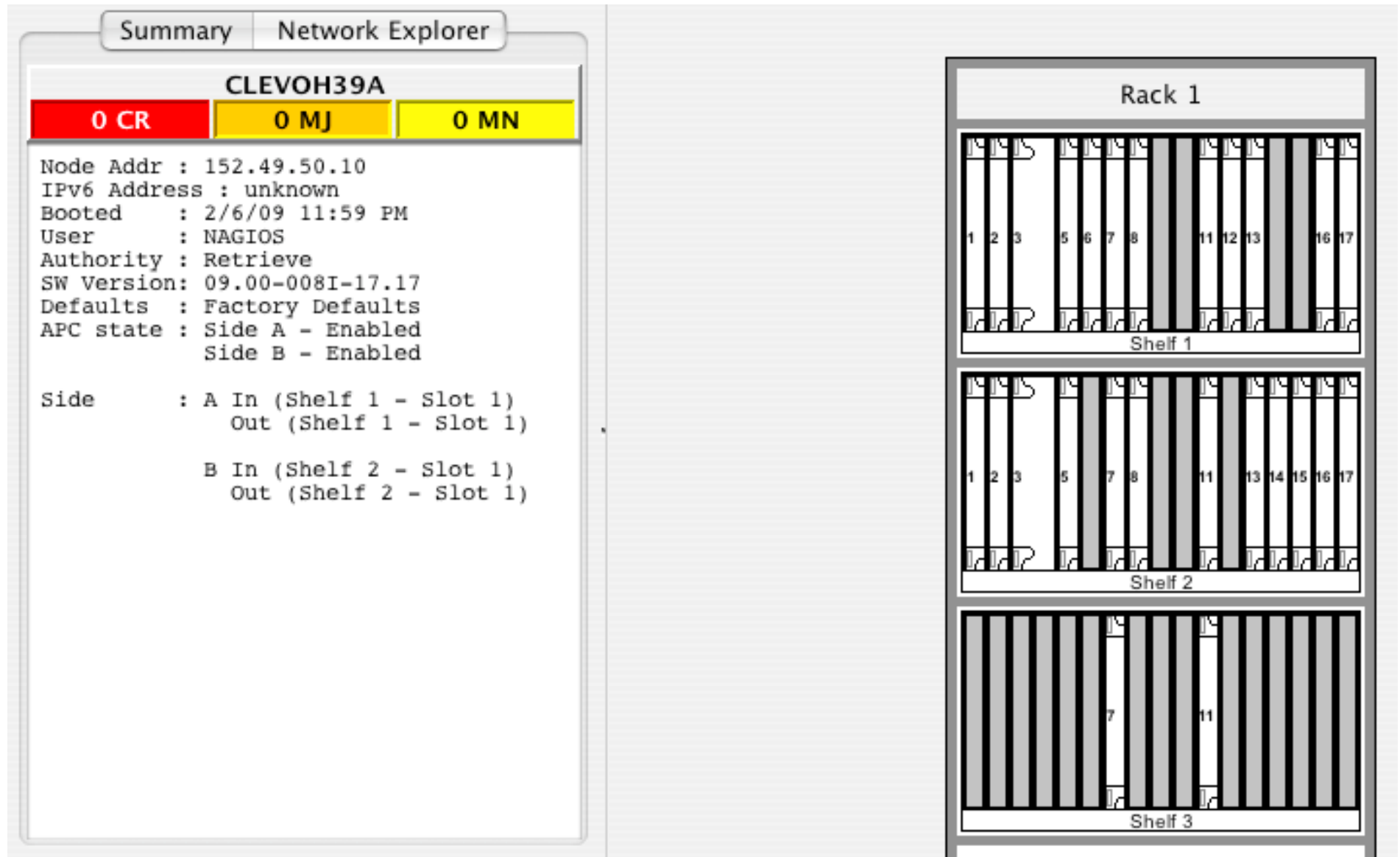
Filters & ROADMs ...

- Band filters drop a specific range of wavelengths allowing the rest to pass through
- ROADMs are programmable filters that allow the provisioner to choose which wavelengths drop and which pass through



OADM Node

CLEVOH39A



Summary

Network Explorer

CLEVOH39A, Shelf 1

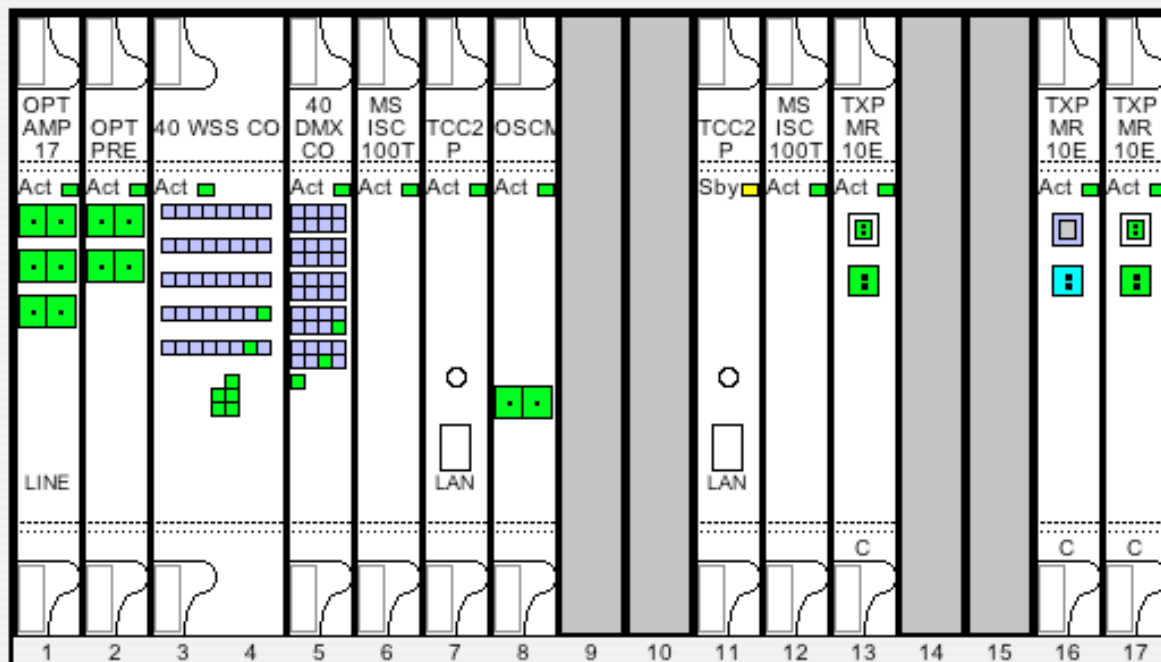
0 CR

0 MJ

0 MN

Slot 1: OPT-AMP 17
 Slot 2: OPT-PRE
 Slot 3: 40 WSS CO
 Slot 5: 40 DMX CO
 Slot 6: MS-ISC-100T
 Slot 7: TCC
 Slot 8: OSCM
 Slot 11: TCC
 Slot 12: MS-ISC-100T
 Slot 13: TXP_MR_10E_C
 Slot 16: TXP_MR_10E_C
 Slot 17: TXP_MR_10E_C
 APC state : Side A - Enabled

Side : A In (Slot 1)
 Out (Slot 1)



Summary

Network Explorer

CLEVOH39A, Shelf 2

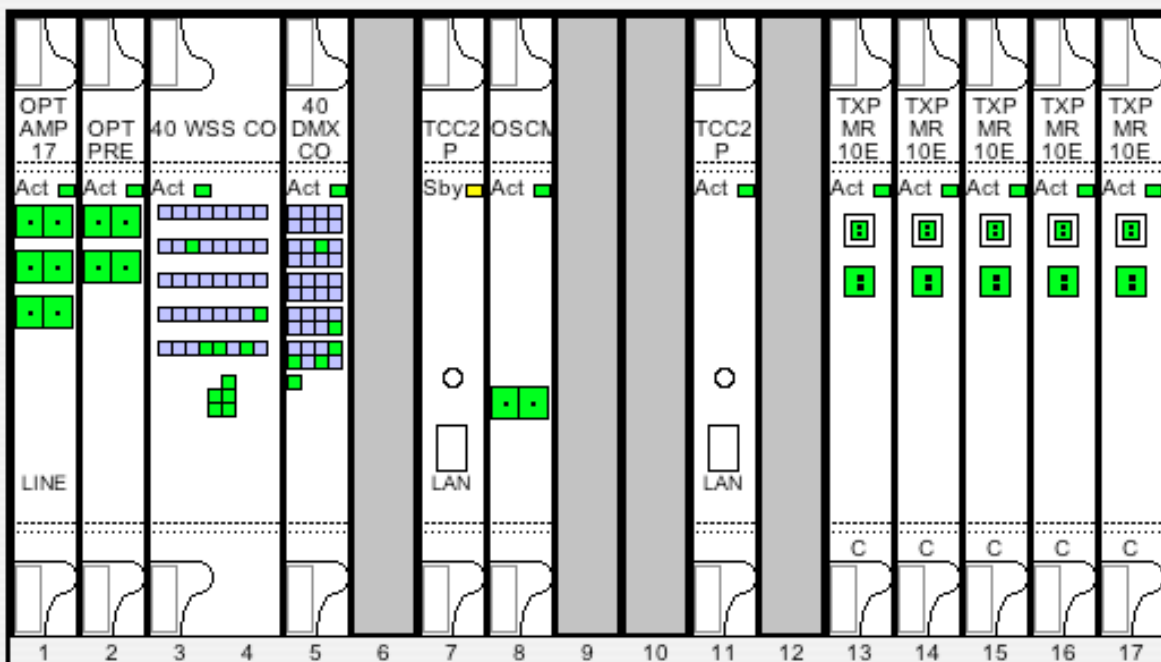
0 CR

0 MJ

0 MN

Slot 1: OPT-AMP 17
 Slot 2: OPT-PRE
 Slot 3: 40 WSS CO
 Slot 5: 40 DMX CO
 Slot 7: TCC
 Slot 8: OSCM
 Slot 11: TCC
 Slot 13: TXP_MR_10E_C
 Slot 14: TXP_MR_10E_C
 Slot 15: TXP_MR_10E_C
 Slot 16: TXP_MR_10E_C
 Slot 17: TXP_MR_10E_C
 APC state : Side B - Enabled

Side : B In (Slot 1)
 Out (Slot 1)





Amplifier Node

Summary ▶

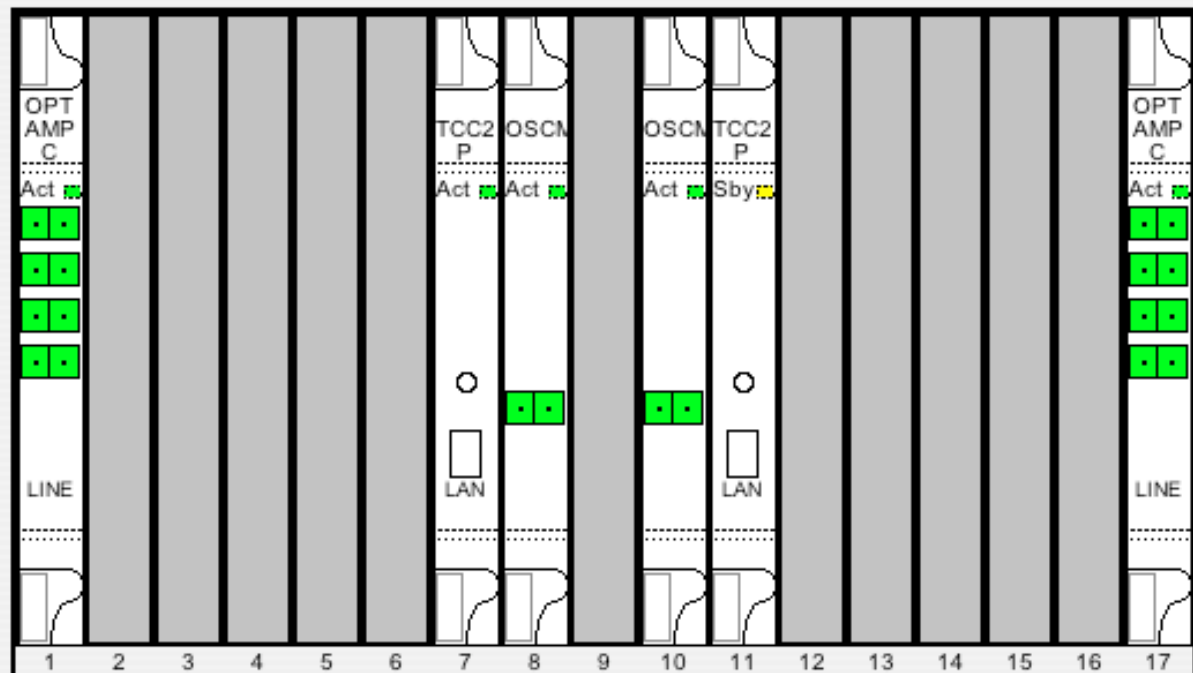
AKRNOH39A

0 CR **0 MJ** **0 MN**

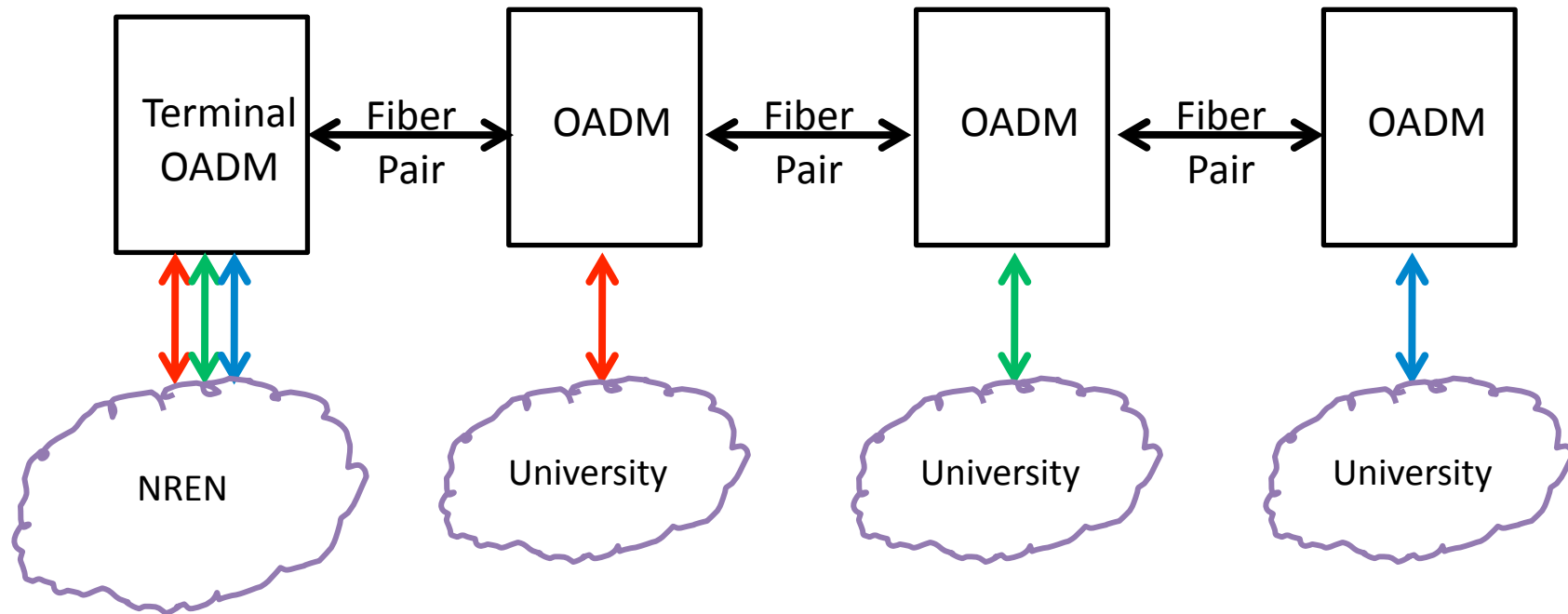
Node Addr : 152.49.50.11
Booted : 2/6/09 4:27 PM
User : NAGIOS
Authority : Retrieve
SW Version: 09.00-008I-17.1
Defaults : Factory Default
APC state : Side A - Enable
 Side B - Enable

Side : A In (Slot 1)
 Out (Slot 1)

 B In (Slot 17)
 Out (Slot 17)



Can Build Complex Networks



NLR CHIC-WASH

win2.grnoc.iu.edu

Cisco Transport Controller

File Edit View Tools Help

Network Scope: All

Summary Network Explorer

Network View

0 CR 0 MJ 0 MN

MCLNVA39A
Critical : 0
Major : 0
Minor : 0

Alarms Conditions History Circuits Provisioning Maintenance

New	Date	Node	Object	Eqpt Type	Shelf	Slot	Port	Wavelength	Path Width	Sev	ST	SA	Cond	Description	Direction	Location
-----	------	------	--------	-----------	-------	------	------	------------	------------	-----	----	----	------	-------------	-----------	----------

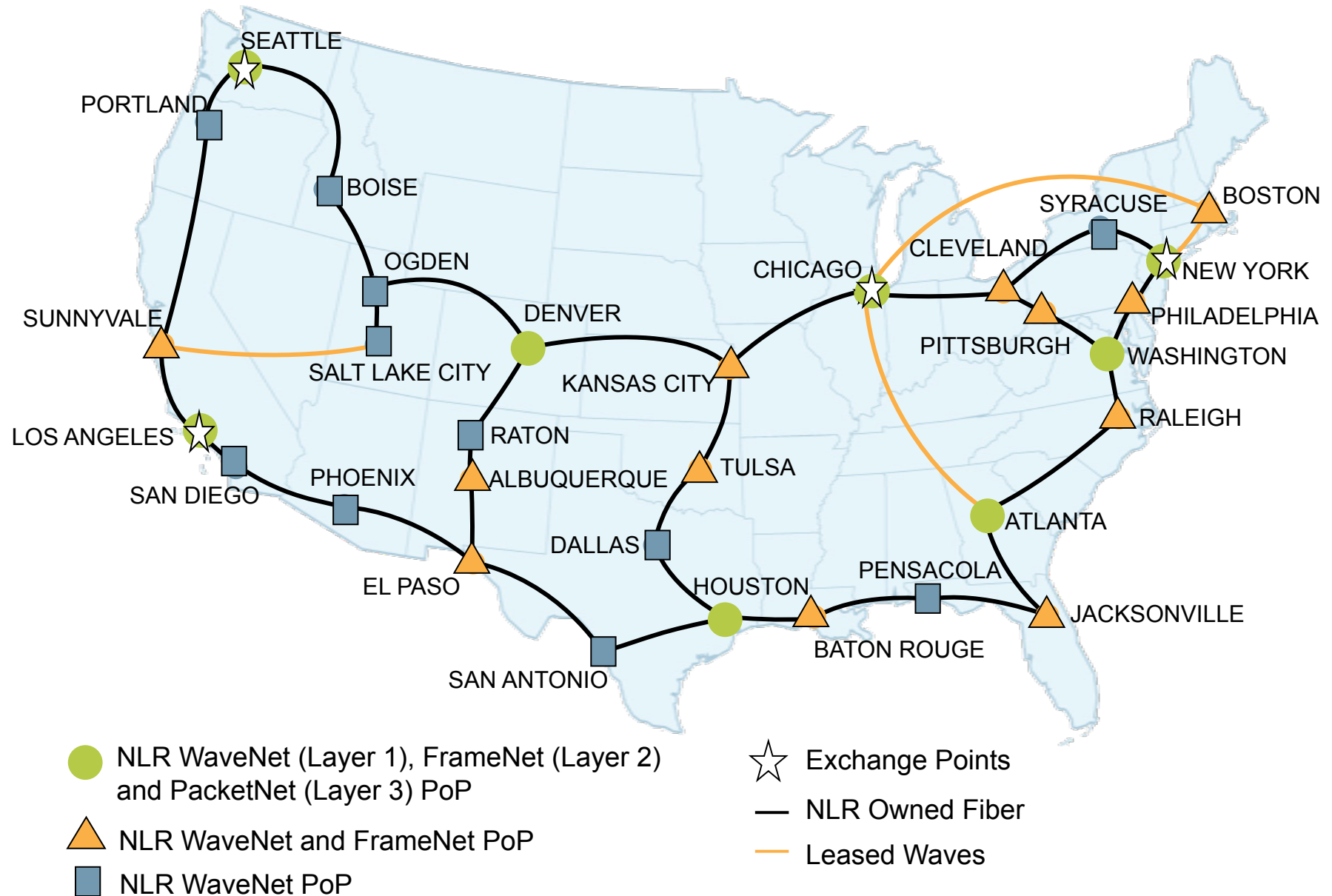
- Three types of optical nodes
 - Single- degree ROADM (Terminal)
 - Multi-degree ROADM (Add/Drop or Pass-Thru)
 - Amplifier

Synchronize Filter... Delete Cleared Alarms ☐ AutoDelete Cleared Alarms

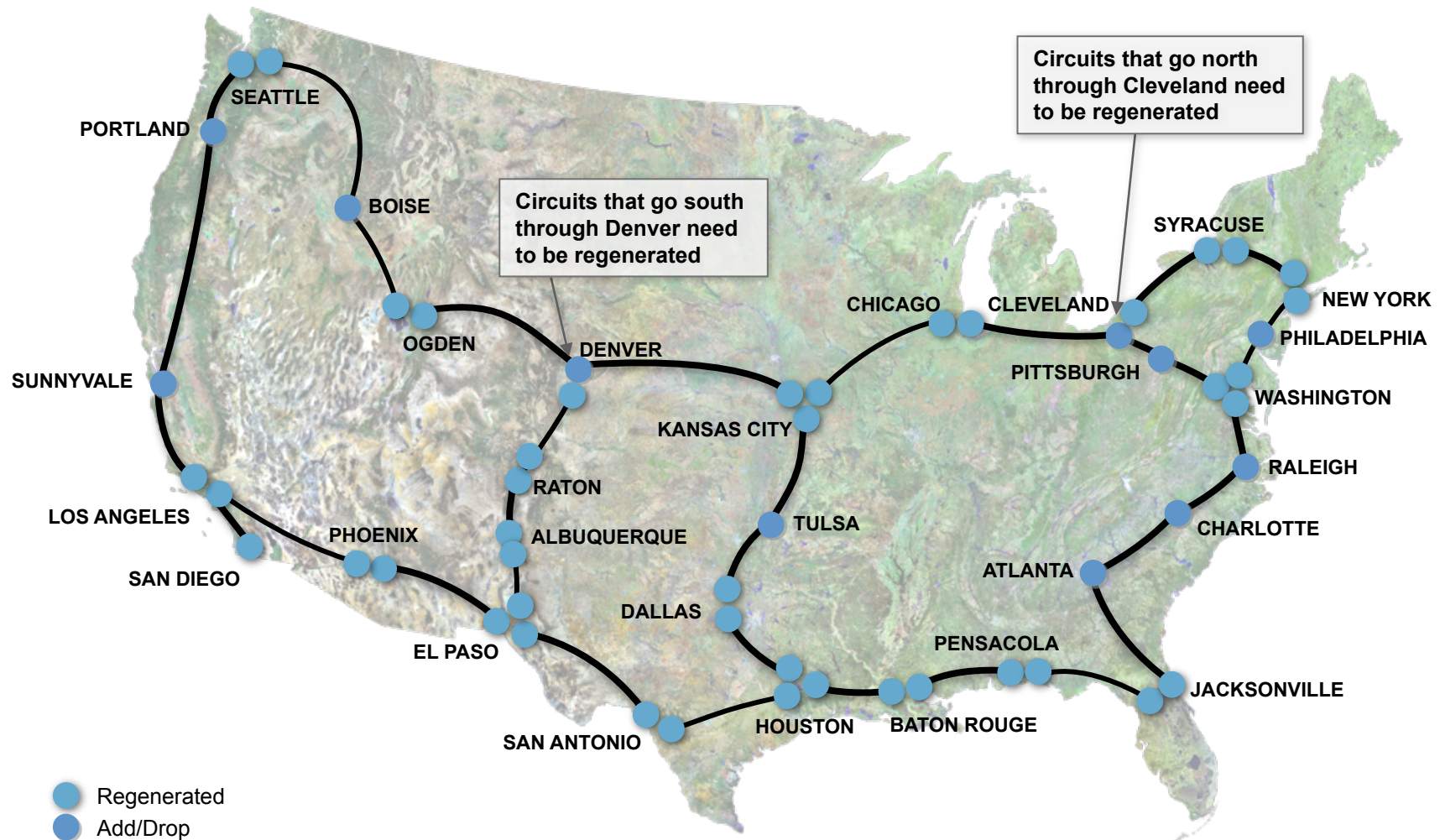
NET CKT

Start CTC LAUNCHER - M... Cisco Transport Co...

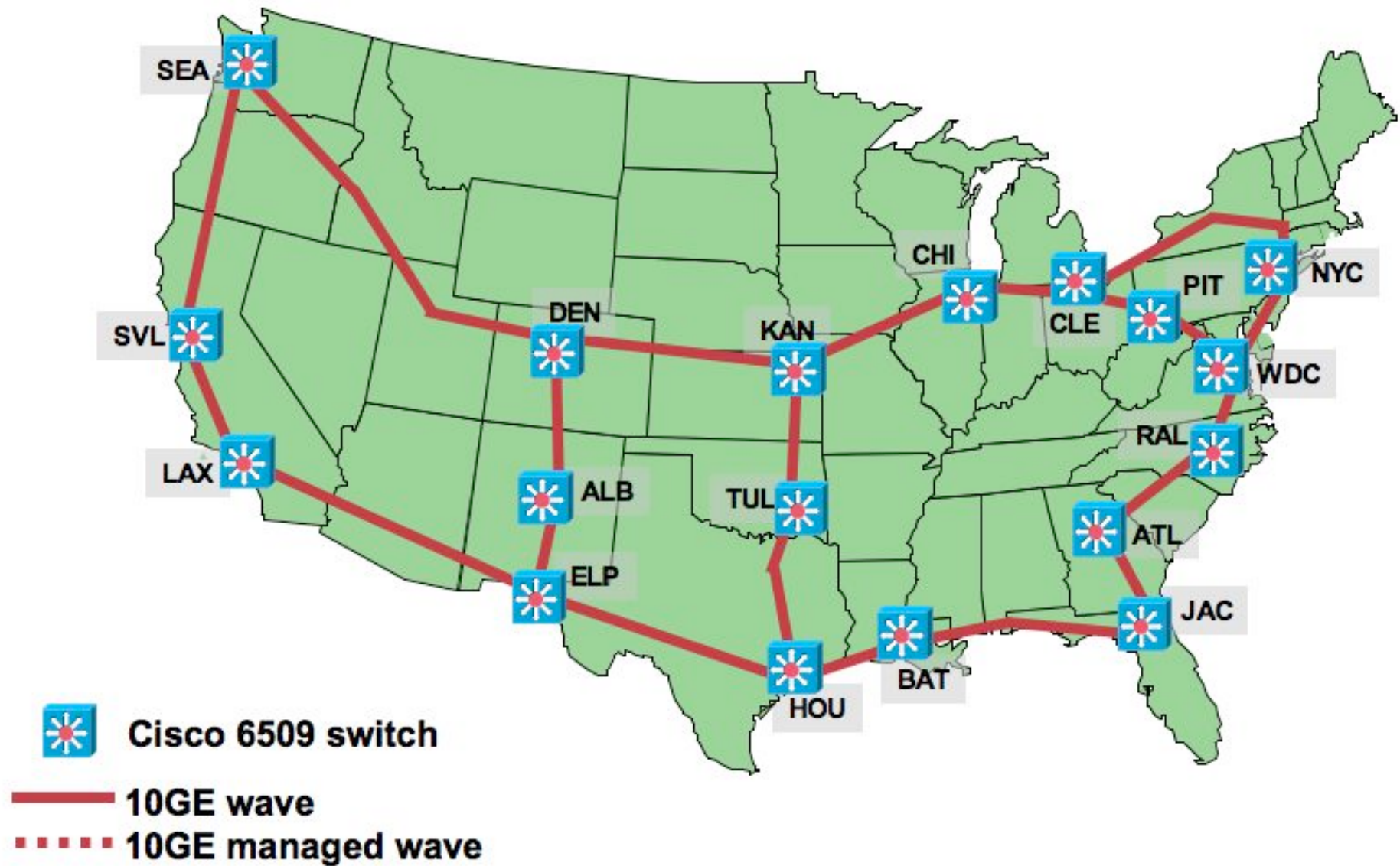
National LambdaRail



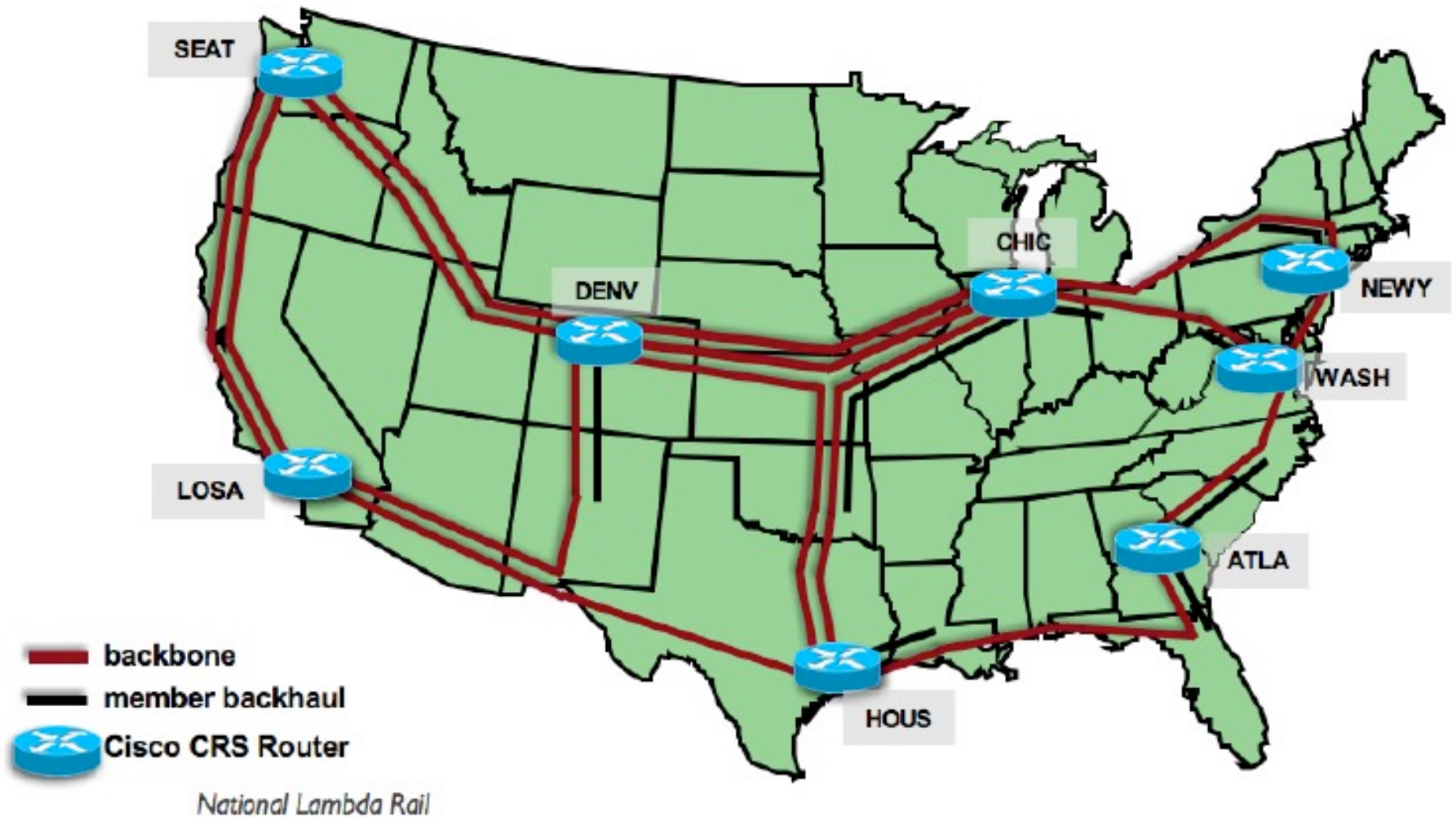
NLR Layer 1 (WaveNet)



NLR Layer 2 (FrameNet)



NLR Layer 3 (PacketNet)



Cisco 15454 Management

- Direct Access to Cisco 15454 ONS DWDM Shelf requires web browser and Java.
- Java versions vary depending on version of CTC
 - CTC 7.0.2 uses Java 1.4.12
 - CTC 8.5.1 and 9.0 use Java 1.5 or newer
- GRNOC Syseng provides Windows hosts available via RDC
- Individual Shelf Management
 - Each Shelf has own TID and IP Address
 - Must login to Front End Shelves individually to view Transponders
- Multishelf Management
 - Single TID and IP Address for multiple shelf system (Node)
 - First Shelf is Node Controller
 - Additional shelves are subtended
 - Requires MS-ISC-100T Cards or External Switch

Cisco OSC (Optical Service Channel)

- Additional Wavelength separate from DWDM Frequencies (1510nm)
- Added to or dropped from composite signal by OSC-CSM or certain amplifier cards
- Transports OC-3/STM-1 formatted signal
 - Payload of OC-3/STM-1 is used to carry a Fast Ethernet “User Channel” between NEs
 - User Channel Terminates on the OSCM or OSC-CSM card RJ-45 port at each node
 - For external “User” communication
 - Can be daisy-chained together or connected to an external switch
 - SONET Section Overhead of OC-3/STM-1 signal is used to carry communications between NEs
 - DCC (Data Communications Channel) - 576 kbps (D4 - D12 of SOH)
 - Used for Network communications between NEs
 - GCC (Generic Communications Channel)

GlobalNOC L1 Tools

- TL1, SNMP & Expect Used for polling and statistics gathering
- Combination of commercial and homegrown apps
 - Nagios & Alertmon*
 - Alertmon is an alarm correlation tool from multiple monitoring tools
 - SNAPP* & LLAMA* (Light Level Aggregation and Measurement Analysis)
 - Used to track light levels on port types LINE, COM, DC, MUX, DMX, TXP and OSC
 - Optical Power Levels retrieved from VOA on individual card
 - Threshold monitoring – under development
 - Homegrown Database (Repository for all operational data)
 - Route and Circuit Representations and status
 - Live Inventory and Node View
 - POP & Rack Views (including photo repository)
 - Contacts
 - Reporting
 - WebGUI
 - How-Tos, File Repository, Maps & Documentation, Links

GlobalNOC AlertMon

Current Alerts

Last Updated 18:17:08 UTC

Unacknowledged Alerts

Network	Host Group	Service Group	Hostname	Service	Duration	Device	Description	Acknowledgement Select All Deselect All	Ack History
Indiana GigaPOP	Syseng On-Call Servers		mail.ictc.indiana.gigapop.net (db)	LOAD	0d 0h 8m 7s		CRITICAL - load average: 39.43, 34.42, 19.75	☐	Host / Service

Footprints Project: Ticket Number: Comment:

Acknowledged Alerts

+	2011-06-09 14:52:07	I-Light: I-light TDM Member - CES DISCONNECT TRACKING TICKET #2 [4336:83]	1 total alert	(remove all)
+	2011-06-21 12:58:24	MAX GigaPOP: MAX GigaPOP IXP Equi6ix Outage [833:115]	1 total alert	(remove all)
+	2011-06-21 11:43:18	MAX GigaPOP: MAX GigaPOP Layer 2 Core Node ASHB Outage Resolved [832:115]	1 total alert	(remove all)
+	2011-06-21 00:49:16	Internet2 TR-CPS: Internet2 TR-CPS Peer ISC F-ROOT (CHIC0) Outage [1415:121]	2 total alerts	(remove all)
+	2011-06-20 15:33:08	System Support: Enable Monitoring for Role (remote : Remote Devices) [9678:101]	10 total alerts	(remove all)
+	2011-06-07 19:30:18	jsherk: 4977:30 - Core Router Upgrade	36 total alerts	(remove all)
+	2011-06-19 15:11:35	System Support: nms-rthr2.kans.net.internet2.edu Various Services "Service Check Timed Out" Alarms [9673:101]	5 total alerts	(remove all)
+	2011-06-18 11:11:06	NLR WaveNet: NLR Layer 1 RGANTX31A FAN-1 FAN: Fan Failure [11962:52]	2 total alerts	(remove all)
+	2011-06-06 19:55:35	NLR WaveNet: NLR - 10GE DENV-SEAT FRGP/UCAR_NOAA Install [11907:52]	1 total alert	(remove all)
+	2011-06-15 13:49:18	NLR FrameNet: NLR Layer 2 Member PSC Brief Outage [6526:55]	1 total alert	(remove all)
+	2011-06-15 01:52:25	System Support: ndb1.net.internet2.edu BWCTL_DB CRITICAL - BWCTL mesh I2OBSBWTCP4 is 8 hours, 2 min, 18 sec behind (WASH -> CHIC) [9629:101]	1 total alert	(remove all)
+	2011-06-14 19:55:47	CEN: CEN Devices ENSW064H & ENSW083H Rancid Collection Alarms [484:95]	1 total alert	(remove all)
+	2011-06-16 08:54:55	System Support: GRNOC Internal backup.bldc.gnoc.iu.edu BACKUP Pool2A [9635:101]	1 total alert	(remove all)
+	2011-05-23 15:19:07	jsherk: 5059:30 - Link to Colubris Down	1 total alert	(remove all)
+	2011-05-21 03:12:25	Internet2 IP: Internet2 IP Network lan.salt.net.internet2.edu Outage Resolved [17392:45]	5 total alerts	(remove all)
+	2011-02-16 21:21:21	NLR WaveNet: NLR Waves Originating in Starlight Cutover to 39 [11685:52]	2 total alerts	(remove all)
+	2011-04-27 15:19:04	Internet2 Infinera: LEARN Circuit Turnup (06022 & 06023) [1298:100]	4 total alerts	(remove all)
+	2011-04-04 06:04:43	System Support: Internet2 Observatory Systems nms-rthr2.wash.net.internet2.edu RAID Alarm [8901:101]	1 total alert	(remove all)
+	2011-03-23 14:22:34	Internet2 Infinera: Circuit Turnup for Merit (06018 06019 06020 06021) [1253:100]	4 total alerts	(remove all)
+	2011-02-14 15:22:19	MAX GigaPOP: MAX GigaPOP Server cflow Outage [685:115]	1 total alert	(remove all)
+	2011-03-04 16:22:22	MAX GigaPOP: MAX GigaPOP Participant Montgomery College IPv6 Outage [718:115]	1 total alert	(remove all)

Networks		
☒ AMPATH	☒ CIC OmniPoP	☒ Connecticut Education
☒ FutureGrid	☒ GRNOC Internal	☒ GlobalNOC Testlab
☒ I-Light	☒ IP Grid	☒ IU CNI
☒ Indiana GigaPOP	☒ Indiana University	☒ Internet2 Network
☒ Internet2 TR-CPS	☒ MAN LAN	☒ MAX GigaPOP
☒ National LambdaRail	☒ Open Science Grid	☐ Playground
☒ REN-ISAC	☐ SDN Interop Lab	☒ TransPAC
☒ other		

Select All | Deselect All

NLR Optical Routes DB



Routes DB

NLR-CHIC-CLEV-DWDM-04999 (40 Channel System)

Endpoint A

Node [CHCGIL39A](#)
 Long Name Chicago ONS 15454 (CHIC-WASH)
 POP [Chicago Terminal](#)
 Address: 111 N. Canal Street
 Suite: 200 (NLR suite S001)
 Chicago, IL 60606

Endpoint Z

Node [CLEVOH39A](#)
 Long Name Cleveland ONS 15454 (CHIC-WASH)
 POP [Cleveland Terminal](#)
 Address: 4000 Chester Avenue
 Suite:
 Cleveland, OH 44103

Path

POP Name A	Node Name A	Type A	POP Name Z	Node Name Z	Type Z	Carrier Circuit ID
Chicago Terminal	CHCGIL39A		Gary OLA	GARYIN39A		CHCGILGM-GARYINII-00021 CHCGILGM-GARYINII-00022
Gary OLA	GARYIN39A		Niles OLA	NILSMI39A		GARYINII-NILSMICL-00011 GARYINII-NILSMICL-00012
Kalamazoo OLA	KLMZMI39A		Niles OLA	NILSMI39A		NILSMICL-KLMZMITS-00011 NILSMICL-KLMZMITS-00012
Concord OLA	CNCRMI39A		Kalamazoo OLA	KLMZMI39A		KLMZMITS-CNCRMIAB-00011 KLMZMITS-CNCRMIAB-00012
Concord OLA	CNCRMI39A		Dexter OLA	DXTRMI39A		CNCRMIAB-DXTRMIBO-00011 CNCRMIAB-DXTRMIBO-00012
Dexter OLA	DXTRMI39A		Detroit OLA	SFLDMI39A		DXTRMIBO-SFLDMIDN-00009 DXTRMIBO-SFLDMIDN-00010
Detroit OLA	SFLDMI39A		Toledo OLA	TOLEOH39A		SFLDMIDN-TOLEOH11-00005 SFLDMIDN-TOLEOH11-00006
Kimball OLA	KMBLOH39A		Toledo OLA	TOLEOH39A		TOLEOH11-KMBLOHAA-00007 TOLEOH11-KMBLOHAA-00008
Kimball OLA	KMBLOH39A		Cleveland Terminal	CLEVOH39A-2		KMBLOHAA-CLEVOH97-00005 KMBLOHAA-CLEVOH97-00006

NLR-CHIC-CLEV-DWDM-04999 (40 Channel System)

Endpoint A

Node [CHCGIL39A](#)
 Long Name Chicago ONS 15454 (CHIC-WASH)
 POP [Chicago Terminal](#)
 Address: 111 N. Canal Street
 Suite: 200 (NLR suite S001)
 Chicago, IL 60606

Endpoint Z

Node [CLEVOH39A](#)
 Long Name Cleveland ONS 15454 (CHIC-WASH)
 POP [Cleveland Terminal](#)
 Address: 4000 Chester Avenue
 Suite:
 Cleveland, OH 44103

Channels

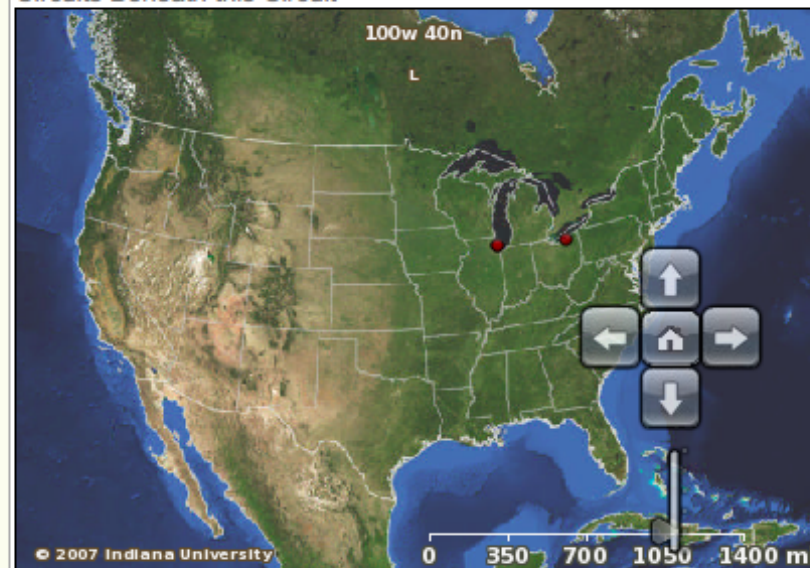
Channel	Wavelength	Circuit name	Description	Express System	Status	Type	Customer	Carrier	Owner	Edit/Delete
1	1530.33	NLR-NEWY-STAR-O192-03559	SURFNet: NEWY-STAR via WASH		active	OC192		National LambdaRail		Edit
2	1531.12	NLR-STAR-WASH-10GE-05701	MATP: Lifetime Lambda STAR-WASH		active/not monitored	10GE		National LambdaRail		Edit
3	1531.90				available	Wavelength				Edit
4	1532.68	NLR-STAR-WASH-10GE-07644	SLR LifeTime Lambda STAR-WASH		active	10GE		National LambdaRail		Edit
5	1533.47				un-allocated	Wavelength				Edit
6	1534.25	NLR-NEWY-STAR-O192-03565	USLHCNet: NEWY-STAR via SYRA		active	OC192		National LambdaRail		Edit
7	1535.04				un-allocated	Wavelength				Edit
8	1535.82				un-allocated	Wavelength				Edit
9	1536.61				un-allocated	Wavelength				Edit
10	1537.40	NLR-JACK-STAR-10GE-03569	FLR Lifetime Lambda: JACK-STAR		active	10GE		National LambdaRail		Edit
11	1538.19				available	Wavelength		National LambdaRail		Edit
12	1538.98				available	Wavelength				Edit
13	1539.77	NLR-PITT-STAR-O192-263	PSC: Lifetime Lambda PITT-STAR		active	OC192		National LambdaRail		Edit
14	1540.56				available	Wavelength				Edit
15	1541.35				un-allocated	Wavelength				Edit
16	1542.14	NLR-STAR-WASH-10GE-266	TeraFlow Project: STAR-WASH		active	10GE		National LambdaRail		Edit
17	1542.94	NLR-STAR-WASH-10GE-267	ESnet: STAR-WASH		active	10GE		National LambdaRail		Edit
18	1543.73	NLR-STAR-WASH-10GE-268	MATP: STAR-WASH (for NASA and MAX)		active	10GE		National LambdaRail		Edit
19	1544.53	NLR-STAR-WASH-10GE-269	NASA Goddard/Optiputer		active	10GE		National LambdaRail		Edit
20	1545.32	NLR-STAR-WASH-10GE-05737	NASA 4X10G Test Bed #1		active	10GE		National LambdaRail		Edit
21	1546.12	NLR-STAR-WASH-10GE-05738	NASA 4X10G Test Bed #2		active	10GE		National LambdaRail		Edit
22	1546.92	NLR-STAR-WASH-10GE-05739	NASA 4X10G Test Bed #3		active	10GE		National LambdaRail		Edit
23	1547.72	NLR-STAR-WASH-10GE-05740	NASA 4X10G Test Bed #4		active	10GE		National LambdaRail		Edit
24	1548.51				un-allocated	Wavelength				Edit
25	1549.32				un-allocated	Wavelength				Edit
26	1550.12	NLR-RALE-STAR-10GE-270	C-Wave: RALE-STAR		planning	10GE		Cisco Systems, Inc		Edit
27	1550.92	NLR-STAR-WASH-10GE-271	C-Wave: STAR-WASH		active	10GE		Cisco Systems, Inc		Edit
28	1551.72	NLR-SEAT-WASH-10GE-293	C-Wave: SEAT-WASH		active	10GE		Cisco Systems, Inc		Edit
29	1552.52	NLR-DALL-RALE-10GE-03594	Cisco IT: DALL-RALE N		active	10GE		Cisco Systems, Inc		Edit
30	1553.33				un-allocated	Wavelength				Edit
31	1554.13	NLR-CHIC-WASH-10GE-273	TransitRail: CHIC-WASH		active	10GE		National LambdaRail		Edit
32	1554.94	NLR-CHIC-CLEV-10GE-09367	Cancer Knowledge Alliance		active	10GE		Darkstrand		Edit
33	1555.75	NLR-RALE-SUNN-10GE-03599	Cisco IT: RALE-SUNN N		active	10GE		Cisco Systems, Inc		Edit
34	1556.55	NLR-DENV-WASH-10GE-05565	UCAR/FRGP_NOAA: Lifetime Lambda		active	10GE		National LambdaRail		Edit
35	1557.36	NLR-ATLA-CHIC-10GE-07872	OpenFlow #4 ATLA-CHIC		active	10GE		National LambdaRail		Edit
36	1558.17				available	Wavelength		National LambdaRail		Edit
37	1558.98				active	Wavelength		National LambdaRail		Edit
38	1559.79				available	Wavelength		National LambdaRail		Edit
39	1560.61	NLR-CHIC-CLEV-10GE-278	NLR Layer 2 BB Circuit: CHIC-CLEV		active	10GE		National LambdaRail		Edit
40	1561.42	NLR-LOSA-NEWY-O192-05746	DS-MediaXstream: LOSA-NEWY		active/not monitored	OC192		Darkstrand		Edit

Circuit Summary: [\(Edit this area\)](#)

Name: **NLR-CHIC-CLEV-10GE-278**
 LLAMA: [View](#)
 Status: **active**
 Activation Date: **2009-02-23 19:25:54**
 Decom Date:
 Planned Activation
 Date:
 Planned Decom Date:
 Role Code: backbone,Layer1,NLR Inc.
 Type: 10GE
 # of Channels:
 Channel #: 0
 Cable Label:
 Descr: NLR Layer 2 BB Circuit:
 CHIC-CLEV
 Customer: [NLR Layer 2 Engineering](#)
 Carrier: na
 Owner: na
 Carrier Circuit ID:
 Act: [Details](#)
 Last Updated: 2010-05-28 15:23:46
 Last Updated By: tyabell
 Autopopulated: No

Map

Circuits Beneath this Circuit



[Need Flash](#)

[Player?](#)

Circuit Endpoints: [\(Edit this area\)](#)

Node	Interface	Descr	Dir	State	Entity
CHCGIL39A-2	FAC-2-16-1-1	Client NLR-CHIC-CLEV-10GE-278	BI	up	na
CLEVOH39A-2	FAC-2-17-1-1	Client NLR-CHIC-CLEV-10GE-278	BI	up	na

Circuit Components (below): [\(Edit this area\)](#)

Path	Position	Channel	Name	Description	Type	Status
	0	39	NLR-CHIC-CLEV-CHAN-03147	-1	Wavelength	active

Lower Circuit Tree Hierarchy

☐ [NLR-CHIC-CLEV-10GE-278](#) (Role: backbone,Layer1,NLR Inc. Type: 10GE SRC-DST: CHIC-CLEV)

☒ [NLR-CHIC-CLEV-CHAN-03147](#) (Role: Native Type: CHAN SRC-DST: CHIC-CLEV)

Circuit Type:

Circuit Role:

Circuit Status:

Circuits built on top of **NLR-CHIC-CLEV-10GE-278** (above):

[\(Edit this area\)](#)

Position	Channel	Name	Description	Type	Status
10	0	NLR-CHIC-CLEV-10GE-06304	NLR Layer 2 BB Circuit: CHIC-CLEV	10GE	active

Circuit Components (below): ([Edit this area](#))

Path	Position	Channel	Name	Description	Type	Status
	0	39	NLR-CHIC-CLEV-CHAN-03147	-1	Wavelength	active

Lower Circuit Tree Hierarchy

- [-] [NLR-CHIC-CLEV-10GE-278](#) (Role: backbone,Layer1,NLR Inc. Type: 10GE SRC-DST: CHIC-CLEV)
 - [-] [NLR-CHIC-CLEV-CHAN-03147](#) (Role: Native Type: CHAN SRC-DST: CHIC-CLEV)
 - [-] [NLR-CHIC-CLEV-DWDM-04999](#) (Type: DWDM SRC-DST: CHIC-CLEV)
 - [NLR-CHCGIL39A-GARYIN39A-FIBR-05281](#) (Role: IRU Fiber Type: FIBR SRC-DST: CHIC-GARYINII)
 - [NLR-GARYIN39A-NILSMI39A-FIBR-05280](#) (Role: IRU Fiber Type: FIBR SRC-DST: GARYINII-NILSMICL)
 - [NLR-NILSMI39A-KLMZMI39A-FIBR-05279](#) (Role: IRU Fiber Type: FIBR SRC-DST: KLMZMITS-NILSMICL)
 - [NLR-KLMZMI39A-CNCRMI39A-FIBR-05278](#) (Role: IRU Fiber Type: FIBR SRC-DST: CNCRMIAB-KLMZMITS)
 - [NLR-CNCRMI39A-DXTRMI39A-FIBR-05277](#) (Role: IRU Fiber Type: FIBR SRC-DST: CNCRMIAB-DXTRMIBO)
 - [NLR-DXTRMI39A-SFLDMI39A-FIBR-05276](#) (Role: IRU Fiber Type: FIBR SRC-DST: DXTRMIBO-SFLDMIDN)
 - [NLR-SFLDMI39A-TOLEOH39A-FIBR-05275](#) (Role: IRU Fiber Type: FIBR SRC-DST: SFLDMIDN-TOLEOH11)
 - [NLR-TOLEOH39A-KMBLOH39A-FIBR-05274](#) (Role: IRU Fiber Type: FIBR SRC-DST: KMBLOHAA-TOLEOH11)
 - [NLR-KMBLOH39A-CLEVOH39A-FIBR-05273](#) (Role: IRU Fiber Type: FIBR SRC-DST: KMBLOHAA-CLEV)

Circuit Type:

Circuit Role:

Circuit Status:

[Reveal](#)

Circuits built on top of **NLR-CHIC-CLEV-10GE-278** (above):

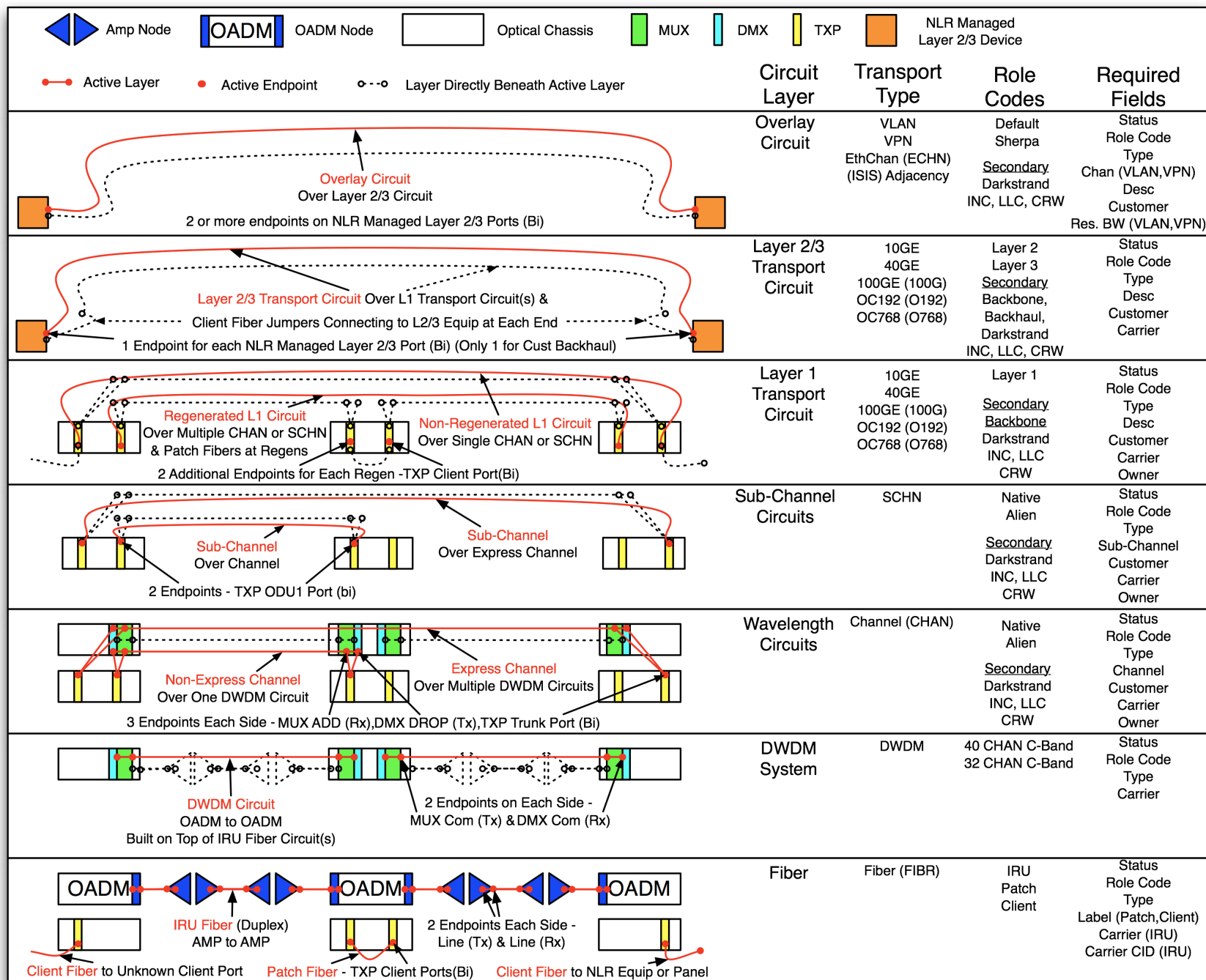
([Edit this area](#))

Position	Channel	Name	Description	Type	Status
10	0	NLR-CHIC-CLEV-10GE-06304	NLR Layer 2 BB Circuit: CHIC-CLEV	10GE	active

Upper Circuit Tree Hierarchy

- [-] [NLR-CHIC-CLEV-10GE-278](#) (Role: backbone,Layer1,NLR Inc. Type: 10GE SRC-DST: CHIC-CLEV)
 - [-] [NLR-CHIC-CLEV-10GE-06304](#) (Role: backbone,Layer2,NLR Inc. Type: 10GE SRC-DST: CLEV-CHIC)
 - [NLR-MP-MP-VLAN-01501 \(pri\)](#) (Type: VLAN SRC-DST: ALBU-ATLA)
 - [NLR-CHIC-CLEV-VLAN-3315 \(pri\)](#) (Role: sherpa Type: VLAN SRC-DST: CHIC-NEWY)
 - [NLR-BB-chic-clev-VLAN-63 \(pri\)](#) (Type: VLAN SRC-DST: CHIC-CLEV)
 - [-] [NLR-CHIC-CLEV-VLAN-63 \(pri\)](#) (Type: VLAN SRC-DST: CHIC-CLEV)
 - [NLR-CHIC-CLEV-ISIS-07952](#) (Type: ISIS SRC-DST: CHIC-CLEV)
 - [NLR-CHIC-KANS-VLAN-3408 \(pri\)](#) (Role: sherpa Type: VLAN SRC-DST: CHIC-KANS)
 - [NCDM from starlight to mclean ra \(pri\)](#) (Type: VLAN SRC-DST: WASH-WASH)
 - [NLR-MP-MP-VLAN-96 \(pri\)](#) (Type: VLAN SRC-DST: WASH-WASH)

NLR Circuit Layer Hierarchy



LLAMA

GlobalNOC Light Level Aggregation and Measurement Analysis

Fiber Circuits

Name	Description	Loss A => Z	Loss Z => A	Details
NLR-AKRNOH39A-CLBNOH39A-FIBR-05294	Segment between AKRNOH39A and CLBNOH39A on optical system CLEV - PITT	20.7	22.3	View
NLR-ALBRNM32A-BNDONM32A-FIBR-05310	Segment between ALBRNM32A and BNDONM32A on Optical System NLR-ELPA-ALBU: using f	19	17.5	View
NLR-ALBYNY28A-WTMRNY28A-FIBR-05376	Segment between ALBYNY28A and WTMRNY28A on Optical System NLR-NEWY-SYRA: using f	11	10.4	View
NLR-ALPITX22A-MRTHTX22A-FIBR-05438	Segment between ALPITX22A and MRTHTX22A on Optical System NLR-SANA-ELPA: using f	14.9	14.7	View
NLR-ANGLNY29A-BRTNNY29A-FIBR-05460	Segment between ANGLNY29A and BRTNNY29A on Optical System NLR-SYRA-CLEV: using f	17.3	14.5	View
NLR-ARPHNE37A-CLSNNE37A-FIBR-05351	Segment between ARPHNE37A and CLSNNE37A on optical system KANS - DENV	21.1	21.2	View
NLR-ARNSC40A-BUVLAL40A-FIBR-05270	Segment between ARNSC40A and BUVLAL40A on optical system RALE - ATLA	22.4	22	View
NLR-ATLNGA40A-MNTIGA40A-FIBR-05255	Segment between ATLNGA40A and MNTIGA40A on optical system ATLA - JACK	22.1	23.2	View
NLR-AUBNNE37A-BLLVNE37A-FIBR-05346	Segment between AUBNNE37A and BLLVNE37A on optical system KANS - DENV	12.3	13.1	View
NLR-AUSTTX23A-GNGSTX23A-FIBR-05332	Segment between AUSTTX23A and GNGSTX23A on Optical System NLR-HOUS-SANA: using f	14.4	15.5	View
NLR-BASLLA24A-RGLYLA24A-FIBR-05260	Segment between BASLLA24A and RGLYLA24A on Optical System NLR-BATO-HOUS: using f	13.6	14.1	View
NLR-BATVNY29A-BFLONY29A-FIBR-05458	Segment between BATVNY29A and BFLONY29A on Optical System NLR-SYRA-CLEV: using f	18.4	14.9	View
NLR-BAVLTX22A-SBNLTX22A-FIBR-05432	Segment between BAVLTX22A and SBNLTX22A on Optical System NLR-SANA-ELPA: using f	15.6	15.6	View

LLAMA Layer 1 Circuit Details: NLR-ALBU-DENV-10GE-05524

UNM Lifetime Lambda

Circuit Endpoints

Device	AID	Type	Description	Light TX	Light RX	Pre FEC	Post FEC	Details
RATNNM34B	FAC-3-1-1	FAC	Client NLR-ALBU-DENV-10GE-05524	-2.9	-3.6			View
RATNNM33B	FAC-3-1-1	FAC	Client NLR-ALBU-DENV-10GE-05524	-3.4	-3.6			View
ALBRNM34B	FAC-3-1-1	FAC	Client NLR-ALBU-DENV-10GE-05524	-4.0	-3.0			View
DNVTCO33B	FAC-3-1-1	FAC	Client NLR-ALBU-DENV-10GE-05524	-3.2	-9.5			View
ALBRNM34B	CHAN-3-2	TXP	Trunk NLR-ALBU-RATO-CHAN-04377	4.6	-11.4	0	0	View
ALBRNM34A	CHAN-5-21-TX	DMX	DMX NLR-ALBU-RATO-CHAN-04377	-11.0				View
RATNNM34B	CHAN-3-2	TXP	Trunk NLR-ALBU-RATO-CHAN-04377	4.6	-11.8	0	0	View
RATNNM34A	CHAN-14-21-RX	MUX	MUX NLR-ALBU-RATO-CHAN-04377		-8.0			View
RATNNM34A	CHAN-12-21-TX	DMX	DMX NLR-ALBU-RATO-CHAN-04377	-11.1				View
ALBRNM34A	CHAN-3-21-RX	MUX	MUX NLR-ALBU-RATO-CHAN-04377		-8.2			View
DNVTCO33B	CHAN-3-2	TXP	Trunk NLR-DENV-RATO-CHAN-04425	4.6	-12.0	0	0	View
DNVTCO33A	CHAN-12-21-TX	DMX	DMX NLR-DENV-RATO-CHAN-04425	-10.9				View
DNVTCO33A	CHAN-14-21-RX	MUX	MUX NLR-DENV-RATO-CHAN-04425		-7.9			View
RATNNM33B	CHAN-3-2	TXP	Trunk NLR-DENV-RATO-CHAN-04425	4.6	-12.1	0	0	View
RATNNM33A	CHAN-3-21-RX	MUX	MUX NLR-DENV-RATO-CHAN-04425		-8.1			View
RATNNM33A	CHAN-5-21-TX	DMX	DMX NLR-DENV-RATO-CHAN-04425	-11.0				View

NLR LLAMA (CHCGIL39A)

LLAMA Device Details: CHCGIL39A

Chicago ONS 15454 (CHIC-WASH)

Trunk Interfaces

Name	Type	Description	Details
LINE-1-1-3	LINE		View
LINE-1-3-2	COM		View
LINE-1-5-1	COM		View
LINE-1-2-1	COM		View
LINE-1-2-2	DC		View
LINE-1-1-1	COM		View

Transponders

Name	Type	Wavelength	Description	Details
CHAN-2-12-2	TXP	1554.13		View
CHAN-2-15-2	TXP	1559.79		View
CHAN-2-2-2	TXP	1543.73		View
CHAN-2-16-2	TXP	1560.61		View
CHAN-2-13-2	TXP	1558.17		View
CHAN-2-14-2	TXP	1558.98		View
CHAN-2-5-2	TXP	1550.92		View
CHAN-2-6-2	TXP	1551.72		View
CHAN-2-3-2	TXP	1544.53		View
CHAN-2-1-2	TXP	1542.94		View
CHAN-2-4-2	TXP	1550.12		View
CHAN-1-14-2	TXP	1538.98		View
CHAN-1-15-2	TXP	1539.77		View
CHAN-1-13-2	TXP	1538.19		View
CHAN-1-17-2	TXP	1542.14		View
CHAN-1-16-2	TXP	1540.56		View
CHAN-2-17-2	TXP	1554.94	RSVD- CLR-3300 DS project	View

NLR LLAMA (CHCGIL39A-LINE-1-1-3)

LLAMA Interface Details: CHCGIL39A LINE-1-1-3

Light Level Statistics: 1 Hour

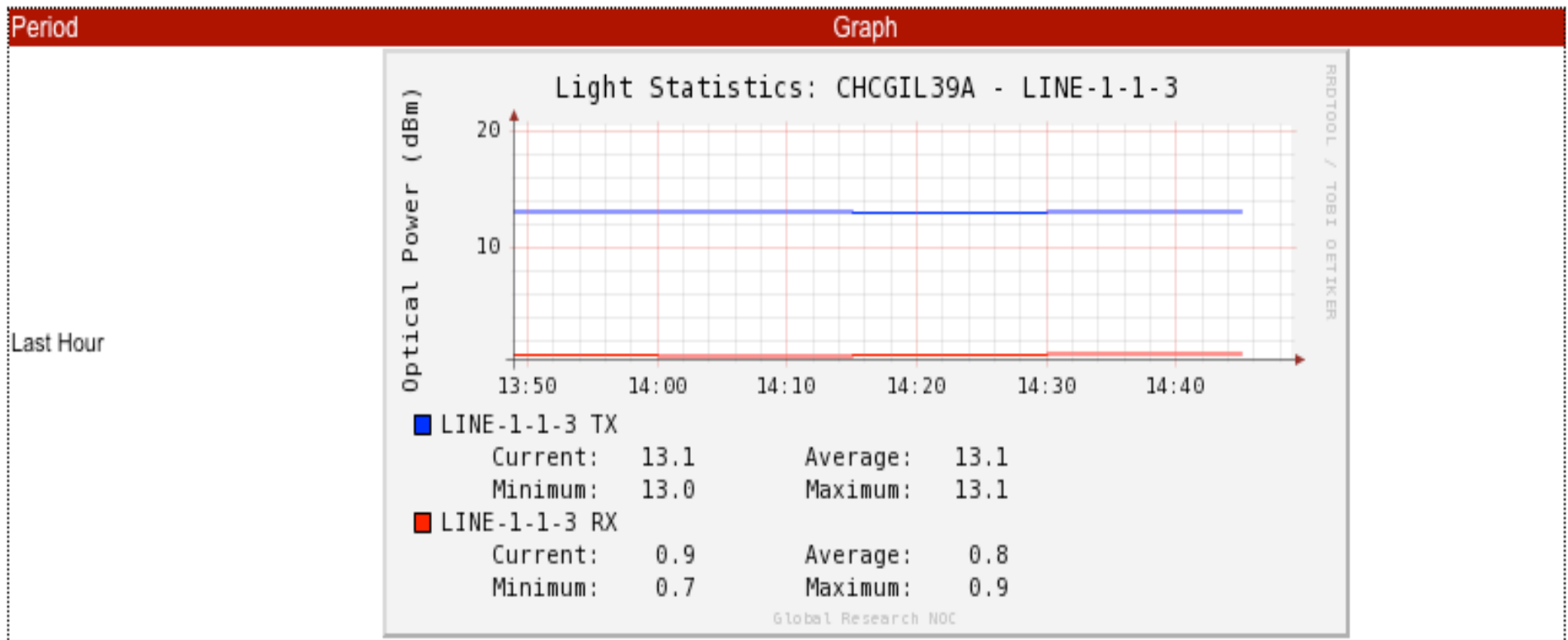
Light Level Statistics: 1 Day

Light Level Statistics: 1 Week

Light Level Statistics: 1 Month

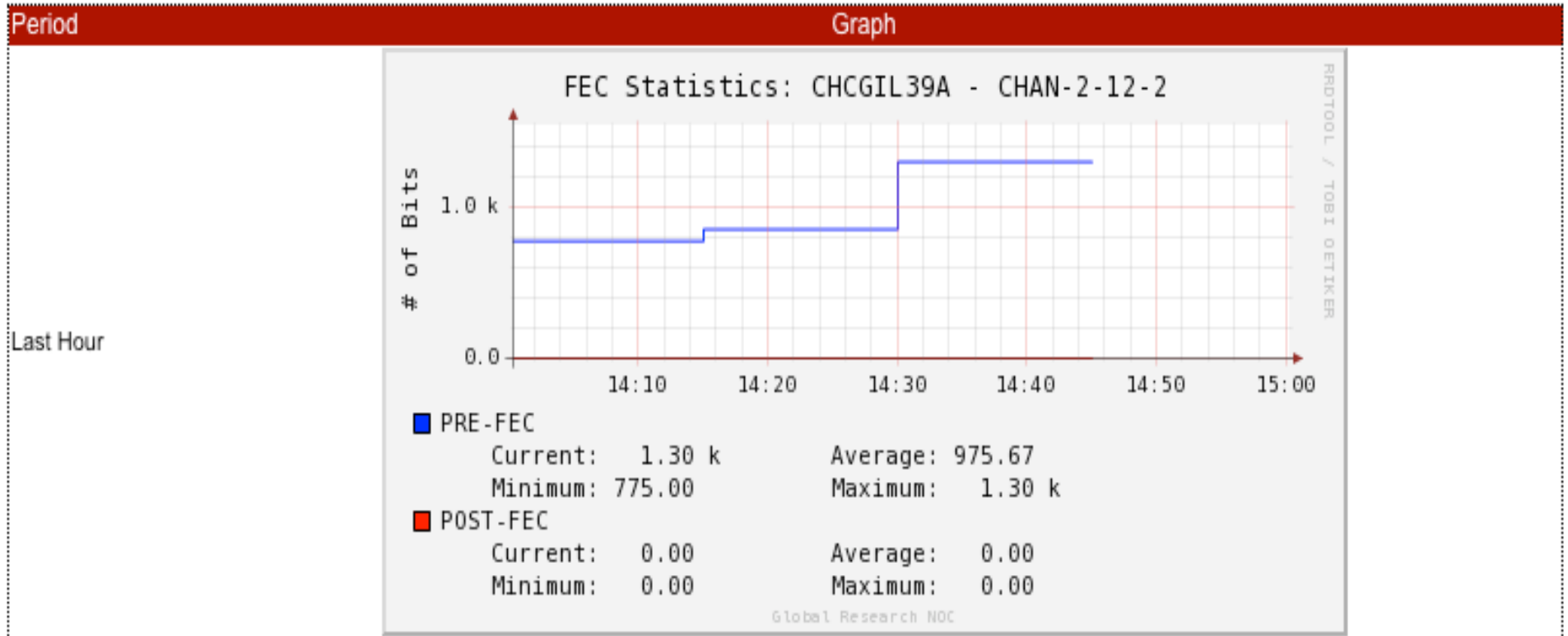
Light Level Statistics: 1 Year

Light Level Statistics



NLR LLAMA (CHCGIL39A-CHAN-2-12-2) FEC

FEC Statistics



GRNOC Links

- <http://globalnoc.iu.edu/>
- <http://globalnoc.iu.edu/grnoc-tool-set.html>
- <http://noc.nlr.net/nlr/network-status.html>
- <http://noc.net.internet2.edu/i2network/live-network-status.html>
- <https://nlrmon.grnoc.iu.edu/llama/>
- [https://tick.globalnoc.iu.edu/fp_tools/public ticket viewer/index.html](https://tick.globalnoc.iu.edu/fp_tools/public_ticket_viewer/index.html)