OFC 2018
MAR 12TH, 2018 - SAN DIEGO
PRESENTATION #M1A.3

A STATISTICAL ASSESSMENT OF NETWORKING MERIT OF 2MxN WSS

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OUTLINE

- Introducing 2MxN WSS: motivations and use cases
- Assessing the impact of 2MxN through SNAP
- Analyzed scenario
- Results
- Conclusions and future work

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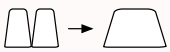
2MxN WSS

MOTIVATIONS AND USE CASES

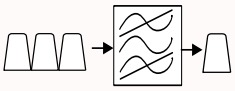
NEXT GEN CDC ADD/DROP REQUIREMENTS

Reduce Loss/Remove EDFA Arrays

Enable A/D port and degree scaling



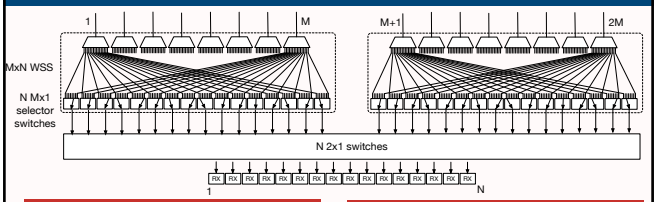
Enable Transition to Superchannels



Improve Performance Through Channel Filtering

 * B. Smith, "Next Generation CDC ROADM," ECOC 2017 - Sep. 18, 2017.

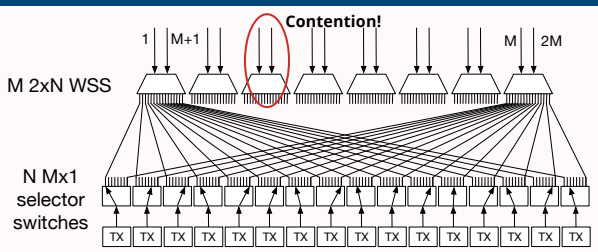
HIGH DEGREE PORT COUNT WITH CURRENT GEN. ROADMS



PROS	CONS
▪ Simple architecture ▪ Fully contentionless	▪ Cost per A/D port increase is >2x ▪ Large footprint due to external bank of 2x1 switches

 * B. Smith, "Next Generation CDC ROADM," ECOC 2017 - Sep. 18, 2017.

INTRODUCING 2MxN WSS

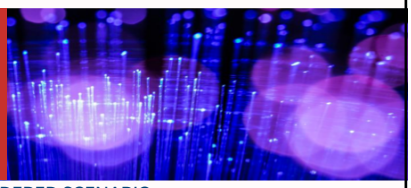


2xxN WSS-BASED ROADMS

PROS	CONS
▪ Simple architecture ▪ Better cost per A/D port scaling ▪ Better density than previous solution	▪ Low probability of wavelength contention over directions sharing WSS

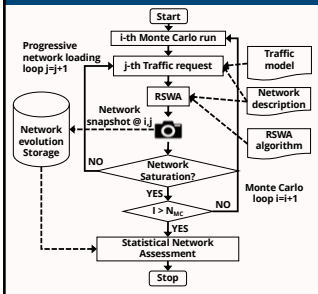
What is the impact of this partial contention at network level?

NETWORK ANALYSES



METHODOLOGY AND CONSIDERED SCENARIO

THE STATISTICAL NETWORK ASSESSMENT PROCESS



- Monte Carlo based algorithm
- **Random traffic patterns** are **loaded** to the network **up to saturation**
- **Metrics** are saved for each allocation process, then **statistically characterized against traffic realizations**.
- We focus on **blocking probability vs allocated number of lightpaths**

* M. Cantono *et al.* "Potentialities and Criticalities of Flexible-Rate Transponders in DWDM networks: a Statistical Approach ," JOCN, 2016
* V. Curri *et. al.*, "Elastic All-Optical Networks: a New Paradigm Enabled by the Physical Layer. How to Optimize Network Performances?," JLT, 2017

SCENARIO: HIGH NODE DEGREE METRO NETWORK

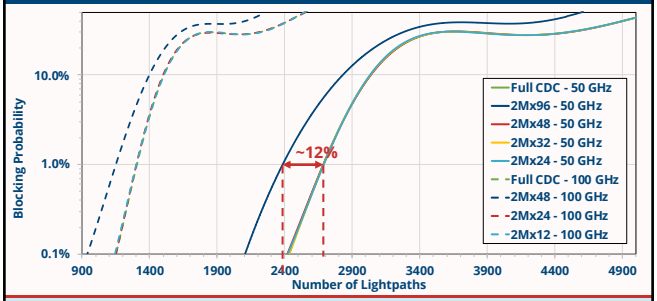
- 40 nodes
- 107 edges
- 5.35 average node degree
- 1< Node degree < 15
- K_{max} = 200 – min-hop routing
- First fit wavelength assignment
- N_W = 48, 96 wavelength per fiber on 50 GHz or 100 GHz bandwidth respectively
- Average node-to-node distance 13 km

NODE LEVEL CONFIGURATION

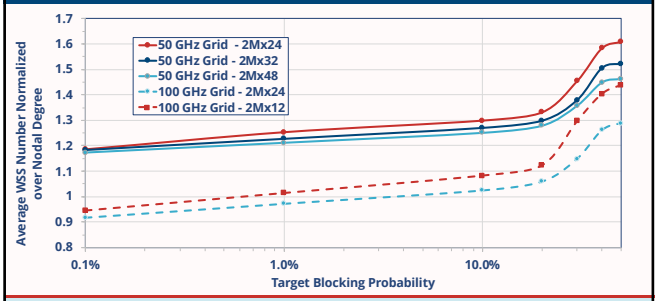
- We consider **N = 12, 24, 48 for N_W = 48,** and **N = 24, 32, 48, 96 for N_W = 96**.
- We consider **full A/D capability (ADC) at each node**, i.e. at each node, **N_W channels can be added/dropped in each direction**.
- We assume **full ADC** to **fairly compare architectures with different A/D port count**
- This means that **N_W/N devices times its degree** needs to be **deployed in each node**.
  - E.g. in a 2 degree node, with 48 A/D ports devices and 96 channels grid, 4 devices are needed to have full ADC
- We verify ***a posteriori* the number of devices** actually needed to reach a target BP given N and N_W.

RESULTS AND COMMENTS

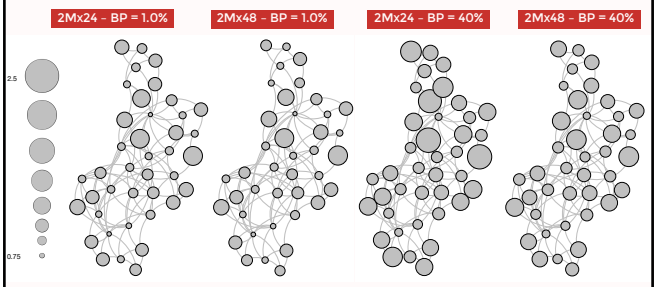
BLOCKING PROBABILITY VS NUMBER OF LIGHTPATHS



AVERAGE NORMALIZED WSS COUNT



AVERAGE WSS COUNT PER DIRECTION – 50 GHZ GRID



CONCLUSIONS AND FUTURE WORK

- 2MxN WSSs represent a good option for high degree count nodes.
- Their **limited wavelength contention** does **not have a relevant impact at network level** for devices **with** A/D ports count **N <= 50% N_W**.
- **Device count analyses show that deploying small port counts WSSs** does **not require the deployment of a significantly additional number of devices with respect to higher port count solutions** when operating a target **BP<20%**

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QUESTIONS? THANK YOU

SLIDES AVAILABLE AT WWW.OPTCOM.POLITO.IT
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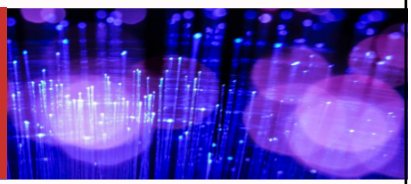
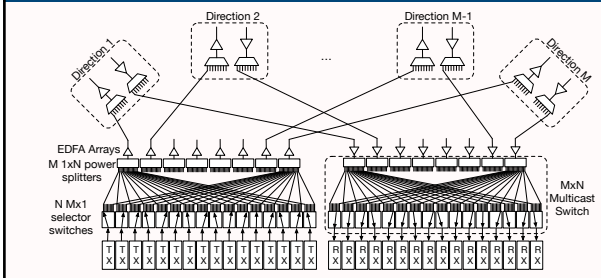
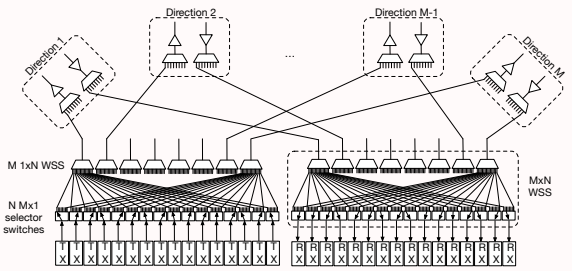
BACKUP SLIDES



MCS-BASED ROADM



CURRENT GENERATION WSS



MxN WSS-BASED ROADMS

PROS

- Better noise performance than multicast switches-based ROADM
  - No EDFA Array needed due to lower insertion losses
- Improved filtering thanks to inherent filtering capabilities of WSS

CONS

- Cost and complexity increase with degree port count M due to technological constraints

 * B. Smith, "Next Generation CDC ROADM," ECOC 2017 - Sep. 18, 2017.

LIMITED ADD/DROP CAPABILITY – 50 GHZ CASE