Network architecture growth path using PSM4

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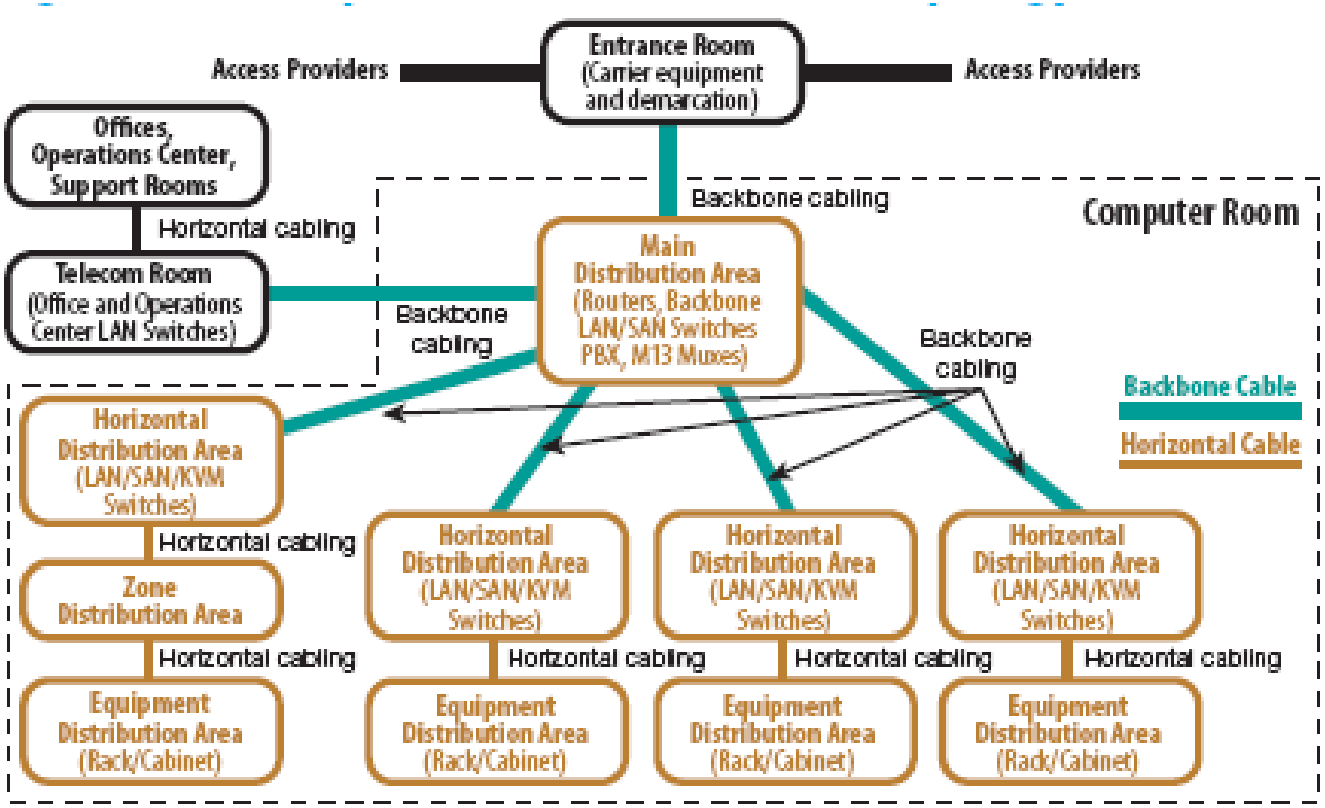
Nov. 2012,

San Antonio

Agenda

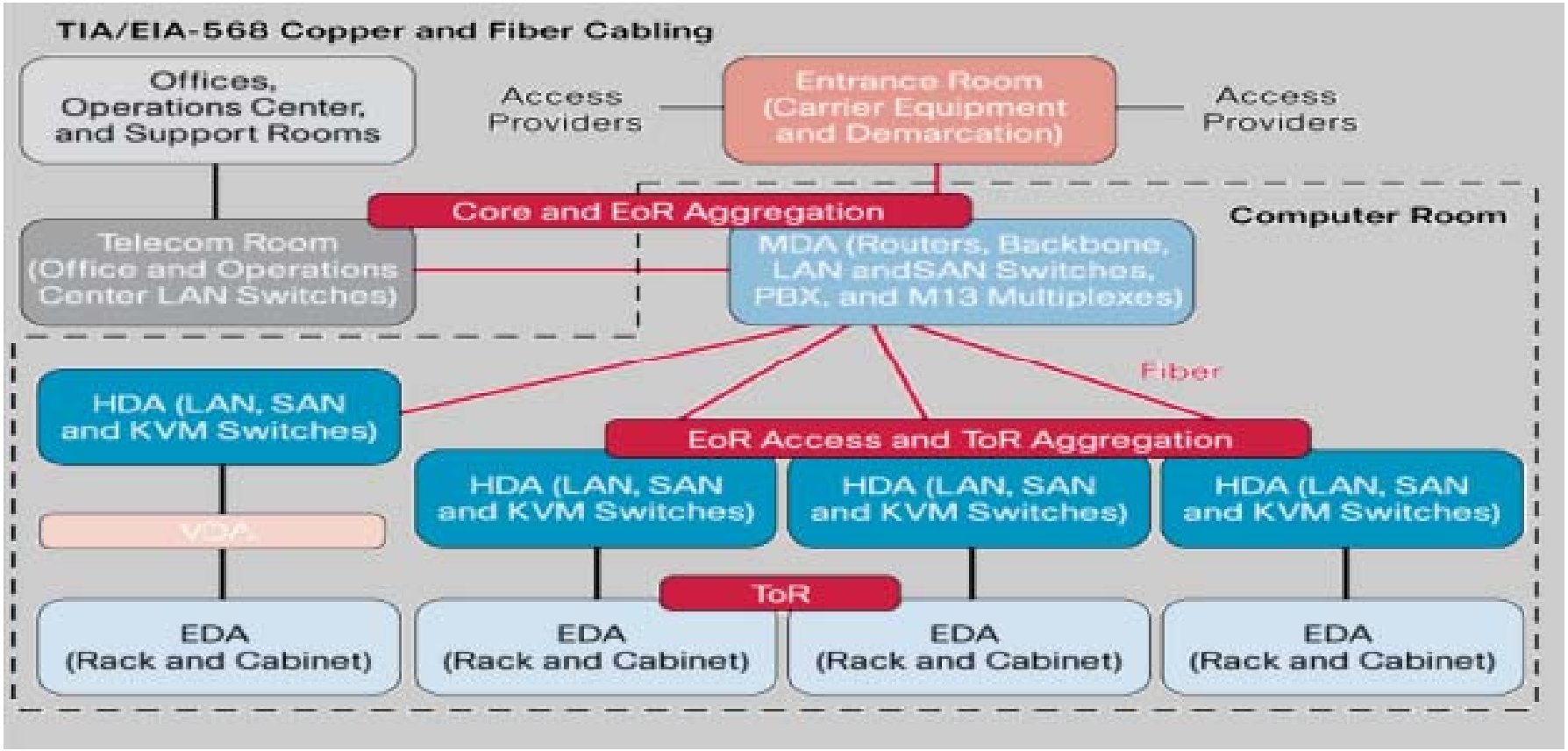
- Network architectures
- Link distances, fiber types and modules
- 10-40-100-400G progression over common fiber plant with constant oversubscription
- Summary and pictures

TIA-942 network design guide

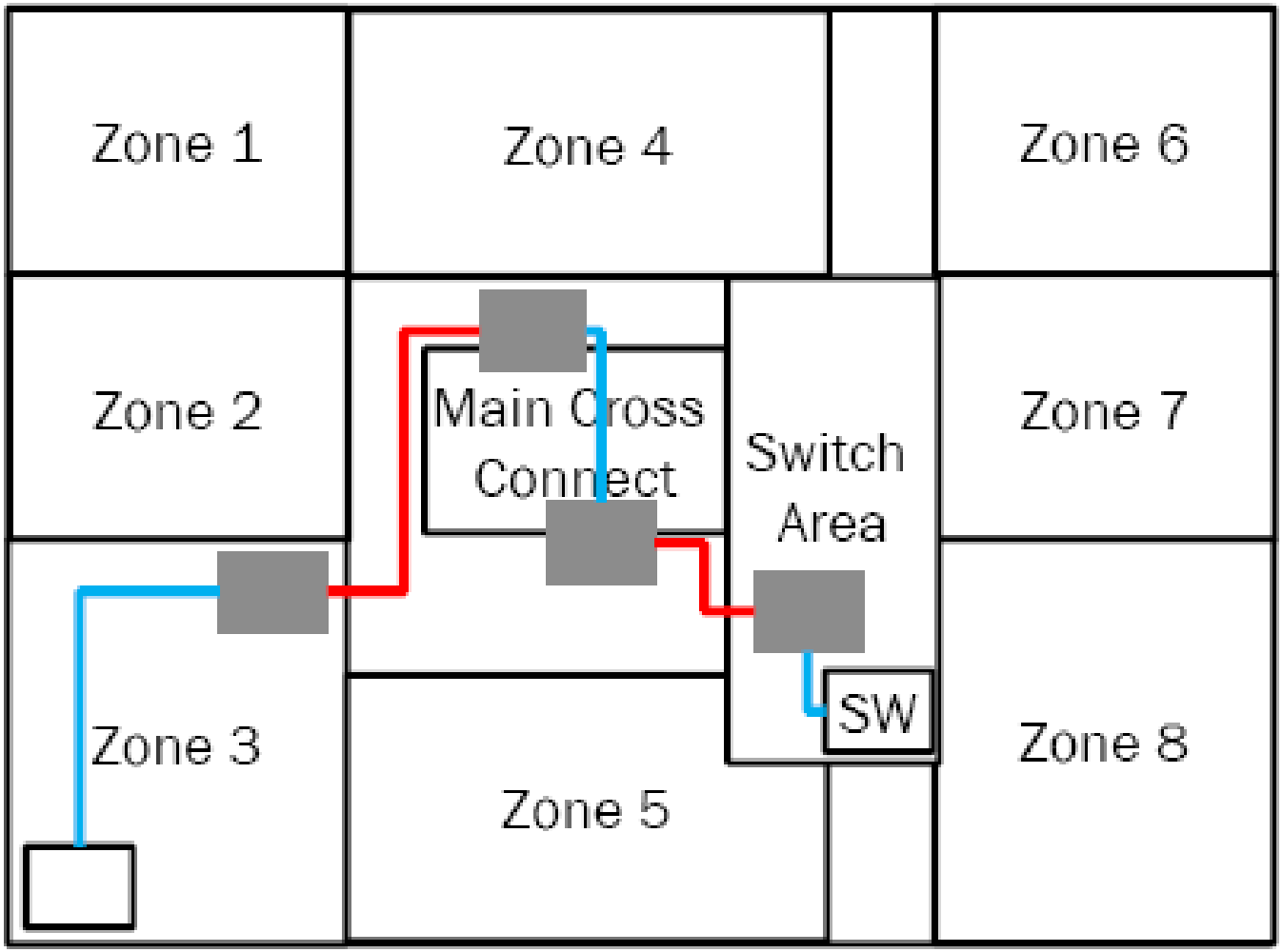


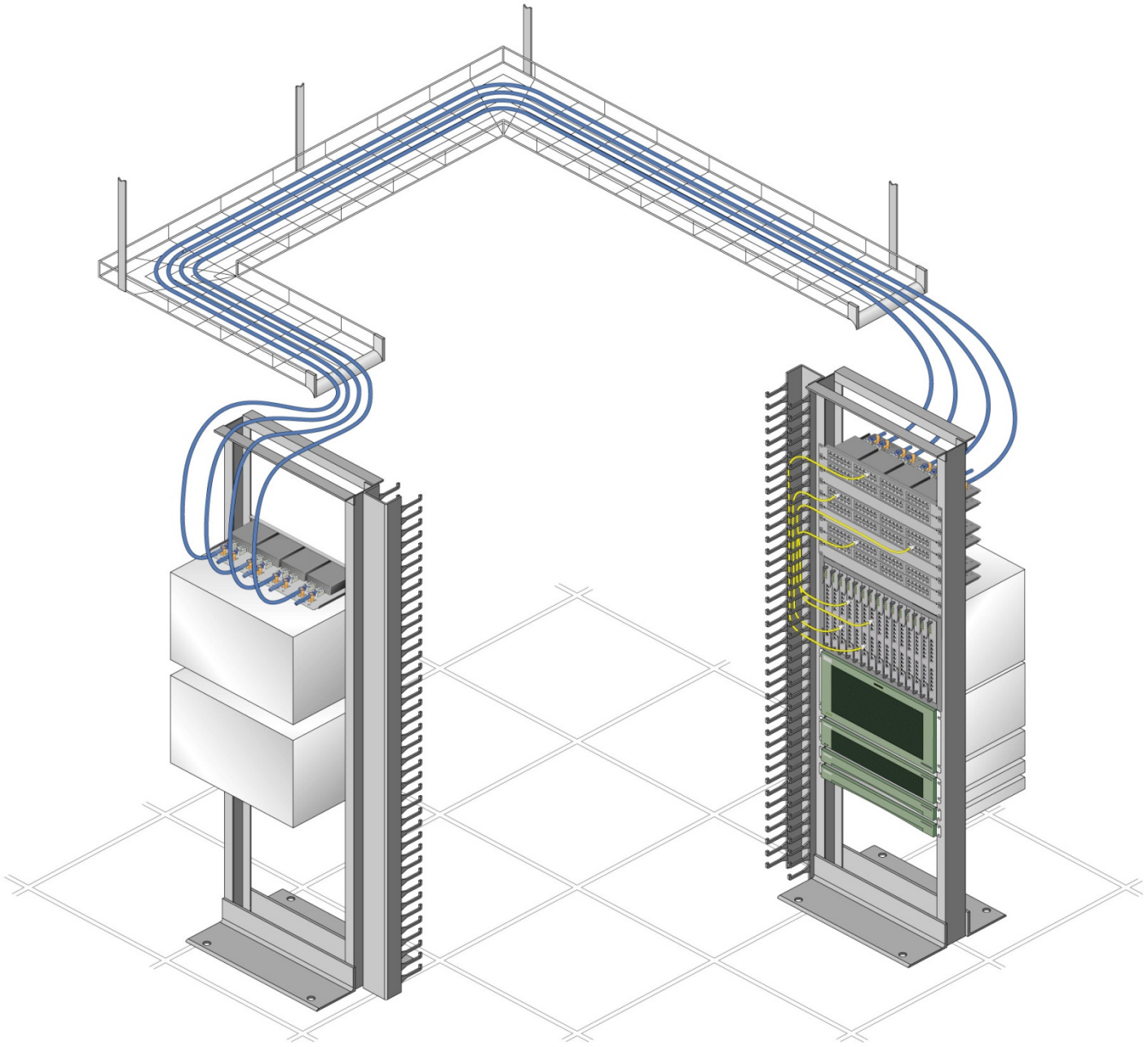
* TIA-942 is currently under revision and it is expected that an Intermediate Distribution Area (IDA) will be defined within TIA-942A. The IDA would connect between the MDA and an HDA.

Network design today



Data center design showing connection points



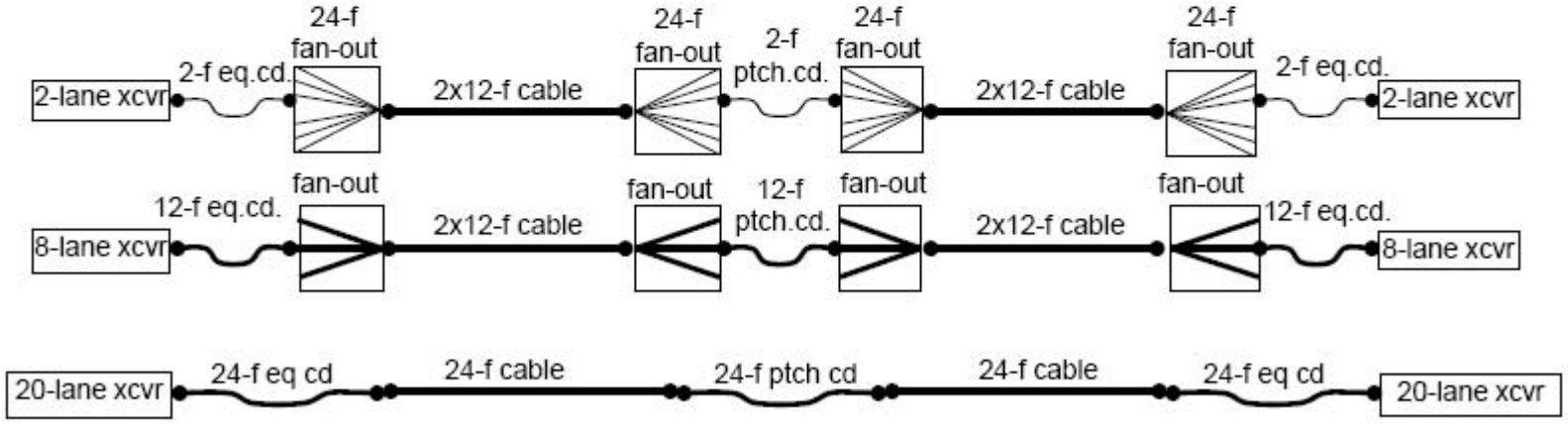


(From Kipp_01_0112)

3 Scenarios

NR4 is a new SM PMD between 500m and 2km. We evaluate two flavors "with WDM" or "no WDM".

PMD	Fiber Needed	Fibers in the Model
100GBASE-SR10	20	24
100GBASE-SR4	8	8
100GBASE-NR4-SM no WDM	8	8
100GBASE-NR4-SM with WDM	2	2
100GBASE-NR4-PAM	2	2
100GBASE-LR4	2	2



Source: Kolesar_02_0911_NG100GOPTX.pdf

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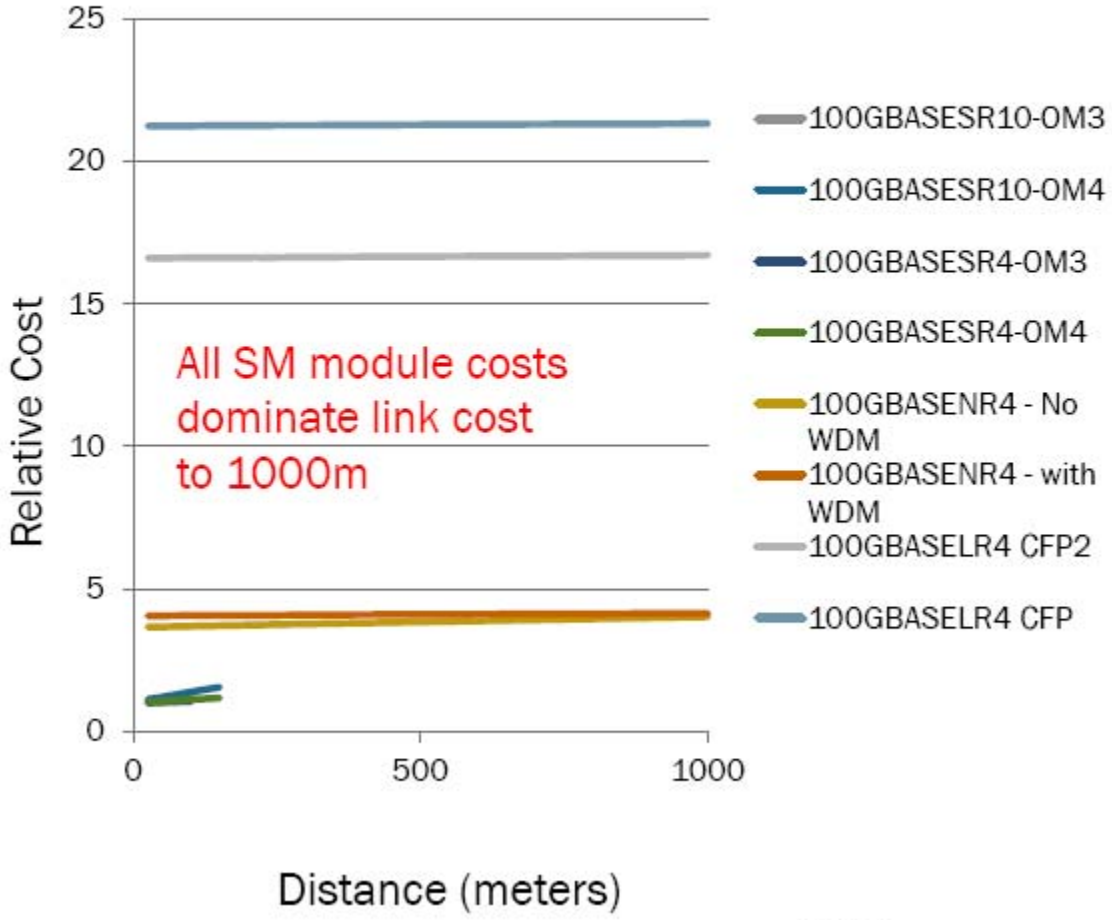
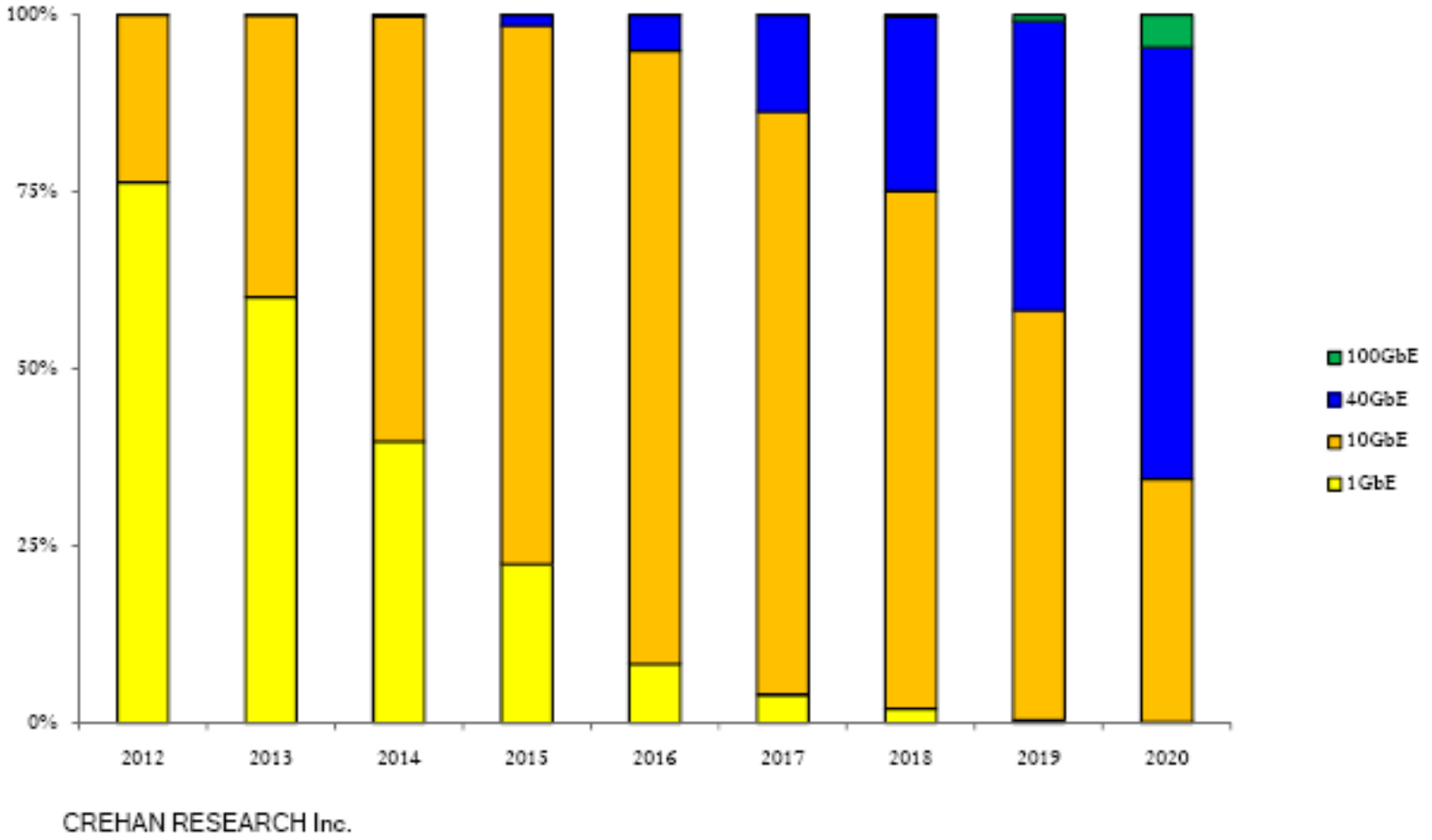
Single-mode Link Cost Analysis



The connectivity costs don't play a significant role in single-mode links. The link cost is dominated by the module cost.

Server port speed forecast



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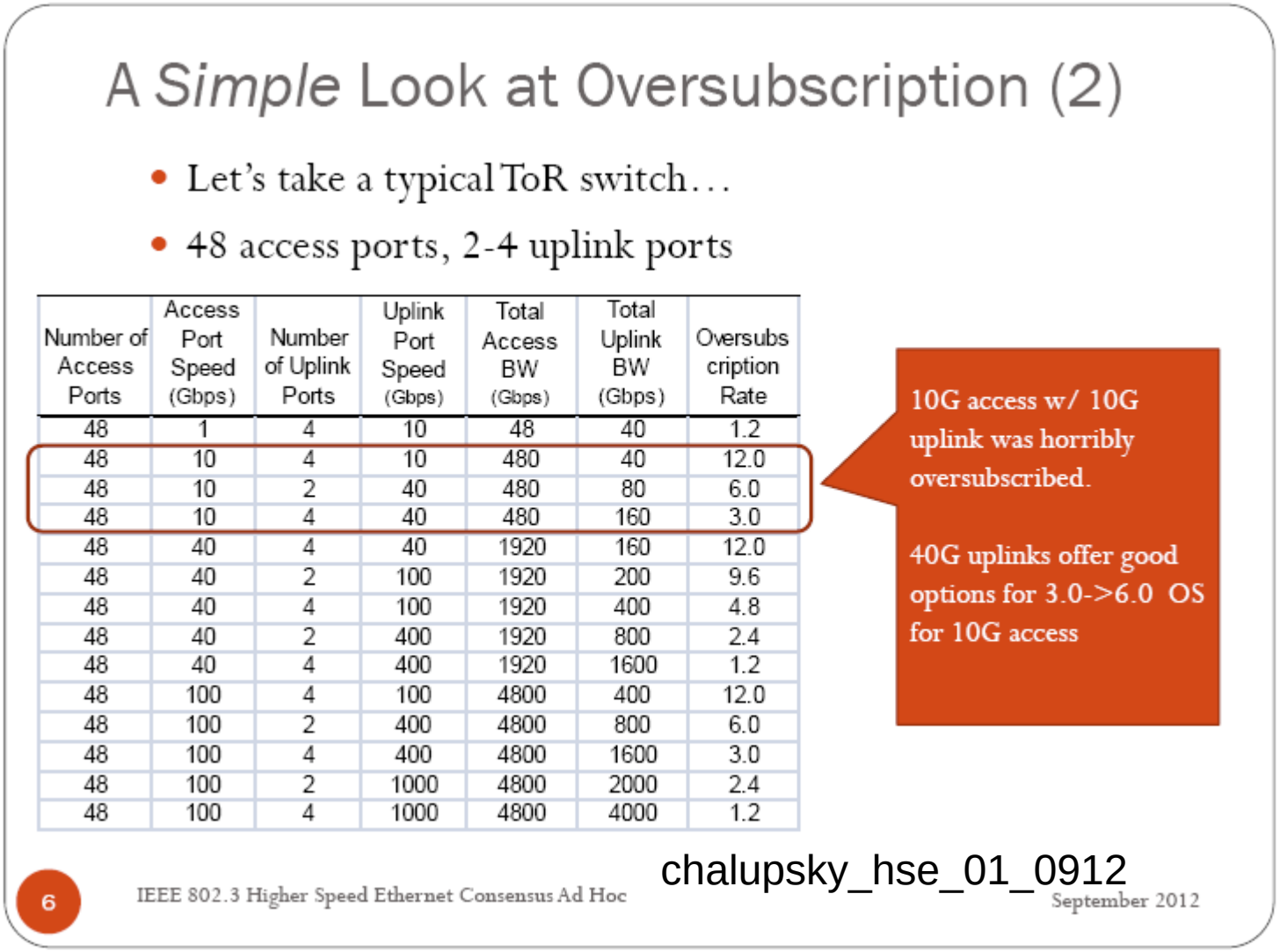
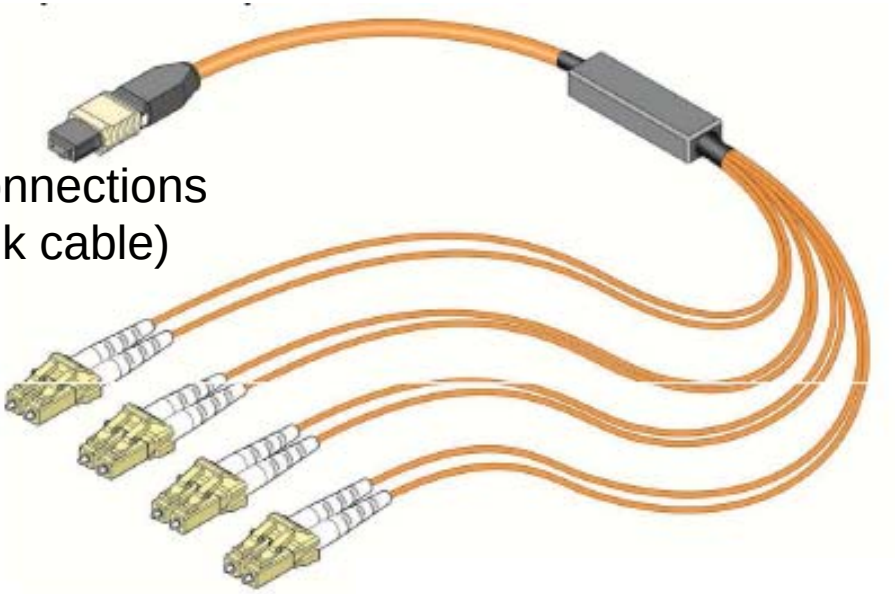
10G Scenario

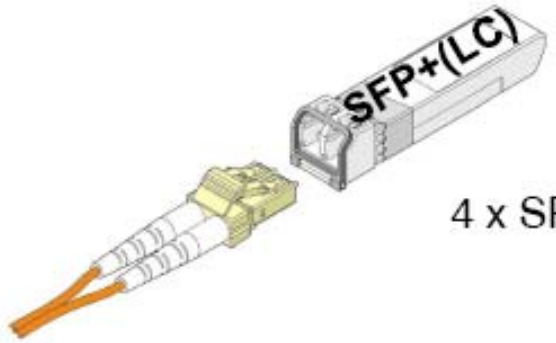
- 

Number of Access Ports	Access Port Speed (Gbps)	Number of Uplink Ports	Uplink Port Speed (Gbps)	Total Access BW (Gbps)	Total Uplink BW (Gbps)	Oversubscription Rate
48	1	4	10	48	40	1.2
48	10	4	10	480	40	12.0
48	10	2	40	480	80	6.0
48	10	4	40	480	160	3.0
48	40	4	40	1920	160	12.0
48	40	2	100	1920	200	9.6
48	40	4	100	1920	400	4.8
48	40	2	400	1920	800	2.4
48	40	4	400	1920	1600	1.2
48	100	4	100	4800	400	12.0
48	100	2	400	4800	800	6.0
48	100	4	400	4800	1600	3.0
48	100	2	1000	4800	2000	2.4
48	100	4	1000	4800	4000	1.2

10G Ethernet solution

8 fiber MPO (1 of 3 connections to 24 fiber ribbon trunk cable)





4 x SFP+

10G Scenario (2012-2014)

- 10G Servers with 10G uplinks requires:
  - 80-160G total uplink BW required for OS of 3-6.
    - 24 fiber ribbon gives 120G of BW (OS of 4)
    - ** THIS WORKS

40G Scenario

A *Simple* Look at Oversubscription (3)

- Let's take a typical ToR switch…
- 48 access ports, 2-4 uplink ports

Number of Access Ports	Access Port Speed (Gbps)	Number of Uplink Ports	Uplink Port Speed (Gbps)	Total Access BW (Gbps)	Total Uplink BW (Gbps)	Oversubscription Rate
48	1	4	10	48	40	1.2
48	10	4	10	480	40	12.0
48	10	2	40	480	80	6.0
48	10	4	40	480	160	3.0
48	40	4	40	1920	160	12.0
48	40	2	100	1920	200	9.6
48	40	4	100	1920	400	4.8
48	40	2	400	1920	800	2.4
48	40	4	400	1920	1600	1.2
48	100	4	100	4800	400	12.0
48	100	2	400	4800	800	6.0
48	100	4	400	4800	1600	3.0
48	100	2	1000	4800	2000	2.4
48	100	4	1000	4800	4000	1.2

40G access needs 100G uplinks… at least.

400G uplinks offer GREAT options for 1.2->2.4 OS for 40G access

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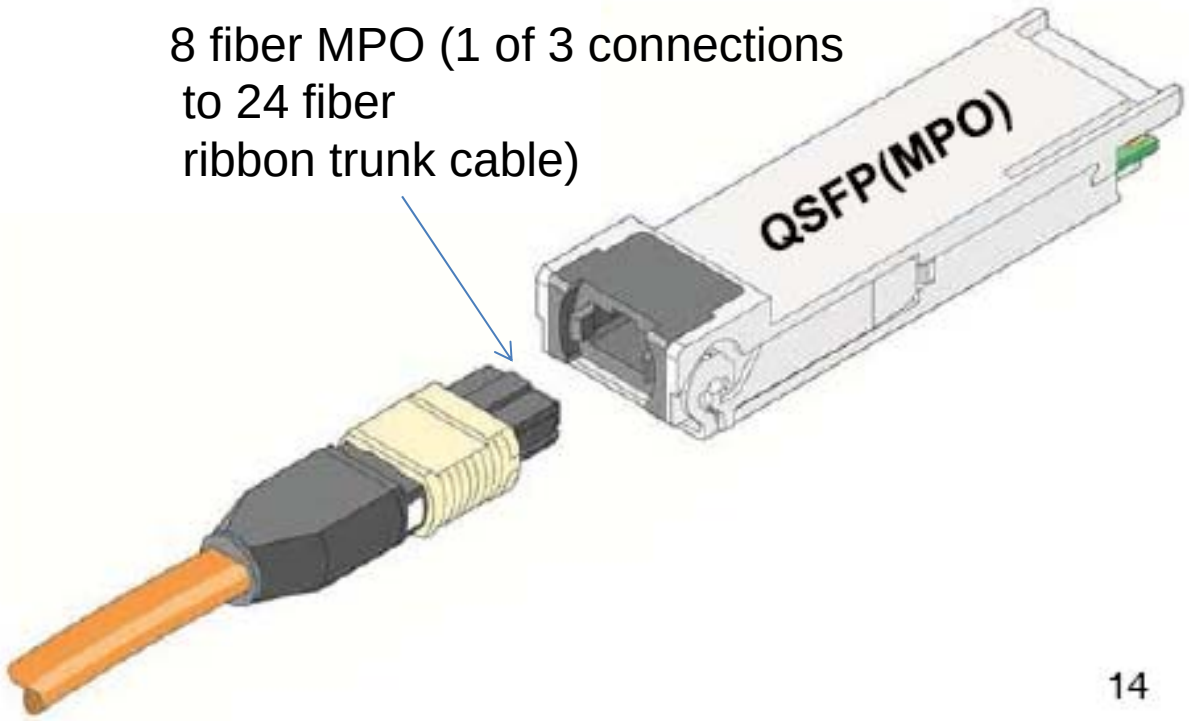
100G Ethernet PSM4 solution



10/40G Scenario (2015-2018)

- 75% 10G, 25% 40G Servers with 100G uplinks requires:
  - 140-280G total uplink BW FOR OS OF 3-6.
    - 24 fiber ribbon using PSM4 gives 300G of BW (OS of 2.8)
    - ** THIS WORKS
    - 24 fiber ribbon using single lane PAM or LR4 gives 1200G of BW (OS of .7)
    - **Probably overkill
- 75% 10G, 25% 40G Servers with 400G uplinks requires:
    - 24 fiber ribbon using 4 lane PAM for 400G gives 1200G of BW
    - **ALSO WORKS but probably overkill

40G Scenario (2019-2022)

- 100% 40G Servers with 100G uplinks requires:
  - 320-640G total uplink BW FOR OS OF 3-6.
    - 24 fiber ribbon using PSM4 gives 300G of BW (OS of 6.4)
    - ** THIS WORKS marginally
    - 24 fiber ribbon using single lane PAM or LR4 gives 1200G of BW (OS of 1.6)
    - **THIS WORKS
- 100% 40G Servers with 400G uplinks requires:
    - 24 fiber ribbon using 4 lane PAM for 400G gives 1200G of BW
    - **ALSO WORKS

100G servers (2021-202?)

A *Simple* Look at Oversubscription (4)

- Let's take a typical ToR switch…
- 48 access ports, 2-4 uplink ports

Number of Access Ports	Access Port Speed (Gbps)	Number of Uplink Ports	Uplink Port Speed (Gbps)	Total Access BW (Gbps)	Total Uplink BW (Gbps)	Oversubscription Rate
48	1	4	10	48	40	1.2
48	10	4	10	480	40	12.0
48	10	2	40	480	80	6.0
48	10	4	40	480	160	3.0
48	40	4	40	1920	160	12.0
48	40	2	100	1920	200	9.6
48	40	4	100	1920	400	4.8
48	40	2	400	1920	800	2.4
48	40	4	400	1920	1600	1.2
48	100	4	100	4800	400	12.0
48	100	2	400	4800	800	6.0
48	100	4	400	4800	1600	3.0
48	100	2	1000	4800	2000	2.4
48	100	4	1000	4800	4000	1.2

100G access with100G uplinks is horribly oversubscribed

400G uplinks offer good options for 3.0->6.0 OS for 100G access

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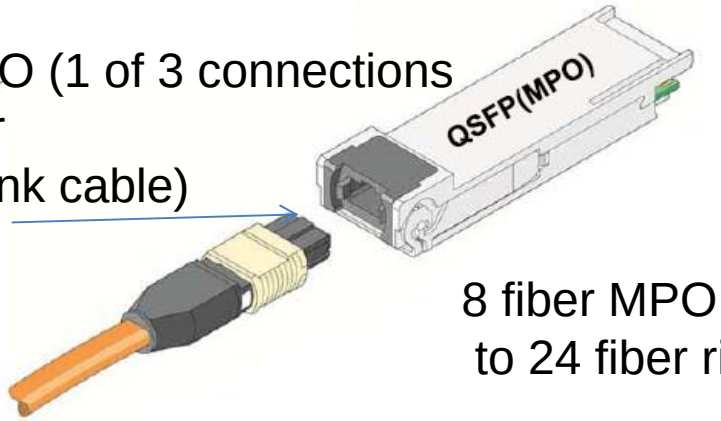
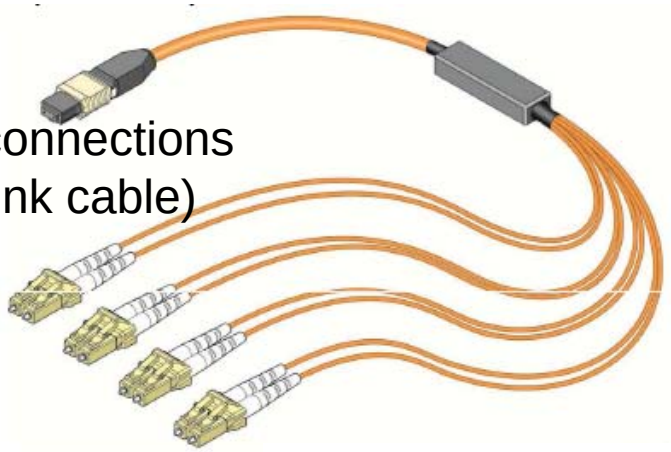
100G Ethernet PAM and 400G PSM4 solution

400G (4x100G PAM) module

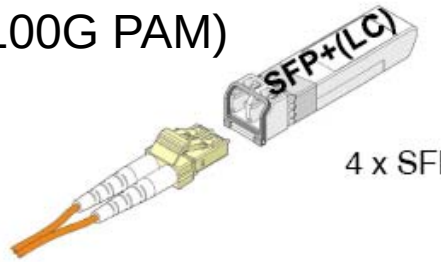
8 fiber MPO (1 of 3 connections to 24 fiber ribbon trunk cable)





8 fiber MPO (1 of 3 connections to 24 fiber ribbon trunk cable)

100G (1x100G PAM) module



100G Scenario (2019-2022)

- 100G Servers with 100G uplinks requires:
  - 800-1600G total uplink BW FOR OS OF 3-6.
    - 24 fiber ribbon using single lane PAM or LR4 gives 1200G of BW (OS of 4)
    - ** THIS WORKS
- 100G Servers with 400G uplinks requires:
    - 24 fiber ribbon using 4 lane PAM for 400G gives 1200G of BW
    - **ALSO WORKS

Summary

- PSM4 provides a cost effective 100G solution for the next 8 yrs.