

#ONFConnect 2019 Presentation

The Impact of Open Source on Communication Service Provider Capital Spending

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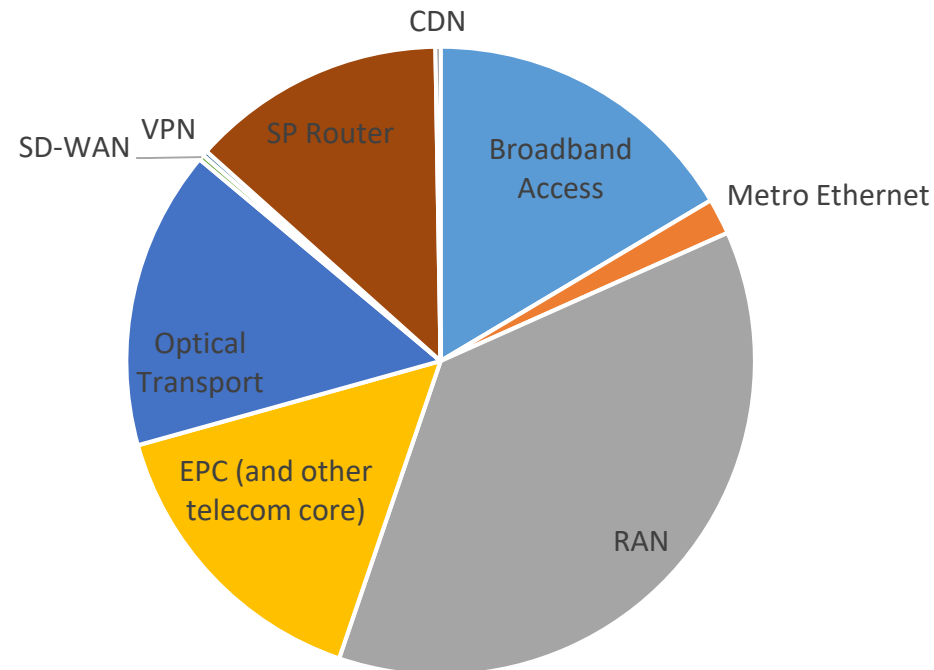
Addressable Market: What is CORD-related

- CORD = Central Office Re-architected as a Datacenter
 - Leverages SDN, NFV and Cloud
 - Integrates multiple open source projects to build agile datacenters for the network edge
 - The open source projects impact:
 - Broadband Access
 - Metro Ethernet
 - RAN
 - EPC (and other telecom core)
 - Optical Transport
 - SD-WAN
 - VPN
 - SP Router
 - CDN

Source: ONF, 2019

Addressable Market: CORD-related Equip/Software 5-Year TAM

5-Year Revenues = \$490B



**Excludes services, non-network systems*

- RAN is large, complex opportunity
- Broadband easier
- Operators move to open source on a project and technology basis over time
- Opex savings can be significant
- Service agility will be improved

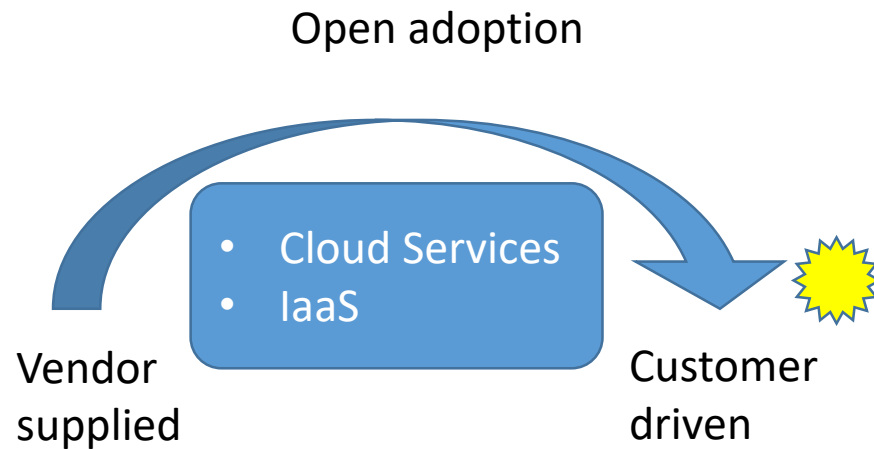
Addressable Market: Broadband and Core Are Easy Targets

Product	Gross Margin	% TAM
Broadband Access	30%	16%
Metro Ethernet	45%	2%
RAN	25%	37%
Telecom Core	60%	15%
Optical Transport	25%	15%
<u>SP Router/SD-WAN/VPN/CDN</u>	<u>60%</u>	<u>15%</u>
Summary	35%	100%

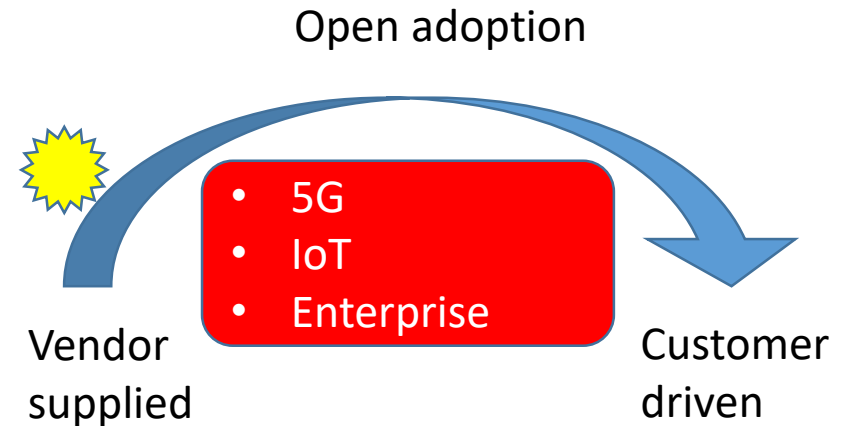
- Broadband and Core are large and have abundant merchant technology sources*
- Homogeneous networks save \$\$\$
- In the cloud market, there was a 50% savings from merchant silicon

**non-systems suppliers of DSPs, radios, processors, optics, etc.*

Adoption Trends: CSPs Can Leverage Hyperscaler Experience

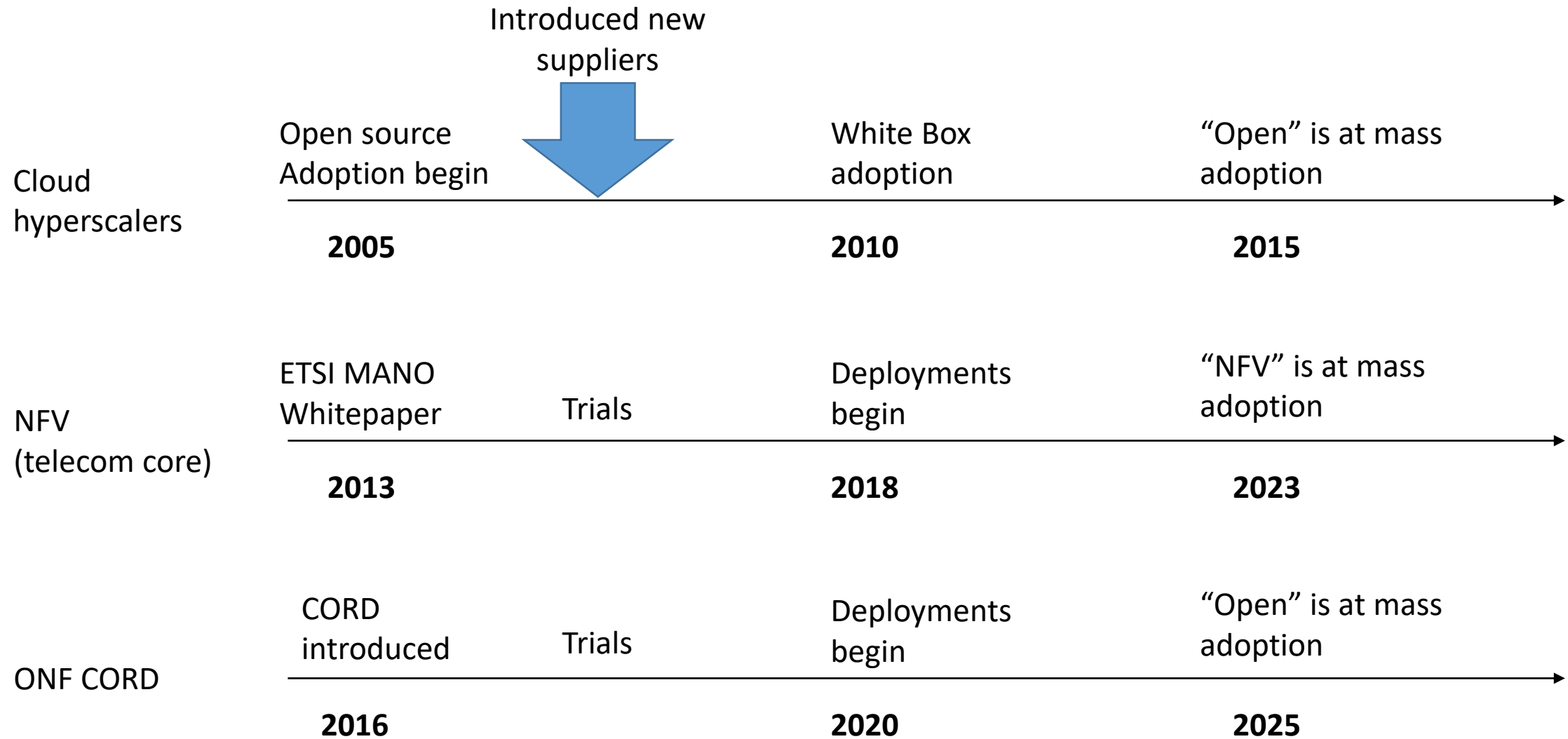


- Hyperscalers made the transition
- Each has enough scale to make demands
- Common technology stack and 100's of locations

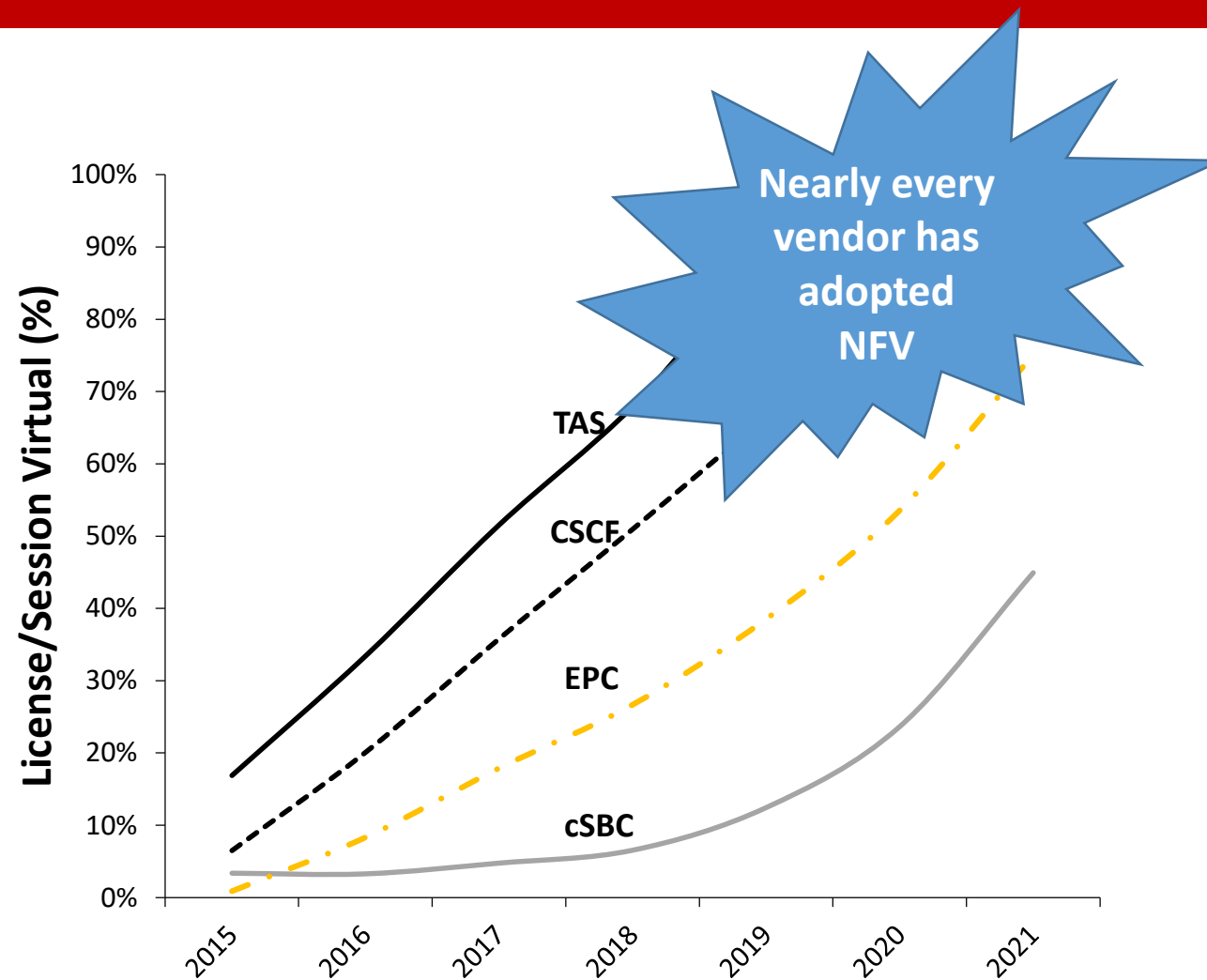


- CSPs are making the transition
- Only together do CSPs have enough scale
- Billions of endpoints, 100's K's edge locations
- Trillions of services revenue
- Society is changing with 5G/IoT, improving lives

Adoption Trends: A 10 Year Journey...



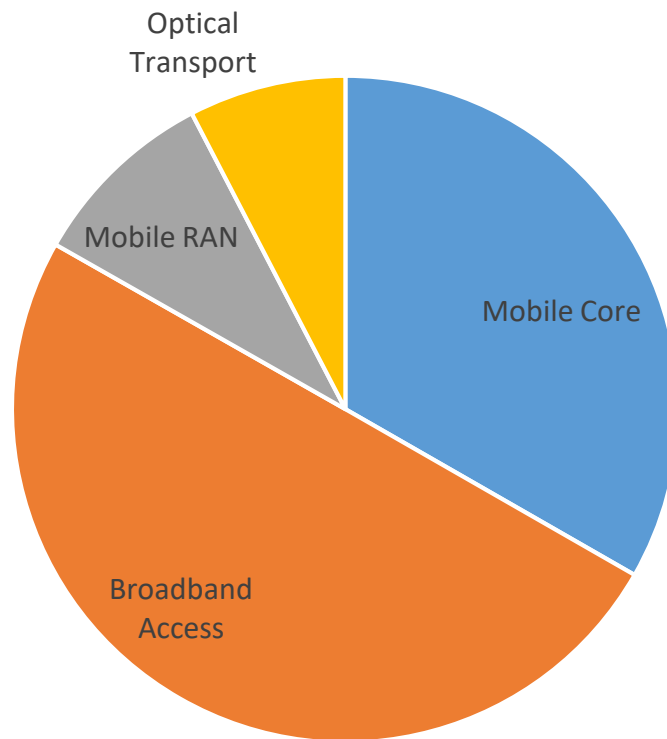
Adoption Trends: NFV License/Session Shipments



- Industry contributing open source for NICs, security, virtualization, orchestration
- Control plane moves quickly to software/server environment
- Open source is causing a rapid adoption of NFV

Adoption Trends: Survey Results

Top ranked Open Source project



% of capex budget focused on open source for top ranked project = **10-15%**

% of total capex budget focused on open source = **0-10%**

capex project growth focused on open source in edge/access in next 2 years = **15%**

Operators are confident that organization will mass-adopt open source deployments by 2023 = **85%**

**July/August 2019 survey of Tier 1 CSPs associated with ONF*

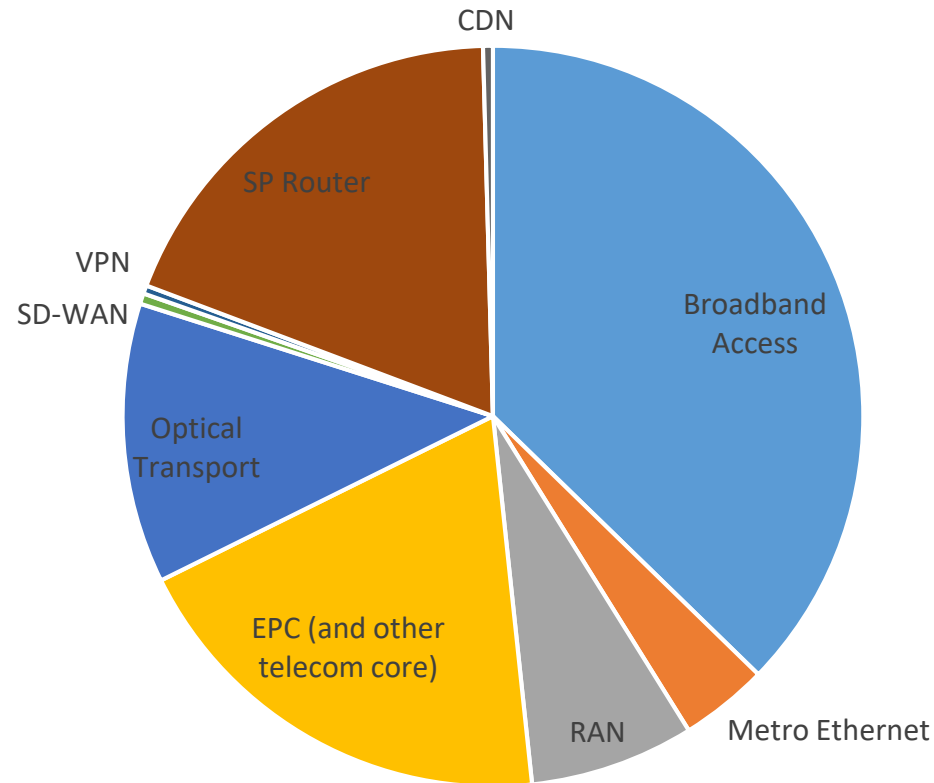
Addressable Market: What's Impacted by Open Source?

Product	In 2023 – Associated with Open Source
Broadband Access	62%
Metro Ethernet	60%
RAN	15%
Telecom Core	46%
Optical Transport	34%
<u>SP Router/SD-WAN/VPN/CDN</u>	<u>46-52%</u>
Summary	37%
Year 5 Revenues that are “open”	\$36B

- **2023...**
37% of vendor revenues to CSPs will be impacted by open source technologies

Addressable Market: In First 5 Years, \$73B Will be Impacted

5-Year total vendor revenues = \$73B



- First mover technologies like Broadband Access will be nearly completed in the journey to open source in five years
- Inflection point of growth in complex systems like RAN will occur a few years later

1. Open Source adoption in CSP networks depends on CSPs working together
2. CSPs have introduced new concepts to kickstart the Open Source movement
3. Incumbent vendors will resist and will co-opt these efforts
4. CSPs will experience capex savings... if the opportunity is big enough for new vendors to profit
5. 85% of CSPs are confident of move to open source in 5 years

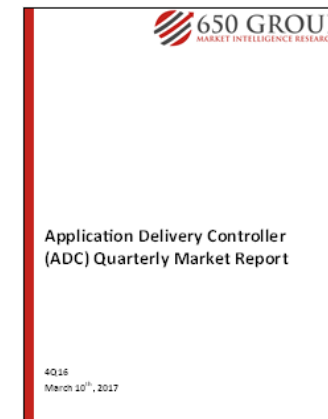
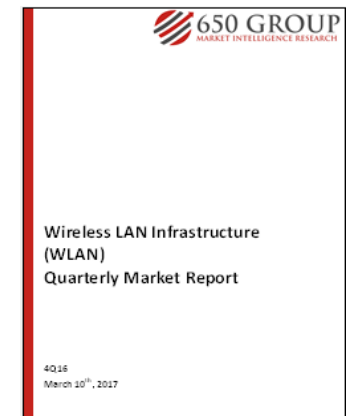
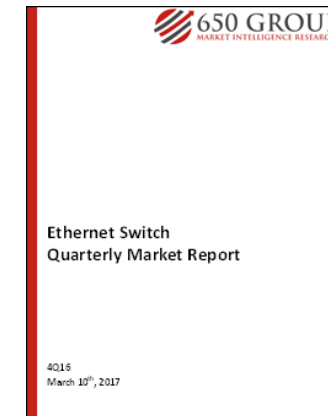
About 650 Group

We started 650 Group to provide our subscribers and customers with a unique perspective on the industries we research. Our team has decades of experience researching our focus industries and in roles at companies similar to the ones we cover. We research the data center, communications and Information Technology markets.

- Founded in 2017 by Chris DePuy and Alan Weckel
- Headquartered in Silicon Valley
- Trusted source of research for system vendors, component manufacturers, service providers, sell-side, buy-side, and standards bodies

What We Offer

- Subscription Services
- Quarterly market share reports
- Long-term market forecasts
- Comprehensive Trends report
 - 80 tables of data from cloud to telco to IT that sizes the market and identifies key vendors
- Weekly hot topics newsletter
- Market intelligence reports
- Custom projects:
 - Market sizing
 - Product positioning
 - Due diligence
- Webinars
- Expert witness services



2019 Program List

- Application Delivery Controller (ADC)
- **Broadband Access**
 - Fixed Wireless Access, Cable, Optical Access
- Cloud and Colocation Providers
 - Search/Social, Colo, IaaS/PaaS, SaaS, & CAPEX study
- **Data Center Interconnect (DCI)**
 - Ethernet DCI, Total DCI
- Ethernet Switching
 - Bundle
 - Total Market
 - Data Center, Enterprise, SMB, CE
- **IOT**
 - Installed Base, Connection Type
- Merchant Silicon in Data Center Switching
 - Switch Fabric ASICs
- **NFV**
- **Optical Networking**
 - Long Haul, Metro, DCI
- **Mobile RAN**
 - Baseband units, macro, small cell, 4G, 5G
 - CBRS
- **Routers**
- SD-Branch
- **SD-WAN (Enterprise and Service Provider)**
- Security
 - Appliance, Virtual, Enhanced NAC
- Servers
 - Smart NICs
- Storage
- **Telecom Core**
 - EPC/5GC, IMS, SBC, OSS, BSS & NFV (MANO)
- Unified Access
 - Cloud Services & Software
 - WLAN + Campus Switching & MultiGig
- WLAN
 - Enterprise, Outdoor, Consumer (incl Mesh)
- WLAN Semiconductors
 - Consumer networks, enterprise networks

Addressable Market: Our methodology

- Have been researching > 20 yrs
- Interview system vendors quarterly
- Interviewed Top CSPs from around the world
- Includes feedback from traditional equipment companies, startups, operators and open source community

Source: ONF, 2019