SIG-NGN – IP Optical Integration for Performances

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Setting the scene

What is IP Optical integration?

- Broadly - this is DWDM interfaces on routers

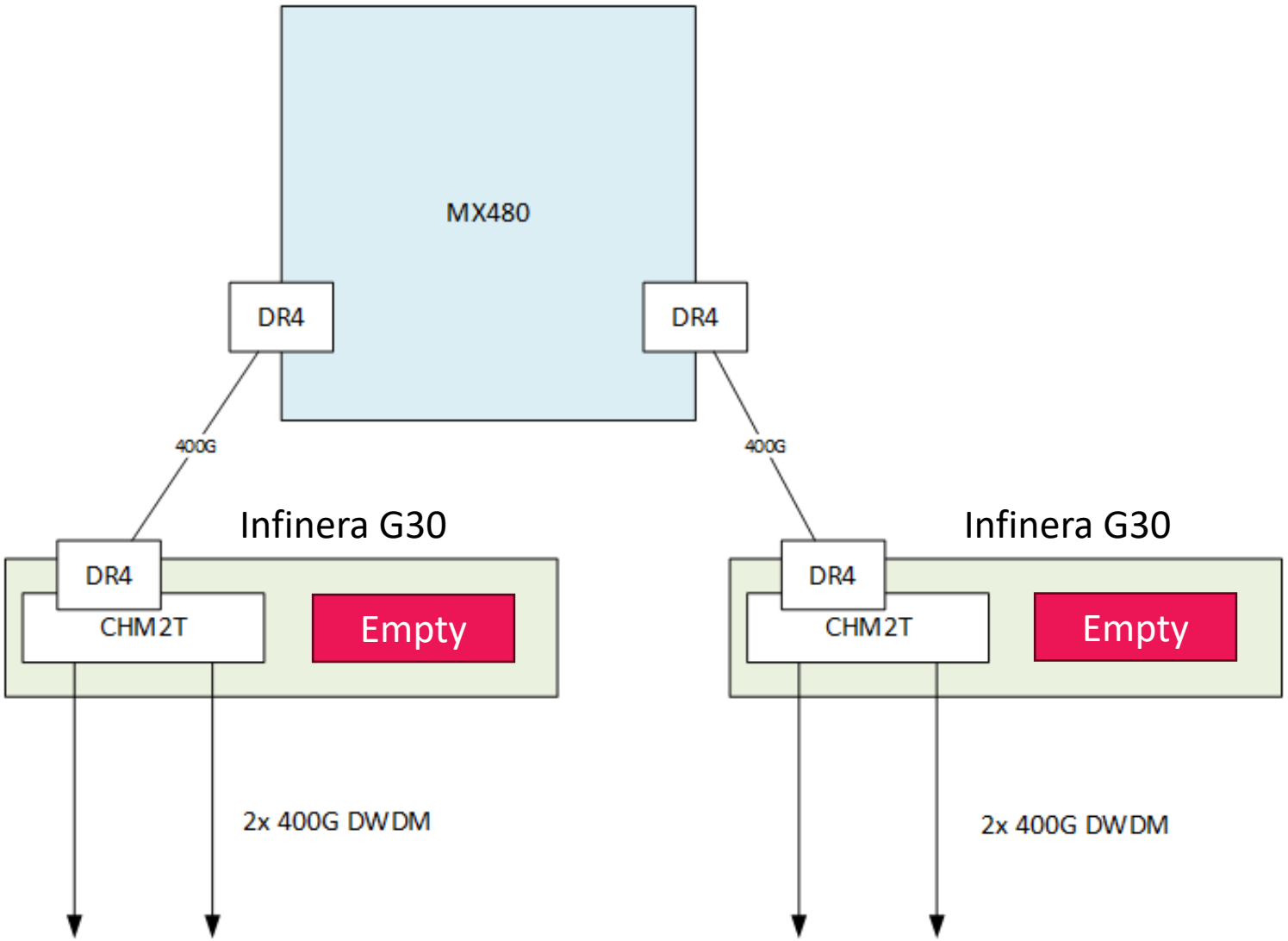
What are the reasons for doing it?

- Reduction of costs, complexity and performance improvement

Why now?

- With ZR, and later ZR+ and ZR+ 0dBm the Ethernet standard is now using natively coherent transmission to deliver the 40Km + range – this led to the development of plugins for QSFP-DD and OSFP with DWDM capabilities

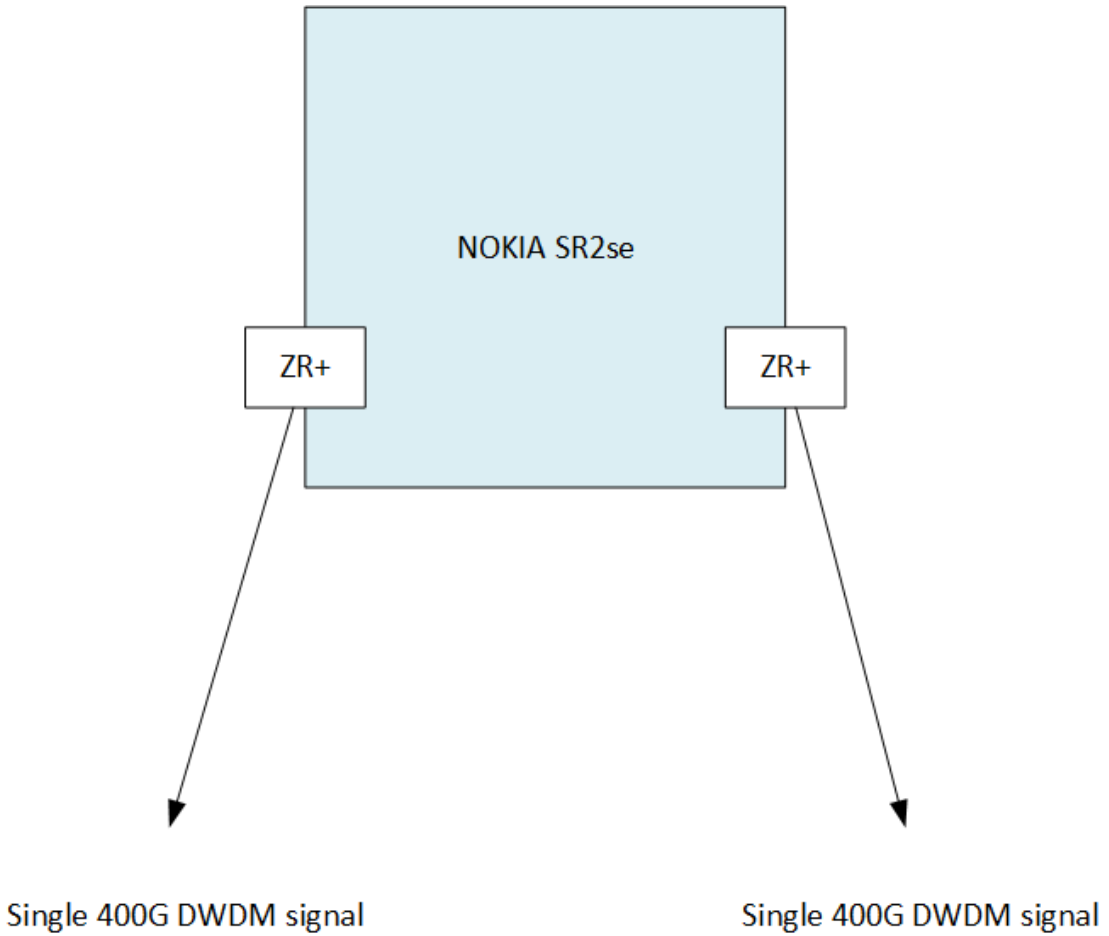
A small node build in GEANT with DCIs



Some observations:

- 2x DCI chassis for resiliency
- Half of each DCI chassis is empty
- Each DCI “sled” provides 2x 400G but we use only 1
- Extra processing of signals at DCI to provide Grey – Colored

A small node build in GEANT with ZR+ 0dBm



Some observations:

- Router straight into the DWDM MUX
- No HW is unused
- Less power consumption, less kit on the data path and less devices to manage
- Lower cost

In numbers

	Number	EUR unit	EUR build	Watts unit	Watts build
Chassis	2	[redacted]		100	200
Sled	2			200	400
Interfaces	4			4	16
					616
Interfaces	2			22	44
					44
		[redacted]		Delta	-572
		% reduction	76	% reduction	93

If you needed 800G x2 still you are looking at [redacted] vs [redacted] or 57.5% reduction in cost

All this with a mature DCI market while ZR+ 0dBm are quite new!

Where is the catch

CHM2T Operation Mode		Symbol Rate [GBaud]		ROSNR at FEC Thr. [dB]		Rx power sensitivity [dB]	Impairments Tolerance					Reference Reach [km]	
Bit Rate [Gb/s]	Modulation Format	15% FEC	27% FEC	15% FEC	27% FEC		CD [s/m]	DGD max [ps]	SOPMD [ps^2]	SOP Tracking [rad/ms]	PDL [dB]	15% FEC	27% FEC
100	SP-QPSK	63.1	69.4	10.7	[illegible]	-25	> 360	75	1200	> 800	6	5900	6900
200	QPSK	63.1	69.4	13.9	13.2	-22	> 300	75	1200	> 800	6	3600	4200
250	QPSK/SP-16QAM	63.1	69.4	16.4	15.7	-19	> 240	75	1200	> 500	6	2600	3000
300	SP-16QAM	63.1	69.4	18.1	17.4	-17	> 180	75	1200	> 500	6	1900	2200
350	SP-16QAM/16QAM	63.1	69.4	19.9	[illegible]	-15	> 120	75	1200	> 250	6	1400	1650
400	16QAM	63.1	69.4	21.6	20.8	-14	> 80	75	1200	> 250	6	900	1100
450	16QAM/32QAM	63.1	69.4	24.5	23.5	-12	> 60	75	1200	> 250	6	600	700
500	32QAM	63.1	69.4	27	25.5	-10	> 30	75	1200	> 200	6	390	450
550	32QAM/64QAM	63.1	69.4	30.2	28.6	-6	> 20	75	1200	> 200	6	200	250
600	64QAM	63.1	69.4	34	32.5	-4	> 15	75	1200	> 200	6	120	150

ROSNR for a 400G signal out of a CHM2T is 20.8 dB while for a ZR+ 0dB we are probably looking at 24+ dB
Moreover, if you do not have those 24 dB you are not getting 400G, while a CHM2T can provide them out of inverse multiplexing of QPSK signals with ROSNR of 13.2 dB!

Why not before

Before

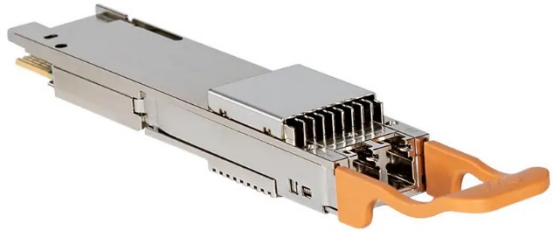
100G CFP2

100G QSFP28

Now

400G QSFP-DD

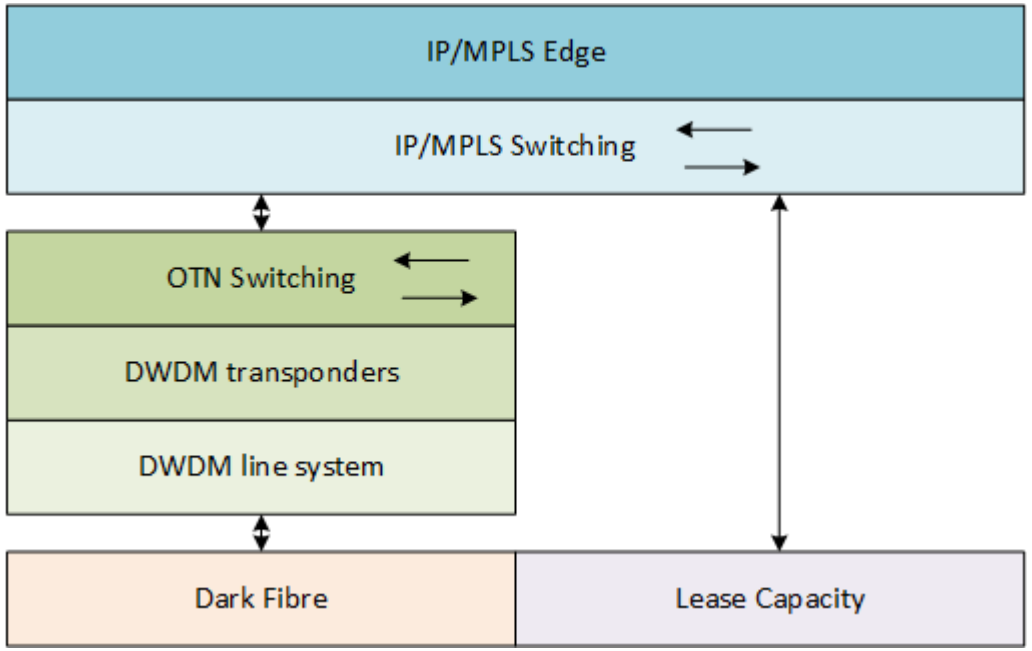
400G QSFP-DD



The same QSFP-DD (or OSFP) formfactor can host both Grey as well as DWDM interfaces. Meaning that any interface of a line card can be DWDM, but this decision does not have to be taken in advance by deploying specialised line cards HW.

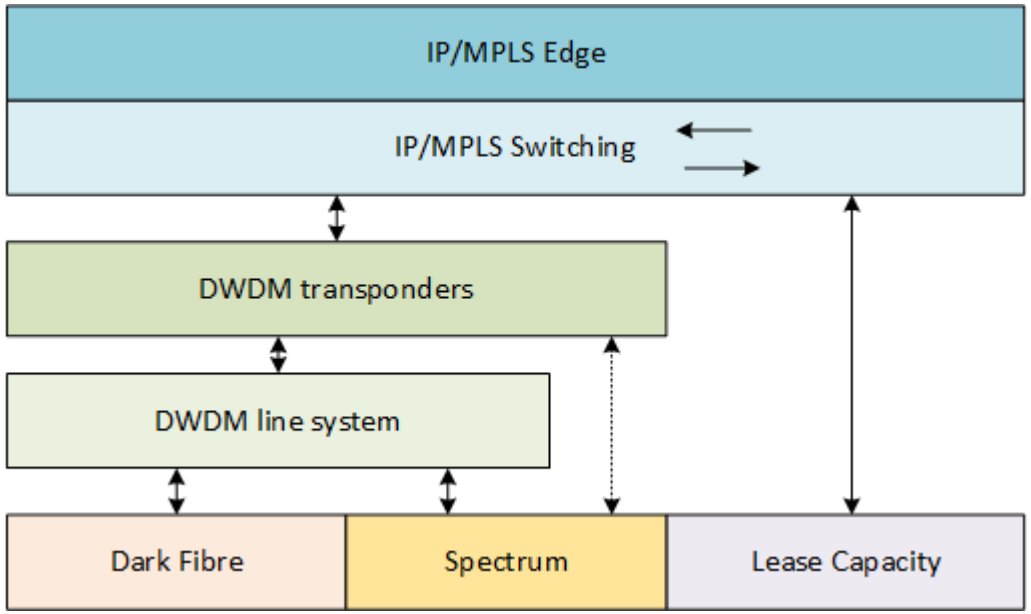
The stack impact

DTNx system



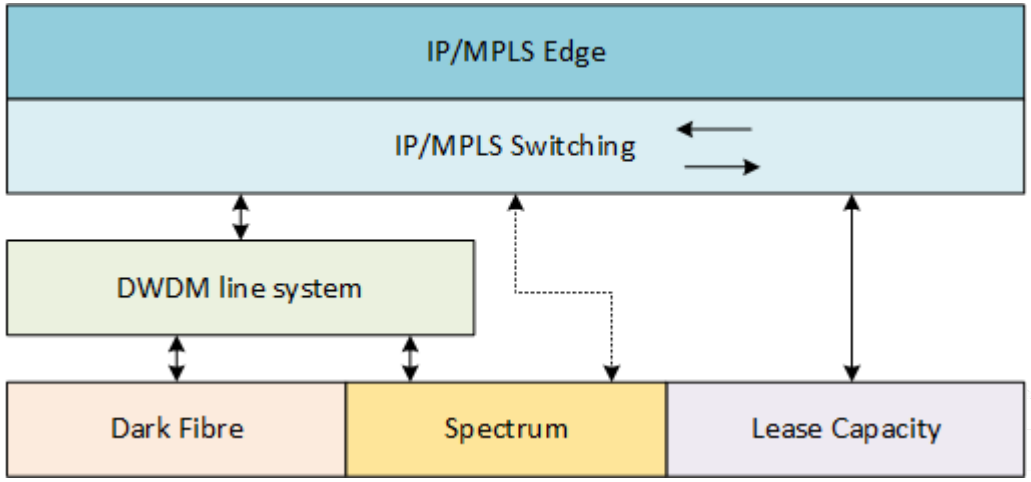
Deduplication of Electronic switching

OLS + DCI



Native DWDM from IP/MPLS

Packet Optical integrated MPLS ->



Conclusions

- **Testing of ZR+ 0dBm interfaces** with Infinera, NOKIA and other vendors
- **Integrate ZR+ 0dBM within GÉANT toolset** for dealing with production of capacity on Fibre
- **Ensure routing kit procured supports high power and cooling at QSFP-DD** – Minimum target should be 22w – NOKIA cards used support min 26w on all interfaces
- Links where distance/OSNR allow (~500/600Km) are candidate for ZR+ use / there are 13 links in the next MPLS topology plan where ZR+ are considered - these are links with no 400G capability today – ie. Requiring upgrade
- **ZR+ will be used to complement DCIs** due to technical limitations (links length/OSNR) and install base
- Long term GÉANT is watching with interest this space, as 800G ZR+ will likely exist and will provide both 800G DWDM as well as 400G DWDM long haul

Thank You

Any questions?

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