



# Cisco Global Cloud Index 2015–2020

## Cisco Knowledge Network (CKN) Session

Thomas Barnett, Jr. – Director, SP Industry Forecasts and Trends

Arielle Sumits – Senior Analyst

Shruti Jain – Senior Analyst

Usha Andra – Senior Analyst

Taru Khurana – Senior Analyst

November 2016

# Cisco VNI and Global Cloud Index

## Visual Networking Index (VNI)

$$\text{A} + \text{B} = 2.3 \text{ ZBs}$$

**A** Non-Data Center Traffic  
**NOT included in GCI**

**B** Data Center-to-User Traffic  
This is the overlap  
between VNI and GCI

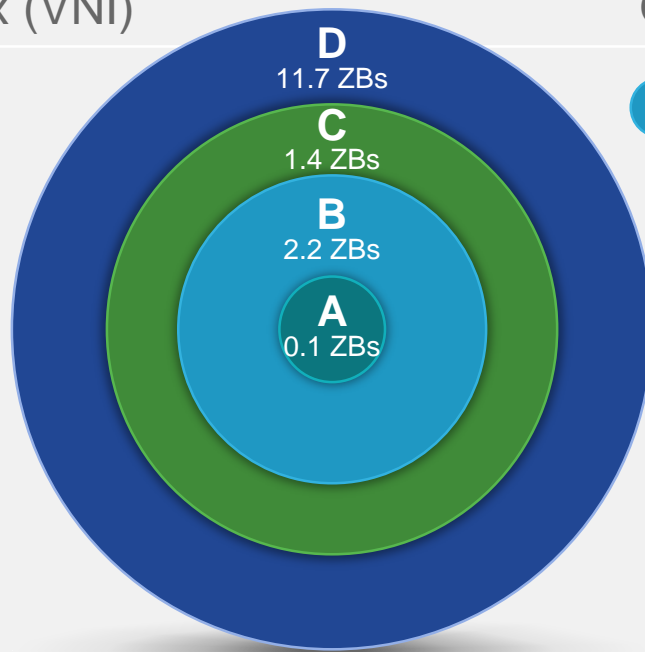
## Global Cloud Index (GCI)

$$\text{B} + \text{C} + \text{D} = 15.3 \text{ ZBs}$$

**B** Data Center-to-User Traffic  
(14%)  
This is the overlap between  
VNI and GCI

**C** Data Center-to-Data Center  
Traffic (9%)  
Traffic that flows from  
data center to data center

**D** Within Data Center  
(77%)  
Traffic that remains within  
the data center



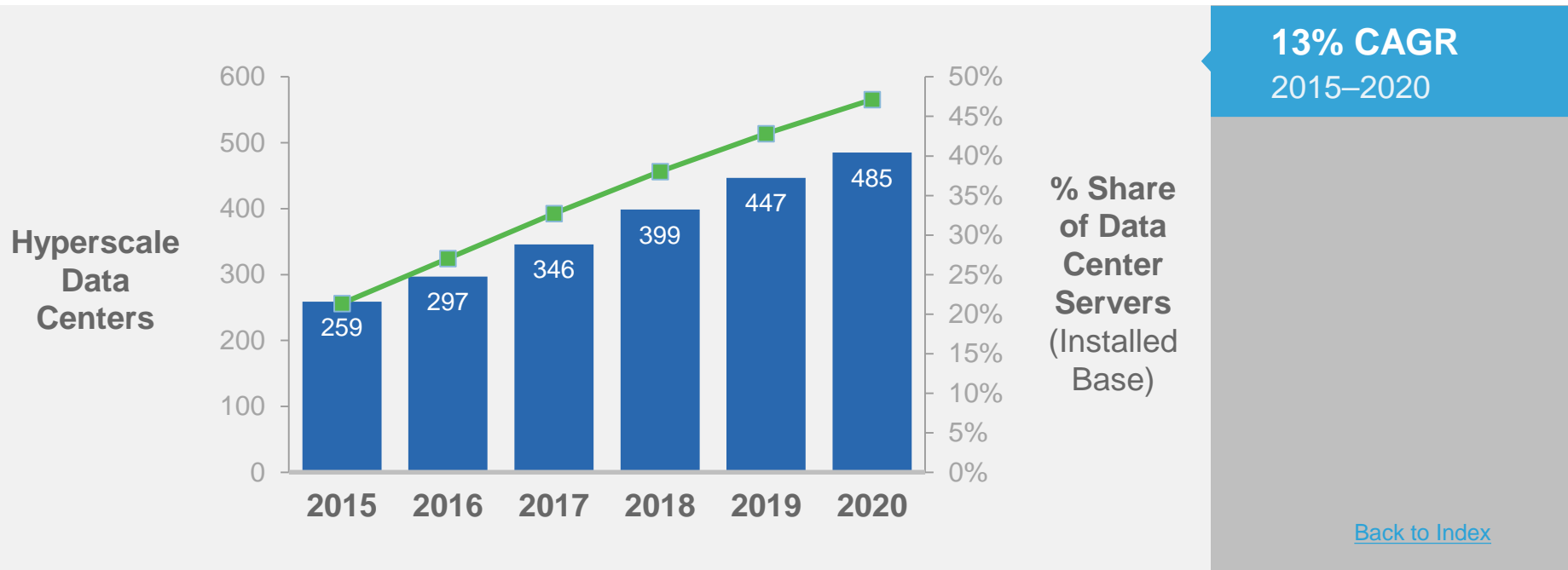
# GCI Forecast Update, 2015–2020

## Top 7 Data Center / Cloud Trends

- 1 [Growth of Global Data Center Relevance and Traffic](#)
- 2 [Continued Global Data Center / Cloud Virtualization](#)
- 3 [Cloud Service Delivery Models \(IaaS, PaaS, SaaS\)](#)
- 4 [Workloads and Traffic by Application](#) **\*\*New**
- 5 [Global Data Center and Cloud Storage](#) **\*\*New**
- 6 [Global Digitization—Impact of IoE](#)
- 7 [Global Cloud Readiness](#)



# Data Center Growth



# Hyperscale in 2020

By 2020, Hyperscale Data Centers Will House:

47%

of all data center **servers**

68%

of all data center **processing power**

57%

of all **data** stored in data centers

53%

of all data center **traffic**

Today:

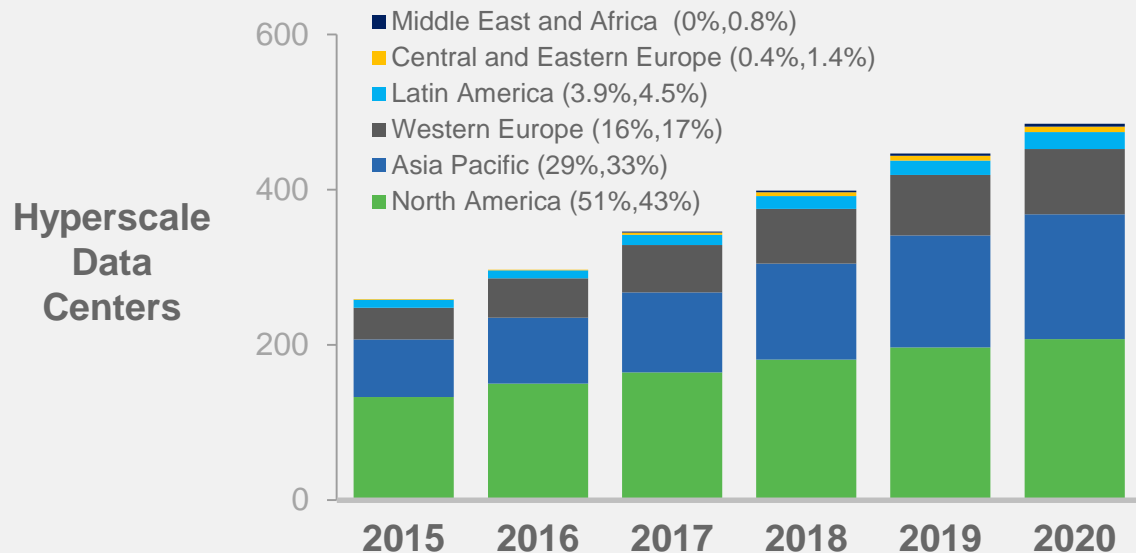
21%

39%

49%

34%

# Regional Growth of Data Centers



**13% CAGR**  
2015–2020

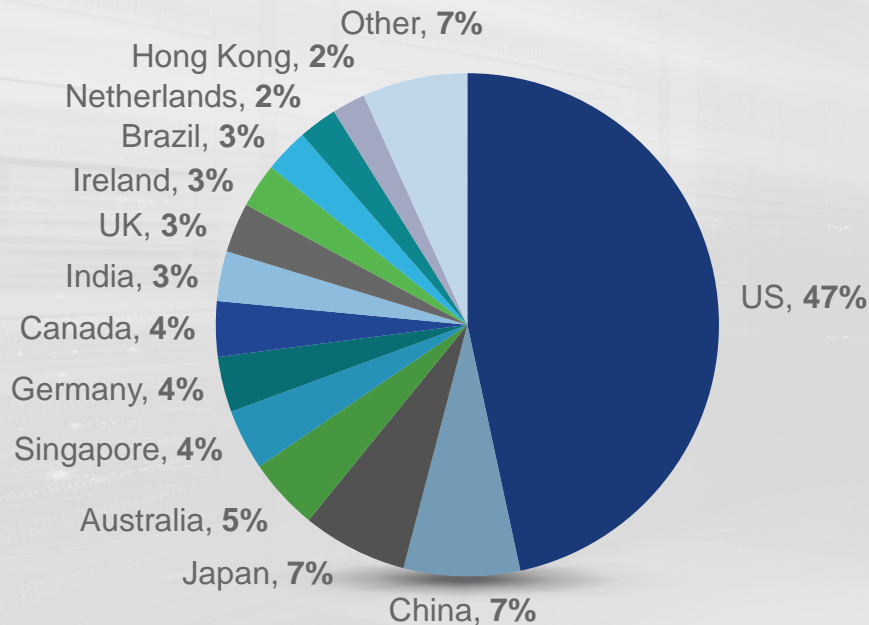
[Back to Index](#)

Note: Percentages within parentheses refer to relative share for 2015 and 2020.

Source: Cisco Global Cloud Index, 2015–2020,  
Synergy Research Group

# Hyperscale Cloud Data Centers

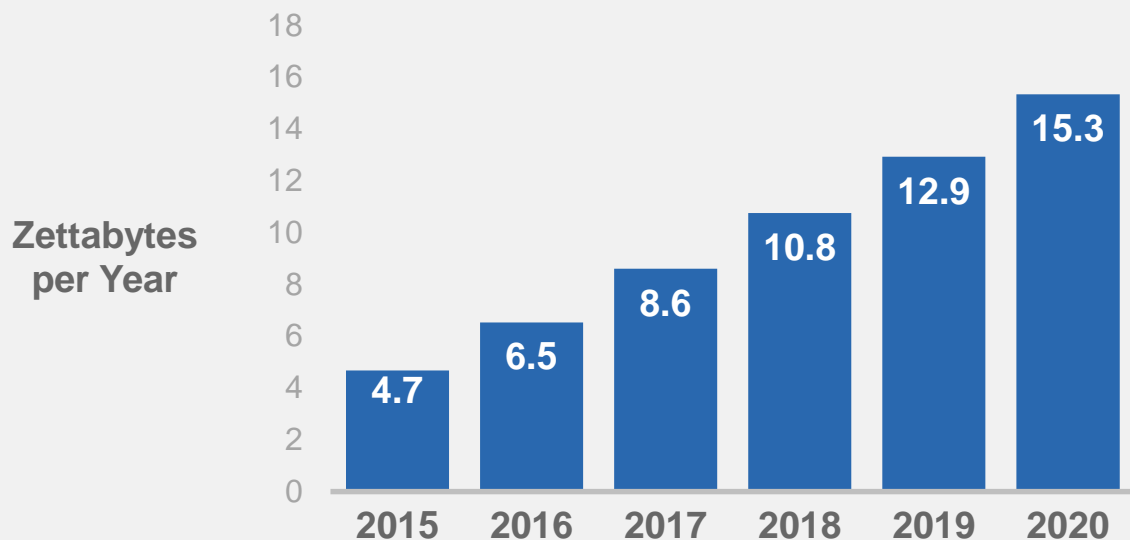
Location by Country—Q2, 2016



[Back to Index](#)

# Global Data Center Traffic Growth

## Data Center Traffic More Than Triples from 2015 to 2020



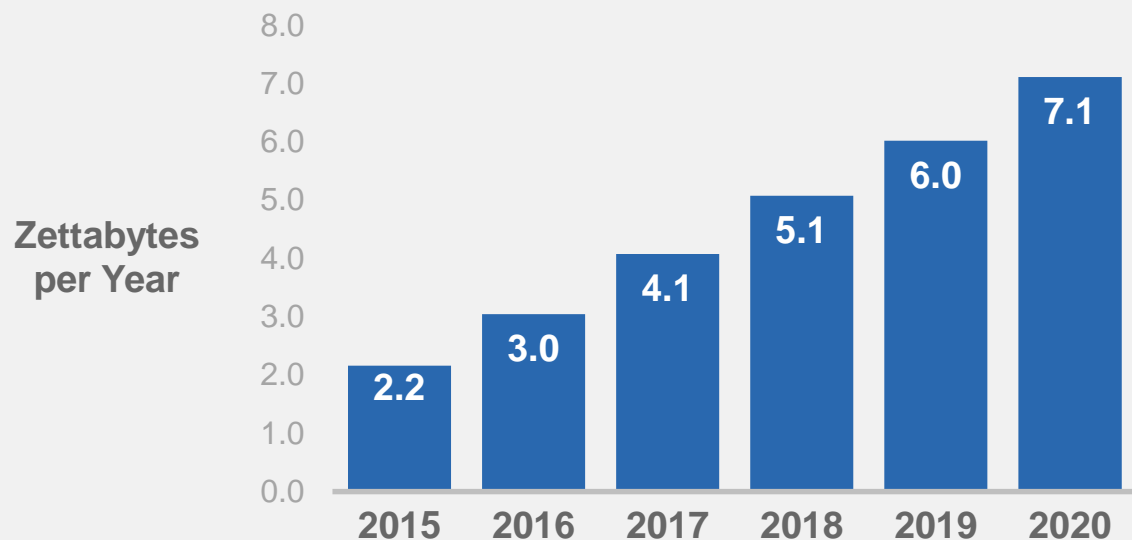
**27% CAGR**  
2015–2020

[Back to Index](#)



# NA Data Center Traffic Growth

Data Center Traffic More Than Triples from 2015 to 2020



**27% CAGR**  
2015–2020

[Back to Index](#)

# Global Data Center Traffic by Region

North America to Have Highest Traffic Volume by 2020

MEA to Experience Highest Traffic Growth

## North America

2015: 2.2 Zettabytes  
2020: 7.1 Zettabytes

**CAGR 27%**

## Western Europe

2015: 843 Exabytes  
2020: 2.7 Zettabytes

**CAGR 26%**

## Central & Eastern Europe

2015: 191 Exabytes  
2020: 632 Exabytes

**CAGR 27%**

## Latin America

2015: 195 Exabytes  
2020: 533 Exabytes

**CAGR 22%**

## Middle East & Africa

2015: 105 Exabytes  
2020: 451 Exabytes

**CAGR 34%**

## Asia Pacific

2015: 1.2 Zettabytes  
2020: 4.0 Zettabytes

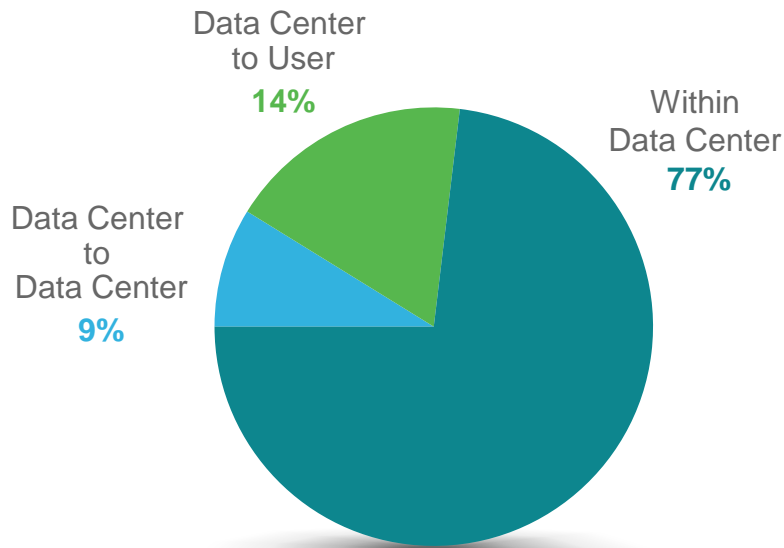
**CAGR 27%**

[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020

# Global Data Center Traffic by Destination, 2020

Most Data Center Events/Content Stays Within the Data Center



Total East-West Traffic Is 86%

(Rack-local traffic would add another slice twice the size of "Within Data Center")

## A Within Data Center (77%)



Storage, production and development data, authentication

## B Data Center to Data Center (9%)



Replication, CDN, intercloud links

## C Data Center to User (14%)

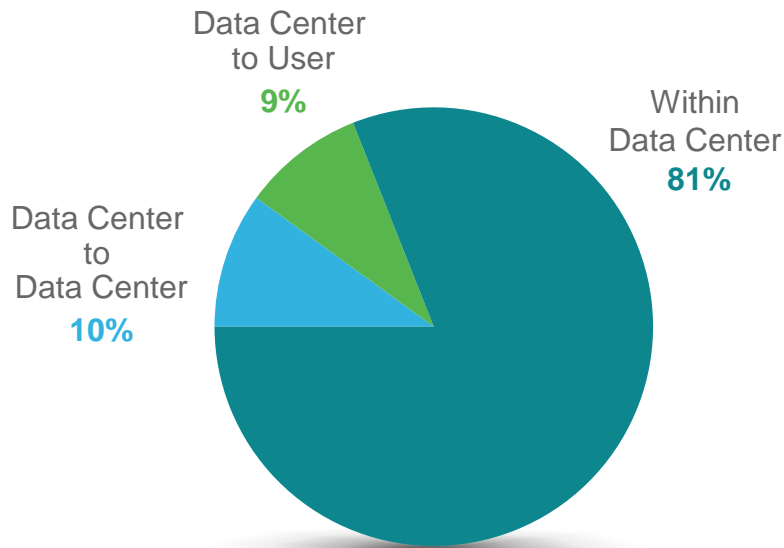


Web, email, internal VoD, WebEx...

[Back to Index](#)

# NA Data Center Traffic by Destination, 2020

Most Data Center Events/Content Stays Within the Data Center



**Total East-West Traffic Is 91%**

(Rack-local traffic would add another slice twice the size of “Within Data Center”)

## A Within Data Center (81%)



Storage, production and development data, authentication

## B Data Center to Data Center (10%)



Replication, CDN, intercloud links

## C Data Center to User (9%)

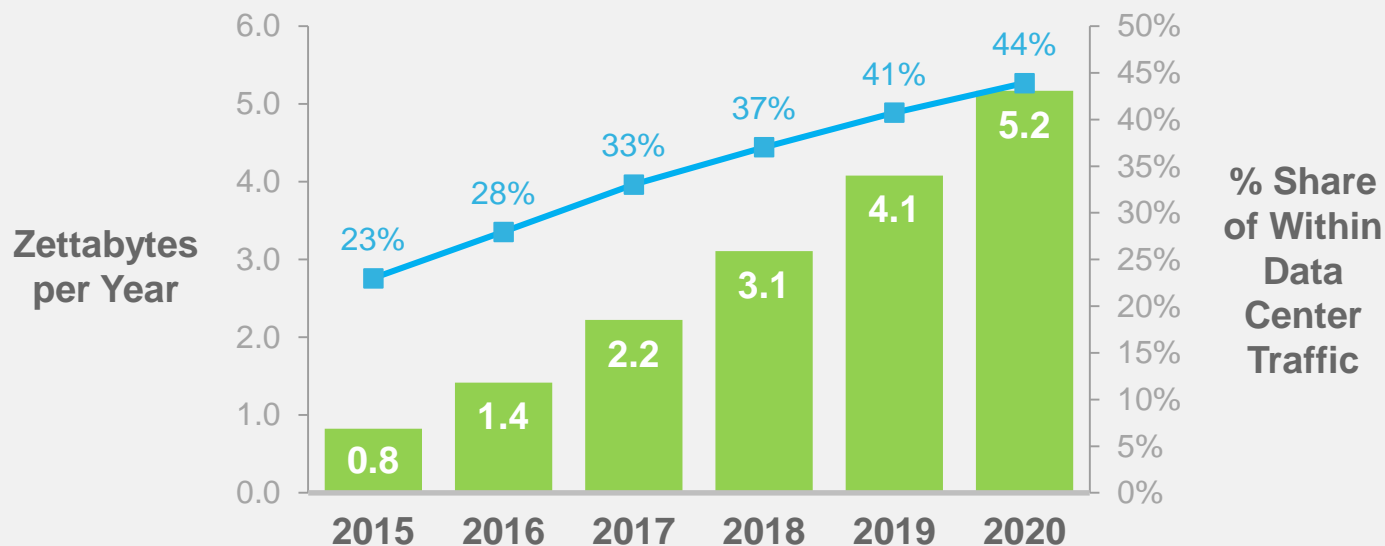


Web, email, internal VoD, WebEx...

[Back to Index](#)

# SDN/NFV Traffic Growth

SDN/NFV To Carry 44% of “Within Data Center Traffic” by 2020



**44% CAGR**  
2015–2020

[Back to Index](#)

# Potential Impact of SDN on Traffic



**Big Data.** Traffic engineering supports “elephant” data flows without compromising “mouse” data flows.



**Video Bitrates.** SDN will allow video bitrates to increase, because SDN can seek out highest bandwidth mid-stream.

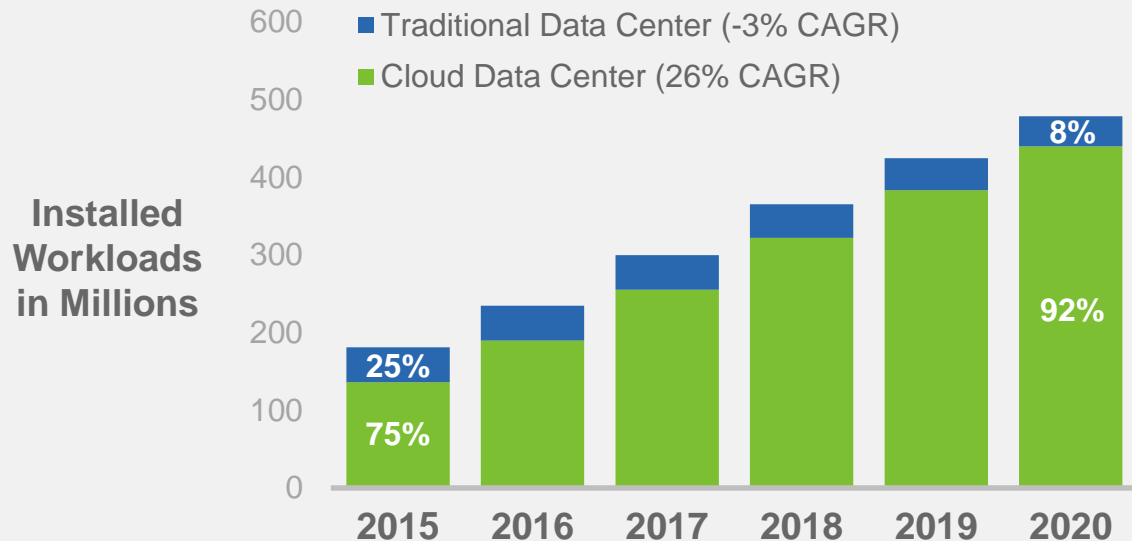


**Cloud Gaming.** SDN can decrease latency, allowing cloud gaming applications to decrease delay by up to 10%.

[Back to Index](#)

# Global Cloud Workloads Surpass Traditional Workloads

92% of All Workloads Will Be in Cloud by 2020



**21% CAGR**  
2015–2020

[Back to Index](#)

# Global Cloud Workload Distribution

Asia Pacific Workloads Grow 4-Fold from 2015 to 2020

North America Will Maintain Largest Share of Cloud Workloads by 2020

## North America

2015: 57.2 Million  
2020: 172.1 Million  
**CAGR 24.6%**

## Western Europe

2015: 27.7 Million  
2020: 76.3 Million  
**CAGR 22.5%**

## Central & Eastern Europe

2015: 4.0 Million  
2020: 12.2 Million  
**CAGR 25.1%**

## Latin America

2015: 5.2 Million  
2020: 16.2 Million  
**CAGR 25.5%**

## Middle East & Africa

2015: 3.6 Million  
2020: 11.8 Million  
**CAGR 26.6%**

## Asia Pacific

2015: 38.3 Million  
2020: 151.5 Million  
**CAGR 31.6%**

[Back to Index](#)

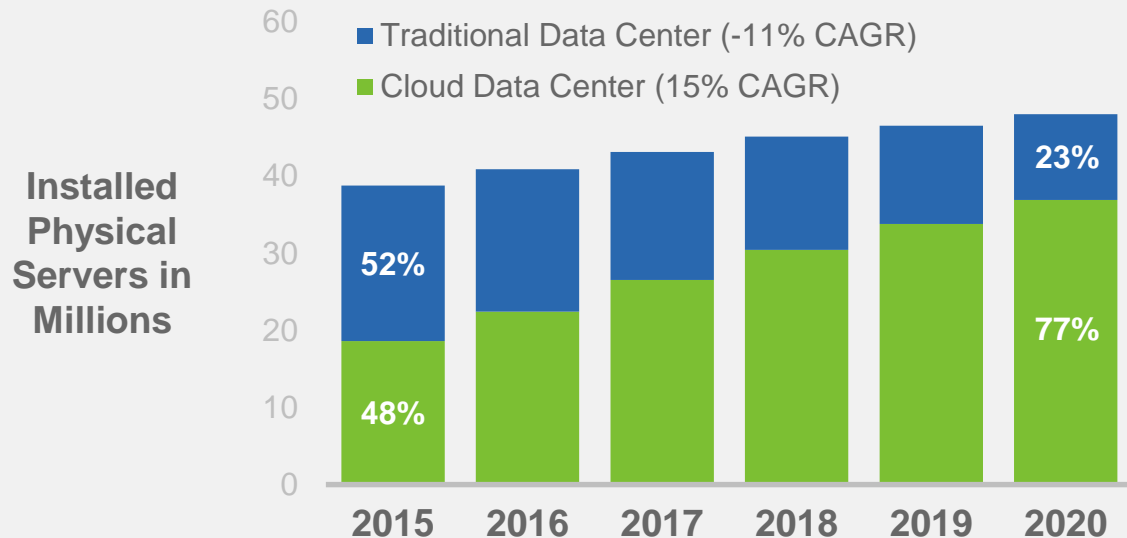
Source: Cisco Global Cloud Index, 2015–2020



# Global Cloud Physical Servers Surpass Traditional Physical Servers

77% of All Installed Servers Will Be in Cloud by 2020

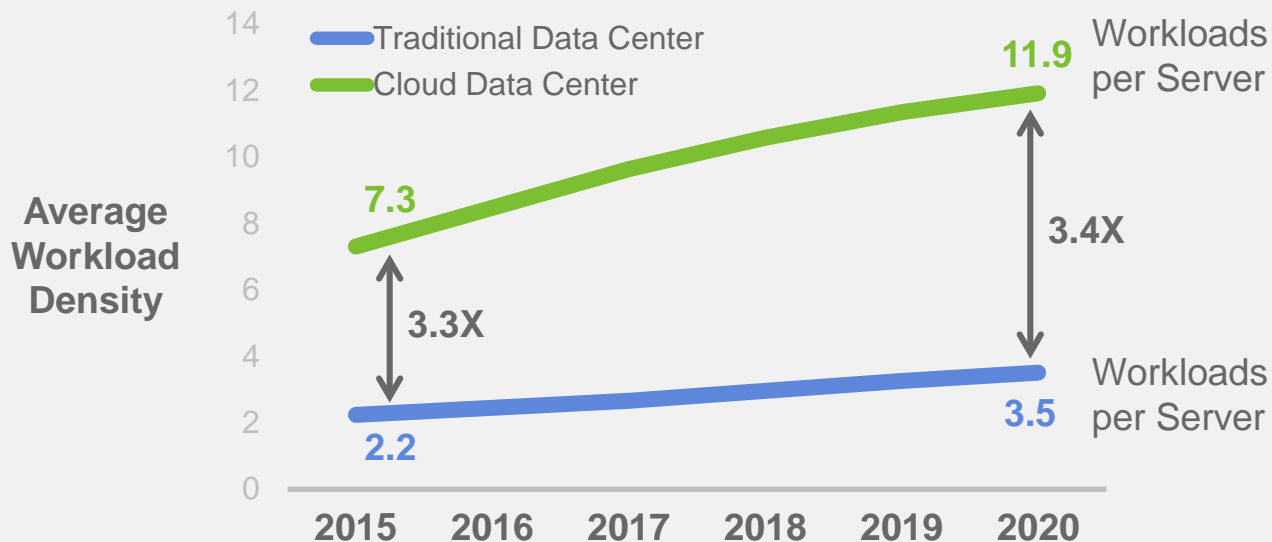
**4% CAGR**  
2015–2020



[Back to Index](#)

# Global Workload Density

Cloud Will Outpace Traditional Data Center by More Than 3-Fold

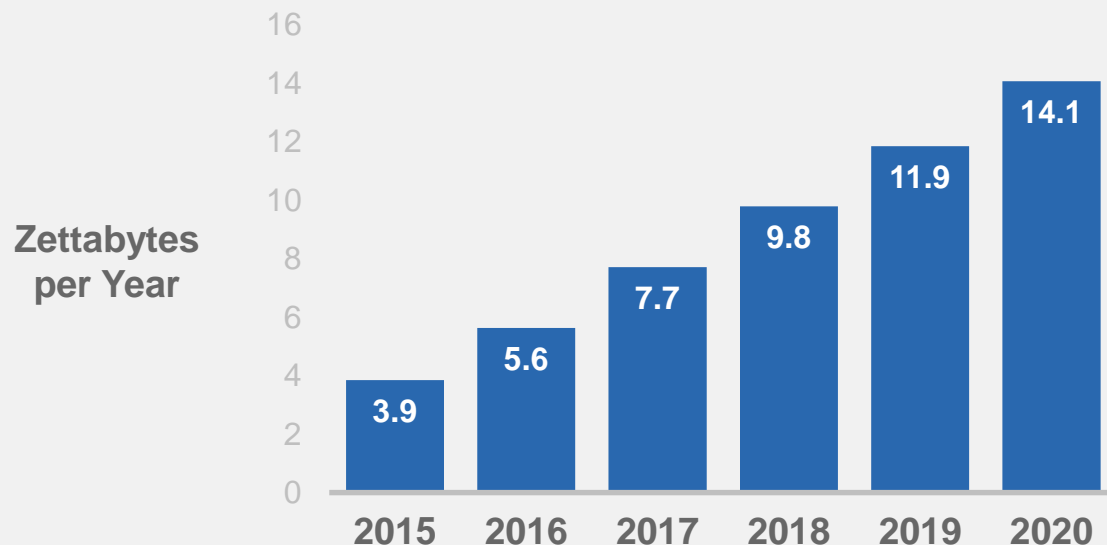


[Back to Index](#)

# Global Cloud Traffic Growth

Cloud Traffic Will Grow 3.7-Fold from 2015 to 2020

Cloud Accounts for 92% of Traffic by 2020 Up from 82% in 2015



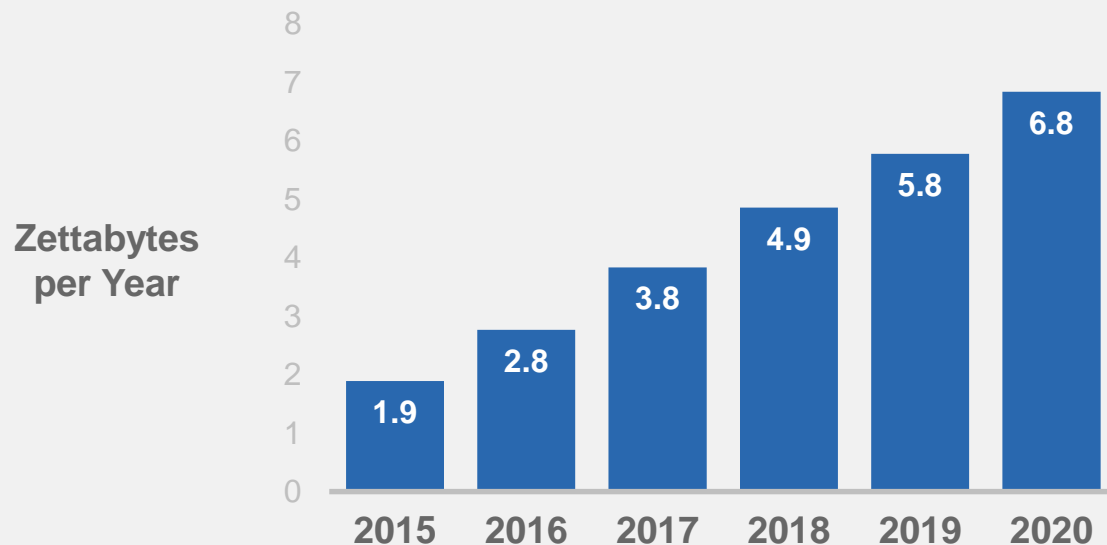
**30% CAGR**  
2015–2020

[Back to Index](#)

# NA Cloud Traffic Growth

Cloud Traffic Will Grow 3.6-Fold from 2015 to 2020

Cloud Accounts for 96% of Traffic by 2020 Up from 88% in 2105



**29% CAGR**  
2015–2020

[Back to Index](#)

# Global Cloud Traffic by Region

North America to Have Highest Traffic Volume by 2020

MEA to Experience Highest Traffic Growth

## North America

2015: 1.9 Zettabytes

2020: 6.8 Zettabytes

**CAGR 29%**

## Western Europe

2015: 718 Exabytes

2020: 2.5 Zettabytes

**CAGR 29%**

## Central & Eastern Europe

2015: 124 Exabytes

2020: 485 Exabytes

**CAGR 31%**

## Latin America

2015: 140 Exabytes

2020: 448 Exabytes

**CAGR 26%**

## Middle East & Africa

2015: 69 Exabytes

2020: 304 Exabytes

**CAGR 34%**

## Asia Pacific

2015: 908 Exabytes

2020: 3.5 Zettabytes

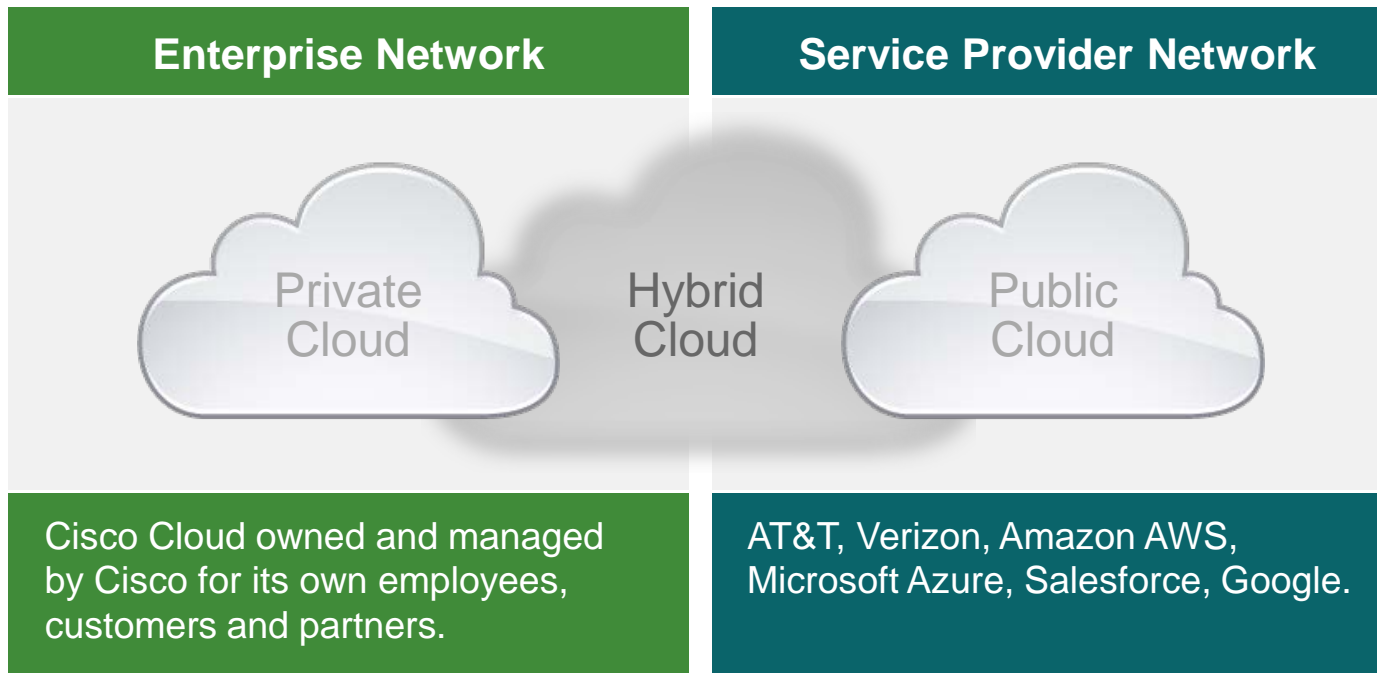
**CAGR 31%**

[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020

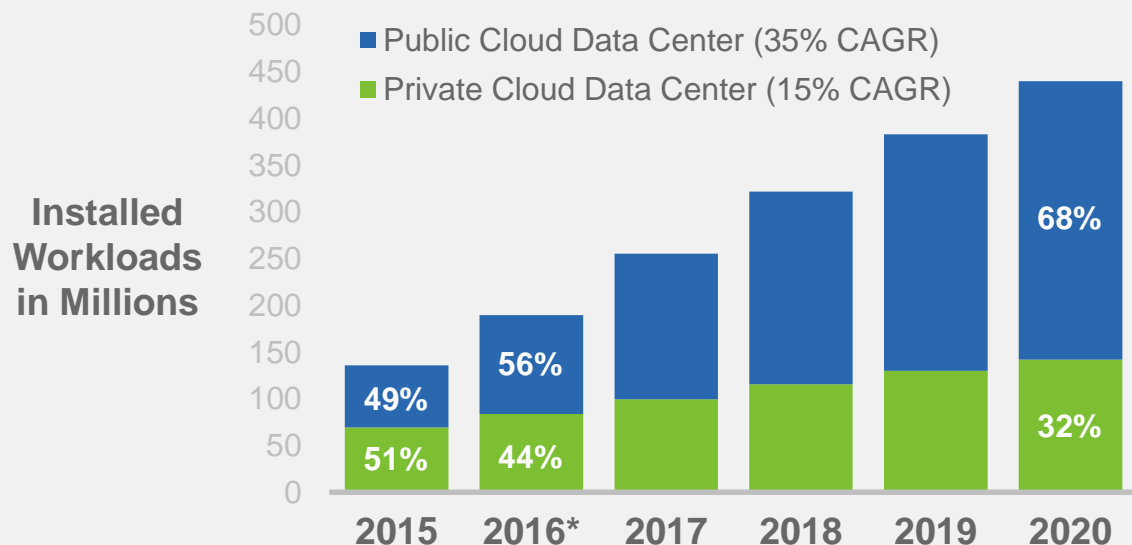
# Private vs. Public Cloud

Hybrid Cloud is a Combination of Private and Public Clouds



# Global Private Cloud vs. Public Cloud

By 2016 Public Cloud will Surpass Private Cloud

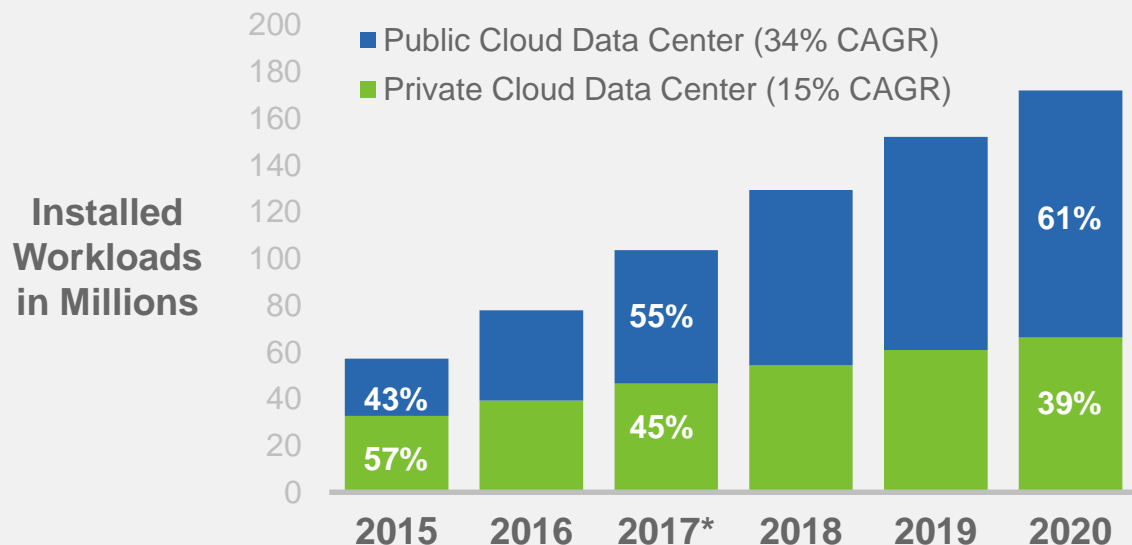


**26% CAGR**  
2015–2020

[Back to Index](#)

# NA Private Cloud vs. Public Cloud

By 2017 Public Cloud will Surpass Private Cloud



**25% CAGR**  
2015–2020

[Back to Index](#)



# Cloud Service Models

## Software as a Service (SaaS)

- Cisco WebEx
- Google Apps
- Salesforce

Generic:

- Web
- Email
- Web Conferencing
- Video streaming
- More

## Platform as a Service (PaaS)

- Google App Engine
- Windows Azure
- AWS Elastic Beanstalk

Generic:

- DevOps
- App deployment
- Testing

## Infrastructure as a Service (IaaS)

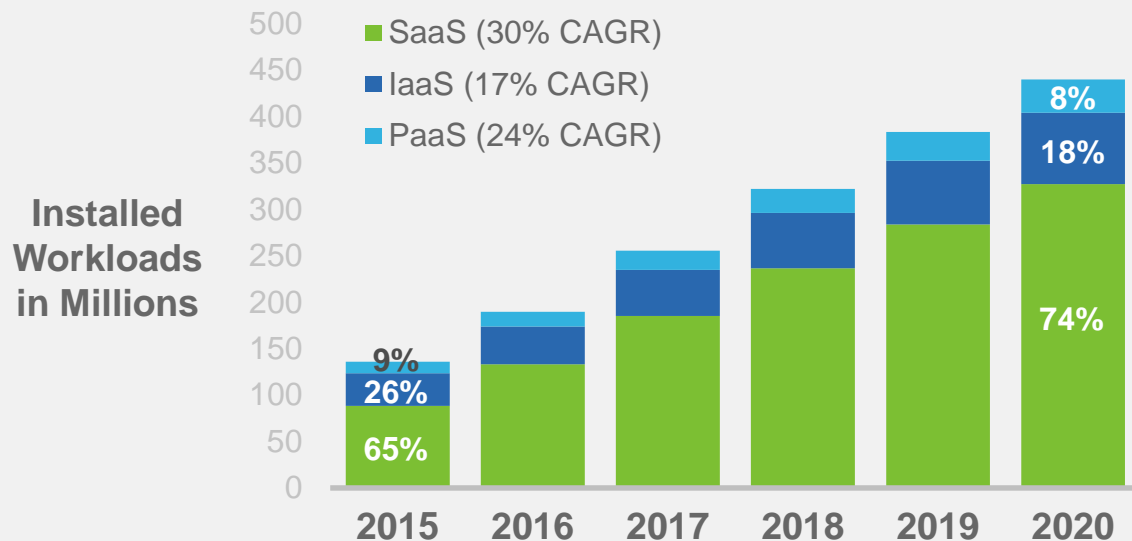
- Amazon AWS
- Rackspace
- Google Compute Engine

Generic:

- Compute as a service
- Virtual desktop infrastructure

# Global Cloud Workloads

## SaaS Most Popular Cloud Service Model Through 2020

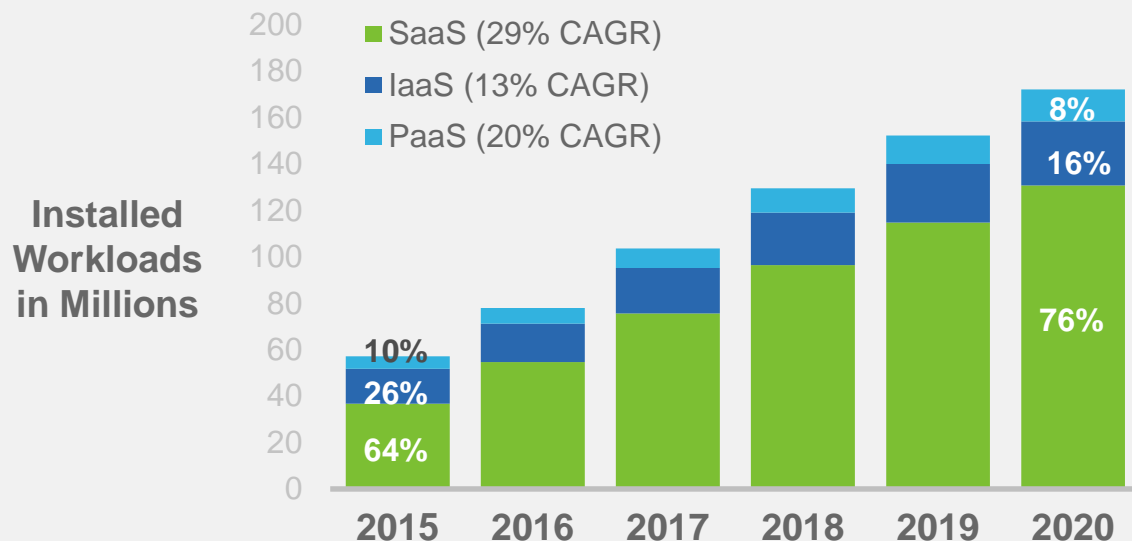


**26% CAGR**  
2015–2020

[Back to Index](#)

# NA Cloud Workloads

## SaaS Most Popular Cloud Service Model Through 2020



**25% CAGR**  
2015–2020

[Back to Index](#)

# SaaS Example: Collaboration in the Cloud

## On a Typical Day

### An Internal Analysis

~40K Meetings

~112K Hours

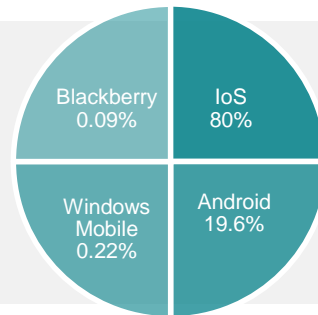
~150K Attendees

August 2015 to  
August 2016





5%

Increase in video  
usage in meetings

Mobile attendees using WebEx are 7% and growing



### An External Analysis

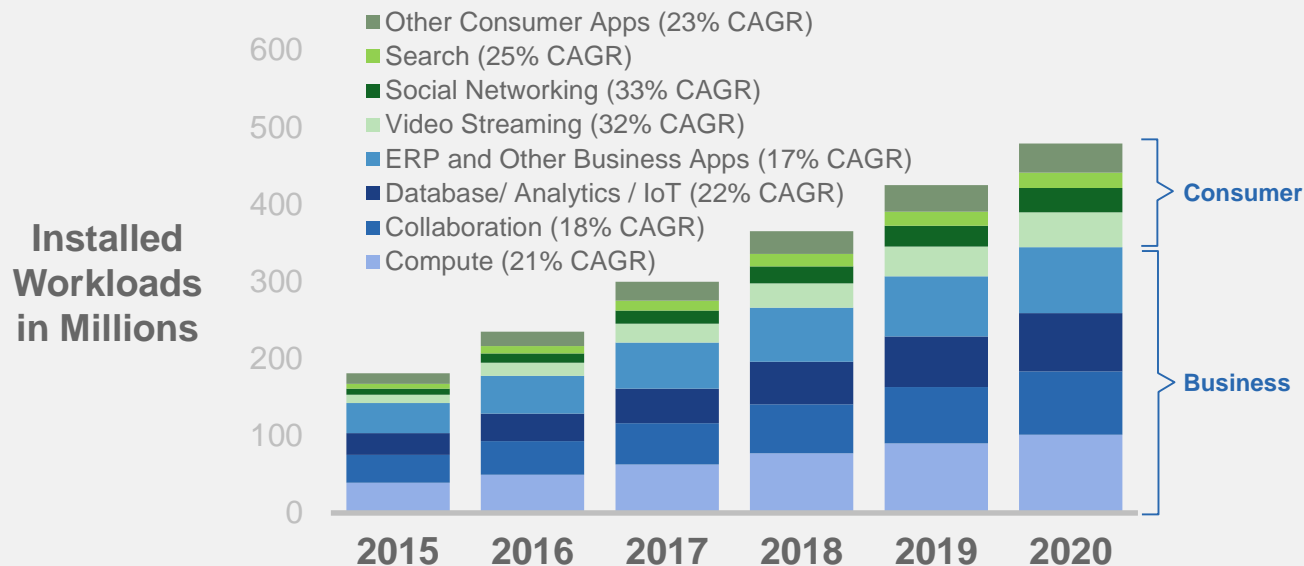
	 Healthcare	 Engineering	 Education	 Banking
Daily End-User Traffic*:	163 TB	6 TB	6 TB	127 TB
Daily Data Center Traffic*:	373 TB	15 TB	13 TB	290 TB

Source: Cisco Tahoe Call Detail Records and Netflow data  
Cisco Global Cloud Index 2015-2020

© 2016 Cisco and/or its affiliates. All rights reserved. Cisco Public

# Global Data Center Workloads

Business Application Workloads Have the Highest Share;  
Social Networking and Media Streaming Have the Fastest Growth



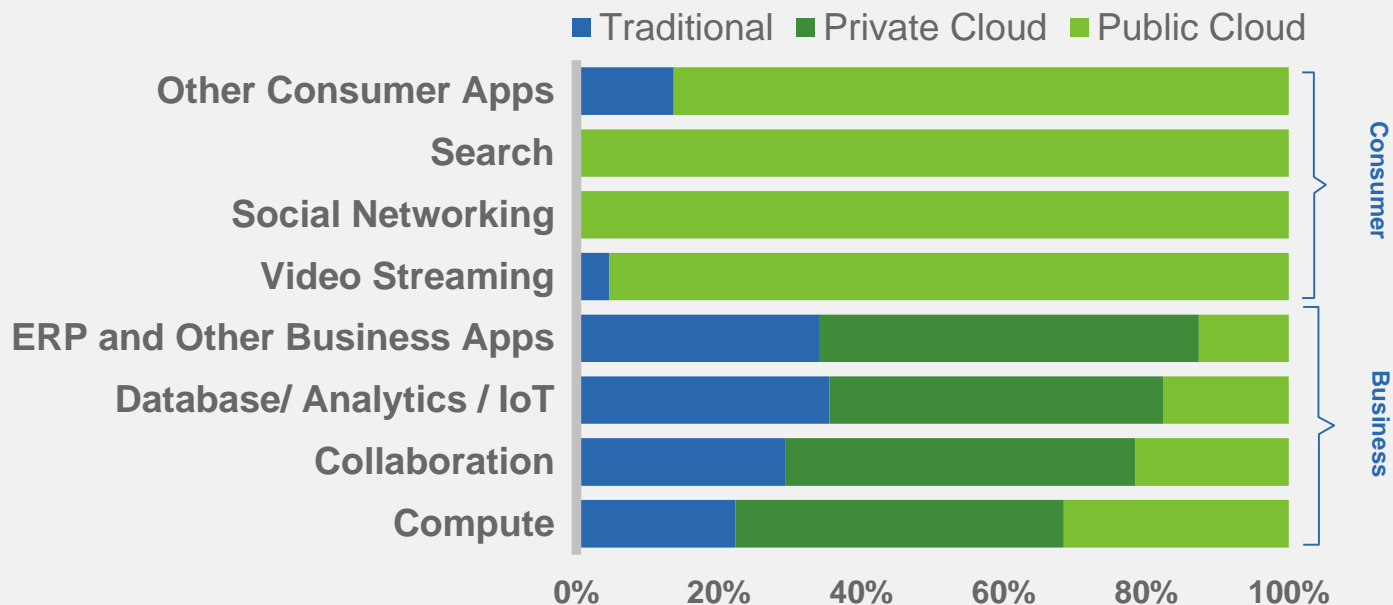
**21% CAGR**  
2015–2020

[Back to Index](#)

# Global Data Center Workloads—2015

Private Cloud Dominates Enterprise Workloads

Public Cloud Dominates Consumer Workloads

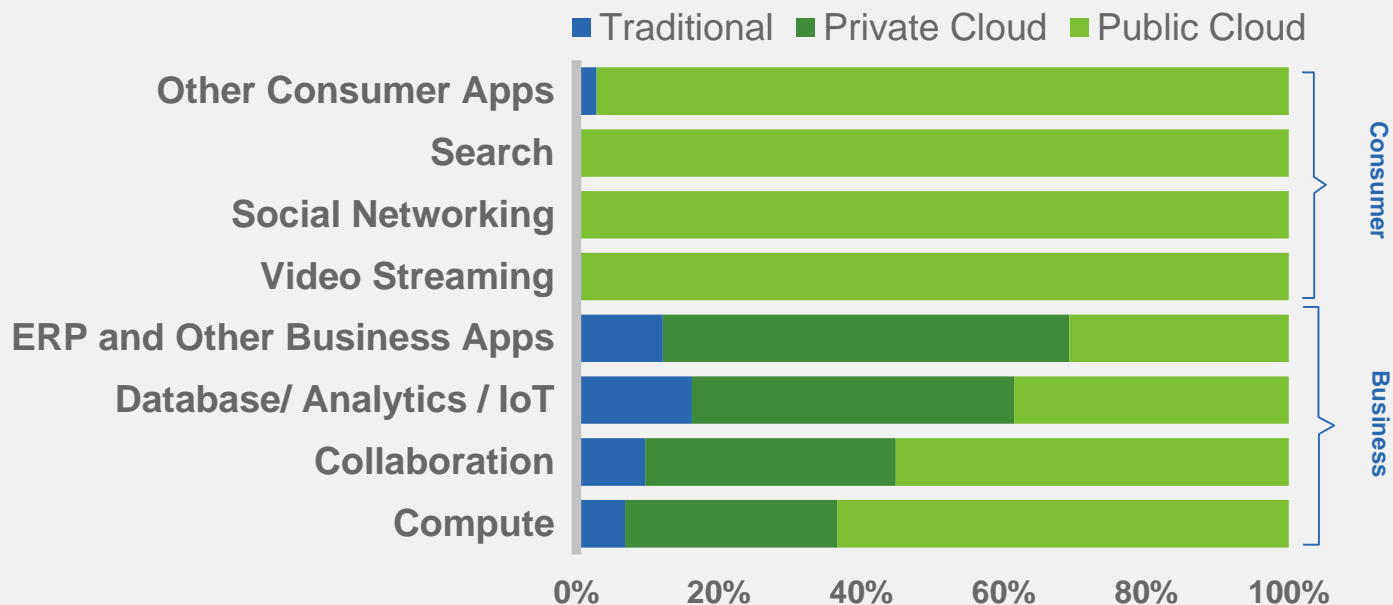


[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020

# Global Data Center Workloads—2020

## Public Cloud Dominates Consumer Applications

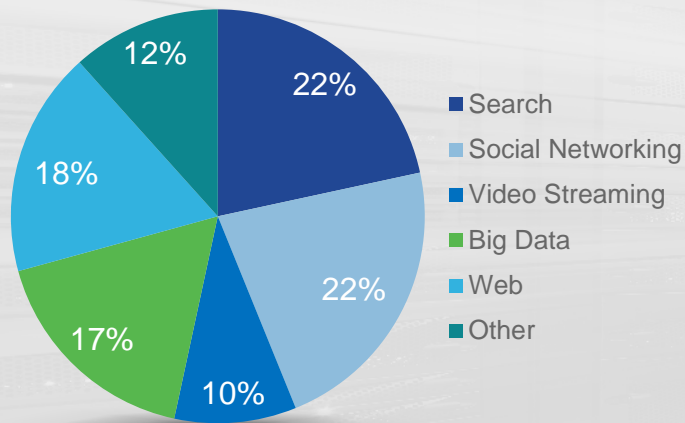


[Back to Index](#)

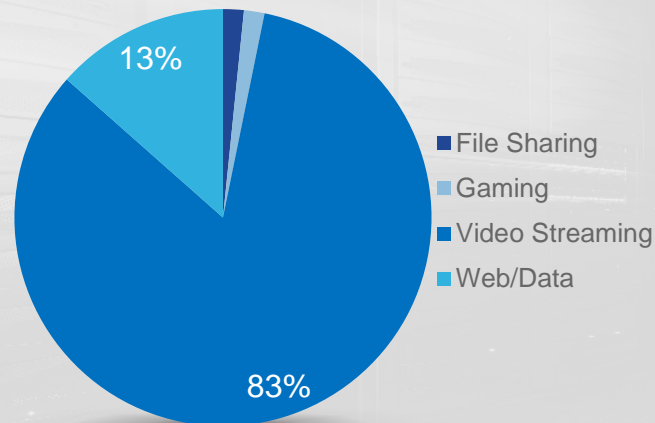
Source: Cisco Global Cloud Index, 2015–2020

# Data Center Traffic by Application—2020

## Within Data Center



## Data Center to End User



Big Data is the fastest growing application within the data center, from 10% in 2015 to 17% in 2020  
Video is only 10% within the data centers but is 83% of data center to end-user

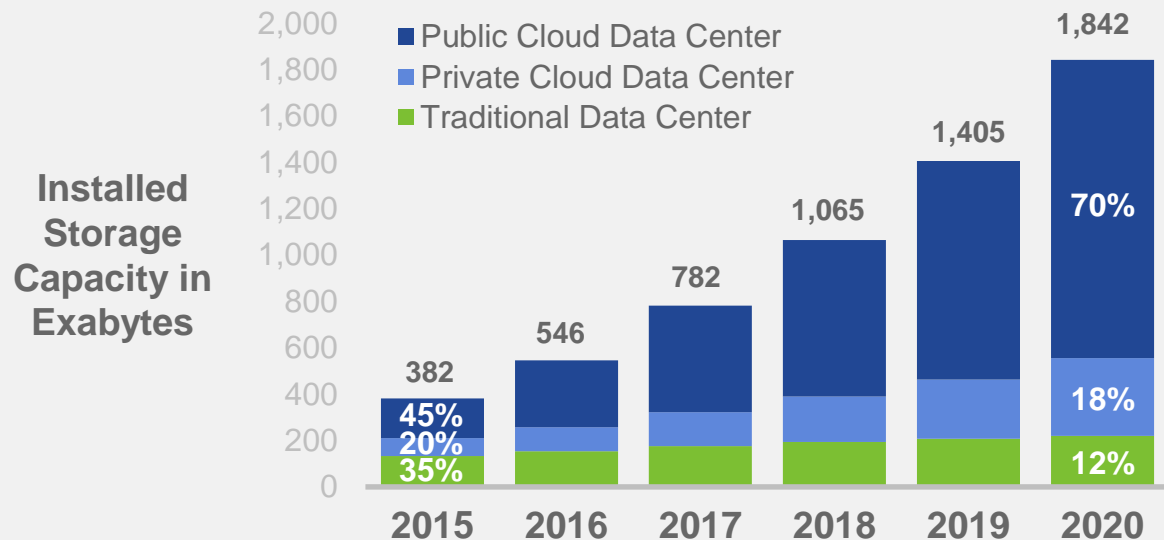
[Back to Index](#)



# Global Data Center Storage: Traditional vs. Cloud

Total Data Center Storage Will Grow Nearly 5-fold from 2015-2020

Cloud Accounts for Nearly 90% of Installed Storage by 2020

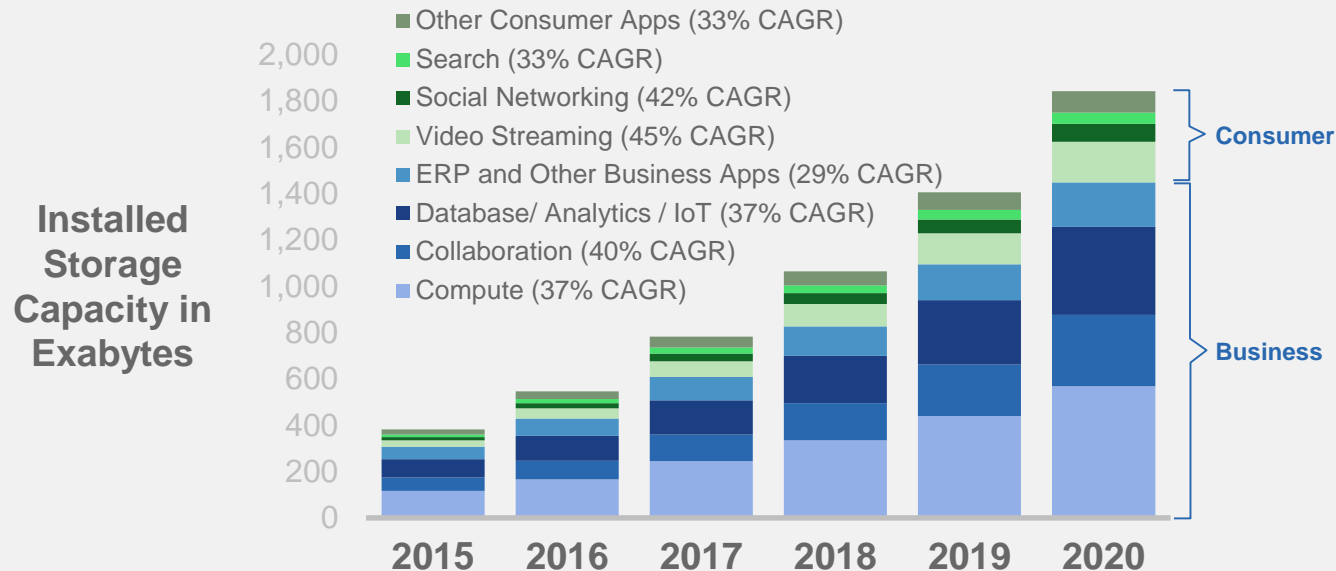


**37% CAGR**  
2015–2020

[Back to Index](#)

# Global Data Center Storage by Workloads

Enterprise Application Workloads Have the Highest Share; Social Networking and Media Streaming Have the Fastest Growth

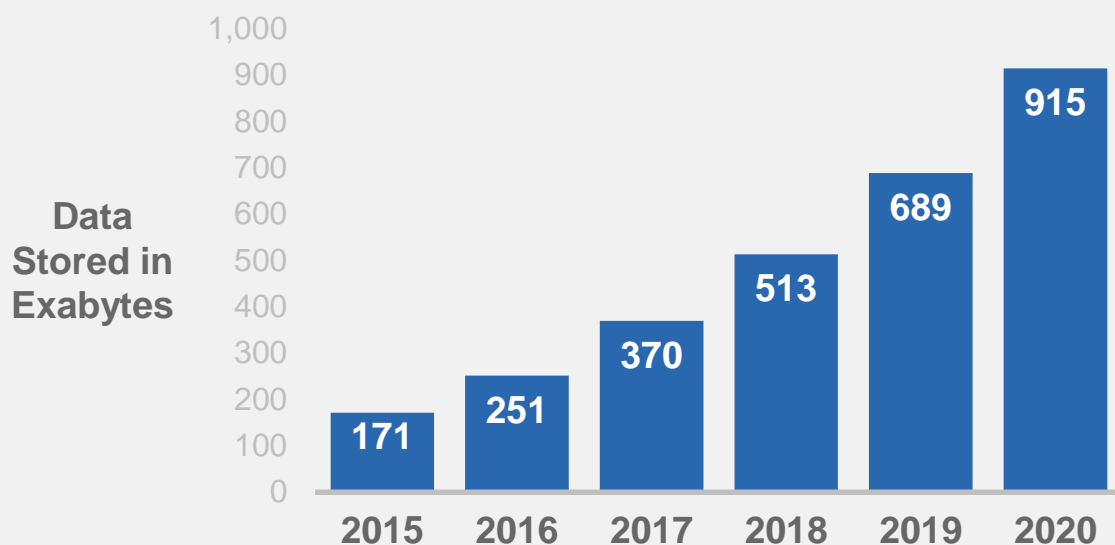


**37% CAGR**  
2015–2020

[Back to Index](#)

# Data Stored in Data Centers

Data Stored to Quintuple by 2020



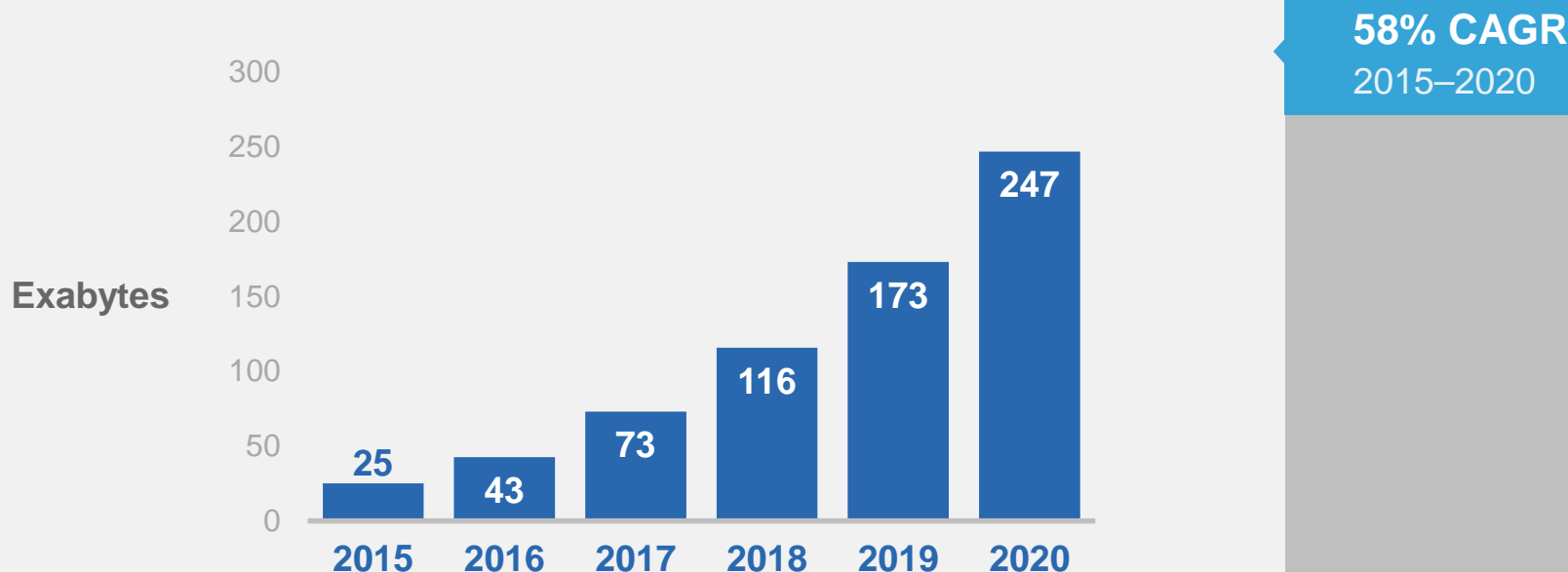
**40% CAGR**  
2015–2020

[Back to Index](#)

# Big Data Forecast

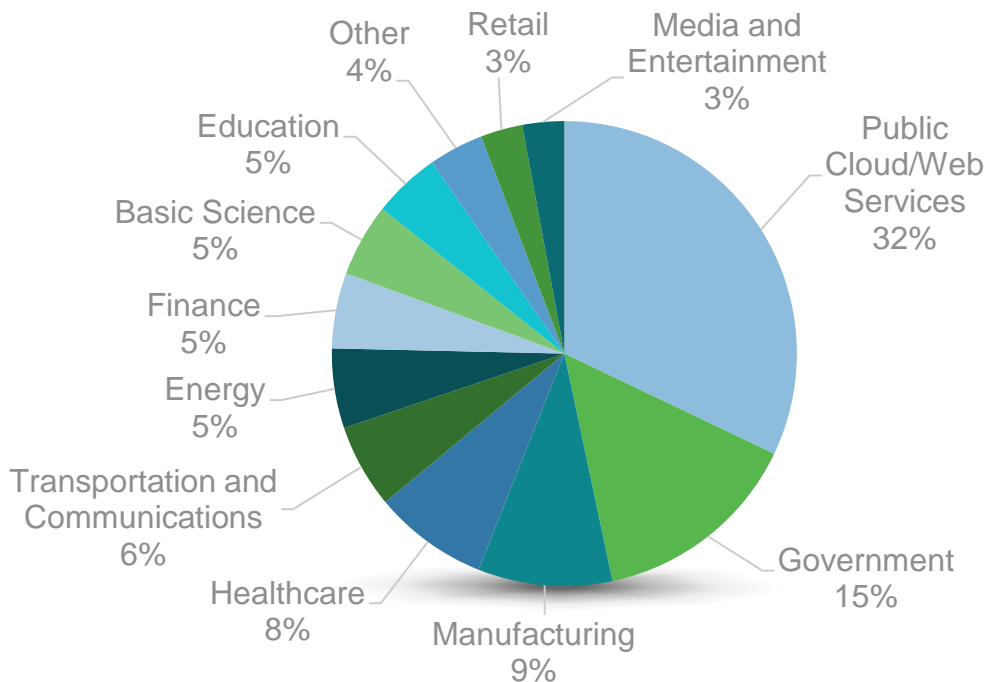
Big Data Volume Grows 10-Fold

Big Data will Represent a Quarter of All Data in Data Center by 2020



[Back to Index](#)

# Data Stored in Data Centers by Vertical—2015



Source: Cisco Global Cloud Index, 2015–2020 and various public sources

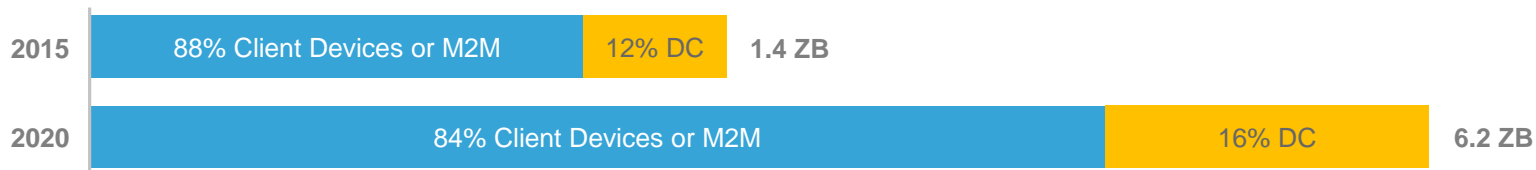
Data Center or Data Set	Size in PB*
Google Data Centers	8,000-10,000
Amazon Cloud Services	7,000-9,000
US Department of Defense	2,000-4,000
Baidu	1,000
Dropbox	500
Bank of America	170
NOAA Weather	120
Large Hadron Collider (CERN)	100
University of Pittsburgh Medical	85
European Bioinformatics Institute	75
Credit Suisse	40
Volkswagon	35
UPS	21

\* Total data stored at the end of 2015

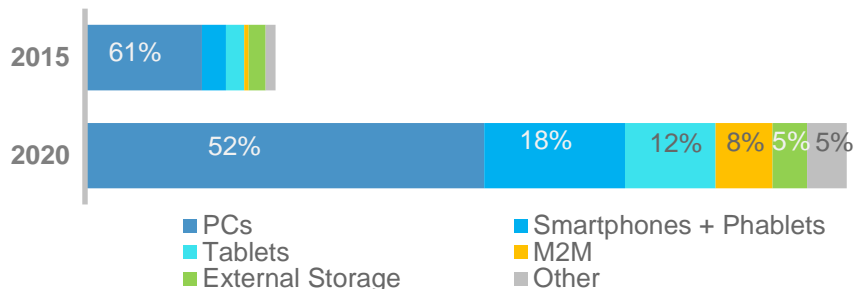
[Back to Index](#)

# Total Stored Data

The volume of all data stored will almost triple by 2020 from 1.4 ZB to 6.2 ZB.  
Most data is stored on client devices, but more moves to the data center over time.

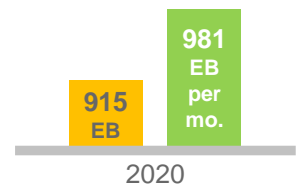


## Data Stored on Client Devices (PCs, Tablets, Phones, M2M...)



Stored data on M2M modules grows the fastest at 68% CAGR

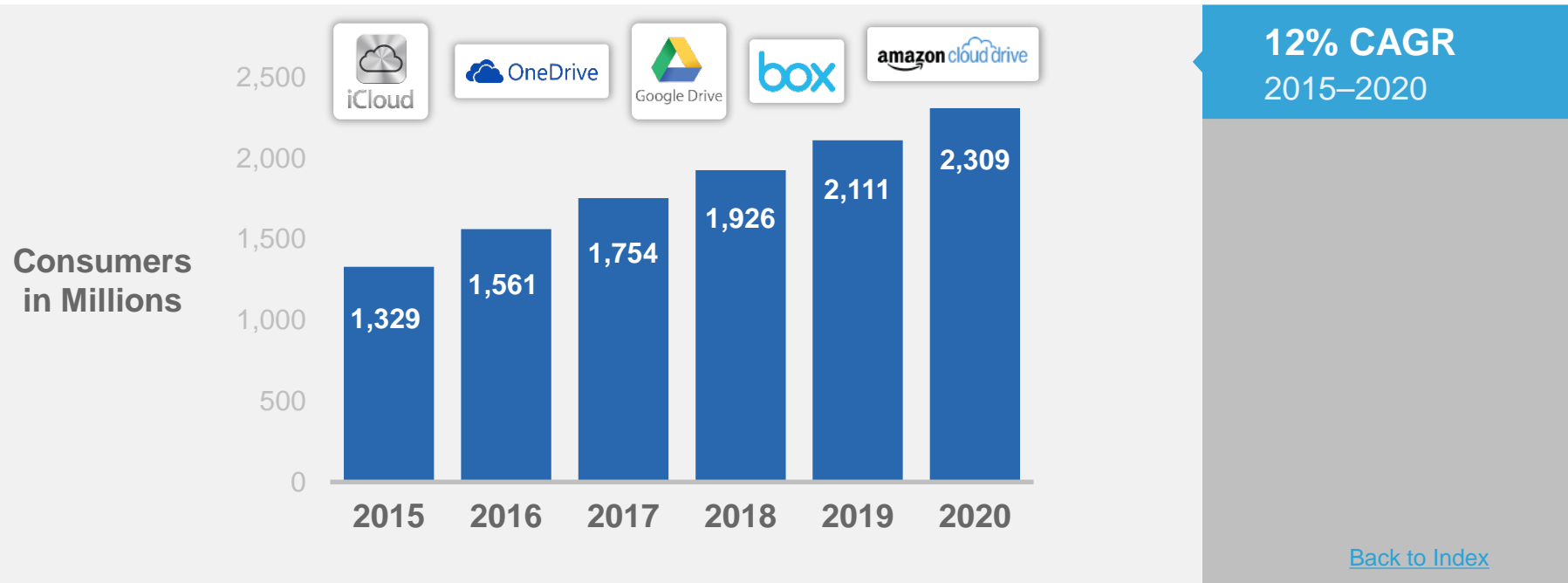
## Data Stored in Data Centers



The gap between traffic and stored reduces over the forecast period

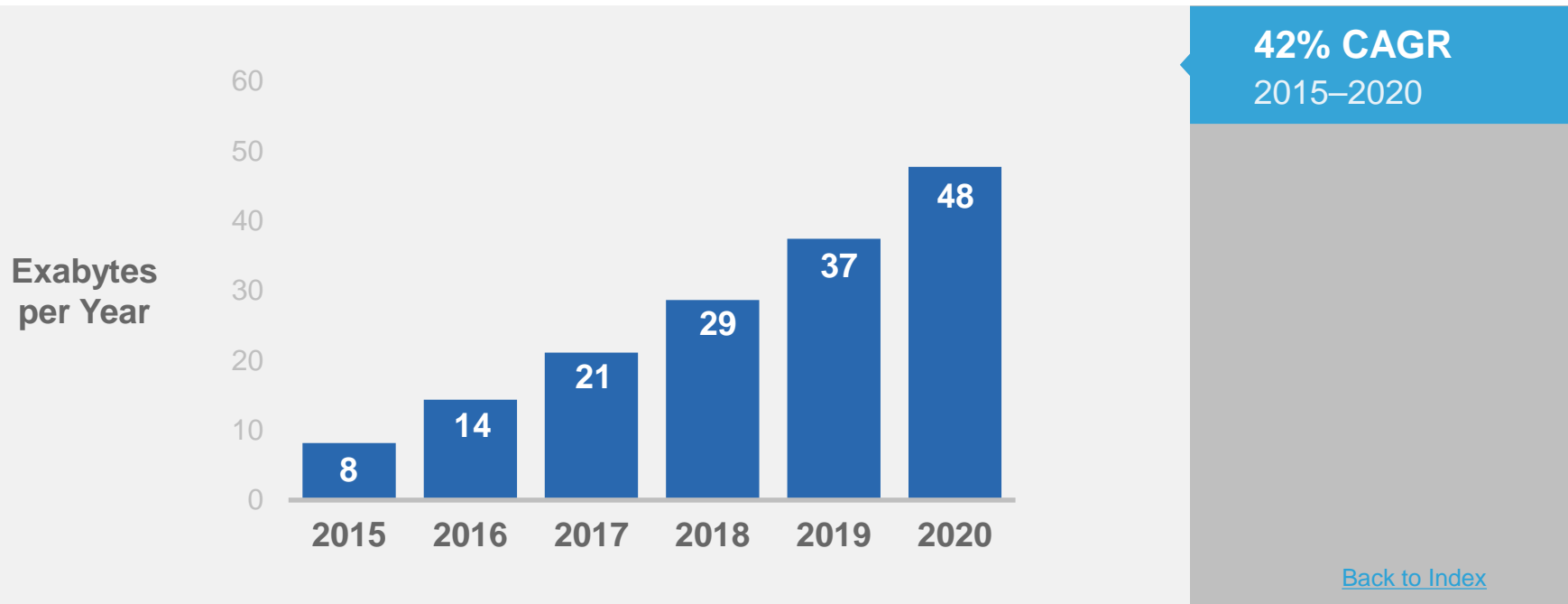
# Global Personal Cloud Storage

Majority, 59%, of Residential Internet Users Will Use Cloud Storage by 2020



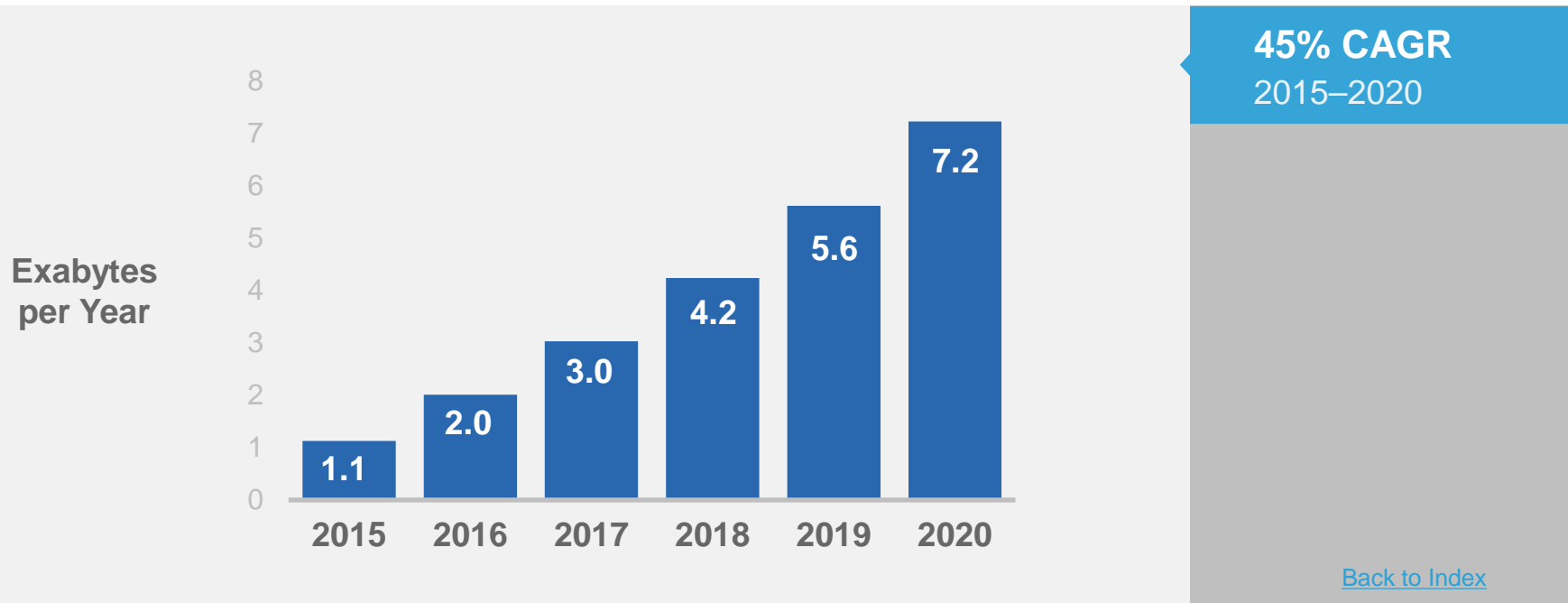
Source: Cisco Global Cloud Index, 2015–2020; Juniper Research

# Global Personal Cloud Storage Traffic\*





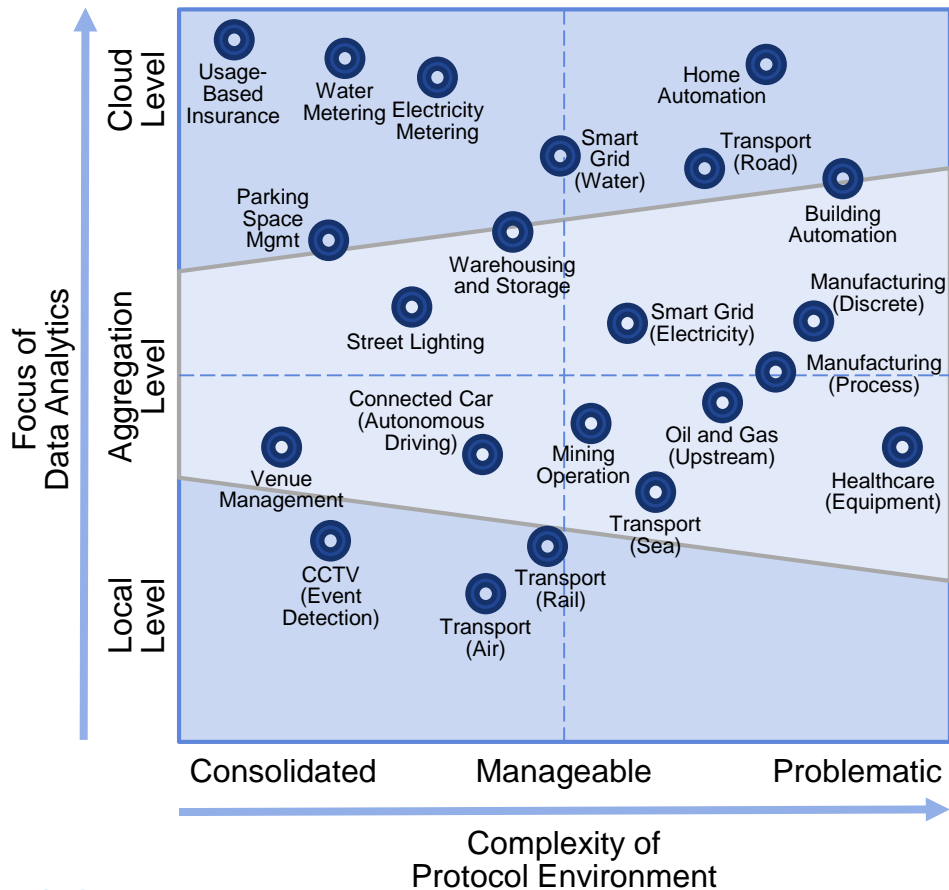
# NA Personal Cloud Storage Traffic\*





By 2020, **59% (2.3 Billion)** of global residential Internet users will use **personal cloud storage**. The average monthly traffic per user will be **1.7 GB**.

[Back to Index](#)



# M2M Applications and Cloud Computing

## Different levels of Data Analytics Requirements Drive Fog / Cloud

Whether data analytics is done in cloud or at the edge (fog) will be driven primarily by time-sensitivity and complexity of data analytics requirements.

[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020;  
Machina Research

# The Data Universe

900 Exabytes of Data  
in Data Centers

5.2 Zettabytes of Data Stored in Devices

600 Zettabytes of Data Created Everywhere

[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020

## Multiple Applications Create Big Data

40 TB per day (0.1% transmitted)

1 PB per day (0.2% transmitted)

50 PB per day (<0.1% transmitted)

10 MB per day (5% transmitted)

A city of  
one million  
will generate  
200 million gigabytes  
of data per day  
by 2020

275 GB per day (1% transmitted)

5 TB per day (0.1% transmitted)

70 GB per day (0.1% transmitted)

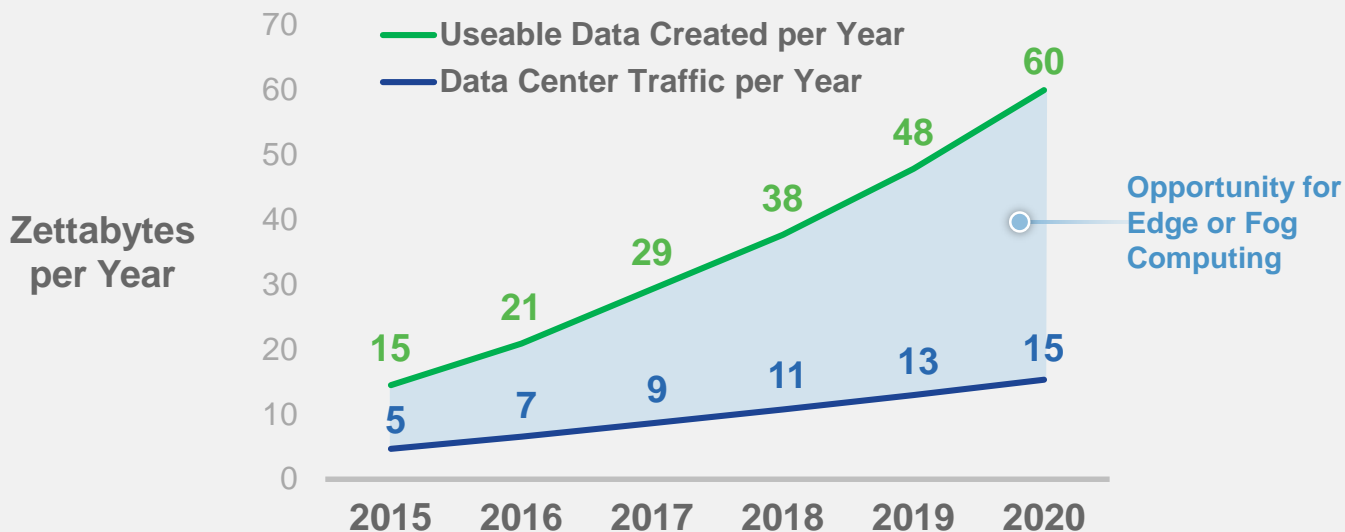
5 GB per day (1% transmitted)

[Back to Index](#)

Source: Cisco Global Cloud Index, 2015–2020

# Data Created vs. Data Center Traffic

Data Created Outpaced



[Back to Index](#)

# Examples of Broad Cloud Adoption

## Barriers Overcome and Operational Efficiency Prevails



### Netflix Closes Last DC, Completes Cloud Migration

"We rely on the cloud for all of our scalable computing and storage needs—our business logic, distributed databases and big data processing/analytics, recommendations, transcoding, and hundreds of other functions."

—Netflix Representative



### 34.3% of Health Information Exchange is Already in the Cloud

"Healthcare organizations are increasingly willing to trust the cloud with Protected Health Information (PHI). 36.2% of patient engagement tools are in the cloud and 5.3% of the organizations leverage cloud for compute cycles to analyze big data."

—2016 HIMSS Analytics Cloud Survey

Deutsche Bank



### Banks to Move 30% of Workloads to Cloud in 3 Years

"Pressure to cut infrastructure costs, increased flexibility, paired with security and compliance services from the cloud vendors has boosted banks' willingness to explore the technology."

—Wall Street Journal



### More than 50% of Workloads in the Cloud

The integrated oil company is undergoing a large scale migration to public cloud. "Pretty much anything and everything we're setting up, they have sensors."

—Zhanna Golodryga, Hess CIO

GE oil and gas migrated half of it's core application to the cloud.

[Back to Index](#)

# Global Cloud Readiness

## Business and Consumer Apps/Network Requirements

### Basic Cloud Apps

#### Network Requirements:

Download Speed:  
Up to 750 kbps

Upload Speed:  
Up to 250 kbps

Latency: Above 160 ms



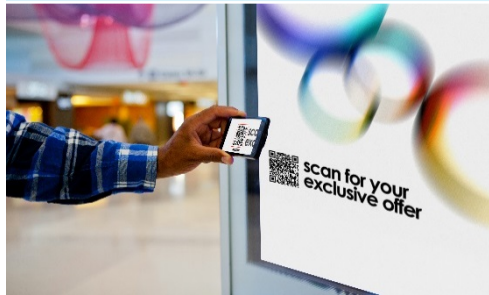
### Intermediate Cloud Apps

#### Network Requirements:

Download Speed:  
751–2,500 kbps

Upload Speed:  
251–1,000 kbps

Latency: 159–100 ms



### Advanced Cloud Apps

#### Network Requirements:

Download Speed:  
Higher than 2,500 kbps

Upload Speed:  
Higher than 1,000 kbps

Latency: Less than 100 ms





# Regional End-User Cloud Readiness—2016

## Supporting Business and Consumer Applications on **Fixed** Networks\*



In 2016, **132 countries** met the advanced single application readiness criteria for fixed networks, compared to **119 countries** last year.

*\* Non-Concurrent Apps*

[Back to Index](#)

# Regional End-User Cloud Readiness—2016

Supporting Business and Consumer Applications on **Mobile** Networks\*



In 2016, **89 countries** met the advanced single application readiness criteria for mobile networks, compared to **81 countries** last year.

*\* Non-Concurrent Apps*

[Back to Index](#)

# Insecurity in the Internet of Things

Dyn, one of the internet's biggest DNS hit with a DDoS



145,000 devices were infiltrated, including security cameras and DVRs in homes and offices around the world.

Largest ever attack recorded, clocking in at 620 Gbps at its peak.

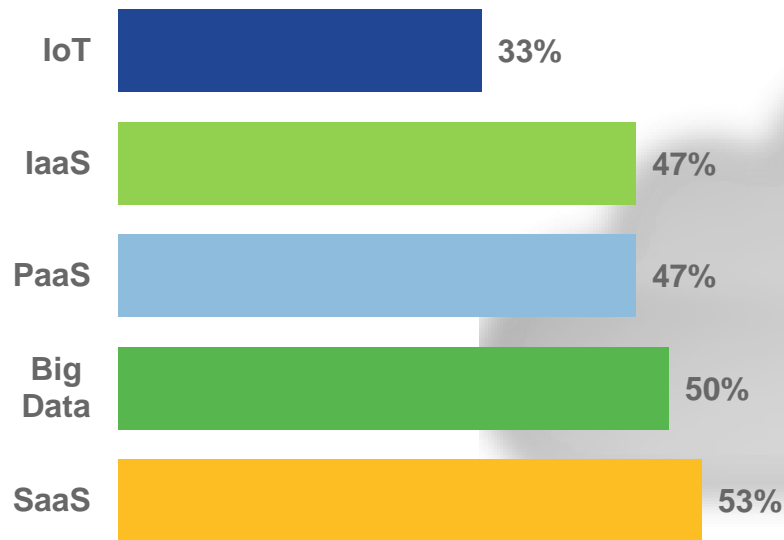
At its peak, equivalent to the entire Internet traffic in Chile, New Zealand, South Africa or Saudi Arabia

[Back to Index](#)

# Sensitive Data in the Cloud

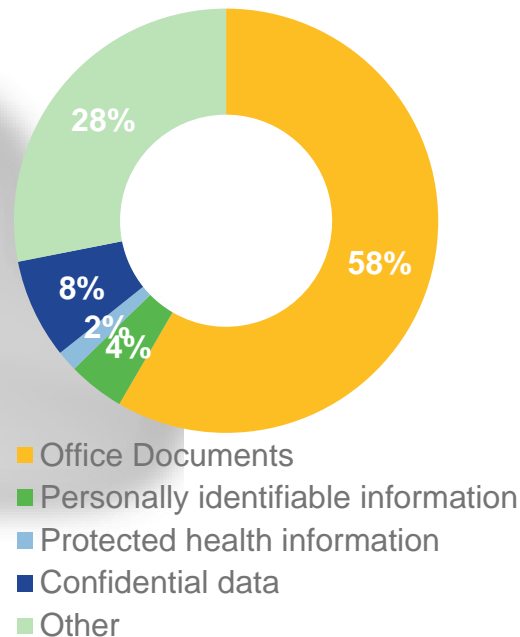
## Sensitive Data Use by Enterprises in Cloud

53% of Sensitive Data Use in the cloud on SaaS



Source: 2016 Vormetric Data Threat Report, 451 Research Group

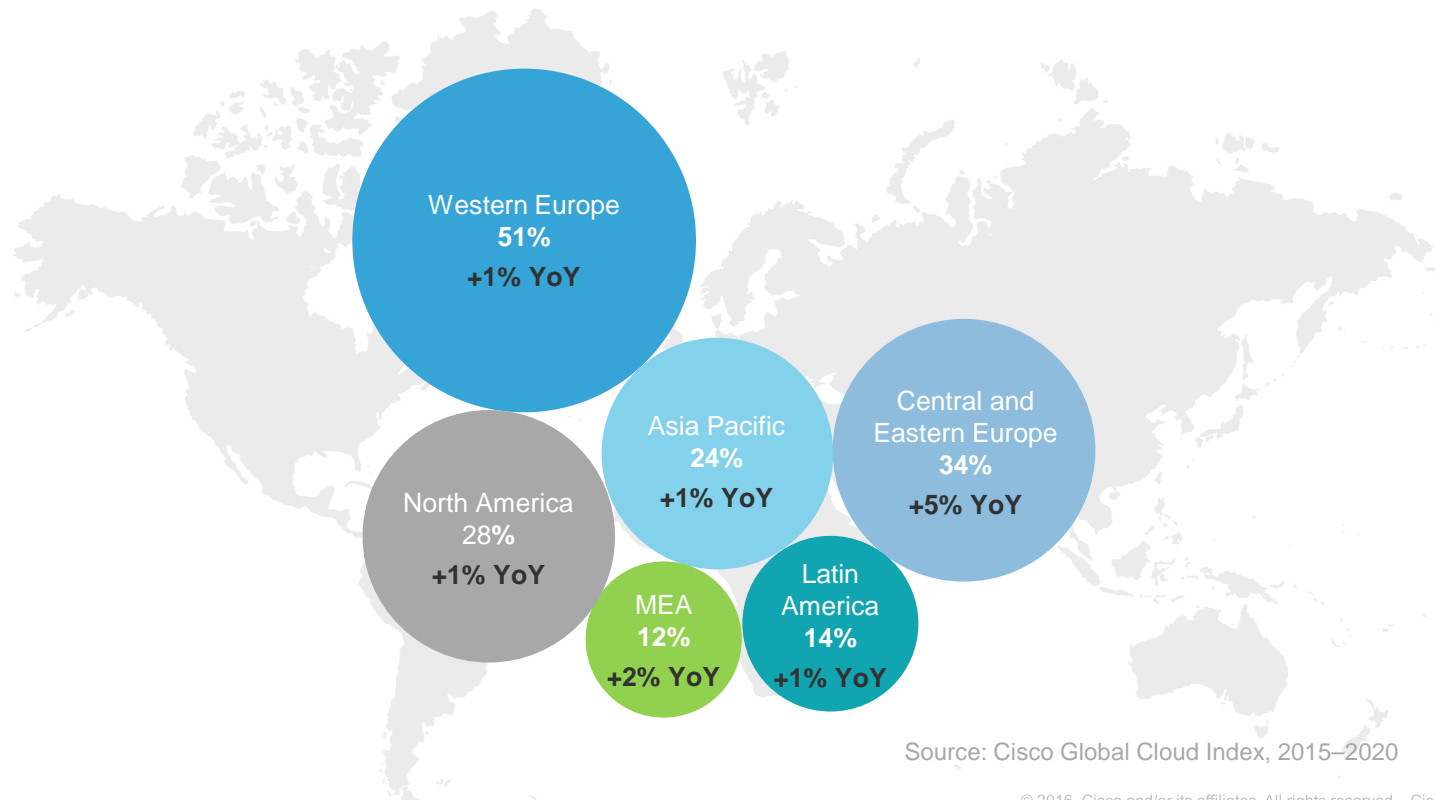
## Percentage of sensitive data stored in the cloud



Source: SkyHigh Cloud Adoption & Risk Report (2016)

# Enabling Authentication and Secure Internet

## Percentage of Secure Internet Servers to All Web-Facing Servers



Source: Cisco Global Cloud Index, 2015–2020

[Back to Index](#)

# Cisco Global Cloud Index

Where to Find More Information / Direct Questions

[www.cisco.com/go/cloudindex](http://www.cisco.com/go/cloudindex)



- Media Release
- GCI White Paper
- Cloud Readiness Report
- GCI Q&A
- GCI Highlights Tool
- Cloud Readiness Tool

To further engage and ask questions, please join the GCI community:

<https://communities.cisco.com/community/solutions/sp/vni-gci>

[Back to Index](#)

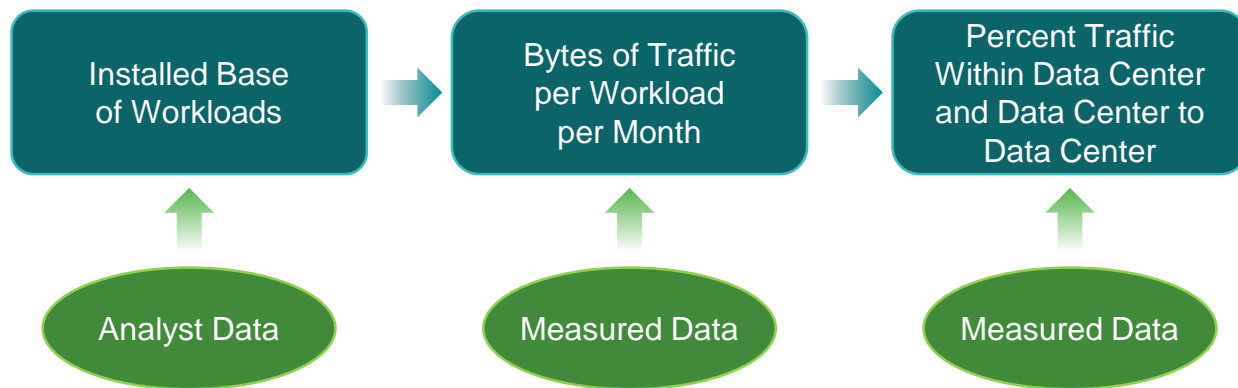




# Global Cloud Index Forecast Methodology

## Projecting Data Center and Cloud Traffic Growth

The methodology begins with the installed base of workloads categorized by workload type and implementation and then applies the volume of bytes per workload per month to obtain the traffic for current and future years.



Detailed methodology description and specific analyst sources included in complete GCI report



# Evolution of Data Center

## Hardware-Defined Network



Purpose-Built Appliances  
High Availability  
High Reliability  
Overprovisioned in the Core

## Software-Defined Network and NFV



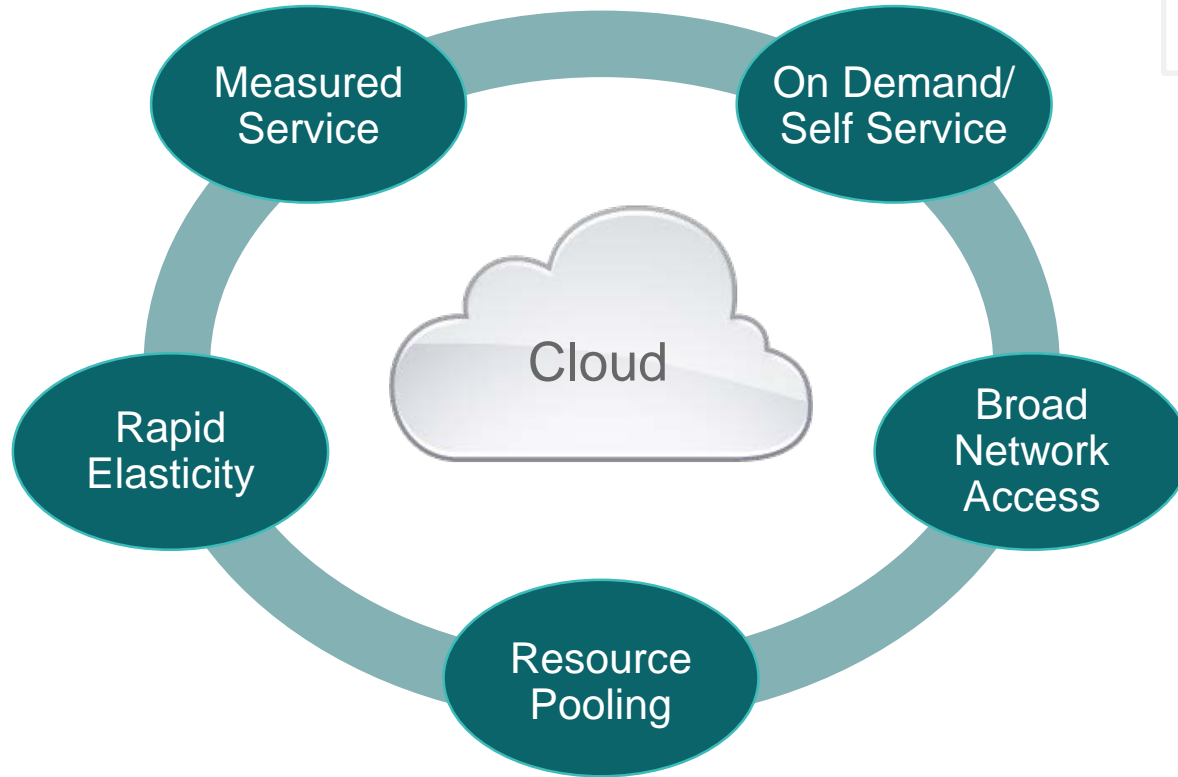
Traffic Engineering  
Dynamic Service Chaining  
Rapid Provision and Service Creation  
Scaling Services  
Workload Mobility  
High Flexibility  
Customization

## Data-Defined Network



Big Data + AI + SDN/NFV  
Predictive Load Balancing  
Intelligent Congestion Management

# Cloud Definition by NIST



# Containers and VMs—A Comparison

## Containers

- Application focused
- Resource efficient
  - don't need hypervisors
  - share a single OS
- Faster and efficient provisioning
- Suited for deploying similar workloads simultaneously at scale
- Security risk from vulnerabilities in shared OS version/ kernel
- Not suited for multi-tenant environments
- Can be migrated to other servers with compatible OS kernels

## Virtual Machines

- Server focused
- Resource heavy
  - need hypervisors to emulate the physical server hardware
  - need own OS copy
- Slower to provision
- Vulnerabilities in particular OS versions cannot be leveraged to compromise other VMs
- Can be migrated from one server to another with suitable hypervisor, without regard for the system's OS

Containers and VMs Can Coexist—Complimentary Technologies