How Data Centers and Central Offices Co-Exist in the Same Space

Craig Culwell
CommScope
Inside Plant Fiber Market Development

How Data Centers and Central Offices Co-Exist in the Same Space

- Convergence of wireless and wireline will force the different work groups to work together
- Supporting the needs of the traditional CO and supporting the needs of low latency data applications requires different mindsets, equipment and environments in the same facility
- Service providers need to support the “rip and replace” DC mindset while at the same time support evolving needs of the incoming OSP fiber cable infrastructure for a lifetime

How Data Centers and Central Offices Co-Exist in the Same Space

Today we will examine

- Why networks are converging and adding edge data centers
- The differences in the supporting infrastructures for DC space in a CO
  - Power
  - Fire suppression
  - HVAC
- The differences in fiber cabling infrastructure

Why networks are converging and adding edge data centers

Network convergence can be defined in many ways

Converged networks can range from shared physical assets to fully integrated software & hardware platforms and more

Physical

Spectrum

Technology

Convergence delivers a competitive advantage by improving efficiency, agility, scale, and time-to-market

Convergence: The Merging of Wireless & Wireline

Start from shared assets and work towards fully integrated systems

3 **Converged Applications**

Multi-Access Edge Computing

Network Slicing NFV CORD

- Network functions converge
- Common credentials & policies
- Containerization

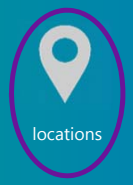
2 **Converged Networking Platforms**

NGPON2 SDN

C-RAN v-OLT v-BBU

- Common hardware for SDN/NFV
- Applications run on COTS
- Similar processes

1 **Converged Access Infrastructure**



- Densification of the wireless network & fixed broadband deployments
- Leverage existing footprint and locations for multi-use, multi-service delivery
- Plan and build wireless/wireline simultaneously

Efficiency, agility, scale, and time-to-market all improve when networks and systems are converged.

We live in a world of ***accelerating*** connectivity and data

«Walmart announced that to upgrade its ability to compete in e-commerce with Amazon. **It turns out that "under a second" was just too damned slow.»**

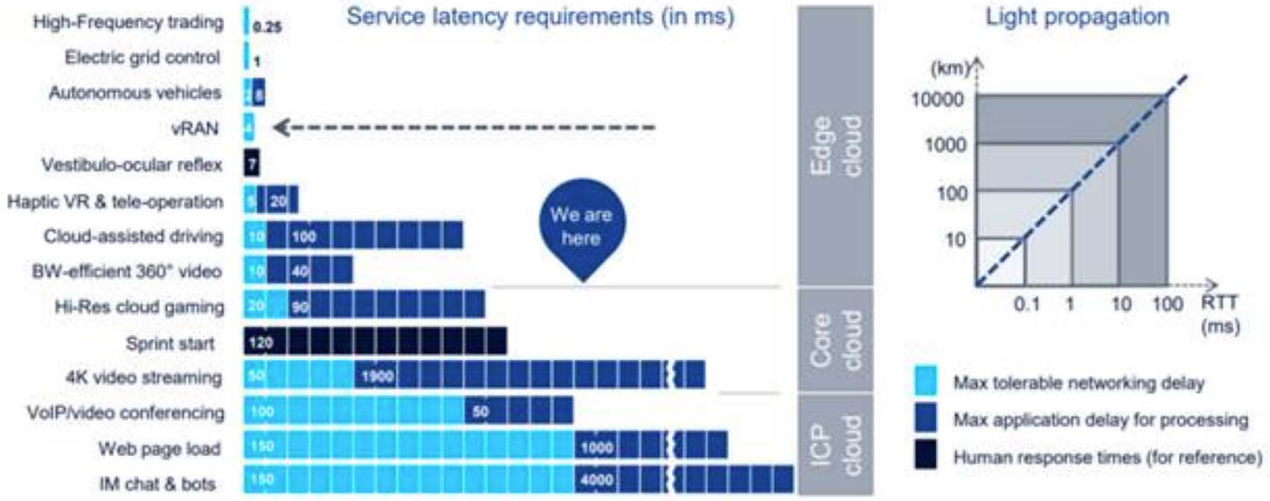
While Data volume drives growth,
Latency drives growth

@The Network Edge

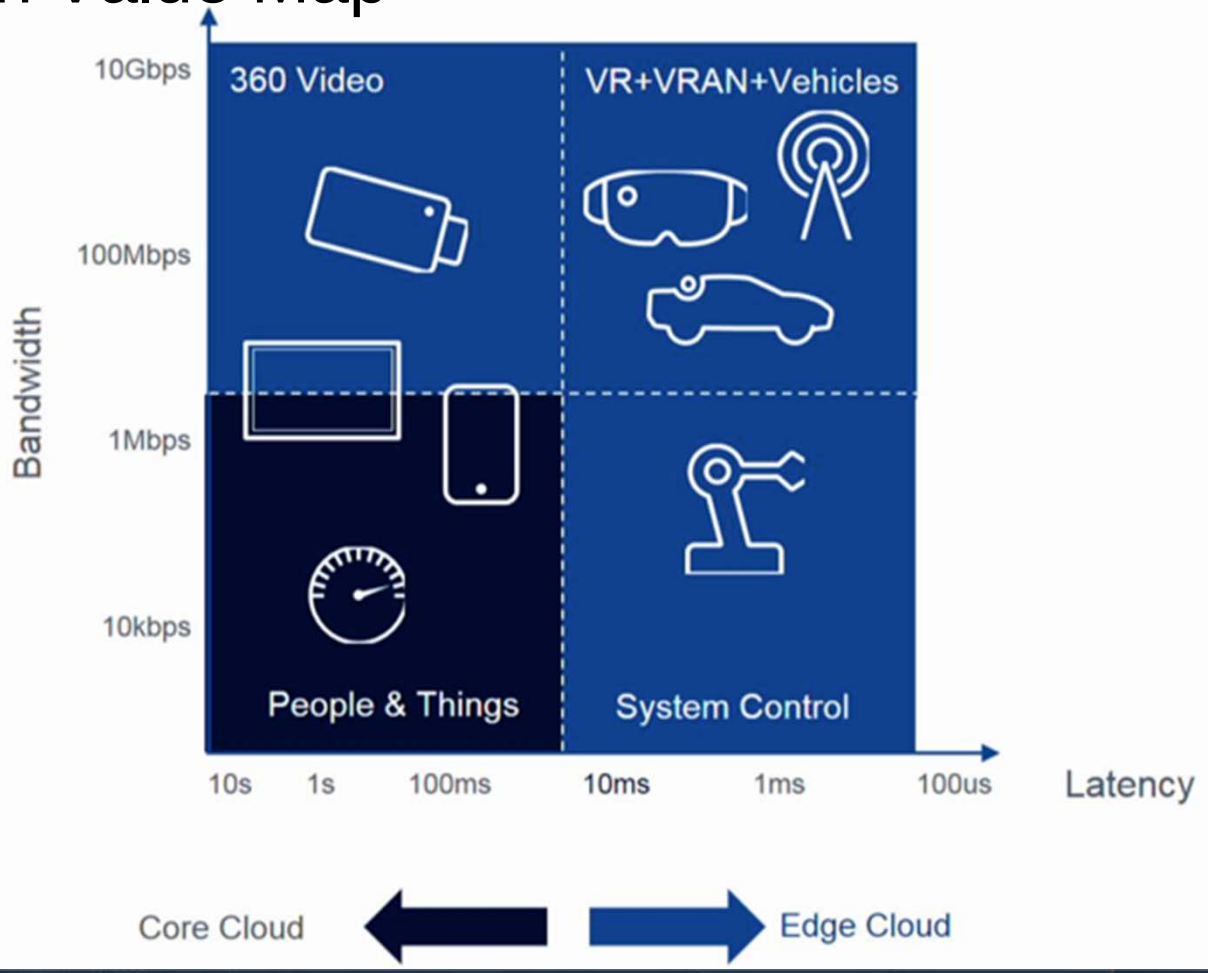
Nielson's Law: Bandwidth doubles every 21 months (~45% CAGR)

Comcast: Bandwidth doubles every 18 months (~60% CAGR)

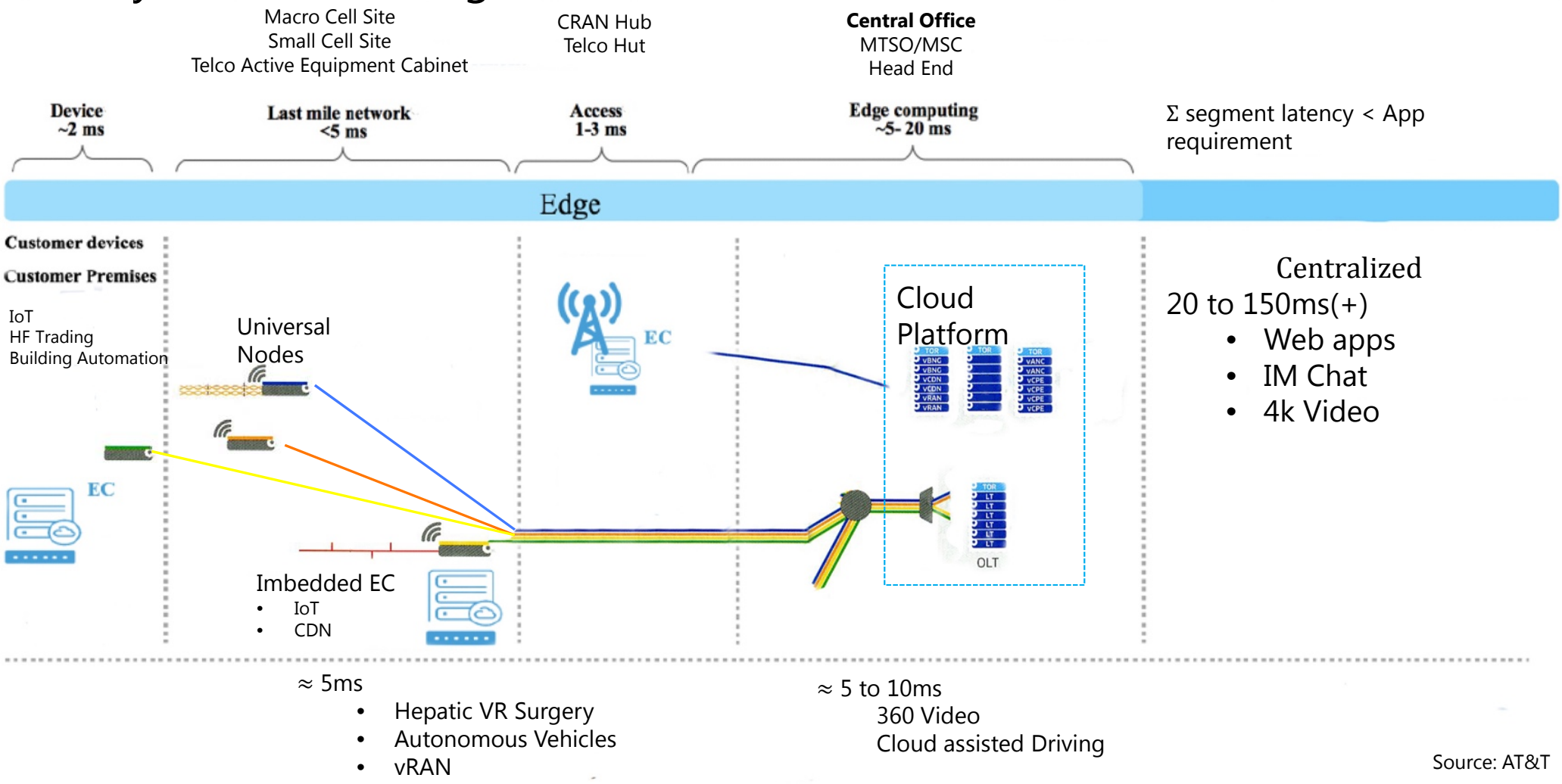
Latency matters … reducing time to save time



Latency & Bandwidth Value Map



Latency Defines the Edge Network Location



Source: AT&T

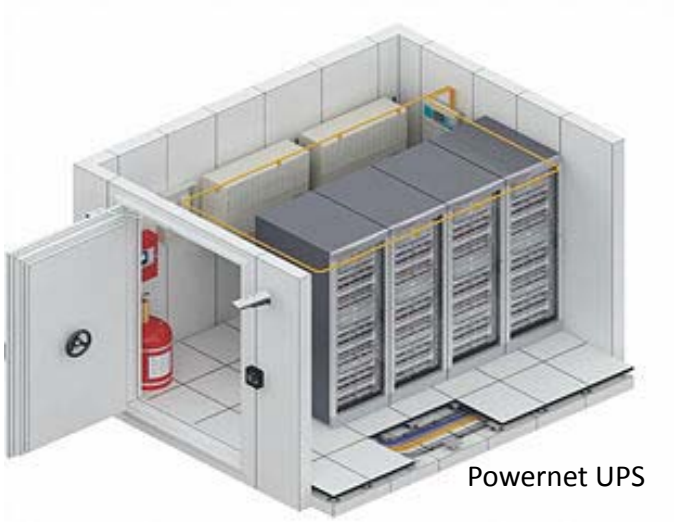
The differences in the supporting infrastructures for DC space in a CO

- Power
- Fire suppression
- HVAC

Three Key Differences Between CO's & DC's

Edge Data Centers are typically not large in scale

- Small – 1 to 8 cabinets 6kw-8kw per cabinet
- Medium – 4 to 12 cabinets 8kw-12kw per cabinet
- Large – 12 to 49 cabinets 12kw-14kw per cabinet



Powernet UPS

1. Electrical Code/Power
   - National Electrical Code exclusion for CO's
   - CO: DC & battery plant DC: AC & UPS
2. Fire Protection
   - Exclusion for automatic fire sprinkler system for telecommunications NEBS compliant CO space
3. HVAC
   - Typically DC equipment has a higher heat dissipation than telco equipment requiring additional cooling
   - Fire suppressed areas must be isolated in case of fire suppression discharge

Deployment Options for DC Space at a CO

- Self-Contained Pod/Container inside or outside a CO
  - Cabinet-based structures that address the challenges of power, fire suppression and cooling

APC® by Schneider Electric EcoAisle

VertivTM SmartMod

Deployment Options for DC Space at a CO

- CO revitalized space carve out
  - Building of a “Data Center” room within a CO separated by at least a 1 hour firewall
  - DC space provides separate power, fire suppression and cooling

Deployment Options for DC Space at a CO

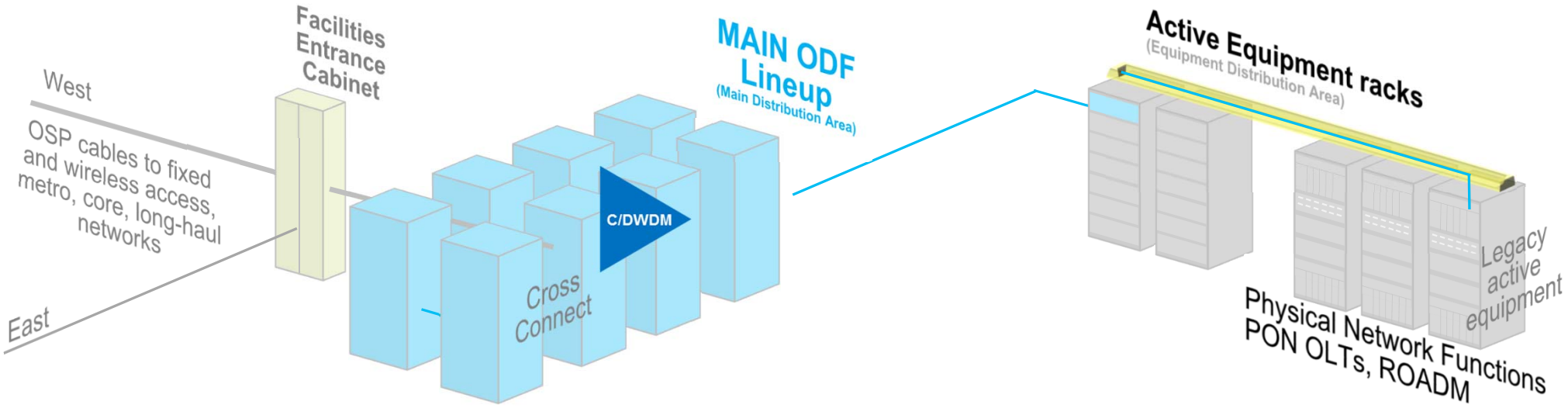
- NEBS compliant CO revitalized space
  - Utilization of servers, switches, routers and such that meet at least NEBS Level 1 (-48 vDC powered) that can be deployed in a traditional CO space, but may require augmented cooling

Radisys DCEngine™ 42U System

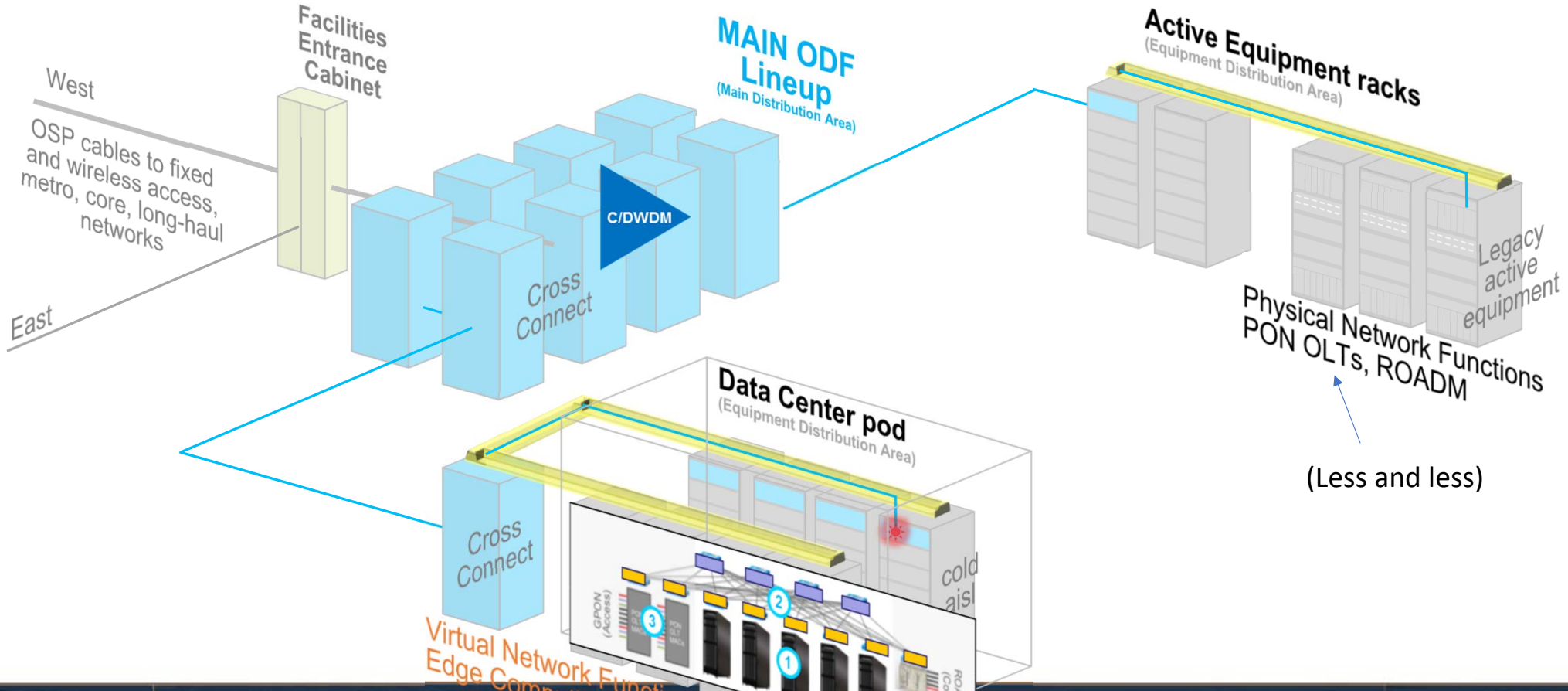
Deployment Options for DC Space at a CO Matrix

	Self Contained Pod or Container	CO Revitalized Space Carve Out	NEBS Compliant CO Revitalized
Electrical Power	Inside CO: AC or DC Outside CO: AC to container from CO	UPS Inverter if <100kw	-48 vDC
Fire Protection	Required for non-NEBS equipment	1 hour firewall from CO, plus fire suppression	Not required with NEBS compliant equipment
HVAC	Required for non-NEBS equipment	Required for equipment & isolation for fire suppression discharge	Based on heat dissipation of equipment, existing cooling may need to be augmented

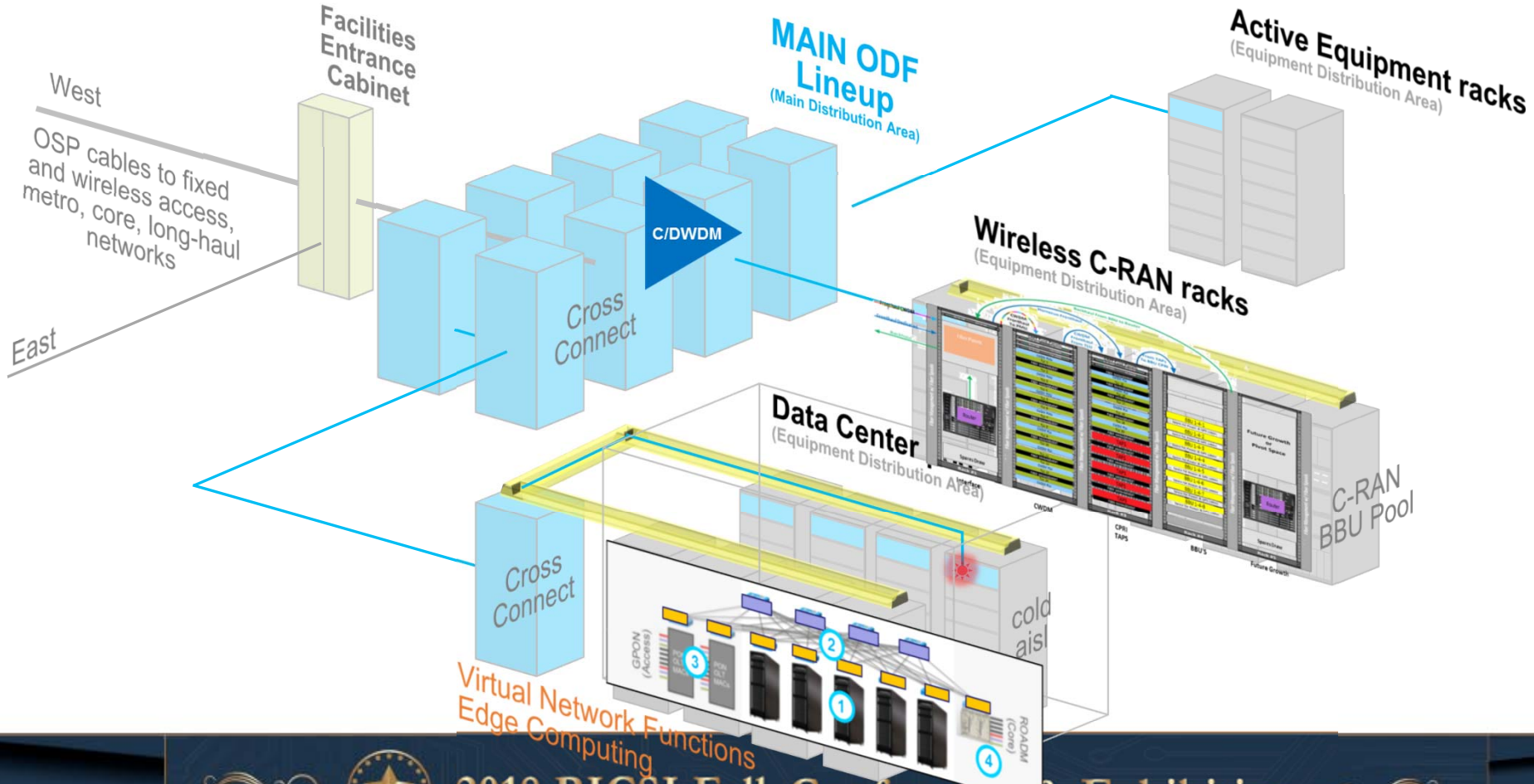
Central Office Evolution Part 1



Central Office Evolution Part 2



Central Office Evolution Part 3



The differences in fiber cabling infrastructure

DC Cabling Considerations

- CO's expertise in singlemode fiber management and connectivity: SC & LC, simplex & duplex
- DC space introduces multimode cabling and connectivity including duplex LC, MPO-8, MPO-12 & MPO-24

MPO-24

The most efficient connector/trunk combination providing lower per port deployment costs.
Highly flexible for multimode duplex and parallel applications
Greater site efficiency due to port fiber density, MPO port count on site, and pathway impact.

MPO-12

Familiar MPO connector and trunk cabling interface
Better density for multimode and singlemode duplex applications than MPO-8

MPO-8

Efficient for point to point QSFP trunk applications
Convenient for QSFP break-outs in specific applications
Lowest panel density of all MPO systems

DC Cabling Considerations

- Plan for flexibility
  - Use of multifiber push-on (MPO) connectors for fiber cables and patch cords makes it much easier and more cost-effective to change configurations when needed
  - Panels that include modules that easily enable changes from LC to MPO and back to LC all while utilizing the same backbone cable
- Plan for density
  - Operators should choose the highest-density fiber platforms and switching equipment to allow for future growth in connectivity for service delivery
- Plan for accessibility
  - Operators should use fiber panels and frames that maximize access to fiber connections

Typical 100GE in the DC

Core Switch/Router to Spine Switch

Deployed mostly 40GE LR4

Start to deploy 100GE CWDM4/LR4

Roadmap is 200GE/400GE FRx/LRx next

Spine Switch to Leaf Switch links

Deployed mostly 40GE SR4/LR4

Start to deploy 100GE CWDM4/PSM4/eSR4/SWDM4

Roadmap is 200GE/400GE FR4/DR4/SRx next

Leaf Switch to TOR Switch links

Deployed mostly 40GE SR4

Start to deploy 100GE SR4/SWDM4/AOC

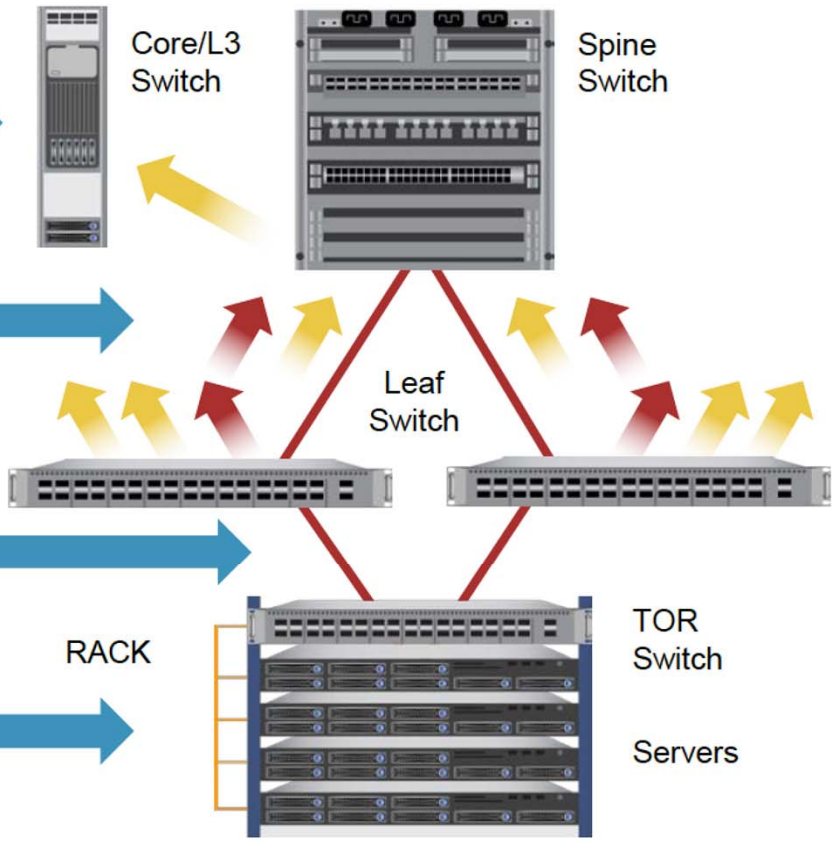
Roadmap is 200GE/400GE SR4/AOC next

TOR Switch to Server links

Deployed mostly 10GE SR/DAC

Start to deploy 25GE SR/AOC/DAC(3m)

Roadmap is 50GE/100GE SR/AOC next



IEEE Optical Applications up to 400G

Rate	PMD	Media	Reach	#Fibers	Wlengths	Lane rate	IEEE Project
25G	SR	1-pair MM	100 m	2	1	25G	802.3by (2016)
40G	SR4	4-pair MM	150 m	8	1	10G	802.3ba (2010)
	FR	1-pair SM	2 km	2	1	40G	802.3bg (2011)
	LR4	1-pair SM	10 km	2	4	10G	802.3ba (2010)
	ER4	1-pair SM	40 km	2	4	10G	802.3bm (2015)
50G	*SR*	1-pair MM	100 m	2	1	50G	802.3cd (2018)
	FR	1-pair SM	2 km	2	1	50G	802.3cd (2018)
	LR	1-pair SM	10 km	2	1	50G	802.3cd (2018)
100G	*SR2*	2-pair MM	100 m	4	1	50G	802.3cd (2018)
	SR4	4-pair MM	100 m	8	1	25G	802.3bm (2015)
	SR10	10-pair MM	150 m	20	1	10G	802.3ba (2010)
	DR	1-pair SM	500 m	2	1	100G	802.3cd (2018)
	LR4	1-pair SM	10 km	2	4	25G	802.3ba (2010)
	ER4	1-pair SM	40 km	2	4	25G	802.3ba (2010)
200G	*SR1.4*	1-pair MM	100 m	*2*	*4*	*50G*	*MSA?*
	SR4	4-pair MM	100 m	8	1	50G	802.3cd (2018)
	DR4	4-pair SM	500 m	8	1	50G	802.3bs (2017)
	FR4	1-pair SM	2 km	2	4	50G	802.3bs (2017)
	LR4	1-pair SM	10 km	2	4	50G	802.3bs (2017)
400G	*SR4.2*	4-pair MMF	100 m	*8*	*2*	*50G*	*NGMMF SG (Mar '18)*
	SR8	8-pair MMF	100 m	*16*	*1*	*50G*	*NGMMF SG (Mar '18)*
	SR16	16-pair MM	100 m	32	1	25G	802.3bs (2017)
	DR4	4-pair SM	500 m	8	1	100G	802.3bs (2017)
	FR8	1-pair SM	2 km	2	8	50G	802.3bs (2017)
	LR8	1-pair SM	10 km	2	8	50G	802.3bs (2017)

Multimode

Singlemode

Duplex

Parallel

Multi-wavelength

Summary

Today we examined

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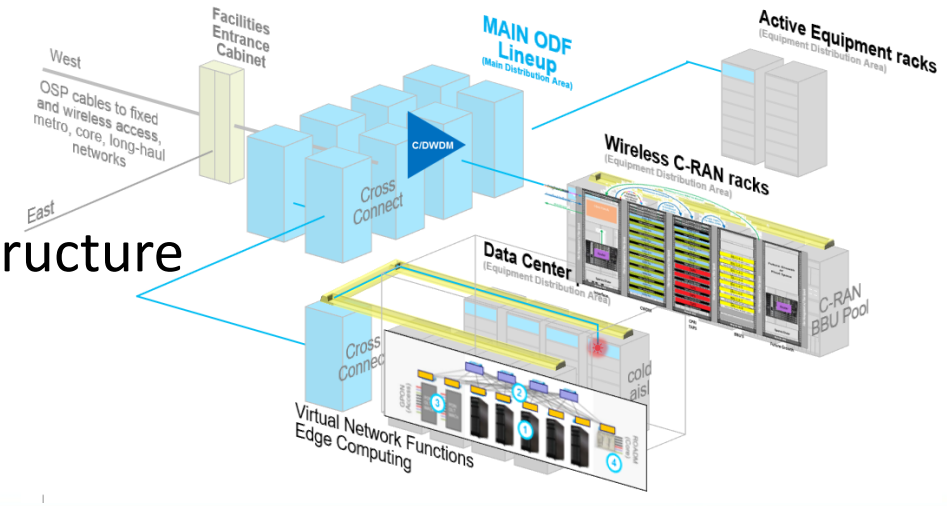

Questions

Thank You!

Craig Culwell
916-730-0533
Craig.Culwell@commscope.com