

Open Compute Project - Market Impact Assessment

Interim Deliverable (Database update with 4Q17 – 3Q18 actuals)

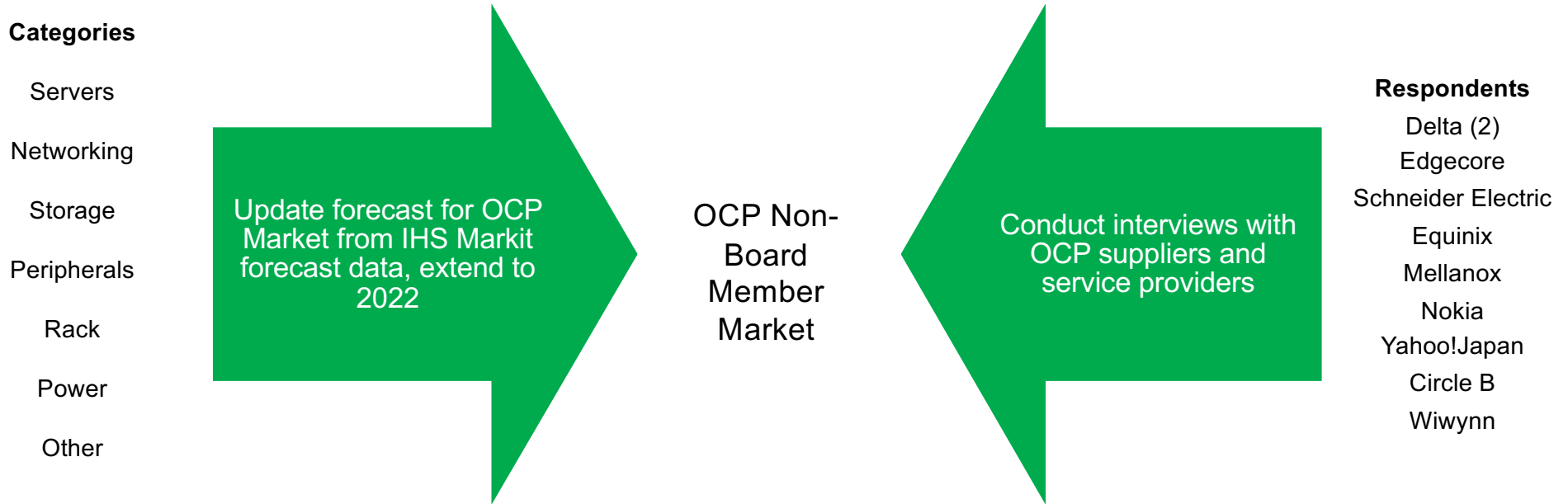
January, 2019

Cloud and Data Center Research Practice



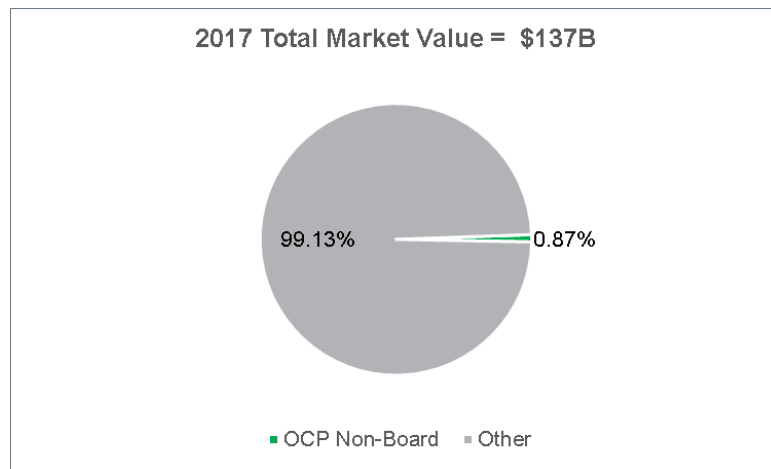
Background

The **Open Compute Project (OCP)** commissioned **IHS Markit** to update its 2018 study on the impact the Open Compute Project Foundation community has had and will continue to have on the technology industry and its member organizations:



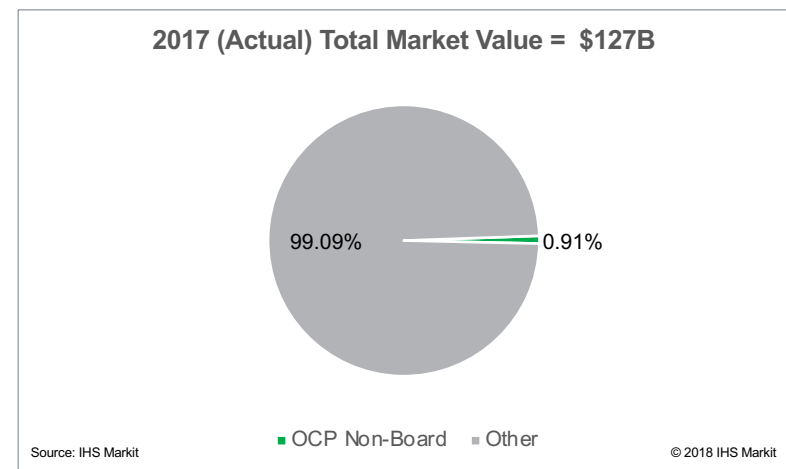
2017 Non-Board OCP revenue actuals shows increased market share

Total market includes: Server, Storage, Network, Rack, Power, Peripheral, and Other Revenue



Projected

- 2017 OCP Non-Board YoY growth 103%
- 2017 OCP Non-Board revenue: \$1.18B

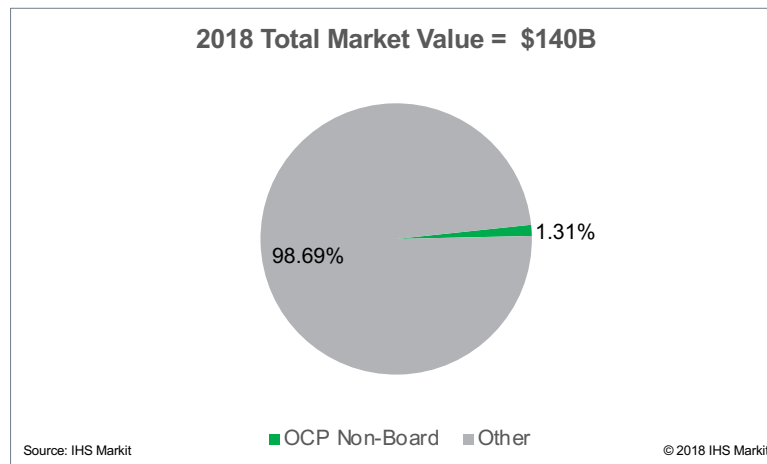


Actual

- 2017 OCP Non-Board YoY growth 99%
- 2017 OCP Non-Board revenue: \$1.16B

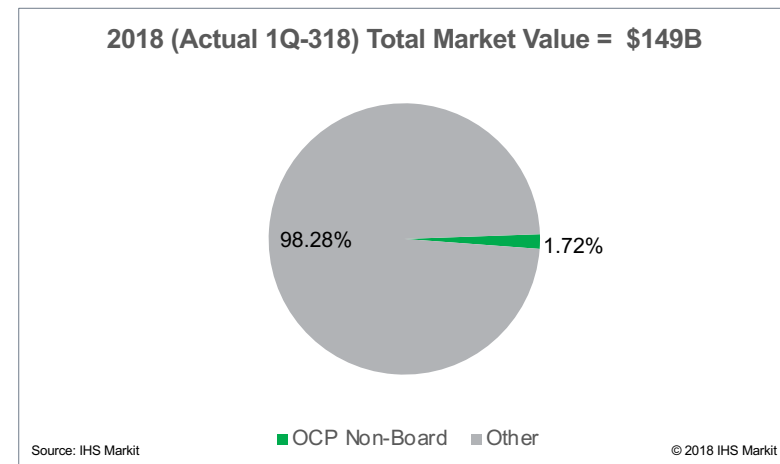
2018 Non-Board OCP revenue tops 2017 forecast, hits \$2.56B for 2018

Total market includes: Server, Storage, Network, Rack, Power, Peripheral, and Other Revenue



Projected

- 2018 OCP Non-Board YoY growth 55%
- 2018 OCP Non-Board revenue: \$1.84B

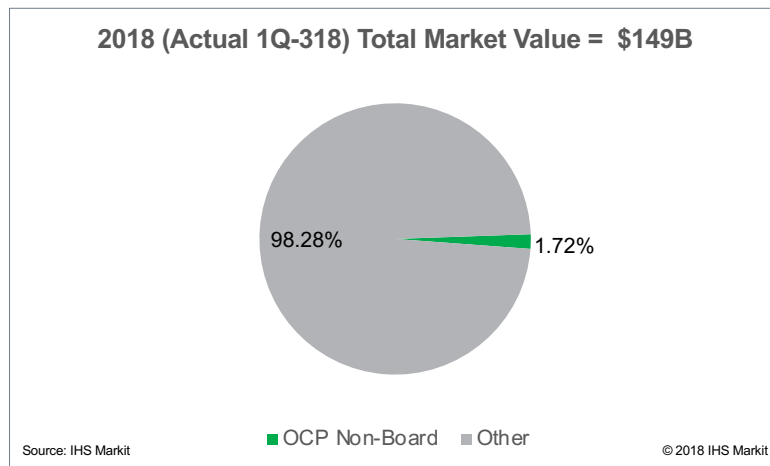


Actual (1Q-3Q18)

- 2018 OCP Non-Board YoY growth 120%
- 2018 OCP Non-Board revenue: \$2.56B

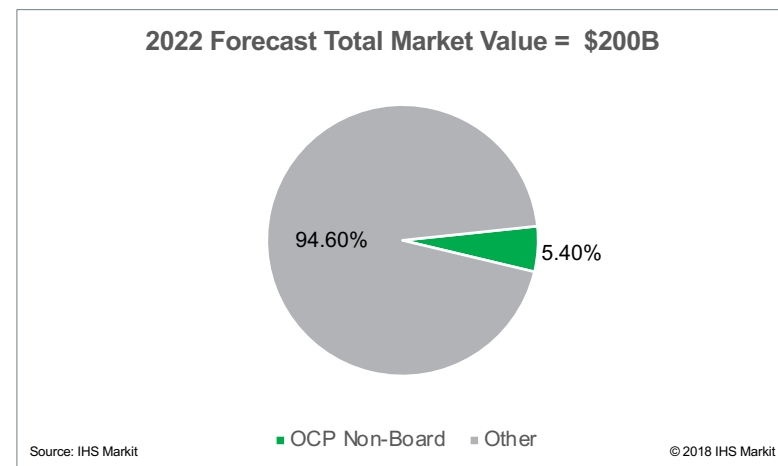
2022 Non-Board OCP revenue share over 5% by 2022

Total market includes: Server, Storage, Network, Rack, Power, Peripheral, and Other Revenue



Actual (1Q-3Q18)

- 2018 OCP Non-Board YoY growth 120%
- 2018 OCP Non-Board revenue: \$2.56B

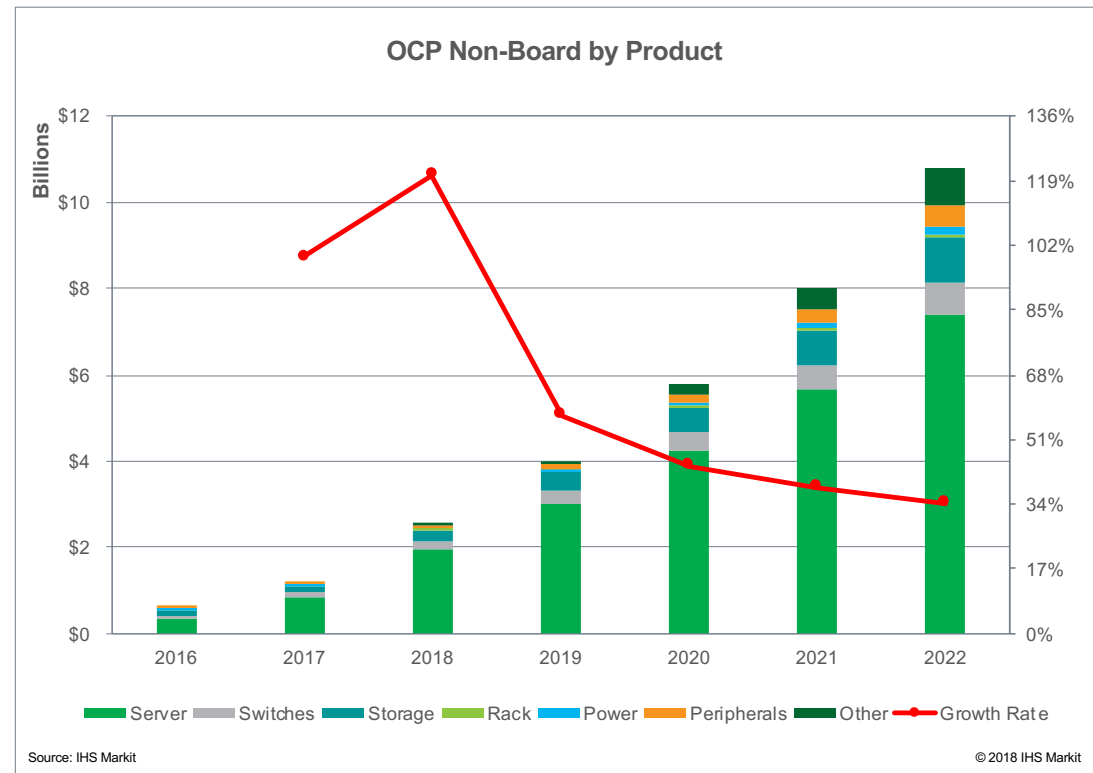


Forecast

- 5YR CAGR 56%
- 2022 OCP Non-Board revenue: \$10.7B

Non-Board OCP revenue expected to top \$10B in 2022

- Servers then storage, followed by networking top categories for revenue
- Growth rate of OCP Non-Board revenue in high double digits out to 2021
- Total market growing in low single digits
- PON potential high growth area
- Market just forming for disaggregated cell tower equipment

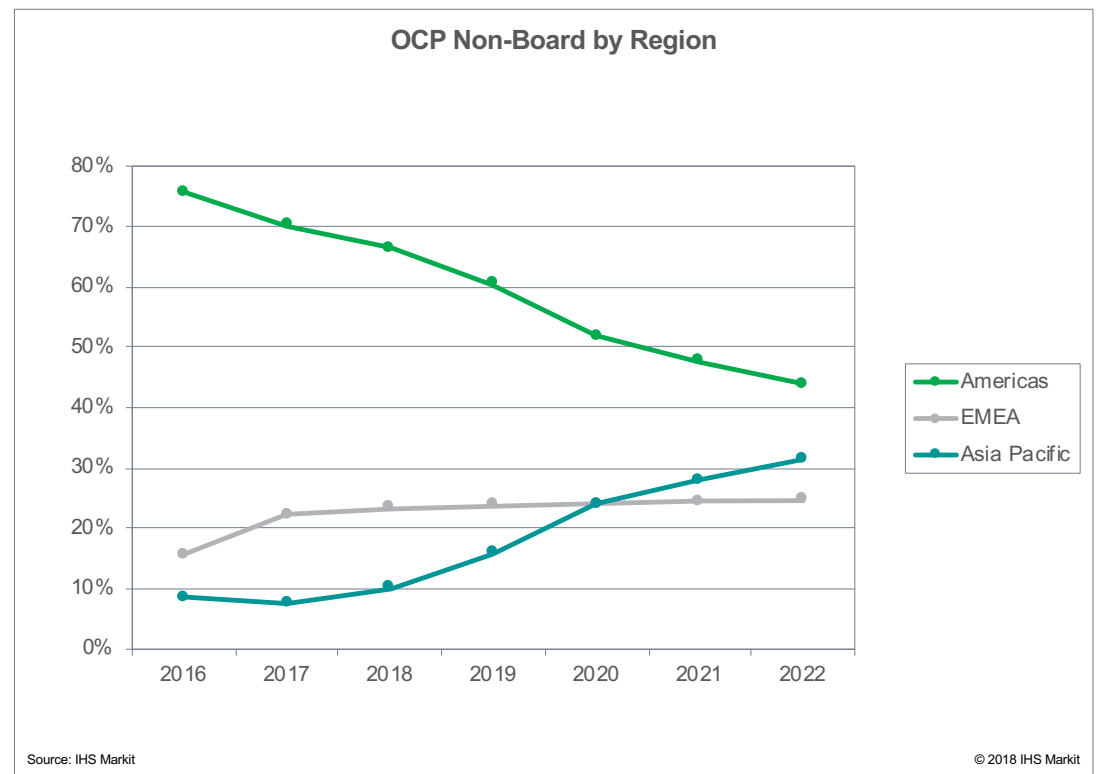


Non-Board OCP PON and WiFi revenue streams come on-line

Values	Product Category	2016	2017	2018	2019	2020	2021	2022	Grand Total
Amount	Server	\$373,587,772	\$846,624,412	\$1,947,826,517	\$3,028,742,951	\$4,252,167,308	\$5,694,241,618	\$7,424,710,737	\$23,567,901,316
	Switches	\$56,603,336	\$102,775,688	\$206,130,437	\$314,581,893	\$419,614,625	\$539,388,030	\$684,212,817	\$2,323,306,825
	Storage	\$122,677,044	\$152,037,425	\$258,472,084	\$385,316,615	\$575,737,558	\$791,801,120	\$1,078,210,371	\$3,364,252,216
	Rack	\$4,624,803	\$8,506,676	\$13,651,537	\$22,192,574	\$34,412,323	\$50,914,292	\$71,651,260	\$205,953,465
	Power	\$11,483,501	\$19,230,362	\$31,432,507	\$58,325,684	\$95,224,067	\$136,938,419	\$200,714,988	\$553,349,526
	Peripherals	\$15,256,837	\$33,101,845	\$63,563,277	\$110,037,867	\$183,788,108	\$309,040,169	\$484,164,681	\$1,198,952,782
	Other	\$0	\$0	\$39,174,274	\$106,615,158	\$238,486,221	\$507,733,186	\$831,723,753	\$1,723,732,592
% Change YoY	Server		126.6%	130.1%	55.5%	40.4%	33.9%	30.4%	
	Switches		81.6%	100.6%	52.6%	33.4%	28.5%	26.8%	
	Storage		23.9%	70.0%	49.1%	49.4%	37.5%	36.2%	
	Rack		83.9%	60.5%	62.6%	55.1%	48.0%	40.7%	
	Power		67.5%	63.5%	85.6%	63.3%	43.8%	46.6%	
	Peripherals		117.0%	92.0%	73.1%	67.0%	68.2%	56.7%	
	Other				172.2%	123.7%	112.9%	63.8%	
Total Amount		\$584,233,292	\$1,162,276,407	\$2,560,250,633	\$4,025,812,743	\$5,799,430,210	\$8,030,056,833	\$10,775,388,606	\$32,937,448,724
Total % Change YoY			98.9%	120.3%	57.2%	44.1%	38.5%	34.2%	

Americas (US) still dominates through 2022

- Americas' early domination due to Non-Board hyperscaler and financial adoption, now driven by telco, CAGR 42%
- APAC will surpass EMEA on strength of hyperscaler and Tier-2 CSP adoption, CAGR 108%
- EMEA growth driven by telco, CAGR 59%

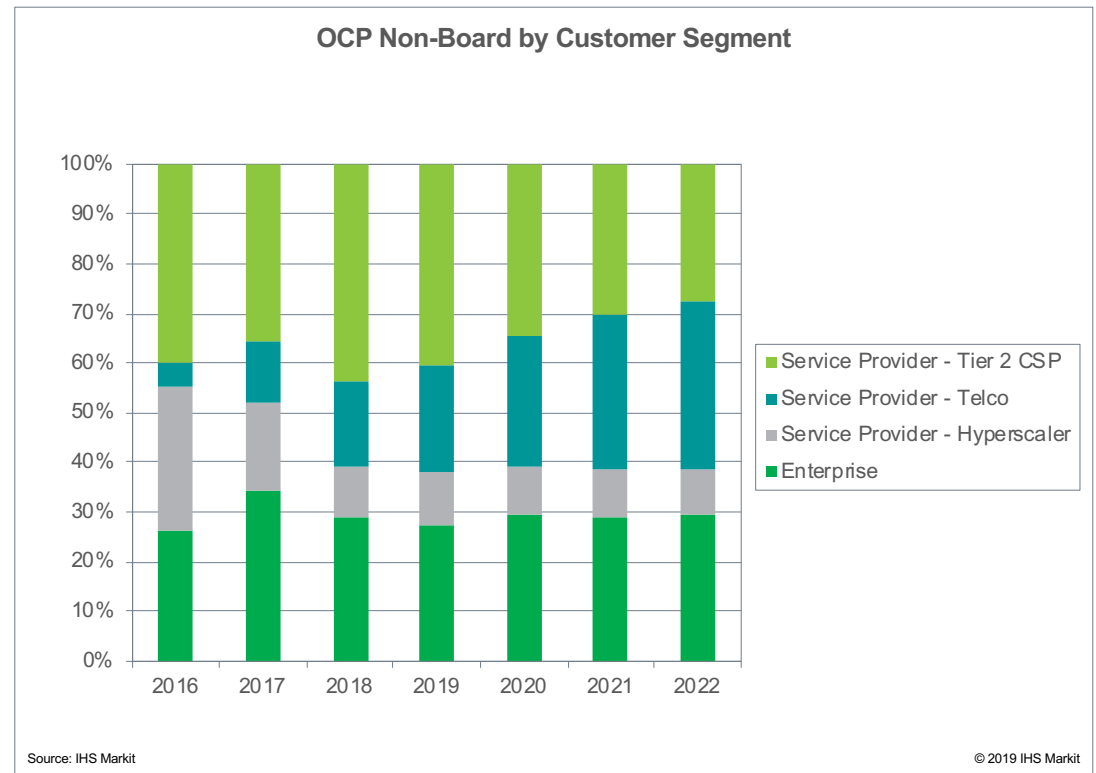


Americas (US) dominates through 2022 - detailed

Values	Region	2016	2017	2018	2019	2020	2021	2022	Grand Total
Amount	Americas	\$442,371,309	\$815,970,400	\$1,702,468,436	\$2,428,789,265	\$3,008,170,220	\$3,829,640,083	\$4,735,853,151	\$16,963,262,863
	EMEA	\$91,800,264	\$258,493,988	\$597,067,827	\$958,224,814	\$1,397,692,308	\$1,963,111,219	\$2,651,396,018	\$7,917,786,440
	Asia Pacific	\$50,061,719	\$87,812,019	\$260,714,370	\$638,798,664	\$1,393,567,681	\$2,237,305,531	\$3,388,139,437	\$8,056,399,420
% Change YoY	Americas		84.5%	108.6%	42.7%	23.9%	27.3%	23.7%	
	EMEA		181.6%	131.0%	60.5%	45.9%	40.5%	35.1%	
	Asia Pacific		75.4%	196.9%	145.0%	118.2%	60.5%	51.4%	
Total Amount		\$584,233,292	\$1,162,276,407	\$2,560,250,633	\$4,025,812,743	\$5,799,430,210	\$8,030,056,833	\$10,775,388,606	\$32,937,448,724
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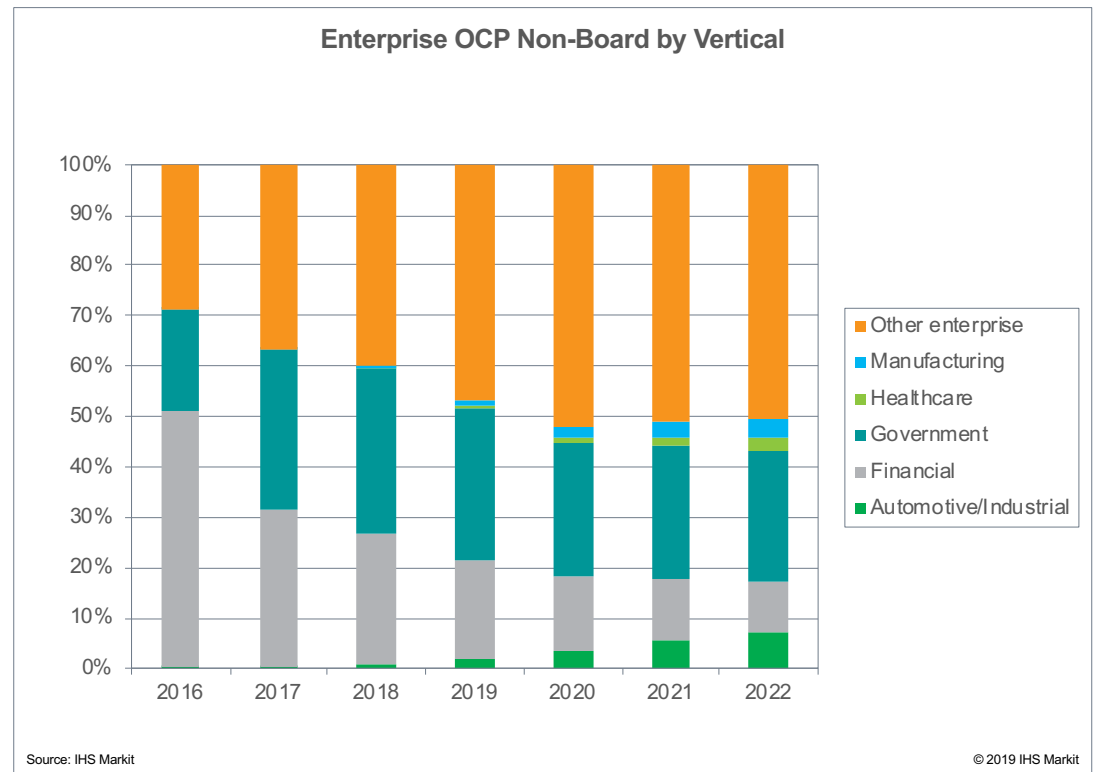
Telco Cloud: the next wave is rolling out

- Non-Board hyperscaler projects stalled in 2018, but tier-2 CSPs now ready to drive growth.
- Telcos 2017 POCs moved to limited production in 2018 expecting ramp in 2019+, especially in Europe
- Telco total OCP spend will surpass Non-Board hyperscalers in 2021
- Top segments for 2022 are Telco, Tier-2 CSP and Enterprise



Finance yields to government and Other (retail and education)

- Government passes Financials spending on Non-Board enterprise OCP products in 2017
- Financial growth slows as use of OCP equipment becomes more wide spread
- Automotive and Manufacturing have highest 5YR GAGR
- Healthcare in very early stages of adoption



Vertical split details

Values	Customer Segment	Customer Vertical	Period								Grand Total
Amount	Service Provider	Hyperscaler	2016	2017	2018	2019	2020	2021	2022	Grand Total	
		Telco	\$27,853,130	\$145,674,197	\$443,708,079	\$875,513,952	\$1,515,741,508	\$2,493,686,554	\$3,654,410,645	\$9,156,588,067	
		Tier 2 CSP	\$233,759,959	\$413,132,231	\$1,118,473,107	\$1,617,898,045	\$1,998,925,622	\$2,440,796,669	\$2,971,065,254	\$10,794,050,886	
		Service Provider Total	\$430,180,491	\$765,996,272	\$1,824,554,389	\$2,913,547,236	\$4,097,630,046	\$5,708,098,332	\$7,619,484,085	\$23,359,490,852	
	Enterprise	Automotive/Industrial	\$517,691	\$1,068,273	\$6,477,955	\$22,522,132	\$58,659,070	\$124,698,196	\$228,985,011	\$442,928,328	
		Financial	\$78,201,246	\$124,772,772	\$189,834,517	\$218,008,255	\$249,108,227	\$283,574,604	\$317,076,781	\$1,460,576,403	
		Government	\$30,803,807	\$125,036,031	\$240,659,832	\$333,521,819	\$452,659,608	\$614,176,736	\$815,125,336	\$2,611,983,170	
		Healthcare	\$0	\$0	\$2,109,432	\$6,459,283	\$19,188,708	\$44,102,222	\$83,114,770	\$154,974,414	
		Manufacturing	\$317,392	\$640,964	\$3,968,945	\$12,908,560	\$31,505,362	\$66,647,264	\$115,948,709	\$231,937,197	
		Other enterprise	\$44,212,664	\$144,762,096	\$292,645,564	\$518,845,456	\$890,679,188	\$1,188,759,479	\$1,595,653,914	\$4,675,558,361	
		Enterprise Total	\$154,052,801	\$396,280,135	\$735,696,244	\$1,112,265,506	\$1,701,800,164	\$2,321,958,501	\$3,155,904,520	\$9,577,957,872	
% Change YoY	Service Provider	Hyperscaler		22.9%	26.6%	60.1%	38.8%	32.7%	28.5%		
		Telco		423.0%	204.6%	97.3%	73.1%	64.5%	46.5%		
		Tier 2 CSP		76.7%	170.7%	44.7%	23.6%	22.1%	21.7%		
		Service Provider Total		78.1%	138.2%	59.7%	40.6%	39.3%	33.5%		
	Enterprise	Automotive/Industrial		106.4%	506.4%	247.7%	160.5%	112.6%	83.6%		
		Financial		59.6%	52.1%	14.8%	14.3%	13.8%	11.8%		
		Government		305.9%	92.5%	38.6%	35.7%	35.7%	32.7%		
		Healthcare				206.2%	197.1%	129.8%	88.5%		
		Manufacturing		101.9%	519.2%	225.2%	144.1%	111.5%	74.0%		
		Other enterprise		227.4%	102.2%	77.3%	71.7%	33.5%	34.2%		
		Enterprise Total		157.2%	85.7%	51.2%	53.0%	36.4%	35.9%		
Total Amount			\$584,233,292	\$1,162,276,407	\$2,560,250,633	\$4,025,812,743	\$5,799,430,210	\$8,030,056,833	\$10,775,388,606	\$32,937,448,724	
Total % Change YoY				98.9%	120.3%	57.2%	44.1%	38.5%	34.2%		

OCP vendor and end user survey results

The following slides present findings from interviews with 10 respondents

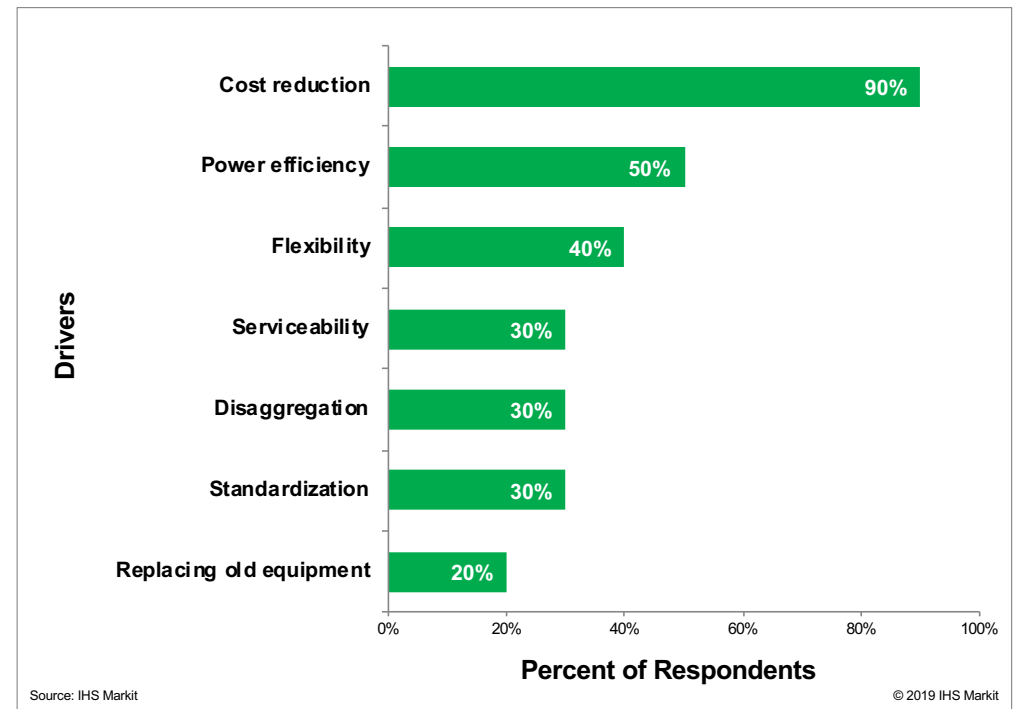


Adoption drivers get more diverse

Q: What are the top reasons your customers give for adopting Open Compute products?

- Cost reduction and power efficiency remain biggest drivers for OCP
- Market now recognizing feature flexibility offered by open hardware
- Disaggregation becoming recognized as a value for OCP equipment
- Standardization around OCP certifications provides measure of “comfort” to the market
- Equipment going end of life sparking evaluation of OCP

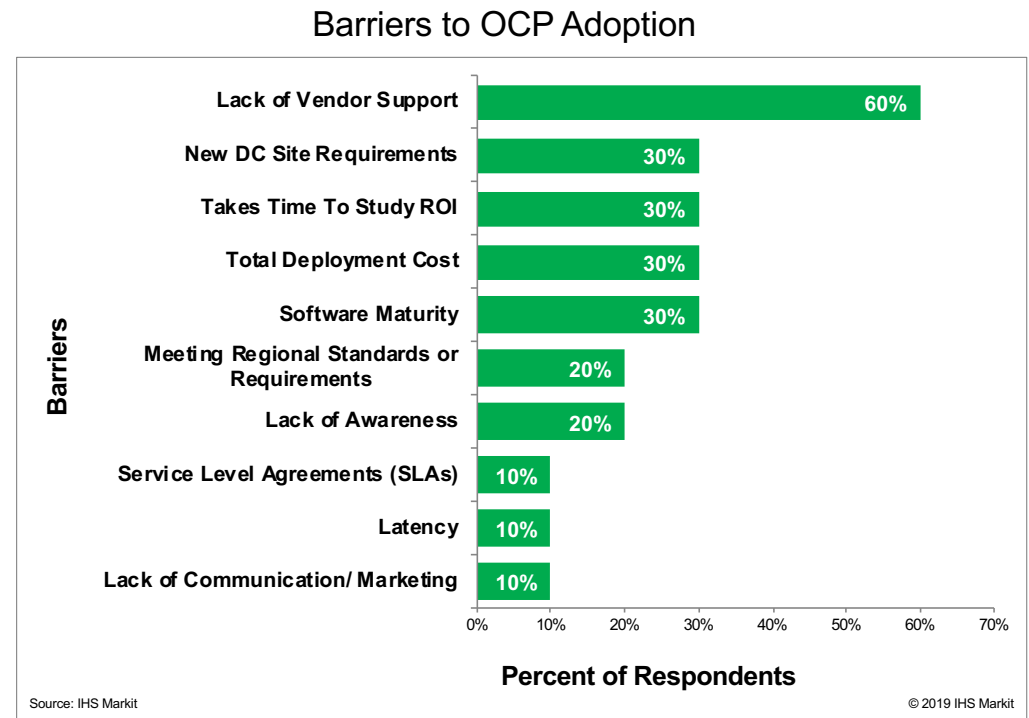
Drivers of OCP Adoption



Adoption barriers become more business related

Q: What are the top barriers your customers and/or target customers raise when evaluating use of OCP products?

- Lack of local vendor support moves to top concern over last year
- Business related challenges join technical issues, signs of maturity
- Vendors still challenged to educate the market and develop awareness
- Trouble sourcing compatible OCP products are a primary barrier
- Latency appears as a discussion point wrt edge computing

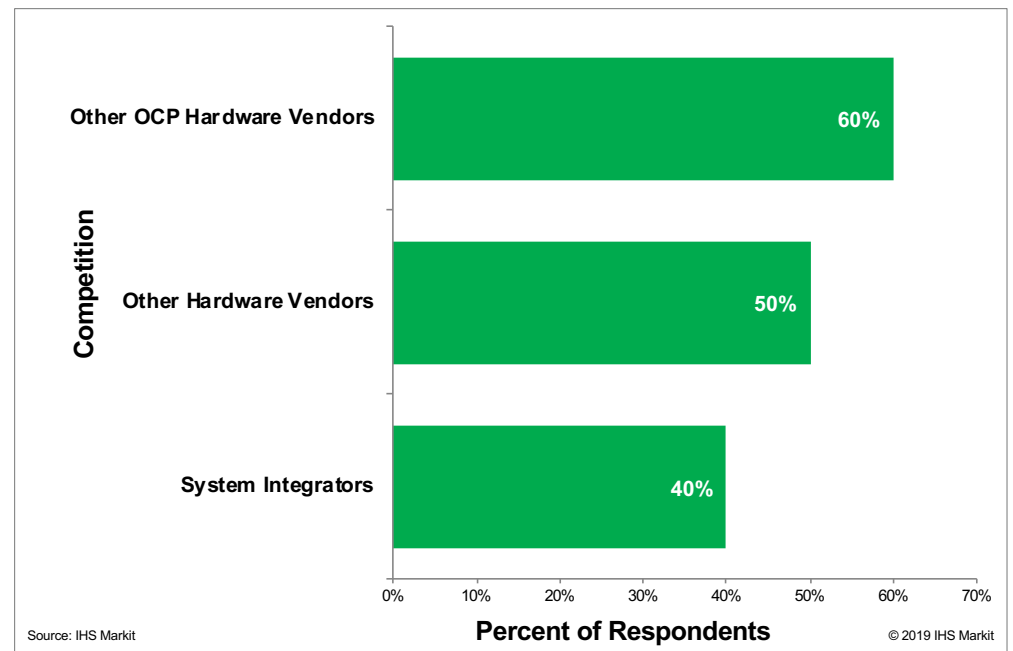


Increased competition shows sign of a maturing market

Q: Whom do you see as your competition for offering OCP products?

- Vendors citing competition by other OCP vendors indicates the choice of products continues to expand, a healthy phase for this market
- Increased competition from traditional vendors also a sign the market is moving away from early adopters to more mainstream buyers
- System integrators offering complete solutions now play dual role, partners for select vendors and competition for others

The Competition Offering OCP Products

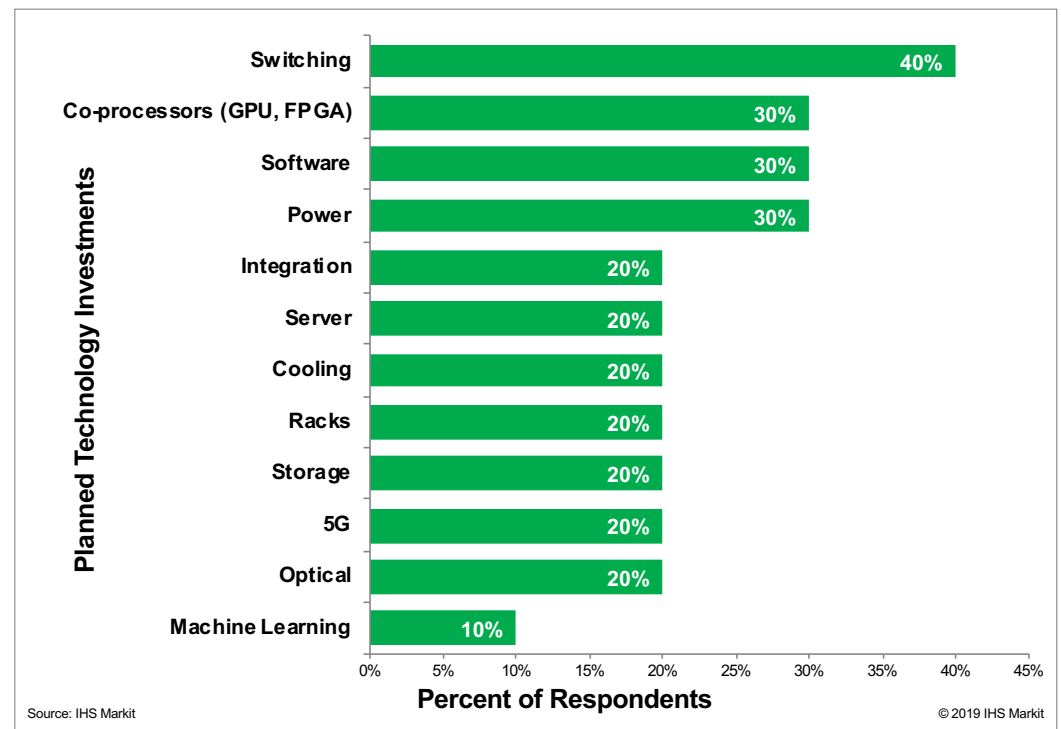


Vendors target AI & ML with co-processors, 200/400GE for switching

Q: What technologies are you focused on developing?

- Software is new, recognition that market still lacks mature software ecosystems
- Many new server designs using Arm CPUs and AMD EPYC now available, co-processor options multiply, edge form factors emerging
- 400GE switching and optical components shipping in 2019
- Closed loop automation investments target DC power and cooling systems

Supplier Technology Investments

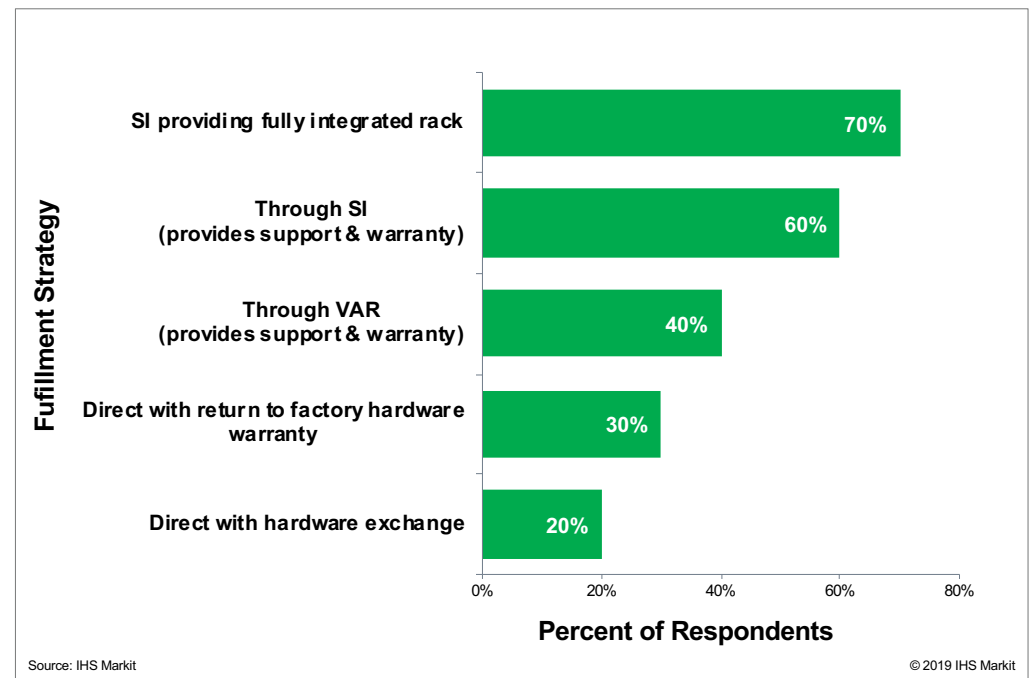


Fully integrated rack systems rise to the top, another sign of maturity

Q: How is order fulfillment done?

- As the market shifts to tier-2 CSPs and Telco, fully integrated racks are preferred
- Direct moves to bottom this year, opposite for last year, relegated to small scale PoCs
- Telco's prefer to purchase at scale from SIs
- Local warranty and support a must as customers move to live production

Order Fulfillment



Memorable mentions

“[Seeing Inquires] ...from born of the web kind of organizations .. major customers of the hyperscalers ... looking to control more of their own platform”

“...ISPs and teleco are the main drivers of OCP adoption in Japan... looking at GPU servers”

“Telcos .. are looking for a 12U rack ...because they want to place OCP equipment in their CO”

“Industry wants open, agnostic and flexible... disaggregation... solutions for both HW and SW products”

“Big challenge is that unless DC is designed on Day 1 for OCP equipment, you end up with a data center overengineered for hosting OCP”

“Tier 2 [CSP] use standard distribution model ... via VAR ...Telcos are dealt w/ ..via ... preferred vendors and integrators...enterprises are sold via long-standing OEM relationships”

“Most customers in APAC (Indonesia and Philippines and South Pacific region customers), aren't aware of or participate in OCP foundation”

“..increasing integration partnerships .. [Large Telco].. has an unnamed [IT integration] partner for open networking”

“OCP has created necessary competition in the traditional market”

“[use] .. machine learning ...to model and predict PUE ...move away reactive maintenance”

“New use cases .. use of aggregation switch and cell-site gateways @the edge”

“Disaggregated OLT is another use case plus 10G PON solutions... currently demoed solutions”

Top takeaways

- OCP 2018 non-board member revenue significantly surpassed expectations
- OCP 2018 non-board member market share, tops forecast
- Credible path for non-board member revenue to top 5% market share by 2022
- Adoption is moving past hyperscalers with tier-2 CSP and telco deployments
- Good expectations for enterprise adoption, with large lighthouse projects in APAC
- Market showing healthy maturation since last year
 - Drivers for adoption more diverse and attention turns to business cases
 - Competition between vendors is increased offering more choice to customers
 - Investments broaden to include commercial software
 - Direct sales give way to SI and VAR fulfilled deals





Definitions

Definitions

Product Scope

Open Compute: equipment certified (OCP-ACCEPTED™ and OCP-INSPIRED) by OCP; includes equipment in certification process

Manufacturers' revenue (US\$): reported for units shipped for revenue recognized during the calendar year. OEM revenue is attributed to the original manufacturer. We do not include revenue from service and support, product maintenance, managed services, and professional services

Product Categories

Servers: A networked physical device that provides shared compute functionality; typically contains a central processing unit (CPU), random access memory (RAM), storage, physical network interface, power supply, and management

Switches: Ethernet switches that forward traffic based on layer 2 information; used to build LANs enterprise/ service provider data center networks; does not include switches deployed for carrier metro Ethernet applications

Storage: A set of storage elements where data is held in an electromagnetic, digital circuitry, or optical form and can be loaded into server memory to be used for computation; can include hard disk and solid state storage devices and can be located within a server or a separate enclosure

Racks: Physical support infrastructure designed to hold power, cooling and IT equipment (servers, storage and network)

Definitions Continued

Power: Power delivery at the rack level that can include power distribution, battery back-up, and power conversion

Peripherals: Includes optical transceivers and Ethernet network adaptors

- Optical transceivers: pluggable modules supporting a single logical connection with an electrical system interface and an optical or electrical TX/RX line interface;
- Ethernet network adaptors: I/O cards used to connect servers and storage devices to Ethernet networks; can provide CPU offload; include stand-up and piggyback cards

Others: Includes passive optical and WiFi network equipment

- Passive optical network equipment: Including OLTs [optical line terminals] and ONTs [optical network terminals]
- WiFi network equipment: Enterprise-class wireless networking devices based on the 802.11 standard, including WiFi access points and controllers

Definitions Continued

Verticals

Market Segment: Organizations purchasing Open Compute Certified (Accepted and Inspired) equipment

Service Provider: Provide IT, communications or physical data center infrastructure services

Cloud: Provide IT and communications services over 3rd party networks; typically does not own end user access networks

Hyperscaler - Operate data centers totaling to >3 million square feet

Tier 2 - Operate data centers totaling to <3 million square feet

Telco: Traditional telecommunication network providers including MSOs and mobile carriers

Enterprise: Provides products and services to target select markets

Healthcare: organizations that provide medical and healthcare goods or services; this sector includes hospital management firms, health maintenance organizations (HMOs), biotechnology and pharmaceutical firms.

Financial: companies that provide financial services to commercial and retail customers; this sector includes banks, investment funds, insurance companies and real estate firms.

Government: provides municipal, state and country wide services to its citizens

Manufacturing: companies engaged in the fabrication, processing, or preparation of products from raw materials and commodities. This includes all foods, chemicals, textiles, machines, and equipment.

Automotive/Industrial: companies that produce goods used in the manufacture of automotive products as well as goods used for construction and manufacturing; specifically aerospace and defense equipment as well as industrial machinery, tools, lumber production, construction, waste management, manufactured housing, cement and metal fabrication.

Other: all other enterprise verticals, such as hospitality, education, retail, etc.

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