Network Resiliency with WSON

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Global IP Traffic

- Compound Annual Growth Rate is 26%, as per Cisco Visual Networking Index
- Annual global IP traffic will reach 4.8 ZB per year by 2022, or 396 exabytes (EB) per month.
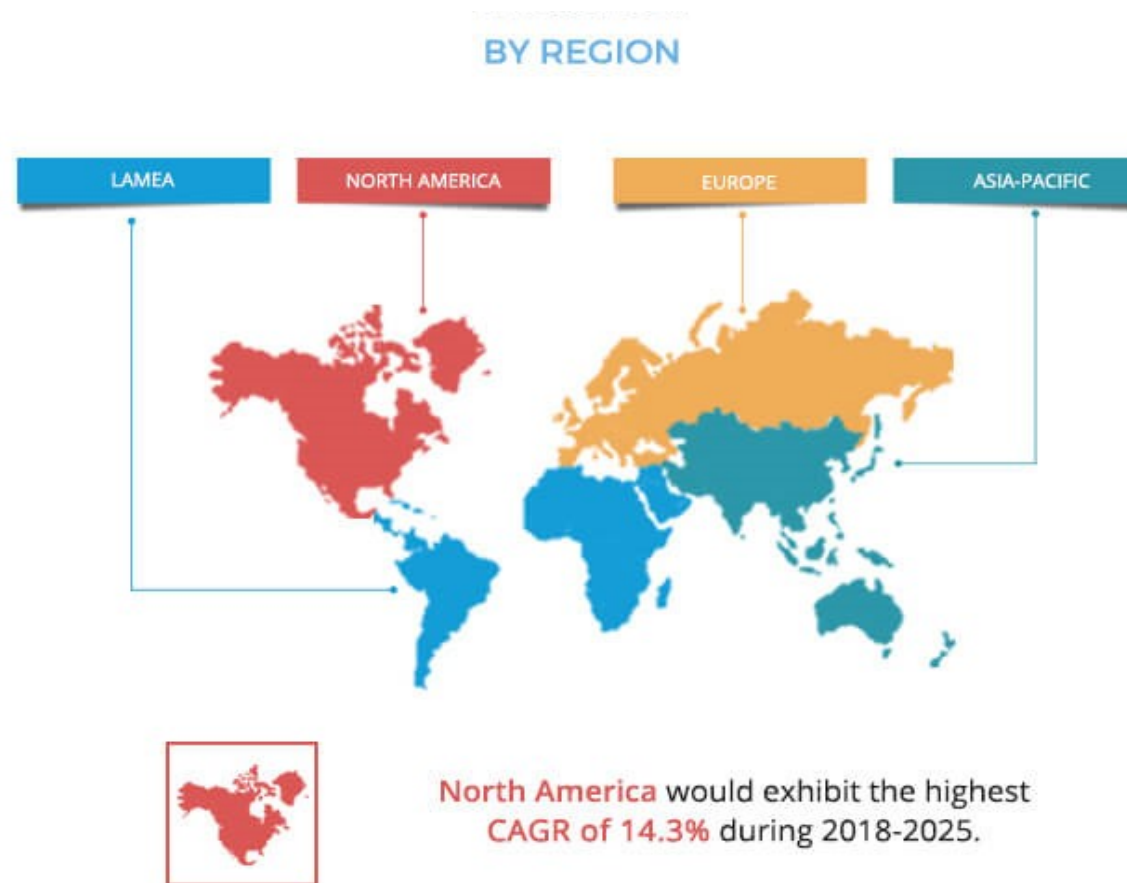- In 2017, the annual run rate for global IP traffic was 1.5 ZB per year, or 122 EB per month.

26% CAGR
2017–2022

Exabytes per Month

Year	Exabytes per Month
2017	122
2018	156
2019	201
2020	254
2021	319
2022	396

Source: Cisco VNI Global IP Traffic Forecast, 2017–2022

- https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html
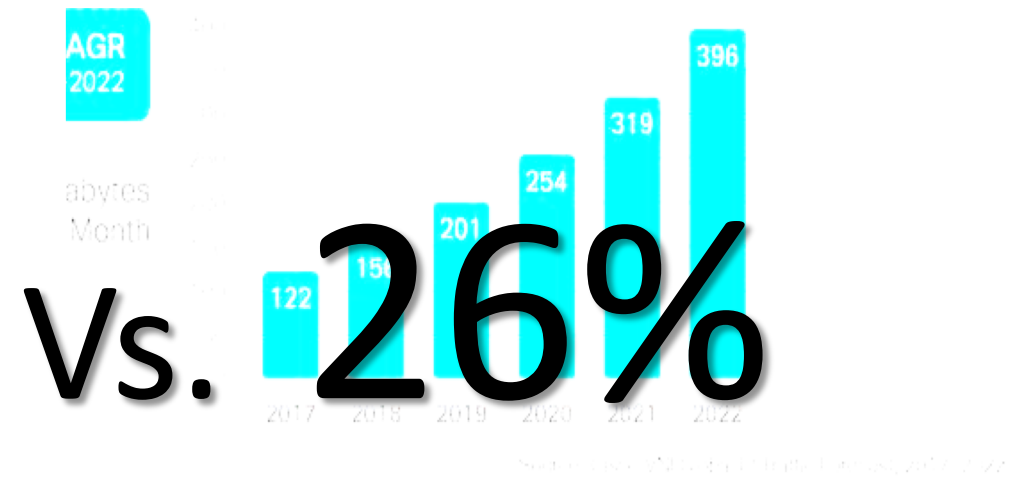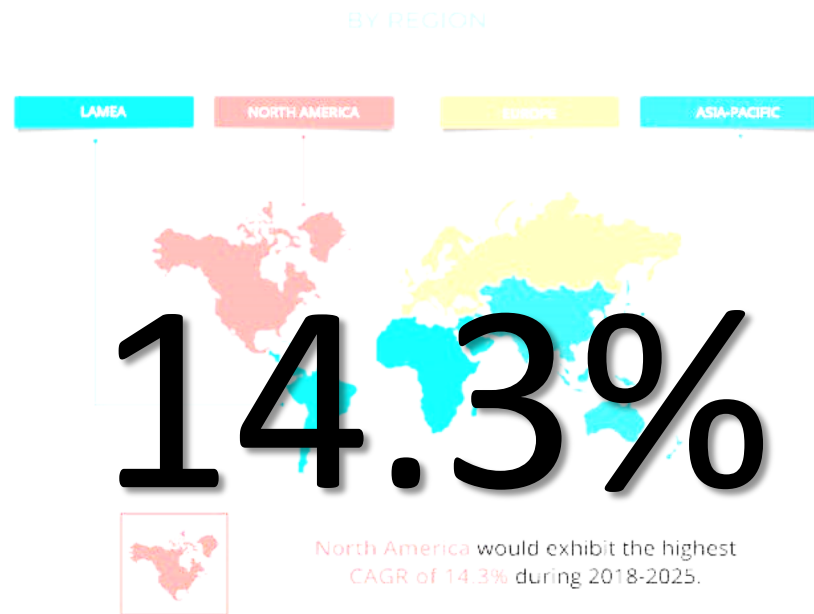
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Global Optical Fiber Market

- Compound Annual Growth Rate is 14.3%, the highest in North America, as per 3rd party market research.

BY REGION

| LAMEA | NORTH AMERICA | EUROPE | ASIA-PACIFIC |

North America would exhibit the highest CAGR of 14.3% during 2018-2025.
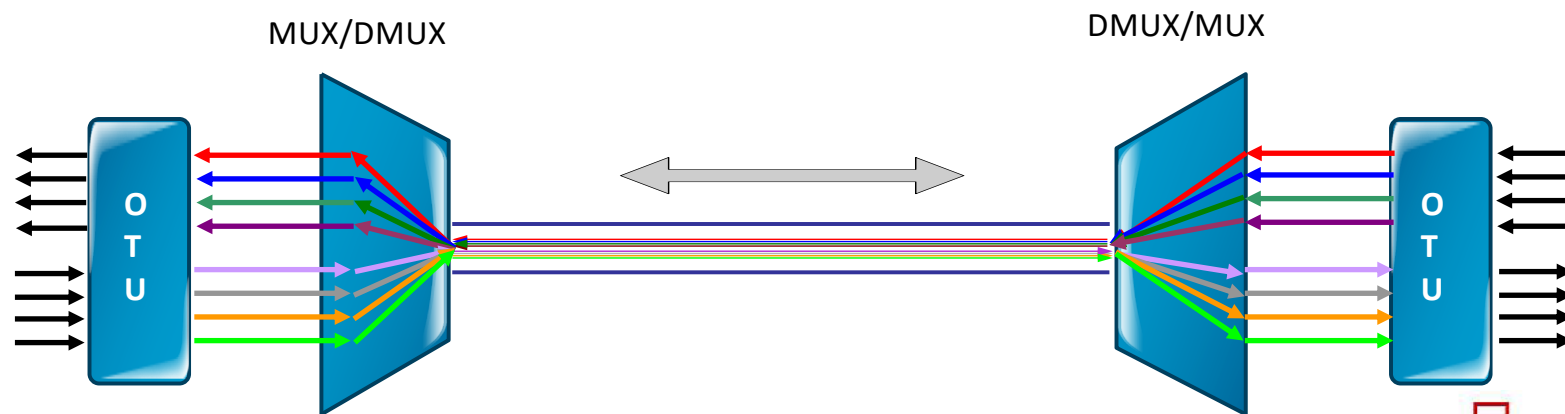
-

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Growth Comparison

14.3% Vs. 26%

DWDM

- Dense Wavelength Division Multiplexing
- An Optical Transport Technology to facilitate large bandwidth transmission
- Optical level dynamic protection & restoration
- One physical link can carry 96 channels
- Channel can be configured as 100/200/400 Gbps per Channel

MUX/DMUX

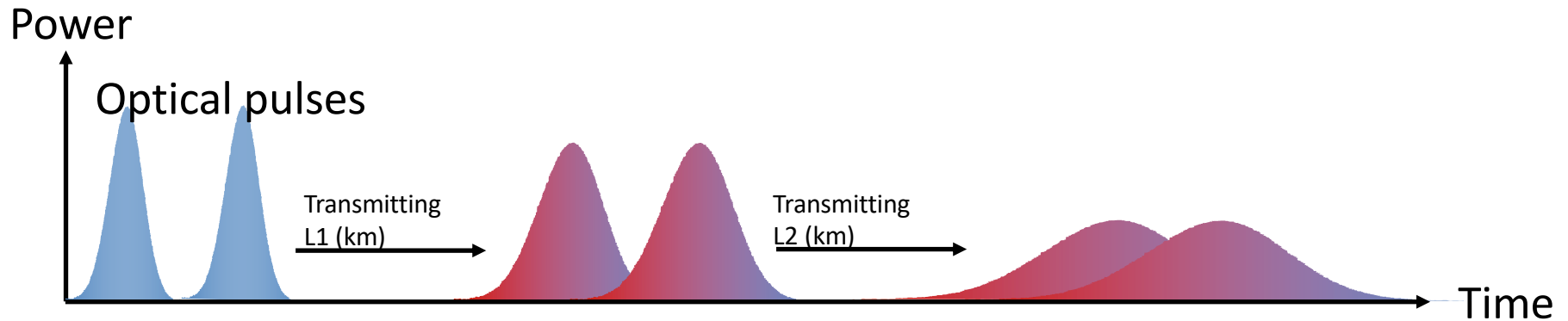DMUX/MUX

O T U

O T U

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Basic Structure

- The overall structure of the WDM system of N-path wavelength:
  - Optical Transponder Unit (OTU)
  - Optical Multiplexer Unit / Optical De-multiplexer Unit (OMU/ODU)
  - Optical Amplifier (OA)
  - Supervisory Channel (OSC/ESC)

Dispersion

Power

Optical pulses

Transmitting L1 (km)

Transmitting L2 (km)

Time
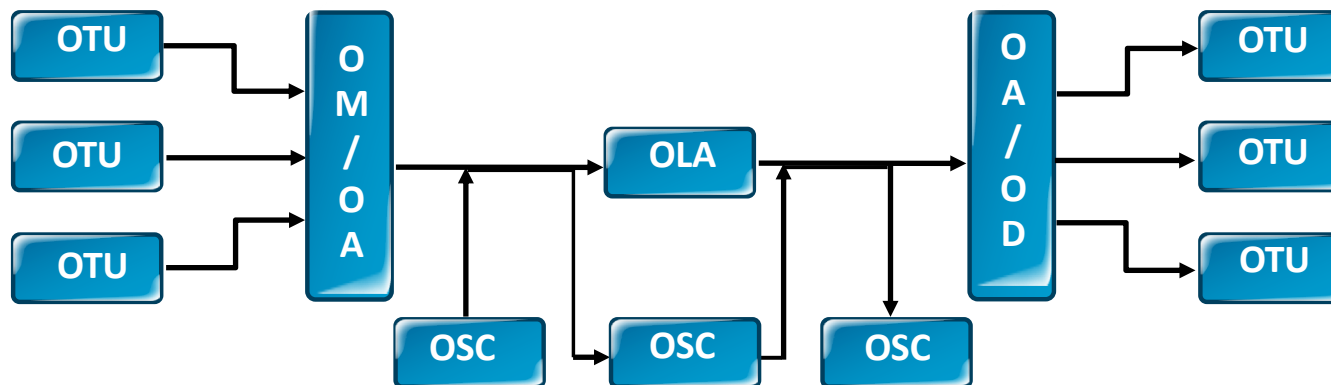
Dispersion in fiber refers to a physical phenomenon of signal distortion caused when various modes carrying signal energy or different frequencies of the signal have different group velocity and disperse from each other during propagation.
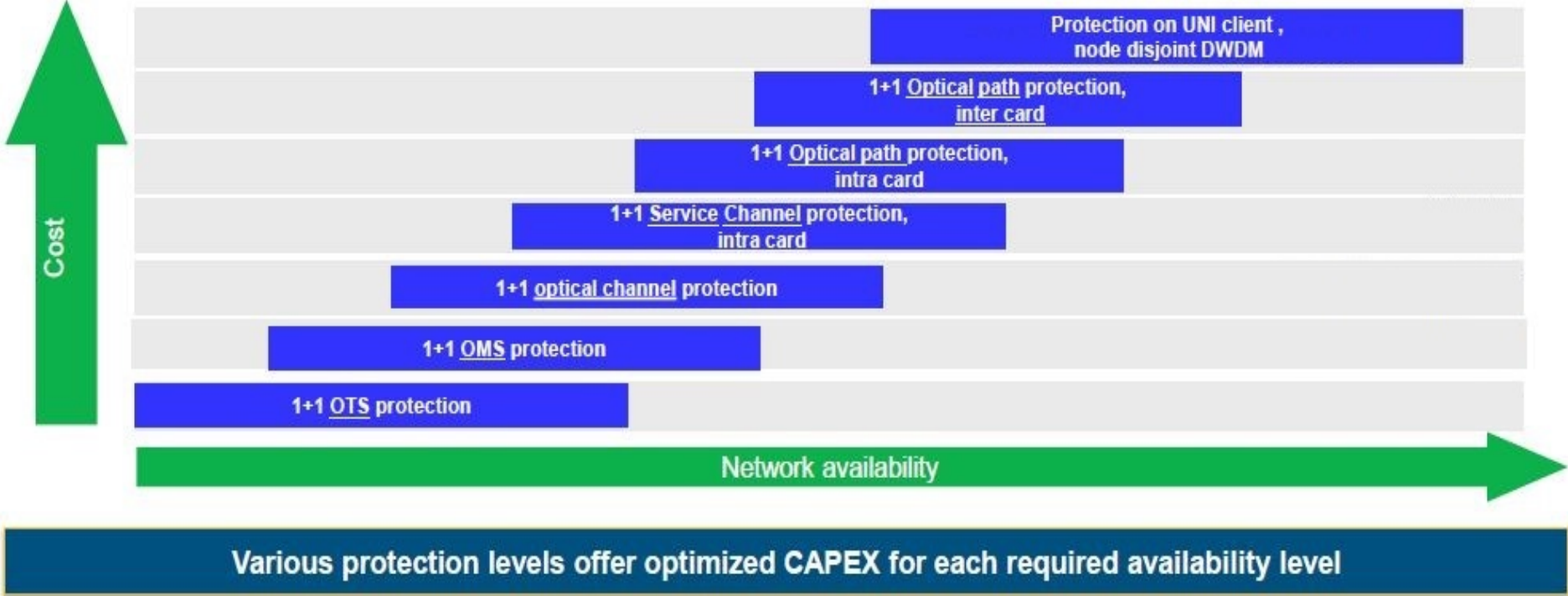

MUX/DMUX

DMUX/MUX

O T U

O T U
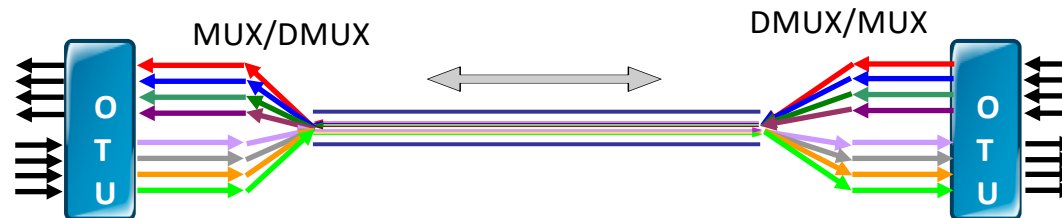
CD(Chromatic Dispersion): Since different frequency (wavelength) components of the light source have different group velocities and light beams with different frequencies have different time delays in transmission, dispersion arising from which is called chromatic dispersion.

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Dispersion Compensation
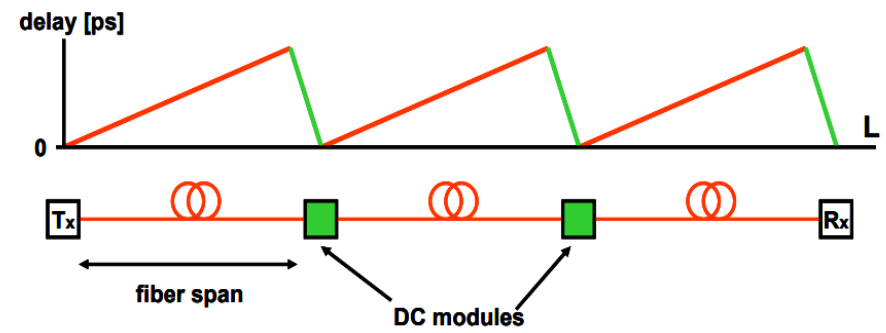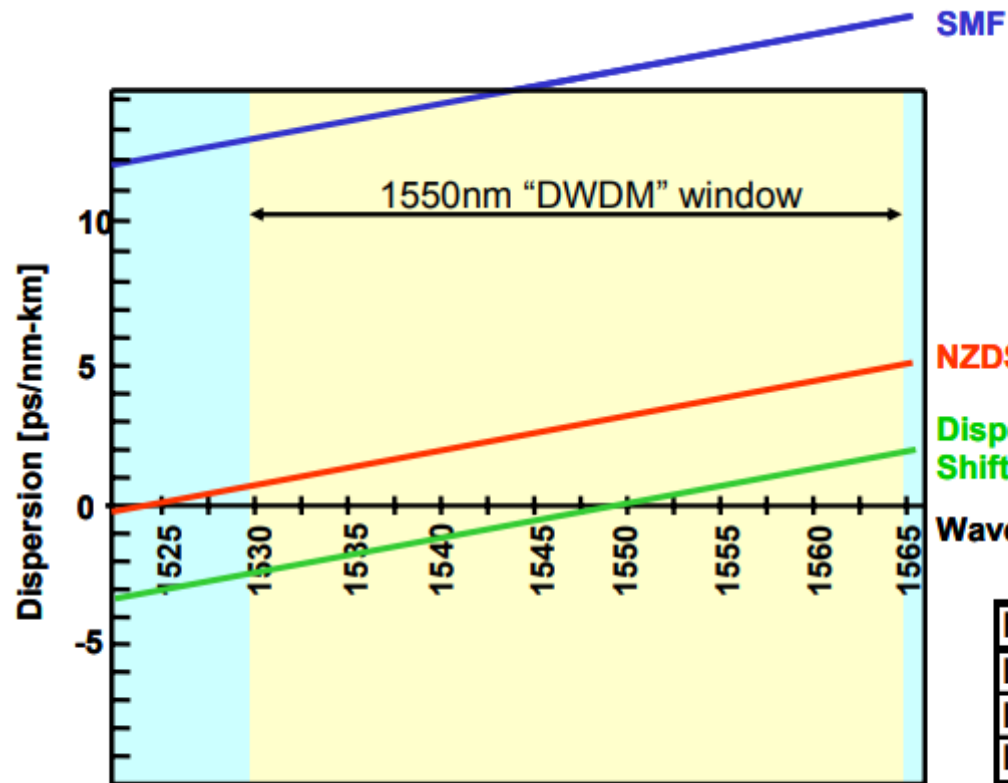
Fiber Type	Chromatic Dispersion ps / (nm * km)	
	1310 nm	1550 nm
ITU G.652 conventional	0	17
ITU G.653 DSF	-15	0
ITU G.655 NZDSF	-12	3

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Protection : (1+1)

Cost

		Protection on UNI client, node disjoint DWDM
	1+1 Optical path protection, inter card	
	1+1 Optical path protection, intra card	
1+1 Service Channel protection, intra card		
1+1 optical channel protection		
1+1 OMS protection		
1+1 OTS protection		

Network availability

Various protection levels offer optimized CAPEX for each required availability level

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Protection : (1+1)
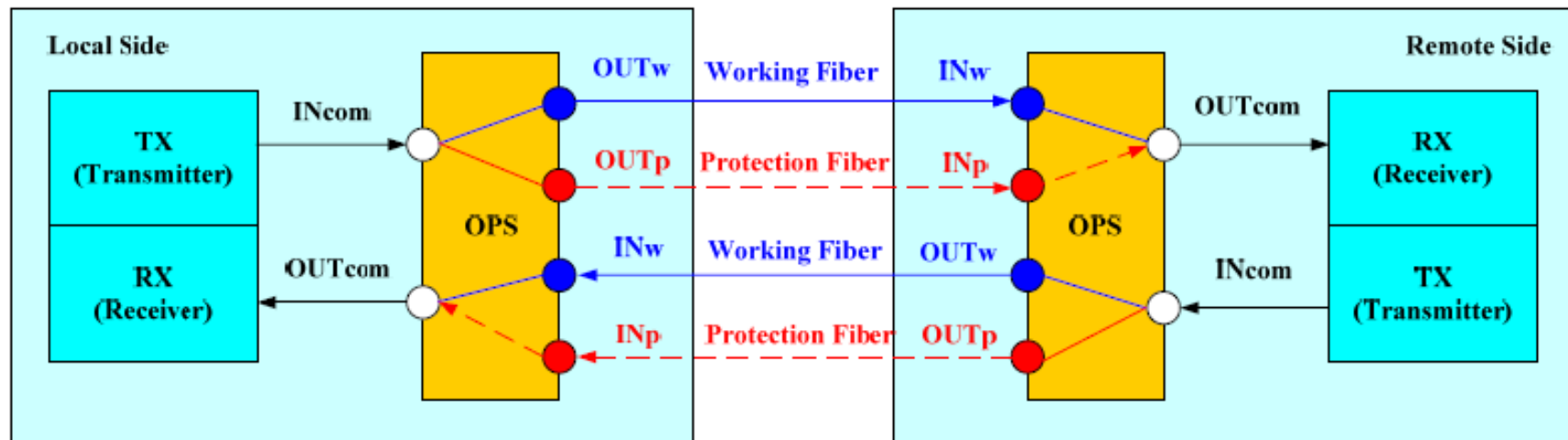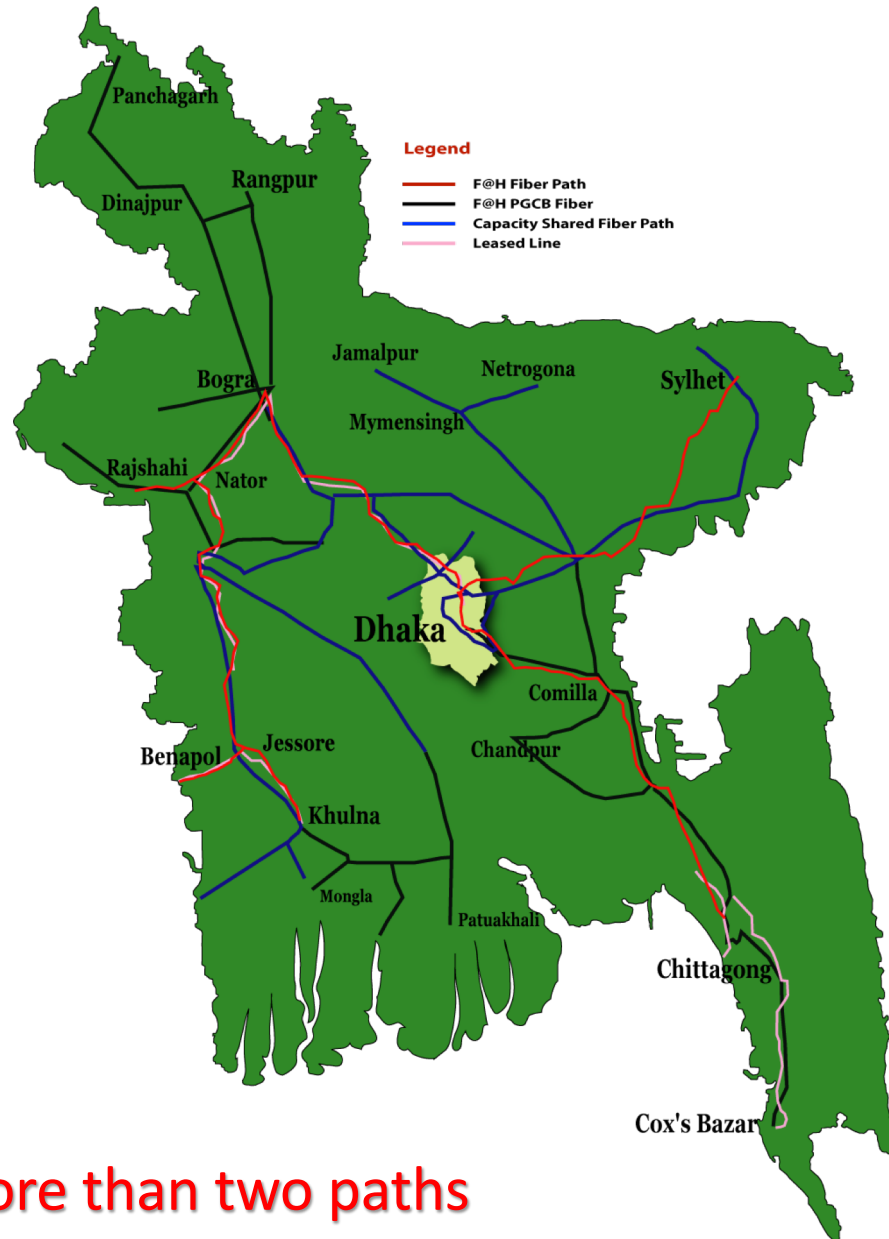

Fig : Using two fiber pair with different paths.

Protection & Restoration : (1+1+R)

Restoration with more than two paths

Legend
- F@H Fiber Path
- F@H PGCB Fiber
- Capacity Shared Fiber Path
- Leased Line

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ASON/WSON by GMPLS :

ASON (Automatically Switched Optical Network)

- Architecture for transport networks enabling distributed connection control
- Requirement and architecture documents have been approved by ITU-T

WSON (Wavelength Switched Optical Network)

- ASON networks based on WDM switching technology (photonic layer)
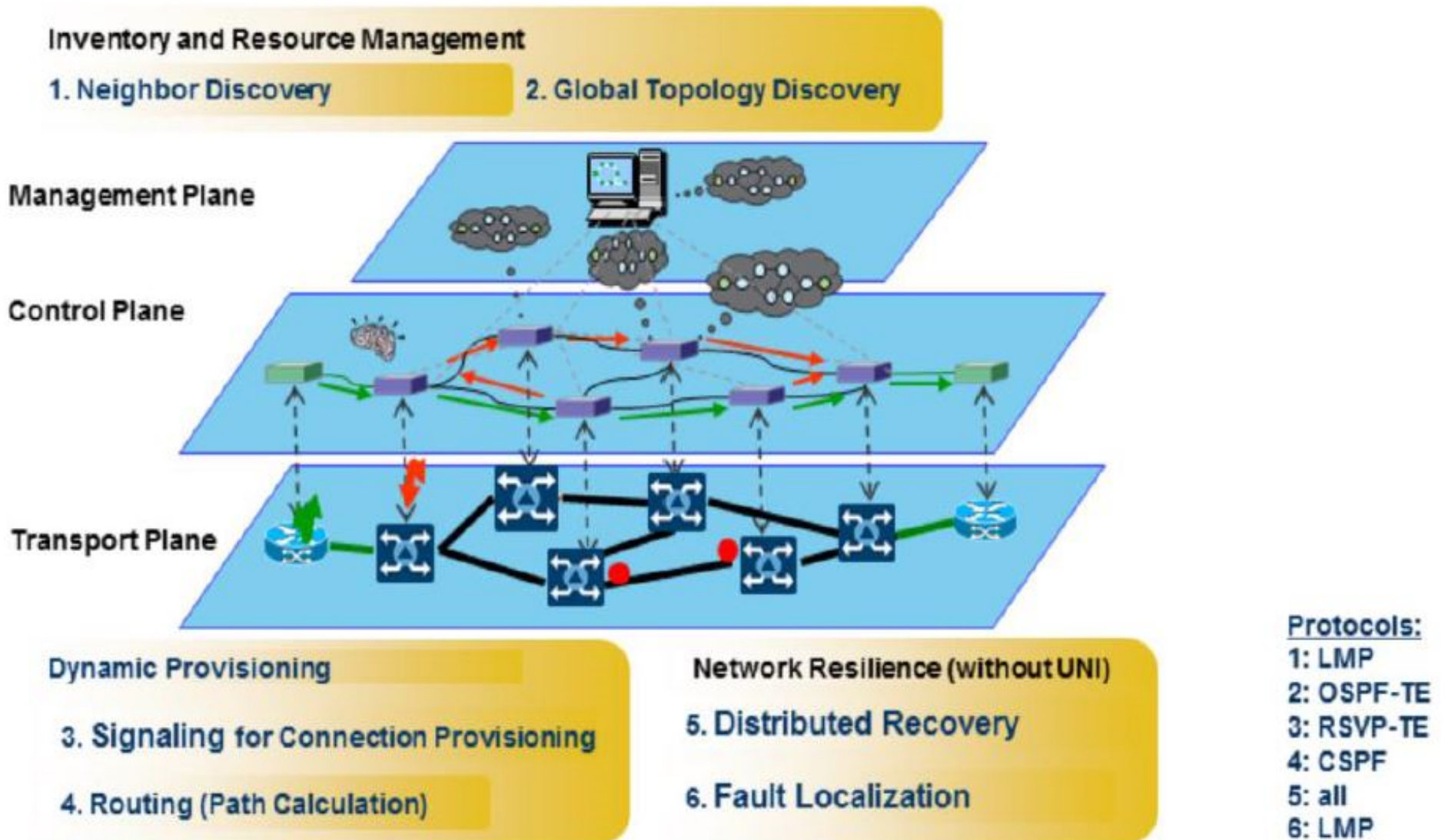- Framework and specific ASON extension under definition by IETF

GMPLS (Generalized Multi-Protocol Label Switching)

- Defines a suite of protocols to implement ASON/WSON functionality
- GMPLS protocol standards are defined at the IETF

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Advantages of ASON/WSON :

- Automated topology/resource discovery

- Automated end-to-end service provisioning

- Multi-layer/domain networking

- Multiple failure network recovery

- Bandwidth efficiency by sharing of restoration capacity

- Bandwidth on demand

- Class of services at transport layer

- Traffic engineering

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GMPLS Control Plane Functions

Inventory and Resource Management

1. Neighbor Discovery   2. Global Topology Discovery

Management Plane

Control Plane

Transport Plane

Dynamic Provisioning

3. Signaling for Connection Provisioning

4. Routing (Path Calculation)

Network Resilience (without UNI)

5. Distributed Recovery

6. Fault Localization

Protocols:
1: LMP
2: OSPF-TE
3: RSVP-TE
4: CSPF
5: all
6: LMP

GMPLS Control Plane Protocols

LMP: Link management protocol
Manage and maintain the health of control and data planes between two
neighboring nodes

OSPF-TE: Open shortest path first-Traffic Engineering
Routing protocols for the auto-discovery of network topology, advertise resource
availability (e.g bandwidth or protection type)

CSPF: Constraint Shortest Path First
Based on OSPF route information, calculated the path for tunnel

RSVP-TE: Resource reservation protocol for traffic engineering
Based on CSPF's result, send message to create the tunnel hop-by-hop.

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FAH DWDM Network

F@H Nationwide Infinera DWDM Network

NMS-View
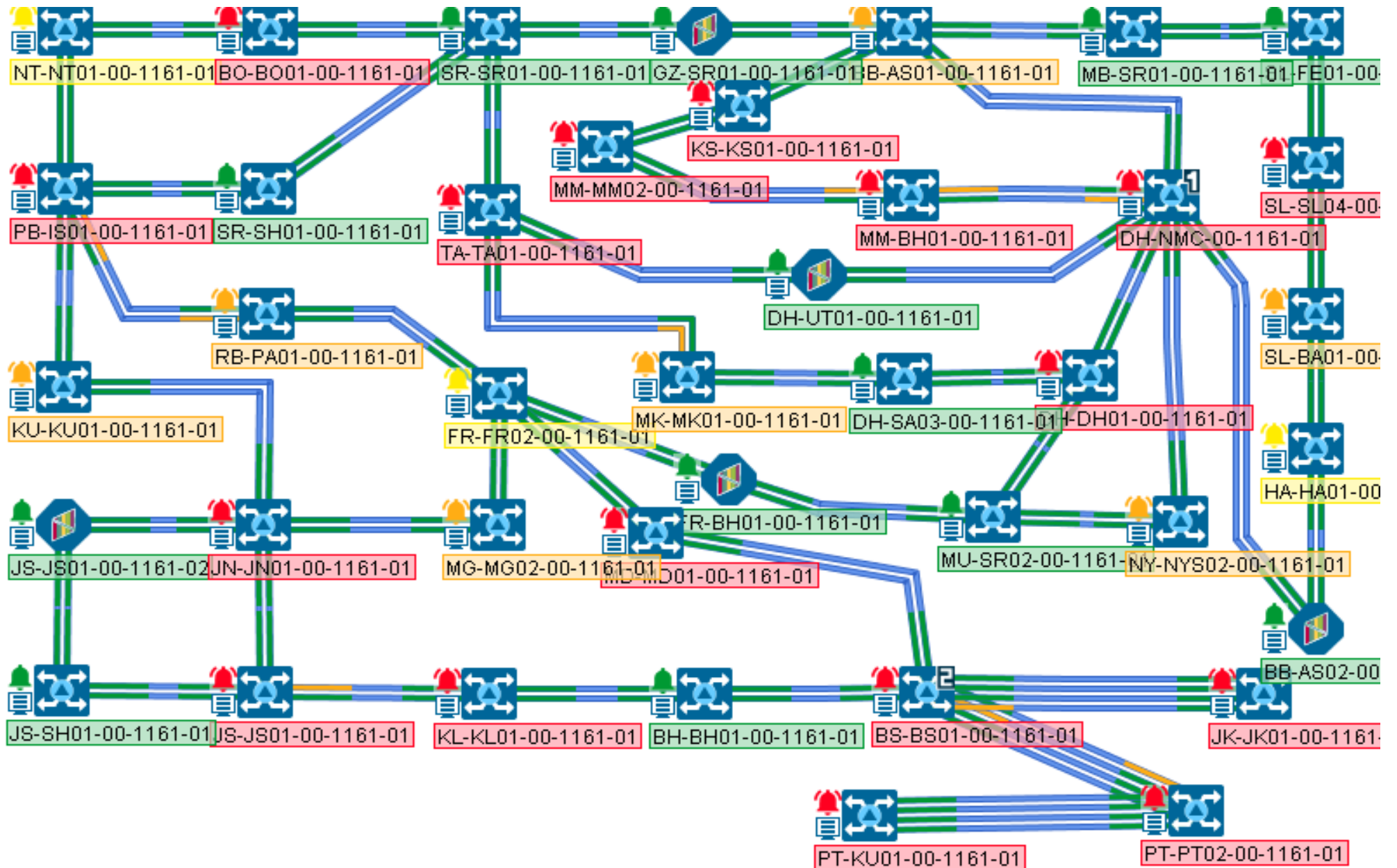
Nuts & Bolts

- Installed & Commissioned Nodes – 41

- Prime Feature – WSON

- Capacity Provisioned – 250 x 10G (1+1+R)

- Project Deployment Time – 3 Months

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Project Hurdles

- Alien Lambda Provision
- Around 500G of Live Traffic Migration from Previous Network
- New PoP Readiness (Infrastructure, Power, Fiber)
- Fiber Readiness
- Leasing Fiber from 3rd Parties
- Proper Passive Protection Path Plan
- Last Mile Security
- Overhead Manageability
- National Transport Infrastructure Development Work

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Major Challenge

- Switching Hits were generating Circuit Flaps

RP/0/RSP0/CPU0:NMC-ASR9K-NATIONWIDE-PE01#sho logging start march 22 15:30:00 end Mar 22 16:52:00 LC/0/4/CPU0:2019 Mar 22 15:32:54.143 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.90 on interface FortyGigE0/4/0.1962 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:32:54.144 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.86 on interface FortyGigE0/4/0.1961 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:32:54.144 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.94 on interface FortyGigE0/4/0.1963 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:32:54.144 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.6.181 on interface FortyGigE0/4/0.1960 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:33:08.869 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.6.181 on interface FortyGigE0/4/0.1960 is up LC/0/4/CPU0:2019 Mar 22 15:33:10.154 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.86 on interface FortyGigE0/4/0.1961 is up LC/0/4/CPU0:2019 Mar 22 15:33:10.155 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.94 on interface FortyGigE0/4/0.1963 is up LC/0/4/CPU0:2019 Mar 22 15:33:10.155 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.90 on interface FortyGigE0/4/0.1962 is up LC/0/4/CPU0:2019 Mar 22 15:52:14.124 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.6.181 on interface FortyGigE0/4/0.1960 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:52:14.125 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.86 on interface FortyGigE0/4/0.1961 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:52:14.125 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.94 on interface FortyGigE0/4/0.1963 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:52:14.125 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_DOWN : BFD session to neighbor 10.0.7.90 on interface FortyGigE0/4/0.1962 has gone down. Reason: Control timer expired LC/0/4/CPU0:2019 Mar 22 15:52:28.269 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.86 on interface FortyGigE0/4/0.1961 is up LC/0/4/CPU0:2019 Mar 22 15:52:28.270 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.90 on interface FortyGigE0/4/0.1962 is up LC/0/4/CPU0:2019 Mar 22 15:52:28.270 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.7.94 on interface FortyGigE0/4/0.1963 is up LC/0/4/CPU0:2019 Mar 22 15:52:28.270 Dhaka: bfd_agent[126]: %L2-BFD-6-SESSION_STATE_UP : BFD session to neighbor 10.0.6.181 on interface FortyGigE0/4/0.1960 is up

<NMC-NW-H6320_L3SW01_251_0_254>display log 2019-3-22 15:32:16.998.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[87]:Interface XGigabitEthernet0/0/15 has turned into DOWN state. 2019-3-22 15:32:16.998.3+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01LACP/3/LAG_DOWN_REASON_EVENT(l)[86]:The member of the LACP mode Eth-Trunk interface went down. (TrunkName=Eth-Trunk107, PortName=XGigabitEthernet0/0/15, Reason=PortDown) 2019-3-22 15:32:16.998.9+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[85]:Interface XGigabitEthernet0/0/20 has turned into DOWN state. 2019-3-22 15:32:16.998.10+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01LACP/3/LAG_DOWN_REASON_EVENT(l)[84]:The member of the LACP mode Eth-Trunk interface went down. (TrunkName=Eth-Trunk107, PortName=XGigabitEthernet0/0/20, Reason=PortDown) 2019-3-22 15:32:17.38.1+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFNET/4/IF_STATE(l)[83]:Interface Eth-Trunk107 has turned into DOWN state. 2019-3-22 15:32:17.978.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[82]:Interface XGigabitEthernet0/0/15 has turned into UP state. 2019-3-22 15:32:18.88.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[81]:Interface XGigabitEthernet0/0/20 has turned into UP state. 2019-3-22 15:32:20.108.1+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFNET/4/IF_STATE(l)[80]:Interface Eth-Trunk107 has turned into UP state. 2019-3-22 15:51:36.908.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[79]:Interface XGigabitEthernet0/0/20 has turned into DOWN state. 2019-3-22 15:51:36.908.3+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01LACP/3/LAG_DOWN_REASON_EVENT(l)[78]:The member of the LACP mode Eth-Trunk interface went down. (TrunkName=Eth-Trunk107, PortName=XGigabitEthernet0/0/20, Reason=PortDown) 2019-3-22 15:51:37.88.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[77]:Interface XGigabitEthernet0/0/15 has turned into DOWN state. 2019-3-22 15:51:37.88.3+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01LACP/3/LAG_DOWN_REASON_EVENT(l)[76]:The member of the LACP mode Eth-Trunk interface went down. (TrunkName=Eth-Trunk107, PortName=XGigabitEthernet0/0/15, Reason=PortDown) 2019-3-22 15:51:37.98.1+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFNET/4/IF_STATE(l)[75]:Interface Eth-Trunk107 has turned into DOWN state. 2019-3-22 15:51:37.718.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[74]:Interface XGigabitEthernet0/0/15 has turned into UP state. 2019-3-22 15:51:37.758.1+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFNET/4/IF_STATE(l)[73]:Interface Eth-Trunk107 has turned into UP state. 2019-3-22 15:51:37.828.2+06:00 NMC-NW-H6320_L3SW01_251_0_254 %%01IFPDT/4/IF_STATE(l)[72]:Interface XGigabitEthernet0/0/20 has turned into UP state.

Our Findings

- Wireshark Report

- Ethernet Analyzer Report

- Cisco TAC Analysis

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Wireshark Report

Cisco_01:e0:94 - Dhaka

Cisco_7e:5b:cb - Khulna

DWDM Cloud

Mirrored Port

Te0/0/1/0 - 10.200.200.253

Te0/0/1/0 - 10.200.200.254

Ping from Khulna to Dhaka

Wireshark Capture

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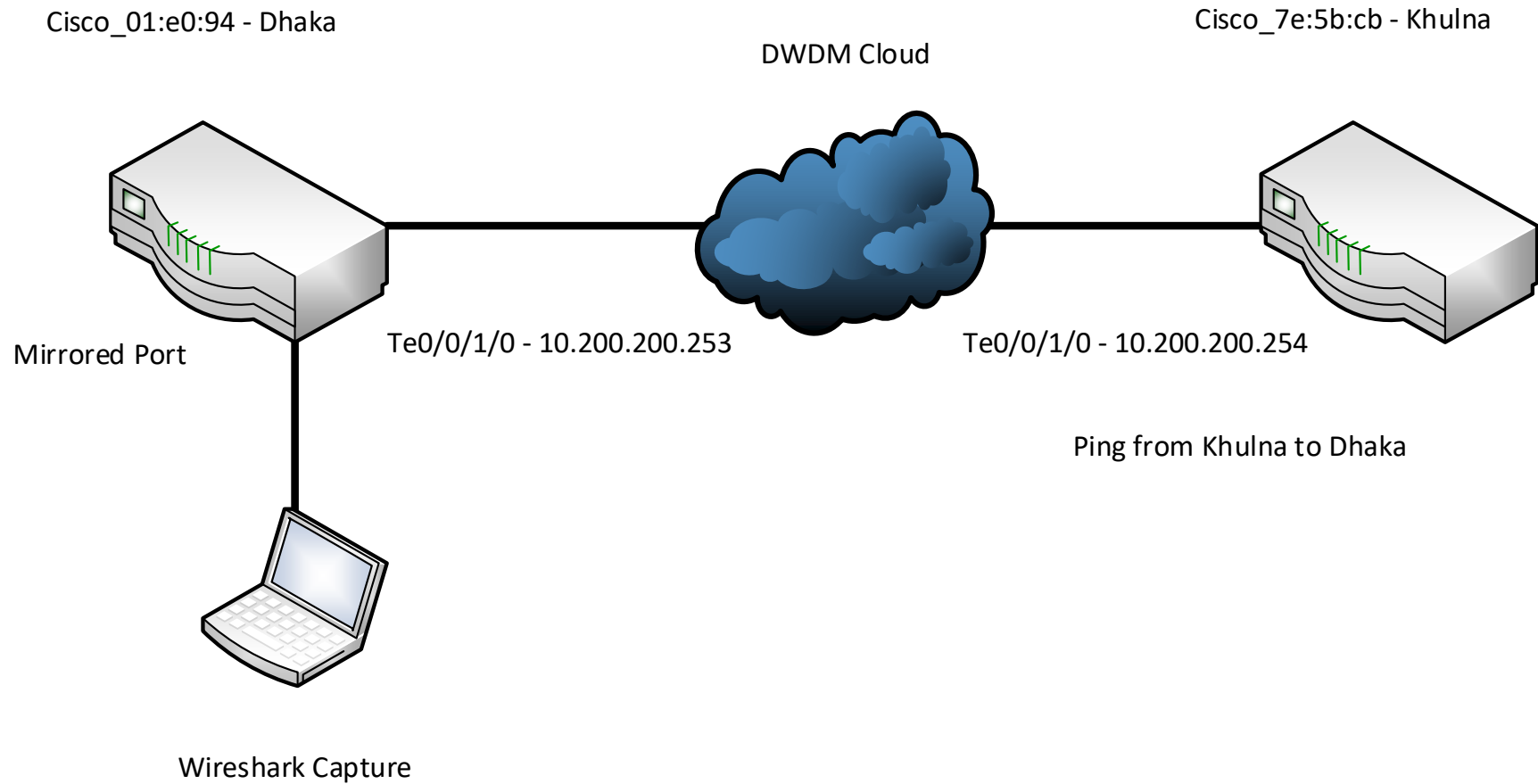
Wireshark Report – Before Switching

Before switching, we saw that Dhaka Cisco router was sending CDP messages to Khulna Neighbor

Wireshark Report – After Switching

After switching, we saw that Dhaka Cisco Router lost ARP of its Khulna Neighbor

Wireshark Report – After Switching

After switching, also the ping from Khulna to Dhaka was interrupted & vice versa

Analyzer Report

NMC Analyzer connected 5-13-12 (Switching Time: 29.89 ms)

But analyzer showed that lambda was switched from Dhaka end in 29.89ms

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Analyzer Report

Khulna Analyzer connected 1-12-6 (Switching Time: 12.75 ms)

But analyzer showed that lambda was switched from Khulna end in 12.75ms

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Big Confusion :

Wireshark report shows there is an interruption during switching

Analyzer report shows there is no interruption

Cisco TAC

- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_TRACE: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), hw event link **down <<<<<< Link flapped on the DWDM end, after which ethernet trace is informing router that HW link is down.**
- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_IM: ethernet_im_hw_event_handler: Interface Te0/0/1/0 (0x000000c0), state down
- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM event (1, 0, None): HW link state (DOWN): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw **link:UP <<<<<< Ethernet event is not tearing down the Link. Physical link is still UP.**
- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM action: Carrier delay timer started for Te0/0/1/0 (0x000000c0), sec=1, nsec=500000000 **<<<<<< Carrier delay timer started**
- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM event processed for (1, 0, None): HW link state (no IM state update): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw **link:UP <<<<< Physical link is still up.**
- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_INFO: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), hw event link down, retval Success
- Apr 10 14:39:16.377 gether/1/fast 0/0/CPU0 t11 ETH_TRACE: Ethernet timer handler **invoked   <<<<<<< Carrier delay timer expired after 1500msec**
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM event (1, 0, None): Cardelay timer (DOWN): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:UP
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM action: PFI protect down for Te0/0/1/0 (0x000000c0)
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM action: Carrier delay timer stopped for Te0/0/1/0 (0x000000c0)
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM action: state pulse to owner thread for Te0/0/1/0 (0x000000c0), state down immediate
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM event processed for (1, 0, None): Cardelay timer (no IM state update): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw **link:DOWN<<<<< Physical link teared down after carrier delay timer expired**
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t12 ETH_EVENTS: FSM event (1, 0, None): State pulse (DOWN): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:DOWN
- Apr 10 14:39:16.377 gether/1/main 0/0/CPU0 t12 ETH_EVENTS: FSM event processed for (1, 0, None): State pulse (update IM with down immediate): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:DOWN

Cisco TAC

- Apr 10 14:39:16.378 gether/1/main 0/0/CPU0 t12 ETH_EVENTS: FSM action: IM state update for Te0/0/1/0 (0x000000c0), state down immediate
- Apr 10 14:39:16.382 gether/1/fast 0/0/CPU0 t12 ETH_INFO: Processed attribute Mcast address set request on Te0/0/1/0 (0x000000c0)
- Apr 10 14:39:16.382 gether/1/fast 0/0/CPU0 t12 ETH_INFO: Processed attribute Mcast address set request on Te0/0/1/0 (0x000000c0)
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_TRACE: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), hw event link up <<<< Physical Link came back up again
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_IM: ethernet_im_hw_event_handler: Interface Te0/0/1/0 (0x000000c0), state up
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM event (1, 0, None): HW link state (UP): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:DOWN
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM action: Carrier delay timer started for Te0/0/1/0 (0x000000c0), sec=1, nsec=500000000 **<<<<<<< Carrier delay timer started again and will wait for 1500msec before bringing the physical interface up.**
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_EVENTS: FSM event processed for (1, 0, None): HW link state (no IM state update): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:DOWN
- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_INFO: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), hw event link up, retval Success
- Apr 10 14:39:19.434 gether/1/fast 0/0/CPU0 t11 ETH_TRACE: Ethernet timer handler invoked
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM event (1, 0, None): Cardelay timer (UP): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw **link:DOWN <<<<< Carrier delay timer expired exactly after 1500msec**
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM action: Carrier delay timer stopped for Te0/0/1/0 (0x000000c0)
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM action: state pulse to owner thread for Te0/0/1/0 (0x000000c0), state up
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t11 ETH_EVENTS: FSM event processed for (1, 0, None): Cardelay timer (no IM state update): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw **link:UP <<<<< Physical interface came back up**
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t12 ETH_EVENTS: FSM event (1, 0, None): State pulse (UP): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:UP
- Apr 10 14:39:19.434 gether/1/main 0/0/CPU0 t12 ETH_EVENTS: FSM event processed for (1, 0, None): State pulse (update IM with up): [admin:UP client admin:UP client admin tx: UP port:ENABLED port tx:ENABLED hw link:UP

Cisco TAC

- Apr 10 14:39:14.876 gether/1/main 0/0/CPU0 t4 ETH_TRACE: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), **hw event link down <<<<<< Link flapped on the DWDM end, after which ethernet trace is informing router that HW link is down.**

- Apr 10 14:39:17.933 gether/1/main 0/0/CPU0 t4 ETH_TRACE: ethernet_link_event_handler: Interface Te0/0/1/0 (0x000000c0), **hw event link up <<<< Link came back up again**

- **As a workaround, increase the carrier-delay timer anything above 3056msec.**

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Initial Findings

- Ethernet Interface Carrier Delay value was changed
  - For Router interfaces, it was changed to 4000ms
  - For Switch interfaces, it was changed to 2000ms

- Chromatic Dispersion Search Value in Lambda Cards was reduced
  - Previous CD Value : -280,000 ps/nm to +280,000 ps/nm
  - After Change CD Value : -2,000 ps/nm to +40,000 ps/nm

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Initial Findings

Observation : Switch Topology

Infinera DWDM Cloud is connected from Switch to Switch for 10GE Circuit:
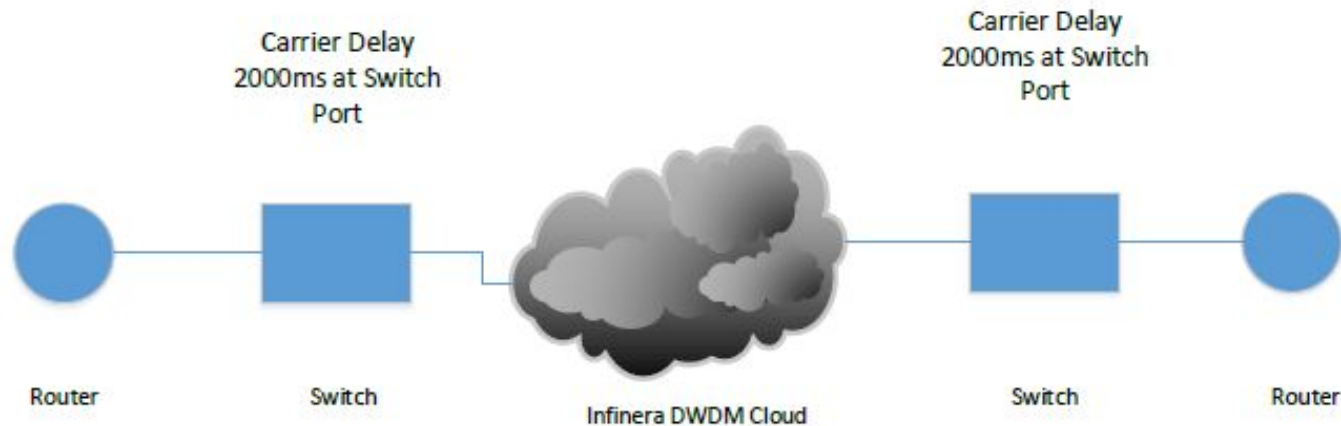
Carrier Delay
2000ms at Switch
Port

Carrier Delay
2000ms at Switch
Port

Router   Switch

Infinera DWDM Cloud

Switch   Router

Output : No physical or Logical Flap Observed, only 2/3 ping loss during switching. Carrier delay value lower than 1000ms shows physical link flap.

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Observation : Router Topology

Infinera DWDM Cloud is connected from Router to Router for 10GE Circuit:
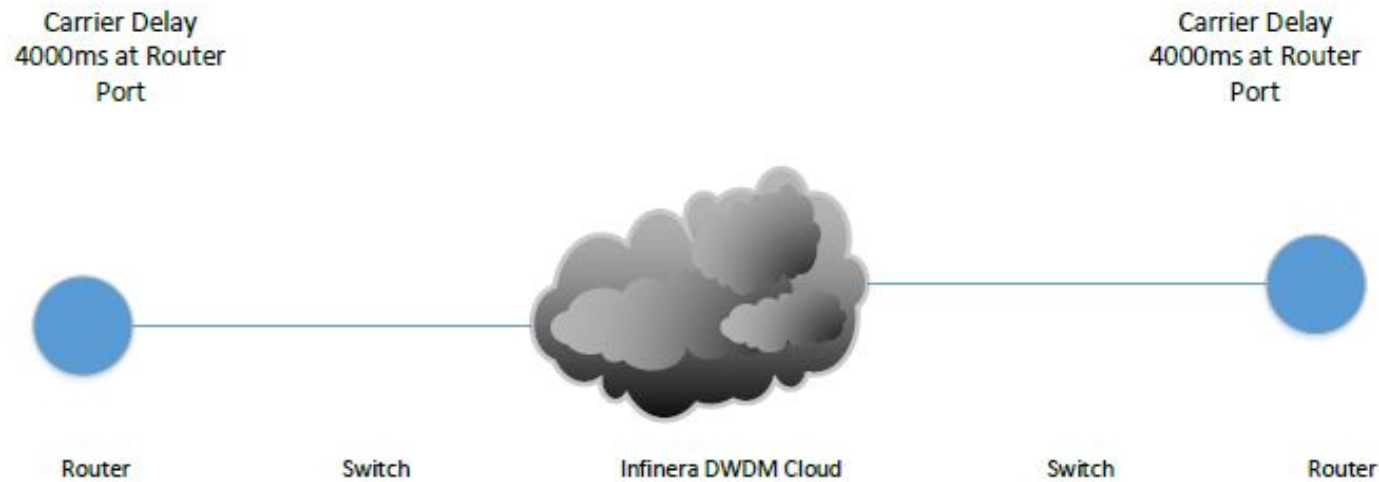
Carrier Delay 4000ms at Router Port

Router | Switch | Infinera DWDM Cloud | Switch | Router

Carrier Delay 4000ms at Router Port

Output : No physical or Logical Flap Observed, only 2/3 ping loss during switching. Carrier delay value lower than 3000ms shows physical link flap.
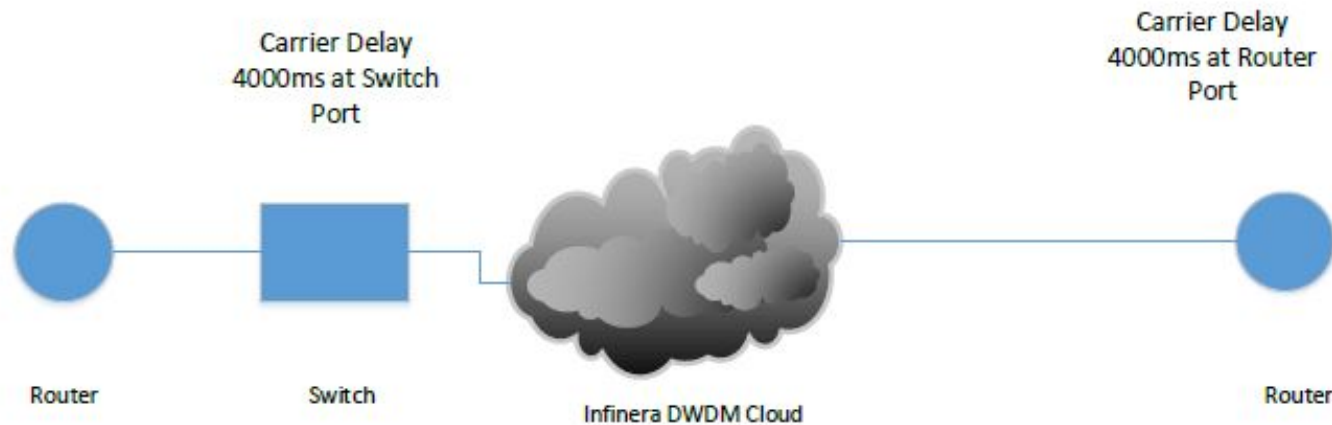
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Observation : Mixed Topology

Infinera DWDM Cloud is connected from Switch to Router for 10GE Circuit:

Carrier Delay
4000ms at Switch
Port

Carrier Delay
4000ms at Router
Port

Router

Switch

Infinera DWDM Cloud

Router

Output : No physical or Logical Flap Observed, only 2/3 ping loss during switching. Carrier delay value lower than 3000ms shows physical link flap.

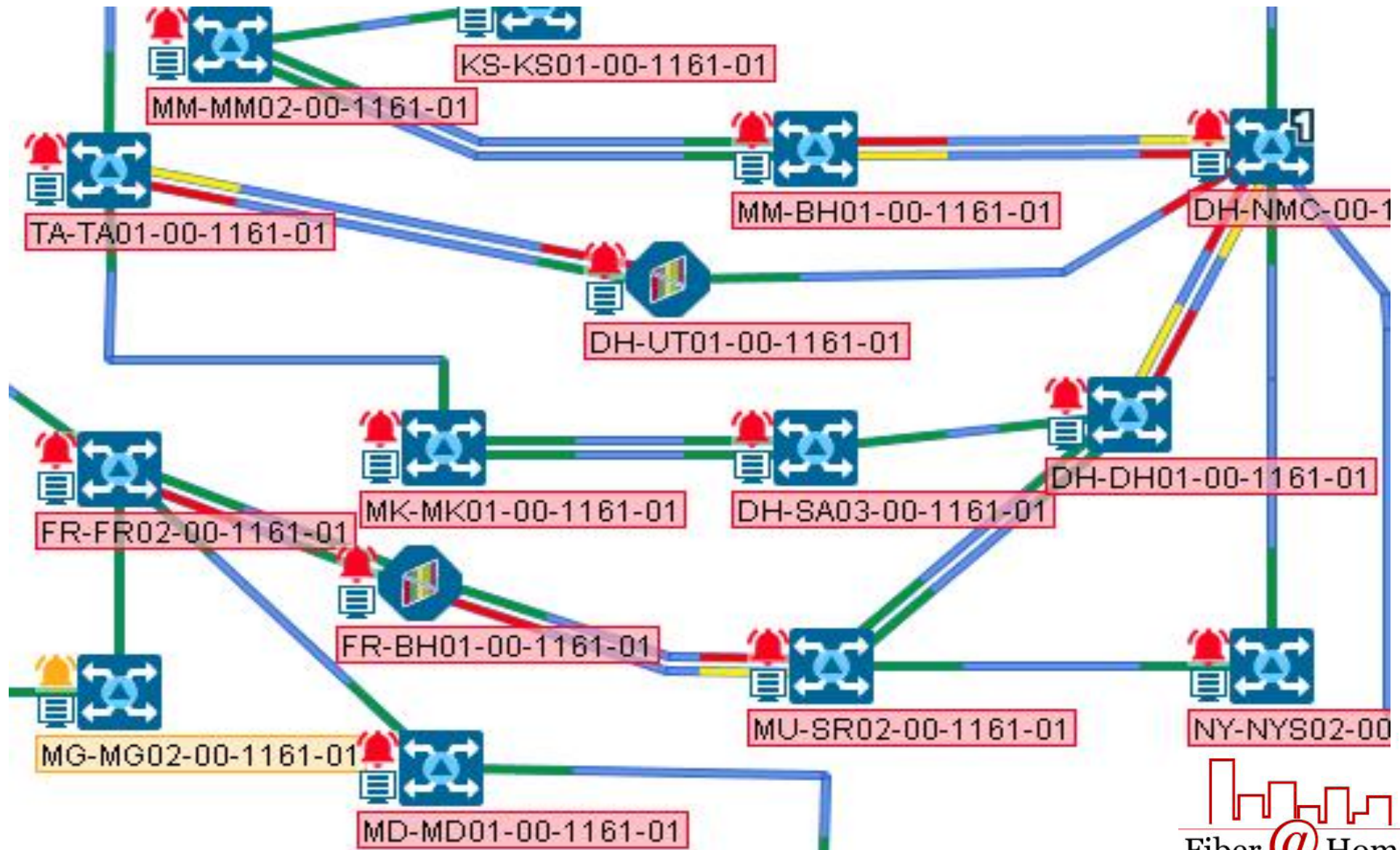Fiber @ Home

Final Findings

- Analyzer was showing that the switching was done below 50ms

- Vendor got cleared with that

- Routers were seeing that carrier was going down

- So we worked with carrier delay and squeeze the time duration required for DWDM system to find the new path by reducing CD searching parameter

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Operational Challenges

- Completely dependent on Optical Parameters
- Absence of real time latency check from DWDM layer
- Path selection is dynamic, so latency may vary
- If low latency is maintained, paths might have to be ignored
- Optical infrastructure has to be fine tuned all the time
- Different vendor DWDM handshaking is difficult
- Limitation on different feature due to licensing issue
- Theoretical standards are not followed all the time
- If one span is effected, numbers of 100G gets effected
- Difficult to integrate open source software
- Vendor dependency exists

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Resiliency – 18th May 2019

Performance

KHULNA-DHAKA L3 SERVICES IMPACT

BOGURA NMC L3 SERVICES IMPACT
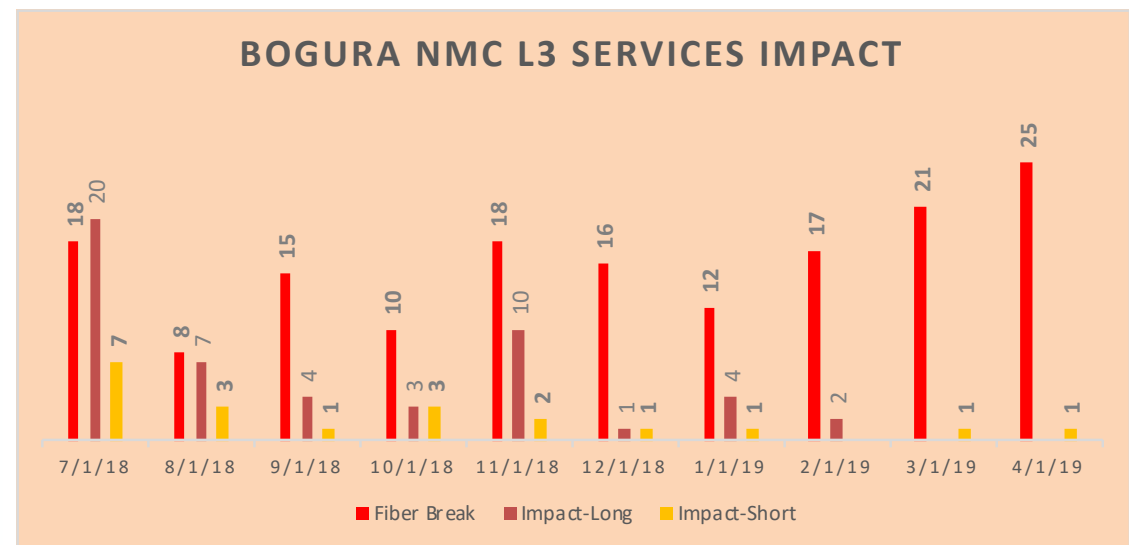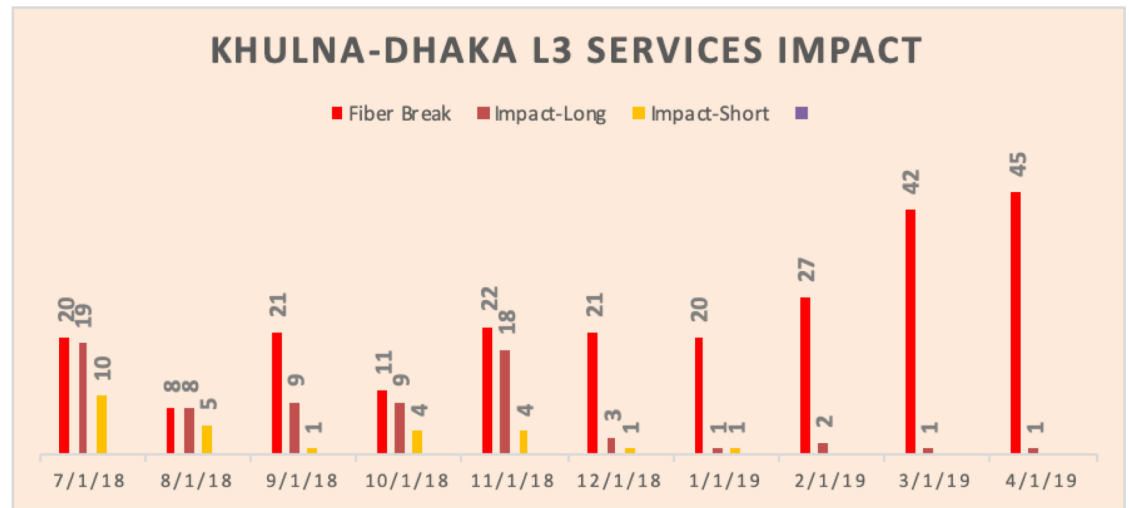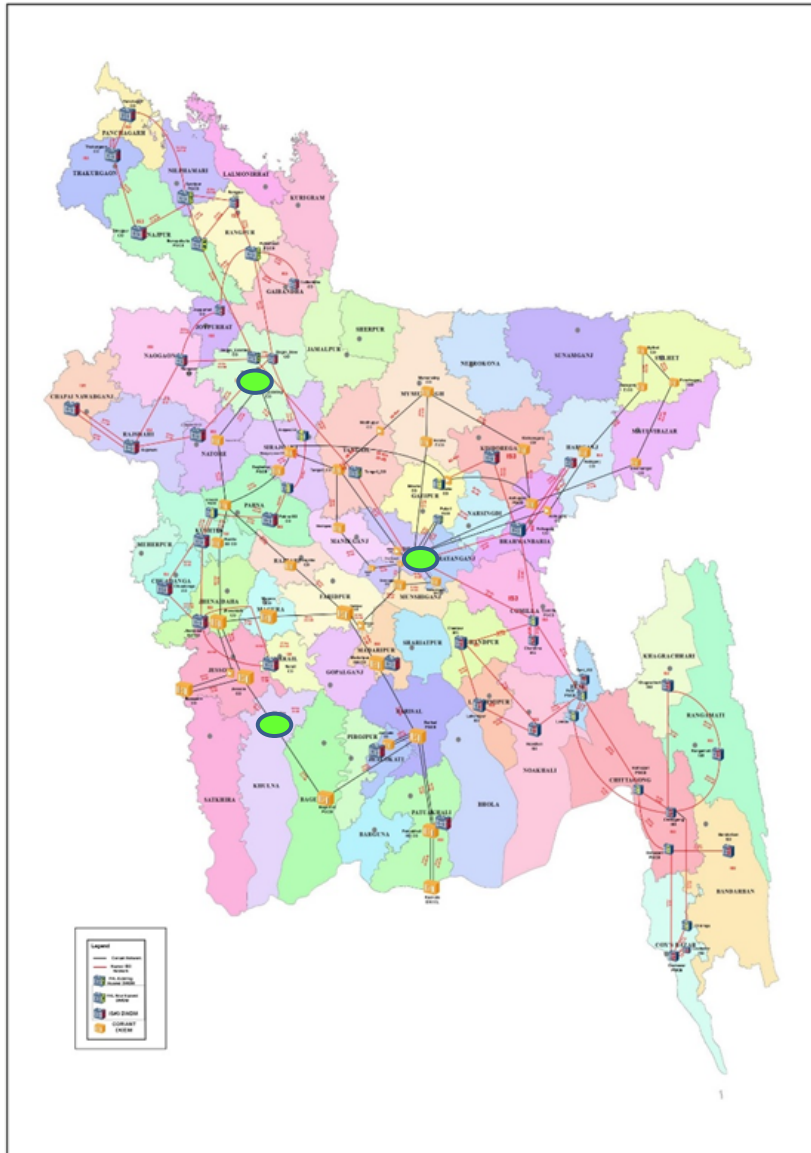
Acronyms

- WDM - Wavelength division multiplexing WDM
- CWDM - Coarse Wavelength division multiplexing
- DWDM - Dense Wavelength division multiplexing
- Mux/Demux - Multiplexer & demultiplexer
- OADM - Optical add-drop multiplexer
- ROADM - Reconfigurable optical add/drop multiplexer
- OTN - Optical transport network
- OTU - Optical transport unit

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Query ?

Thanks