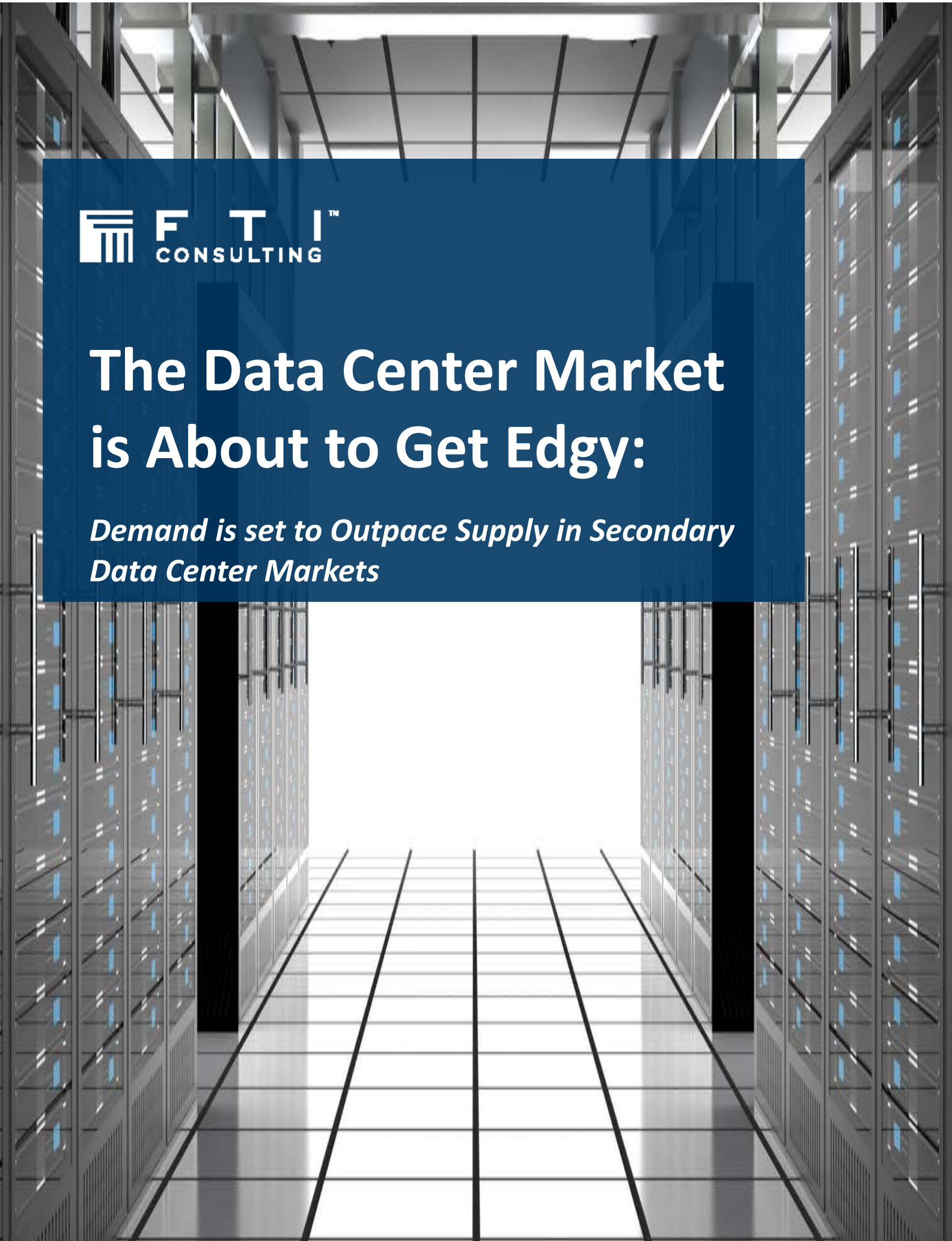


FTI CONSULTING

# The Data Center Market is About to Get Edgy:

## *Demand is set to Outpace Supply in Secondary Data Center Markets*

# Migration to the Edge

Rapid adoption of over-the-top (OTT) video, the proliferation of the Internet of Things (IoT) and growth of high quality, bandwidth-hungry content is leading service providers increasingly to move select strategic IT assets closer to the edge of the network. To the benefit of customers, providing local connectivity to the network edge will lead to improved quality of service and security. For web content companies and cloud service providers, edge connectivity will allow them to satisfy increasing consumer demand, for quicker response times needed in streaming content rich social platforms, webpage load speeds and processing data for IoT devices.

Edge connectivity is especially relevant when you consider that IoT devices have limited computing abilities and will increasingly rely on computational power, access to data storage, high bandwidth and low latency connectivity. Moreover, the increasing demand for bandwidth is taxing the current legacy network infrastructure. The 24/7 collection of data for internet connected devices such as phones, computers, cars, buildings, and nearly every electronic device with a sensor is forecasted to grow to 20.8B devices by 2020.[1] The graphic to the right illustrates the network edge and the challenge of low latency computing with the centralized cloud architecture.

To help alleviate current network constraints, utilization of content distribution networks (CDN) - third party providers such as Akamai Technologies, Limelight and CenturyLink / Level 3 or content companies using homegrown solutions such as Netflix and Comcast - are increasingly in demand to cache popular content and web-application data on servers closer to end users residing outside of the traditional internet hubs, such as: New York, Los Angeles, Northern Virginia, Dallas, or Silicon Valley (also referred to as Tier-I markets).

The increased demand for data center space in smaller emerging markets (also referred to as Tier-II and Tier-III markets and include cities such as: Denver, Phoenix, Portland, Atlanta, Minneapolis, Columbus, and Nashville) has created a whole new category of data center service providers referred to as “edge data centers” - facilities that extend the “edge” of the network, further from traditional Tier-I internet hubs and closer to end-users.

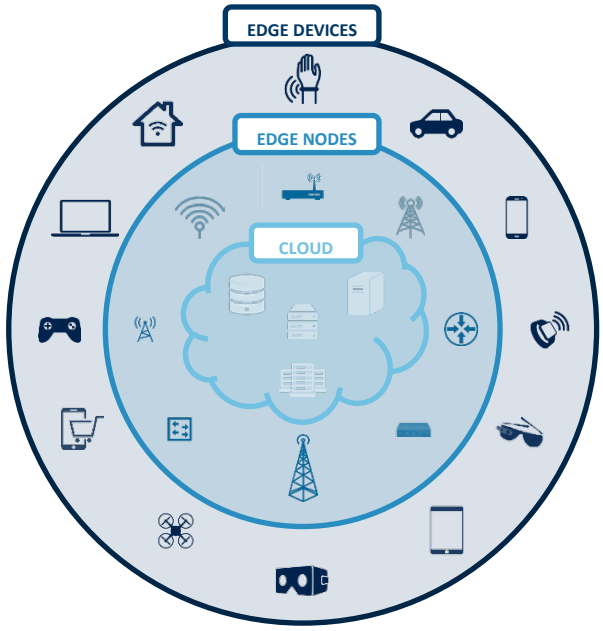



*Figure 1: FTI Consulting*

Smaller data center markets tend to have fewer well-funded competitors than do Tier-I markets, and have room for new entrants with high-quality data centers providing colocation to quickly gain market share. **Although demand has outpaced supply in the wholesale and retail colocation markets for several years, we believe that supply of high quality colocation data center space at the edge will soon become even tighter, and give rise to above-average pricing increases in select, underserved markets. We also believe that certain Tier-II and Tier-III markets will largely remain insulated from the larger wholesale and retail colocation focused providers as they continue to concentrate on larger hubs in Tier-I markets. The dynamics will lead to a unique opportunity in the underserved secondary market for opportunistic companies and/or investors.**

The IoT community is still debating where analysis and data processing would best take place; on the edge/fog (see below for further information on edge/fog computing), the device itself, a local gateway, or a centralized cloud. Some IoT devices will not have stringent latency demands and would likely be aggregated to the cloud. However, the majority of IoT spending today is on latency-sensitive, data-intensive technologies for commercial, industrial, and transportation applications which are applications not well suited for the traditional cloud environment. Examples include large mobile machinery and factory assembly lines, self-driving vehicles and aircraft maintenance, disaster recovery systems or sending alerts to technicians to make preventive repairs.

[1] Gartner (November 2015)

IoT is not the only platform driving edge demand. As OTT continues to proliferate, it creates an ever greater need for content delivery networks. A recent *451 Research* article noted that a terabyte of data created at the edge would take over half a day to upload to the cloud or an on-premises datacenter for analysis, by which time its value would have been eroded dramatically.[2]

For example, commercial jets generate 10 terabytes for every 30 minutes of flight time and it is estimated that one autonomous car will generate and consume 40 terabytes of data for every eight hours of driving.[3] In comparison, at the end of 2014, it was estimated that Facebook accumulated around 600 TB of data per day.[4] The advancement of IoT bodes well for data center providers focused on providing colocation space at the edge.

# The Supply / Demand Problem

Edge Data Center Demand Drivers - The forecasted explosion of IoT-related data and data-hungry applications combined with the continued growth in CDN traffic, should result in robust demand for edge data center services.

**OTT Content -** Consumers are increasingly switching to streaming video OTT (Netflix, Hulu and others) and away from traditional content delivery (cable TV and satellite services). In 2015, IP video streaming accounted for 70% of all internet traffic, and is expected to grow to 82% in 2020.[5] Mobile video streaming is on a similar trajectory, accounting for 60% of all mobile data traffic in 2016 and expected to rise to 78% by 2021.[6] With the growth, consumers will continue to expect faster and higher quality video streaming which implies more demands on network infrastructure.

**Cloud Services / IoT -** Businesses continue to consume increasing amounts of cloud services and collect massive amounts of data that require processing. Limited bandwidth makes it slow and expensive to move data from remote locations to central data centers. Poor network response will become even more apparent as IoT is embraced and devices, including; sensors, cameras, and a myriad of other internet-connected devices produce larger amounts of data that will need to be processed in real-time.

The Cisco Global Cloud Index estimates that 600 zettabytes (ZB) will be generated by all people, machines, and things by 2020, up from 145 ZB generated in 2015.[7] Most of the forecasted 600 ZB in 2020 will be ephemeral in nature and will be neither saved nor stored, but Cisco GCI estimates that at least 10% will be retained leading to 10 times more useful data being created (60 ZB, 10 percent of the 600 total) than will be used (6 ZB) in 2020.

[2] 451 Research, "Just One Database rebrands as Edge Intelligence, focuses on IoT"
[3] Cisco and Network World, "Just One Autonomous Car will use 4,000 GB of data/day."
[4] Aviationweek.com, "Internet of Aircraft Things: An Industry Set to be Transformed."
[5] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast 2015-2020
[6] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast 2016-2021
[7] Cisco Global Cloud Index: Forecast and Methodology, 2015-2020

## Edge vs. Fog Computing

What is "edge computing" and how does it differ from "fog computing"? "Edge" and "fog" computing have become the predominant terms to describe the next evolution of cloud computing. Both of these terms aptly describe the concept of moving intelligence and processing capabilities closer to the data generation source. Fog computing focuses the intelligence at the local area network level of the architecture, collecting and processing data in a fog node or IoT gateway.

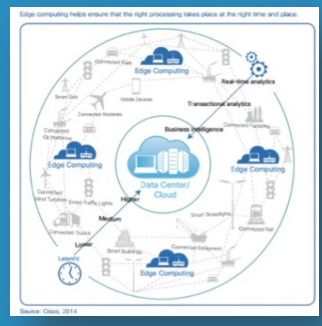



*Figure 2: Fog and Edge nodes coordinate the flow of data from the network's edge to the cloud. Image source: Cisco Systems*

Compared to executing bulk processing in a centralized server (e.g. fog node), edge computing pushes processing even closer to the sources of data. Hence, each network device plays a role in the processing of information via connecting sensors to Programmable Automation Controllers to handle communications, processing workload, etc. This design enables an advantage over fog computing through less points of failure as each device can essentially operate independently creating redundancy within the ecosystem. Depending on the application, one architecture solution may be preferable over the other, but both will play a critical role in this current evolution of cloud computing.

**Growth of CDN -** Third party CDN providers utilize dedicated private networks of thousands of specialist edge servers and storage to cache popular content nearer to populations using the data. Akamai Technologies, the CDN market leader, says its network carries 15% - 30% of the world's web traffic. [8]

Another CDN provider, Limelight Networks, delivered record online traffic levels surpassing its previous December 2016 record by more than 20% and in Q1 2017, reported its highest revenue in 16 quarters, another indication of the rising demand for services.[9] CDN providers are expected to continue to benefit as the amount of data delivered increases and consumers demand faster load-times with more reliable delivery.

CDN traffic currently represents 39% of all internet data (total IP traffic, excluding managed IP traffic) and is expected to grow at a CAGR of 38%, with CDN traffic reaching 62% of all internet data, by 2019.[10] The growth could increase even more if 4K televisions are adopted more quickly than expected today because streaming 4K content with high dynamic range can eat up 7GB - 10GB of data per hour.[11]

Do-it-Yourself CDN deployments for major content owners are growing; edge data center providers are seeing multiple DIY CDN deployments in Tier-II and Tier-III markets. Because CDN providers do not have data centers of their own, they will increasingly rely on edge data centers to provide space and ever increasing power requirements for their growing footprint needs.

Some companies, like Netflix, Comcast and Apple, are also moving their CDN capabilities in-house; however, they still require edge data center space and connectivity to execute this strategy.

Customer quality of service is an important concern for web content companies and cloud service providers to ensure adoption of these services continues on its current upward trajectory. Edge data centers will likely play a vital role in the strategy, resulting in increasing demand for edge data center colocation space.

**Aged Network Infrastructure -** Today's cloud-based approach to data storage and processing is pressuring scarce network bandwidth beyond its capabilities. The estimated 80 billion internet enabled devices in play by 2020 will create bandwidth demands to and from the cloud that are not currently available.

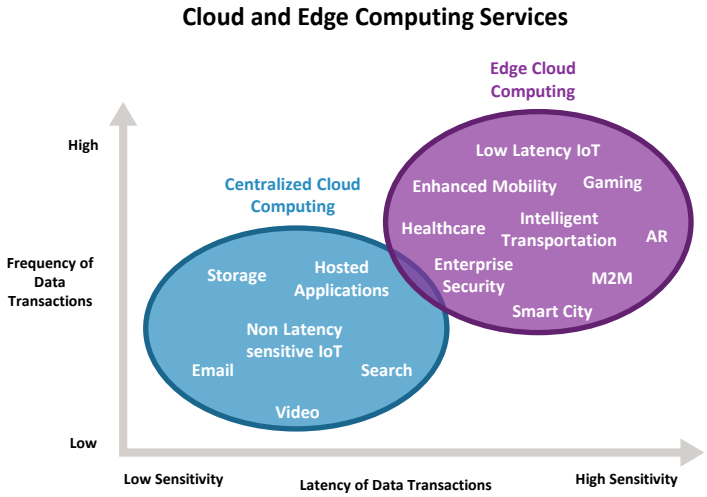



*Figure 3 illustrates the key differences (data frequency and latency) between cloud and edge computing applications. Source: ECI – The Elastic Network "Enriching Edge Services With Virtualized Transport", Hayam Porat, CTO*

[8] Akamai website
[9] 2017 Q1 Highlights http://investors.limelight.com/
[10] Cisco Visual Networking Index Forecast and Methodology, 2014-2019
[11] Consumer Reports "How Easy is it to Burn Through a 1TB Data Cap"

Today's cloud models are not equipped to handle the volume and diversity of data that IoT, for example, will produce. Internet connectivity could also be an issue in remote areas where only poor connectivity exists. Moving from best effort internet service to high availability internet service requires new architecture and a significant infusion of investment capital.

As mentioned in the introduction, response-critical applications need localized processing. When considering manufacturing, utility, healthcare, and transportation applications, there is a common critical requirement that spans these industries: immediate processing and analysis of operational data for mission critical insights and decisions. The traditional centralized cloud model does not meet the needs of these types of applications due to the low latency requirements that cannot be satisfied with a roundtrip between the data source and cloud-based platforms.

On-demand or cloud gaming is another critical application where low latency requirements are sacrosanct. The current cloud computing infrastructure is unable to meet these interactive response requirements from the gaming end-user community. Internet gaming is yet another high-growth application that demands the benefits of edge computing, especially given its reliance on sensor data from mobile devices to facilitate complex, virtual and augmented reality environments for the end user.

## Edge Data Center Supply

### Why aren't the Tier-I providers focused on the growing edge data center market?

The answer is, supply in Tier-II and Tier-III data center markets has remained constrained as the large wholesale retail colocation providers tend to focus on large Tier-I markets in which they can leverage economies of scale with their hyper scale builds. In today's market, Tier-I providers continue to deal with the competing capital pressure to expand campus capacity in existing markets and must also balance concerns over new market expansion.

The challenge of market expansion in edge geographies has created an opportunity for niche edge providers to meet the quickly increasing demand, albeit in a supply-constrained market. An edge data center differs from a traditional colocation facility in that it is about creating interconnection ecosystems in cities away from the traditional core markets.

Edge data center providers that potentially fit the Tier-II and Tier-III data center criteria, include: EdgeConneX, vXchnge, Cologix, T5, CyrusOne, CloudHQ, AirTrunk, Compass, DCI, 365 Data Centers and Peak10.

The rapid growth of and investment in these companies is a validation of demand for edge data center space and suggests more supply is needed. EdgeConneX, which started focusing its business on edge data centers in 2013, has grown from zero to approximately 30 data centers in North American and Europe. The Company is currently targeting another 10 -15 global markets for expansion. vXchnge purchased 8 data centers from Sungard in 2014 and currently has 14 data centers, mostly in Tier-II markets.

There has also been increased PE investment in edge data center companies; such as the purchase of Cologix by Stonepeak and the April 2017 purchase of 365 Data Centers by a consortium of PE funds. Outside of such niche providers, the market has been relatively untouched by larger wholesale and retail colocation providers.

## Key Differentiators of Quality Edge Data Centers

### Not All Data Centers Are Created Equal

While location and proximity to a market are key attributes in defining an edge data center, simply existing in a Tier-II or Tier-III market is not enough to be considered a high quality edge data center. A quality edge data center will typically provide access to 50% or more of consumers and enterprises in its market and connect with 75% or more of the local internet usage. [12]

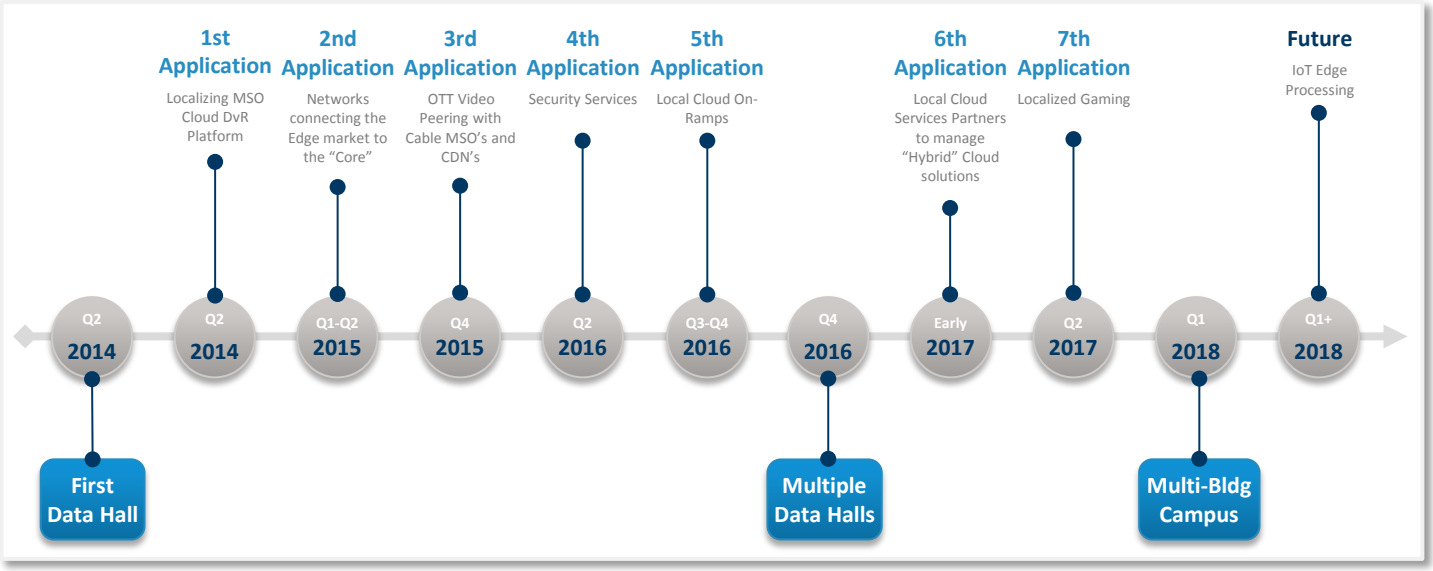
Local consumers and enterprises will notice benefits of the edge when performing high-bandwidth tasks such as video consumption or cloud-based applications – quality edge data centers will minimize latency to provide a higher quality experience for the end user. Service providers should be able to offer this better performance at a lower cost at the edge. Analysts at ACG Research estimate that local caching of content in a metro area with a population of one million would save approximately $110 million (about 50% savings) in backbone transport costs over five years. [13]

[12]Kerravala, Zeus. 7 key criteria for defining edge data centers. Network World 5/26/2016
[13]ACG Research

## EdgeConneX Portland Data Center

### Case Study: Evolution of Applications and Edge Demand

To illustrate the growing need for infrastructure at the edge, EdgeConneX provided a timeline that reflects how it is continuing to evolve to meet the needs of new applications that require a presence at the "Edge."




## Conclusion

The rapid growth forecasted for data-hungry applications and IoT related data combined with the continued growth in CDN traffic, is certain to result in robust demand for edge data center services. Traffic congestion on aging network infrastructure is resulting in traffic slowdowns, reduced capacity, service interruptions and a degradation of delivery quality that is unsuitable for many low latency dependent applications.

Further, long-haul network transport costs are increasing, resulting in higher costs to move the growing amount of data from users to centralized data centers.

Edge data centers help reduce latency via geographical proximity to the user and limit the amount of data that needs to travel via long-haul networks, thereby saving money.

Based on the extensive work we have performed in the data center space, we believe that the above mentioned dynamics will be catalysts for edge data center demand in the coming years. There are indications that some data center companies and investors are already betting on the upcoming opportunities in edge data center markets.

**Some PE funds have recently made investments in data center companies that have an edge presence in Tier-II and Tier-III markets. There are also several niche data centers that did not exist a few years ago that now have strong footprints in Tier-II and Tier-III markets, a potential indication of the future demand that these companies are forecasting in the edge data center markets.**

To date, edge data center companies have benefited from limited competition from the large data center companies focused on Tier-I markets. The trend will help smaller companies in the emerging edge data center space with a first mover advantage.

**Quality edge data center providers are positioned to offer better performance at a lower cost at the edge than traditional centralized data center providers. Edge data center providers that are able to differentiate themselves from other providers in Tier-II and Tier-III markets with high quality edge data center assets should benefit from the growing demand for their services.**

[12]Kerravala, Zeus. 7 key criteria for defining edge data centers. Network World 5/26/2016
[13]ACG Research

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