Hot Technology Trends and Telecommunications Cabling to Support Them

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- Primary contributor ISO/IEC TR 14763-2-1 telecom identifiers, ANSI/TIA-606-B telecom administration, and editor ANSI/TIA-606-C revision

Hot Technology Trends

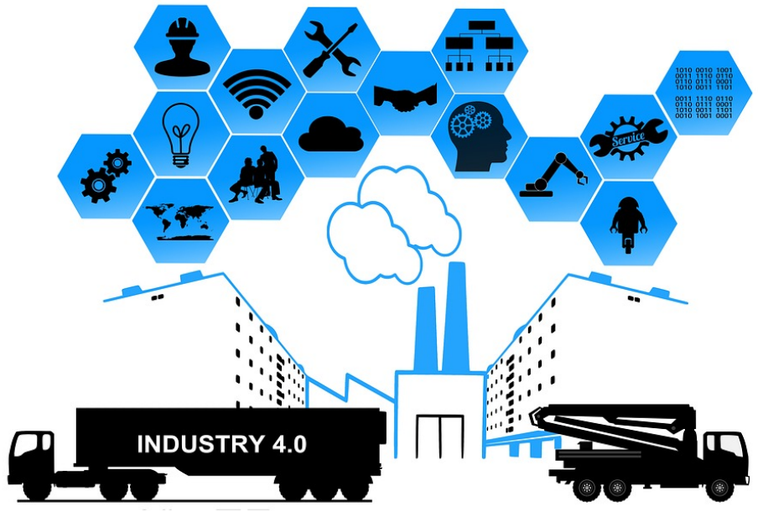
- Internet of Things (IoT)
- Smart Cities
- Artificial Intelligence (AI)
- Edge Data Centers
- Cloud Computing
- Big Data
- Blockchain

Internet of Things

- Network of devices other than standard ones (desktop, laptops, phones, tablets) that use Internet Protocols communicate
- Can include appliances, vehicles, or other devices
- The number of IoT devices is ~12 billion and expected to be >20 billion by 2020

Internet of Things

- IoT devices individually typically don't generate large volumes of traffic (smart cameras and smart TV's are exceptions)
- Total amount of data created will be large because of the very large number of devices (>500 ZB or 5 x 10^{23} B by YE 2019)
- Some applications will be sensitive to latency (e.g., manufacturing control & autonomous vehicles)



Internet of Things

- IoT enables new types of applications
- Consumer applications
  - Virtual assistants (e.g., Alexa & Echo, Google Home)
  - Lighting, HVAC, smart entertainment systems, security systems, smart refrigerators
  - Assistants and health monitors for seniors & disabled
  - Self-driving vehicles (by 2040, 95% of new vehicles will have self-driving capabilities)

IoT Commercial Applications

- Remote monitoring and emergency notification systems using room sensors, smart beds, wearables, & implants
- Smart buildings – HVAC, lighting, security
- Manufacturing – sensors and RFID tags for automated monitoring and management of manufacturing equipment, monitoring and management of production and inventories

Smart Cities

- Use of information and communications technologies to improve the quality of government services and the welfare of citizens

Image from www.jct600.co.uk

IoT for Smart Cities

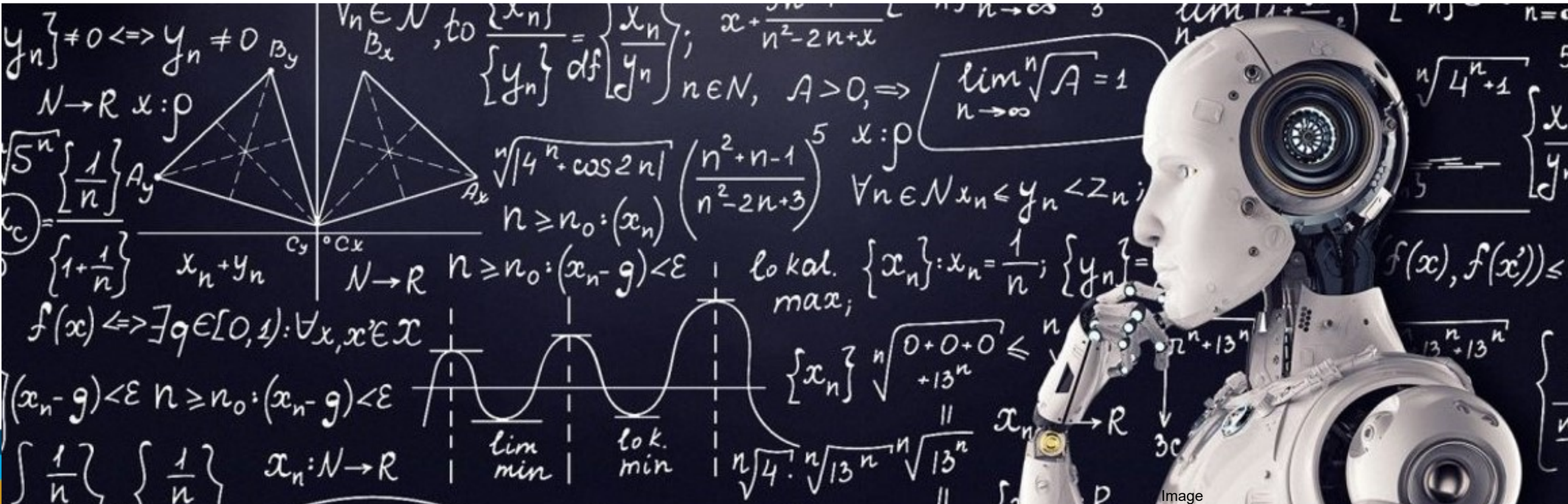
- Parking availability
- Public transportation – demand based transportation
- Road with smart tolls (RFID or license plate recognition)
- Smart watering of foliage in public spaces
- Traffic management - notification & optimizing street lights
- Security & crime prevention
- Smart trash cans & monitoring of cleanliness of public areas
- Smart energy meters
- Smart lighting

Other Smart City Applications

- Municipal broadband (Wi-Fi, WiMax, fiber)
- Web & mobile app access to city services & info
- Smart card for payment for transportation

Artificial Intelligence

- AI used by IoT devices to perform functions
- AI can be used to improve the efficiency and operation of networks, buildings, and data centers



Image

Edge Data Centers

- Deployed at the edge of a network closer to sources of data to reduce latency and traffic to central data centers
- Wide variety of locations (e.g., colos, closet of office buildings, gas stations, outdoor enclosures, base of cell towers, utility poles)
- TIA Edge Data Center Position Paper published;
- Addendum to TIA-942-B for Edge Data Centers in progress

Cloud Computing

- Delivery of computing services over the network
- Many different service models, but all models still require servers and storage located in a service provider or enterprise data center
- Requires flexible and high speed data & storage networks

Big Data

- Very large volumes of data , both structured and unstructured, that is too large to process using standard database methods
- May include wide variety of IoT, consumer, and commercial data
- Allows businesses to answer more questions, more accurately and quickly – e.g., targeted ads or products to stock in stores

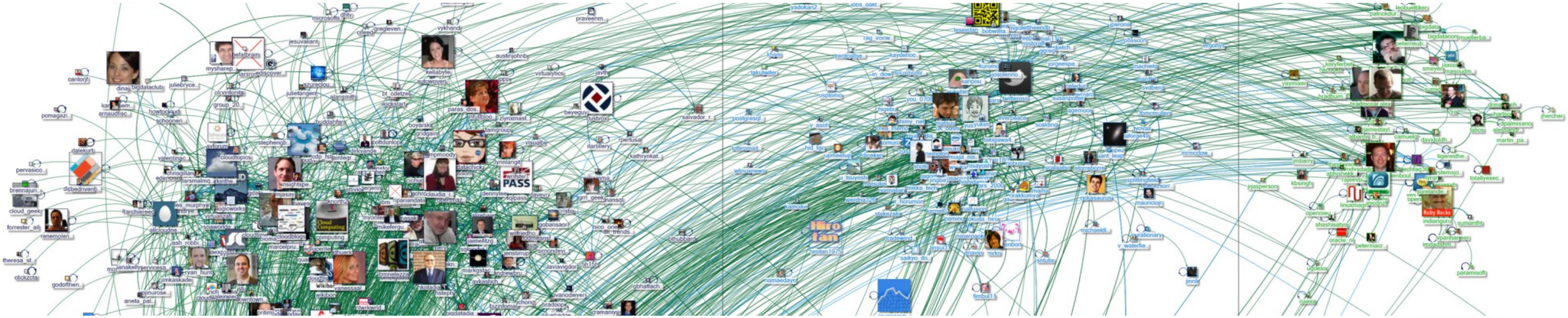
Blockchain

- Distributed records (blocks) that are linked using cryptography
- Eliminates central point of control, but throughput is a concern as transactions are not validated until processed by 51% of the nodes
- Used for digital currencies; can be used for distributed bank ledgers, property records, and contract records
- Future is uncertain

TELECOMMUNICATIONS CABLING TO SUPPORT HOT TECHNOLOGIES

At The Edge

- IoT, Smart Cities, and distributed Artificial Intelligence need new communications technologies at the network edge to support large quantities of devices, large traffic volumes, and need for low latency



Wireless at the Edge

- 5G mobile networks
  - being deployed this year by carriers
  - major enabler of IoT
  - Lower latency and higher bandwidth than LTE (1-20 Gbps)
  - Much higher density of antennas to support high speeds for users and high device density for IoT

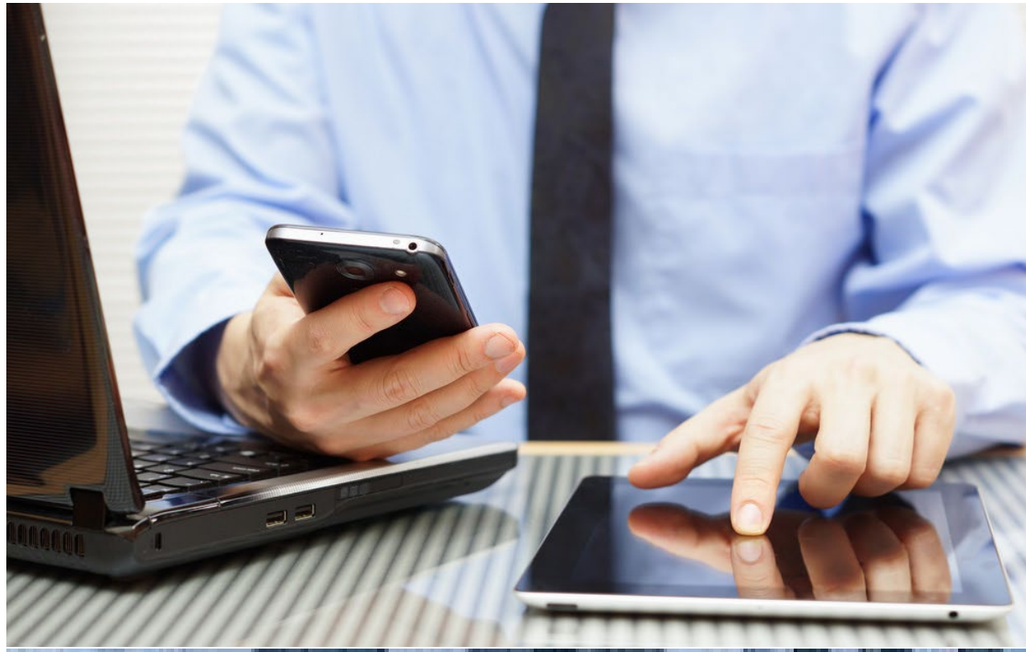
- Wi-Fi 6 (IEEE 802.11ax)
  - to be approved this year
  - downward compatible with older Wi-Fi devices – Wi-Fi 5 (802.11ac), Wi-Fi 4 (802.11n), and older 802.11a/b/g.
  - Lower power modes and less latency to support IoT
  - Throughput >10 Gbps
  - Wi-Fi will help offload traffic from mobile networks

Cabling for 5G Antennas

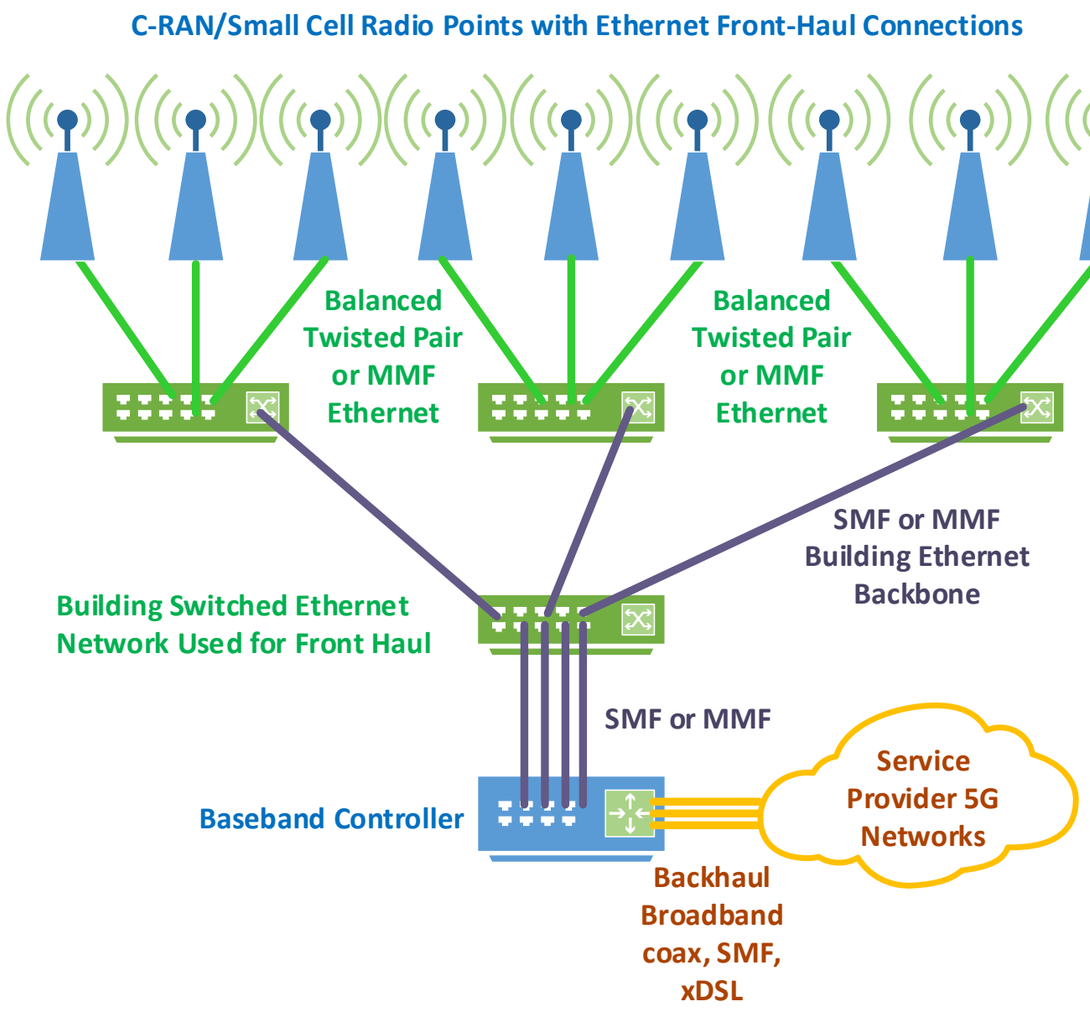
- Backhaul - cabling from the baseband unit (which processes user & control data) and the rest of the carrier network
- 5G outdoor antennas will use a wide variety of backhaul circuits with microwave and particularly single-mode fiber being most common
- Fronthaul – cabling from 5G baseband units to 5G antennas will also be predominantly single-mode optical fiber

Cabling for 5G Antennas

- 80% of mobile traffic is indoors
- Multiple solutions for 5G to support phones indoors
- Performance requirements for large buildings not met with DAS and outdoor antennas outside building
- Most promising solutions are standalone small cells and cloud radio access networks (C-RAN)



5G C-RAN Small Cells



- C-RAN and Small Cell deployments can use Ethernet network for front haul to small cell antennas in building
- C-RAN networks provides central management, better hand-off between cells, and allow 5G devices to be supported simultaneously by multiple antennas
- Most antennas will use balanced twisted pair but may use optical fiber depending on antenna (1G-20G) recommend 2 x Cat 6A, 7, or 7A

Cabling for Wi-Fi 6 Antennas

- 5G will not replace Wi-Fi networks
- Wi-Fi will help offload mobile networks as they do today and support a wide variety of in-building traffic including IoT
- Cabling for Wi-Fi 6 / 802.11ax access points should be two Cat 6A, 7, or 7A to provide power and adequate bandwidth

BICSI MIDDLE EAST & AFRICA

Wired Communications at the Edge

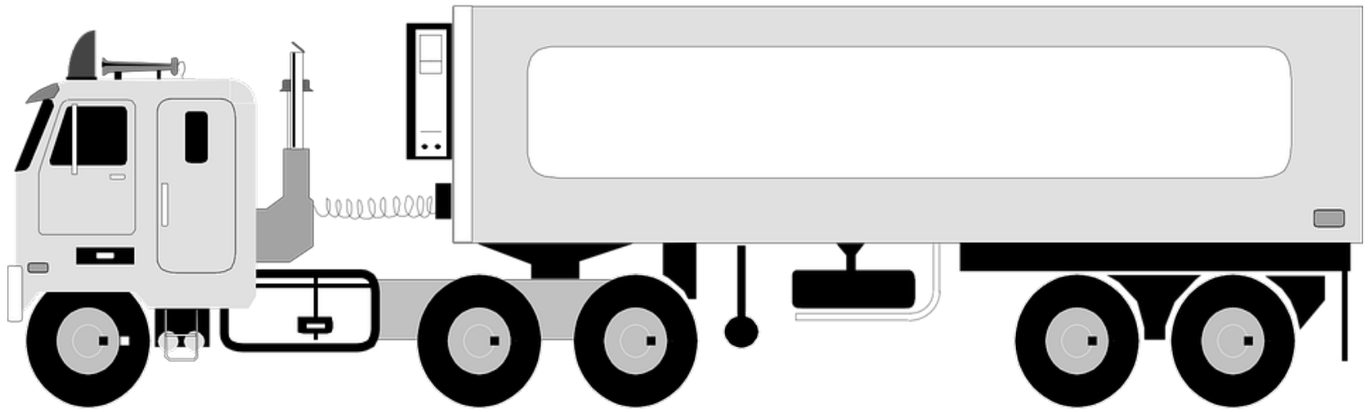
- Balanced twisted pair expected to be popular due to low cost and ability to support remote powering

Existing Single-Pair Ethernet Standards

- 100Base-T1 (IEEE 802.3bw) 15 m 100Mbps Ethernet for vehicles
- 1000Base-T1 Type A (IEEE 802.3bp) 15 m 1Gbps Ethernet for vehicles
- 1000Base-T1 Type B (IEEE 802.3bp) 40 m 1Gbps Ethernet for vehicles and industrial
- Support up to 4 in-line connectors + mating connectors at ends

Single-Pair Multi-Gig Automotive

- IEEE 802.3ch Multiple Gigabit Automotive Ethernet target May 2020
- 2.5 Gbps Ethernet for at least 15 meters
- 5 Gbps Ethernet for at least 15 meters
- 10 Gbps Ethernet for at least 15 meters
- All channels with 4-inline connectors and mating connectors at ends

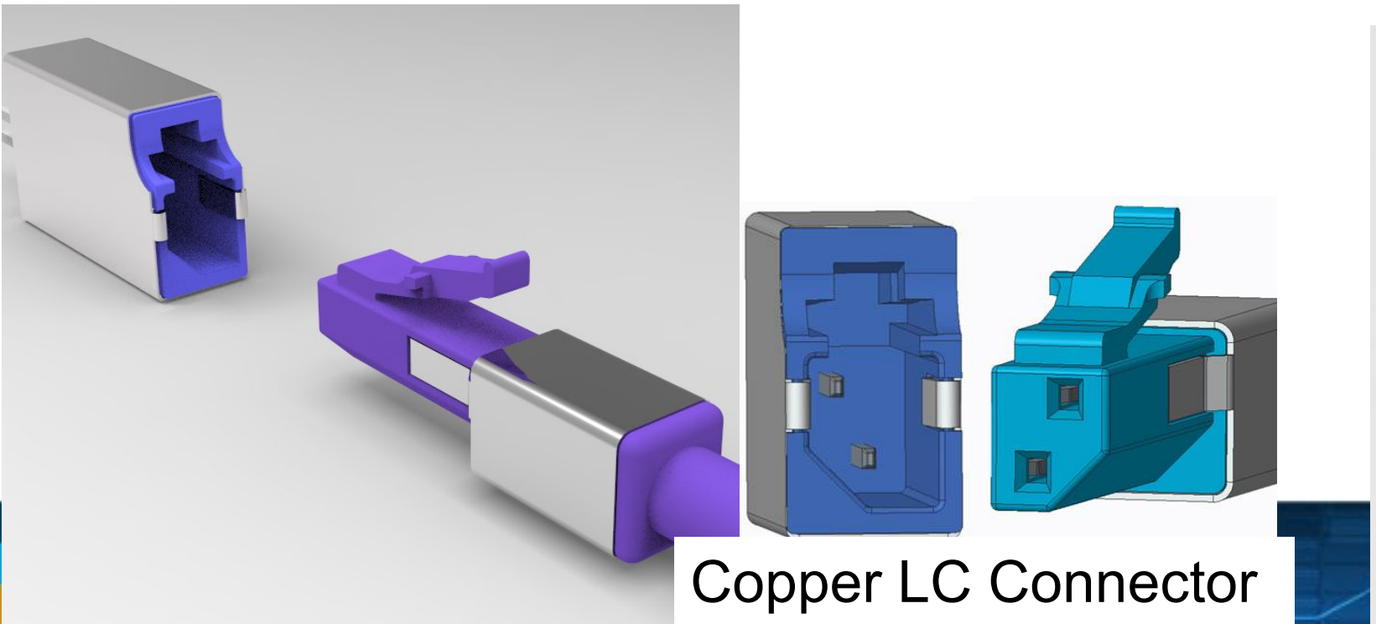


IEEE 802.3cg Single-Pair Ethernet

- 10 Mbps Ethernet with optional PoE over a single-pair
- 10Base-T1S – 15m link segment with up to 4 in-line connectors operating from 0.3-200MHz (automotive) – 22-24 AWG cable
- 10Base-T1L – 1,000m link segment with up to 10 in-line connectors operating from 0.1-20MHz (industrial & IoT) – 14-18 AWG cable
- 25m mixing segment with 8 or more nodes (multi-drop half-duplex)
- Sept 2019 target for approval

IEEE 802.3cg Single-Pair Ethernet (SPE)

- 10BASE-T1L will support optional Type E Power over Data Lines (PoDL) remote power provisioning. Four classes of Type E power sourcing equipment (PSE) will be specified to support up to a minimum of 13.6W over up to 1 km of single balanced pair point-to-point cabling
- Copper LC connector from CommScope for MICE1 environments
- Industrial style connecter from Harting for MICE2 & 3



Copper LC Connector

Industrial SPE Connector

Single-Pair Ethernet Cabling Standards

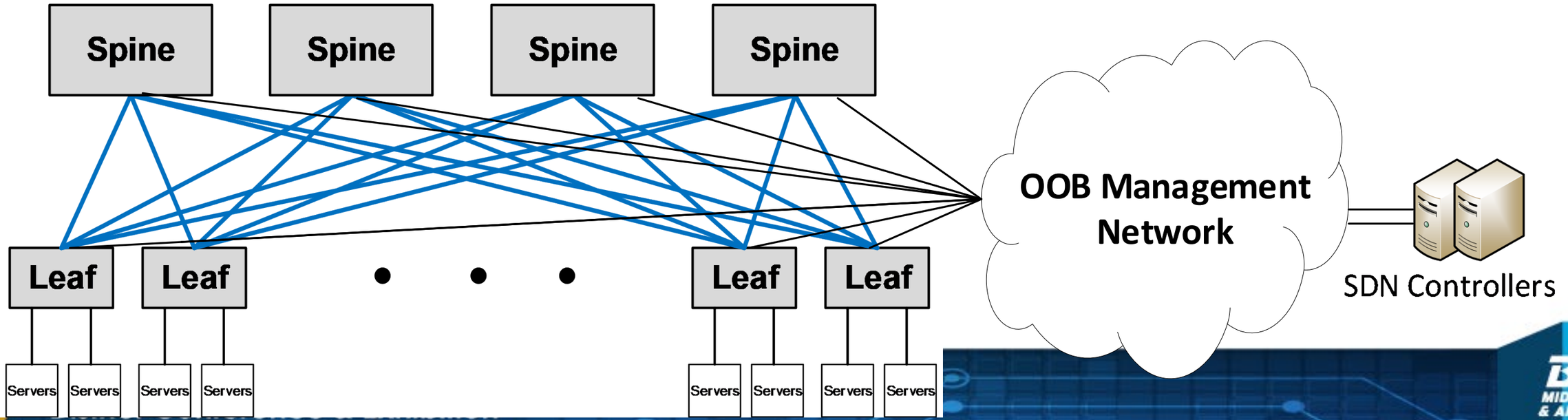
- ISO/IEC TR 11801-9906 Balanced 1-Pair Cabling Channels Up to 600 MHz (non-industrial)
- ISO/IEC 11801-3 Amendment 1 (industrial 1-pair)
- ANSI/TIA-568.5 Single Balanced Twisted-Pair Telecommunications Cabling and Components (non-industrial)
- TIA will probably adapt ISO/IEC 11801-3 Amendment 1
- Future amendments to all ISO/IEC and TIA premises standards to incorporate single-pair to support specific use cases but not replace 4-pair to workstations

In the Data Centers

- Cloud Computing requires low latency and high bandwidth data and storage networks that can be reconfigured to meet varying needs – typically spine & leaf topologies
- IoT, Smart Cities, Big Data require large, low latency storage networks to store large volumes of data and provide the data to servers that process this data
- Blockchain is more processing than data and traffic intensive

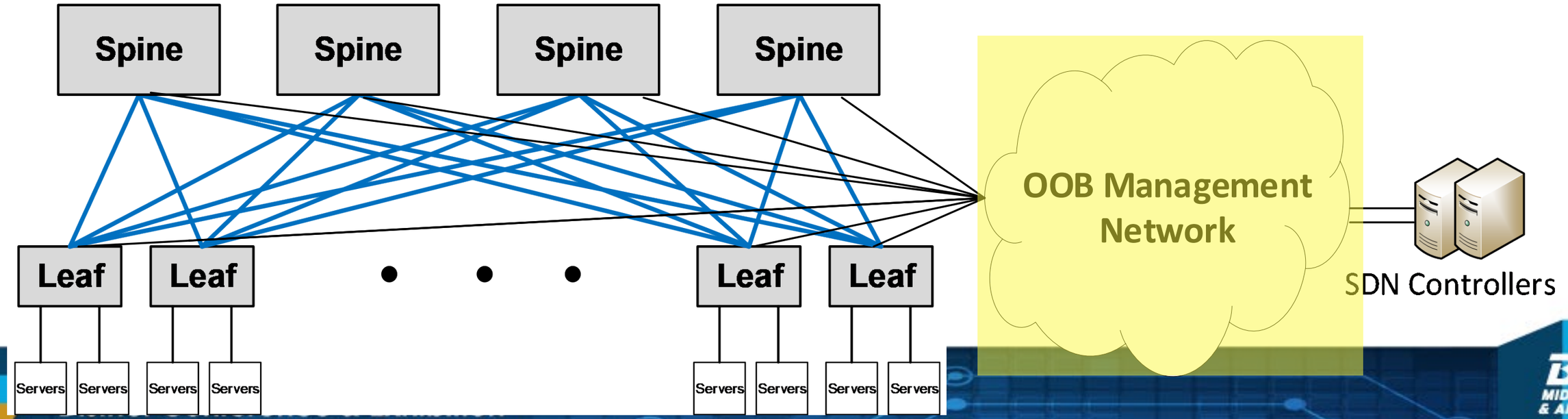
Faster Flexible Networks

- Spine Leaf Switch configuration reduces latency and allows all ports to operate at line speed (non-blocking)
- Software Defined Networks (SDNs) separate network control the forwarding hardware to provide more centralized control and allow network to be reconfigured dynamically (e.g., for cloud computing)



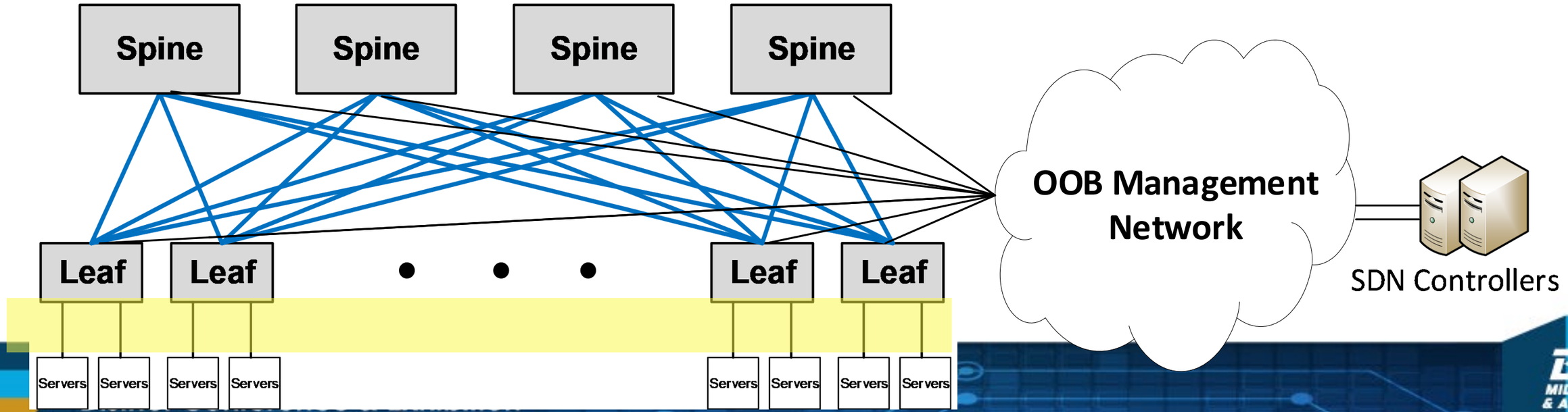
Management Cabling Mostly 1G

- Management Network connections mostly balanced twisted pair 1G Ethernet with optical fiber between management switches (Category 6, 6A, 7, 7A)
- Some standards such as ISO/IEC 11801-5 & CENELEC EN 50173-5 specify Cat 6A minimum except cabling to external network interface



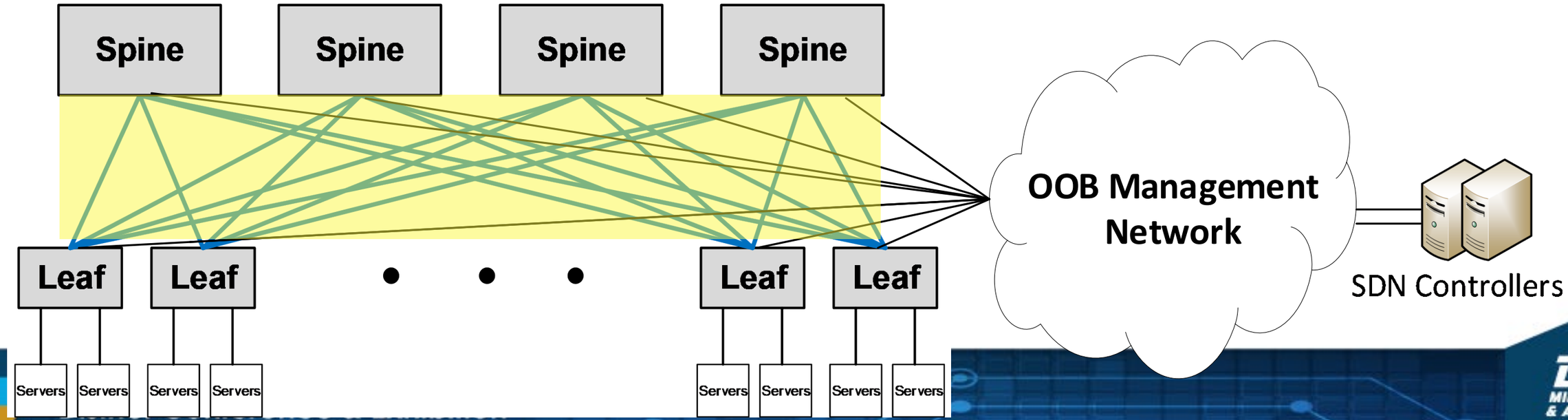
Leaf Switch Cabling Mostly 10G-50G

- Direct Attach Cable (DAC) twinax or Advanced Optical Cable (AOC) to ToR switch – recommended within a cabinet or to adjacent cabinet
- Balanced twisted pair 10G – Cat 6A or higher (100m)
- Balanced twisted pair 40G – Cat 8 (30m)
- 1-pair multimode fiber (MMF) 10, 25, 40G (BiDi), 50, 100G (BiDi) – 100m



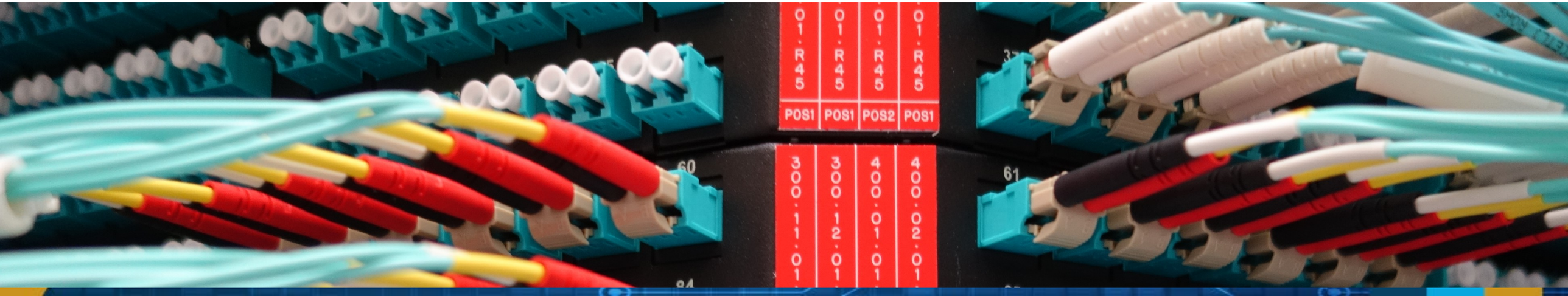
Spine Switch Cabling 40G+

- Direct Attach Cable (DAC, 15m) or Advanced Optical Cable (AOC, 100m) within a distributor (main, intermediate, zone/horizontal) within a row
- 1-pair MMF (duplex LC, 100m) 40G (BiDi), 50G, 100G (BiDi)
- 4-pair MMF (MPO, 100m OM4, 150m OM5) 40G, 100G, 200G, 400G (Dec19)
- 1-pair single-mode fiber (SMF, 2km) – up to 400G for large data centers



Other Considerations

- High densities needed in data centers where space is a premium and there are many connections, though in many data centers power rather than space limits capacity
- High density panels still need to meet labeling requirements (e.g., TIA-606-C, ISO/IEC 1476-3) for proper management & troubleshooting
- Automated Infrastructure Management (AIM) for the physical cabling infrastructure can aid in automated building & data center management



Questions?

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