Cisco Visual Networking Index (VNI) and VNI Service Adoption

Global Forecast Update, 2016–2021

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Global Internet Growth and Trends

Key Digital Transformers

By 2021

	More Internet Users	More Devices & Connections	Faster Broadband Speeds	More Video Viewing
2016	3.3 Billion	17.1 Billion	27.5 Mbps	73% of Traffic
2021	4.6 Billion	27.1 Billion	53.0 Mbps	82% of Traffic

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

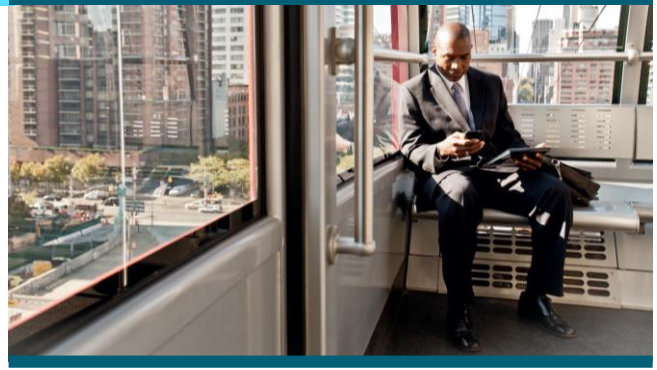
Overview

Establishing the Zettabyte Era

By 2021, global IP traffic will reach an annual run rate of 3.3 zettabytes per year

What is a zettabyte?

- One trillion gigabytes
- Approximately 10^{21} (1,000,000,000,000,000,000,000 bytes)



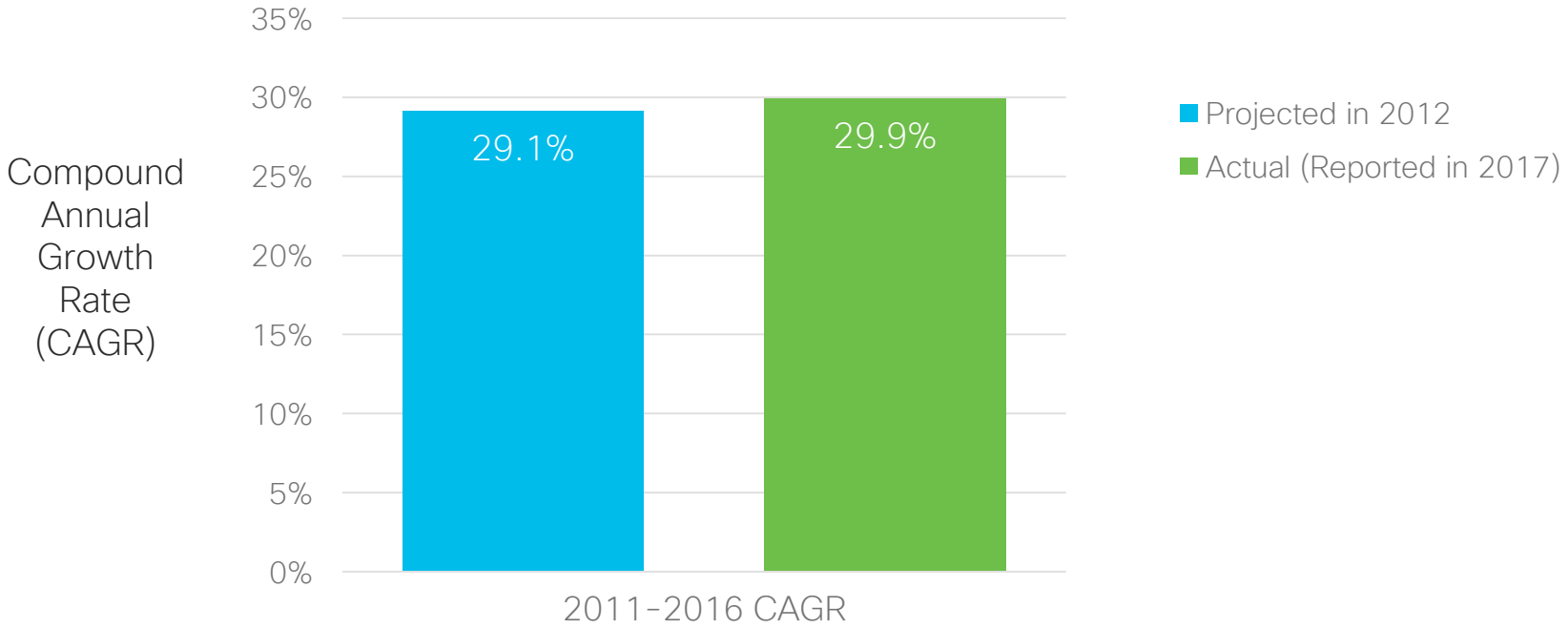
3.3 zettabytes is equal to:

- 14X more than all IP traffic generated in 2010 (232 exabytes)
- All movies ever made crossing global IP networks every minute

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

VNI Projections and Actuals (Global)

Actual growth has been within ±10% of projected growth

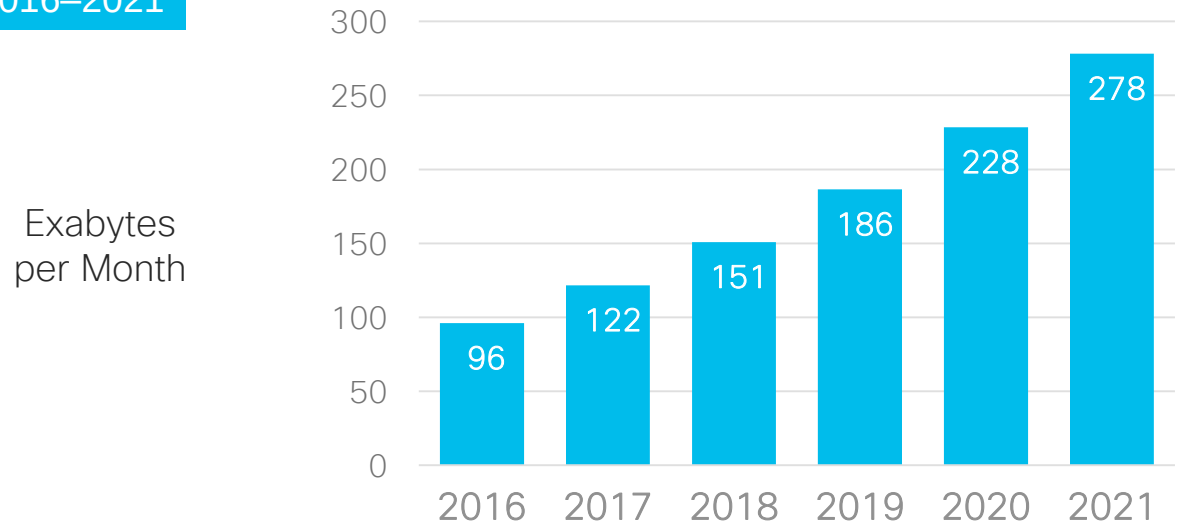


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global IP Traffic Growth

Global IP traffic will increase 3-fold from 2016 to 2021

24% CAGR
2016–2021

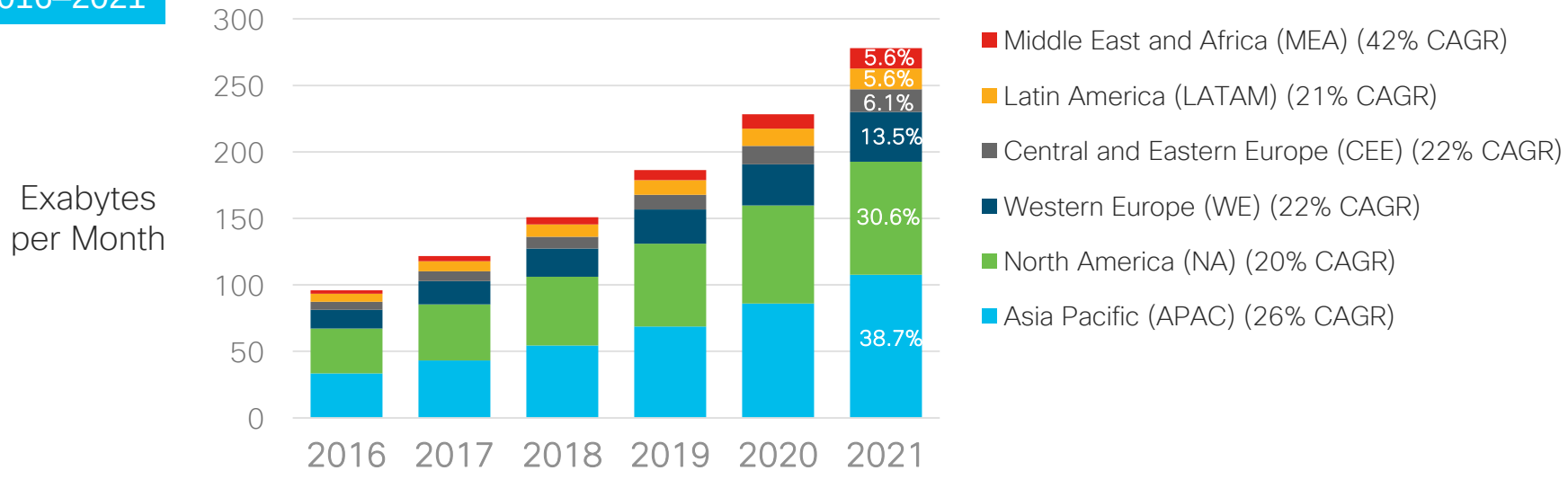


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global IP Traffic Growth by Region

MEA has the highest growth rate (42%) from 2016 to 2021
APAC will generate 39% of all IP traffic by 2021

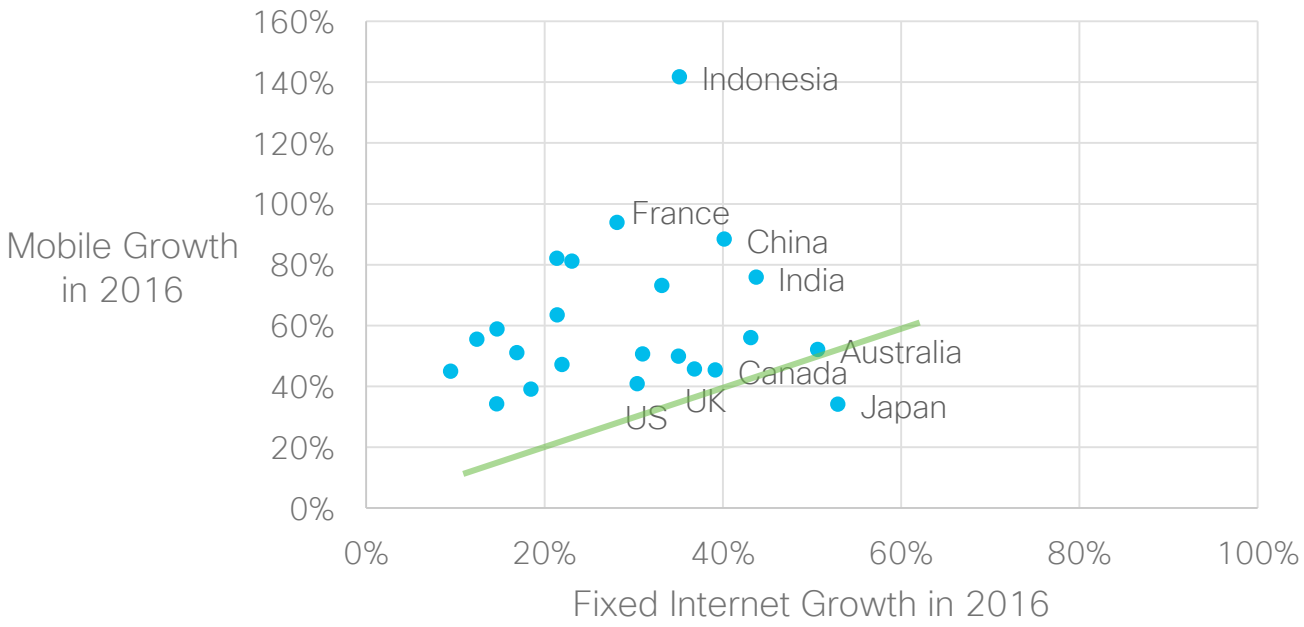
24% CAGR
2016–2021



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Fixed and Mobile Growth in 2016

Most countries have higher mobile than fixed growth
But there are a growing number of exceptions



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Top Trends

Top Trends

Devices & Connections

1. Devices/Connections Mix
2. IoT/M2M by Verticals
3. IPv6 Adoption

Traffic Trends

4. Traffic Growth by App
5. Traffic Pattern Analysis
6. “Cord-Cutting”

Network Performance and User Experience

7. Wi-Fi Momentum
8. Accelerating Speeds
9. Security Analysis

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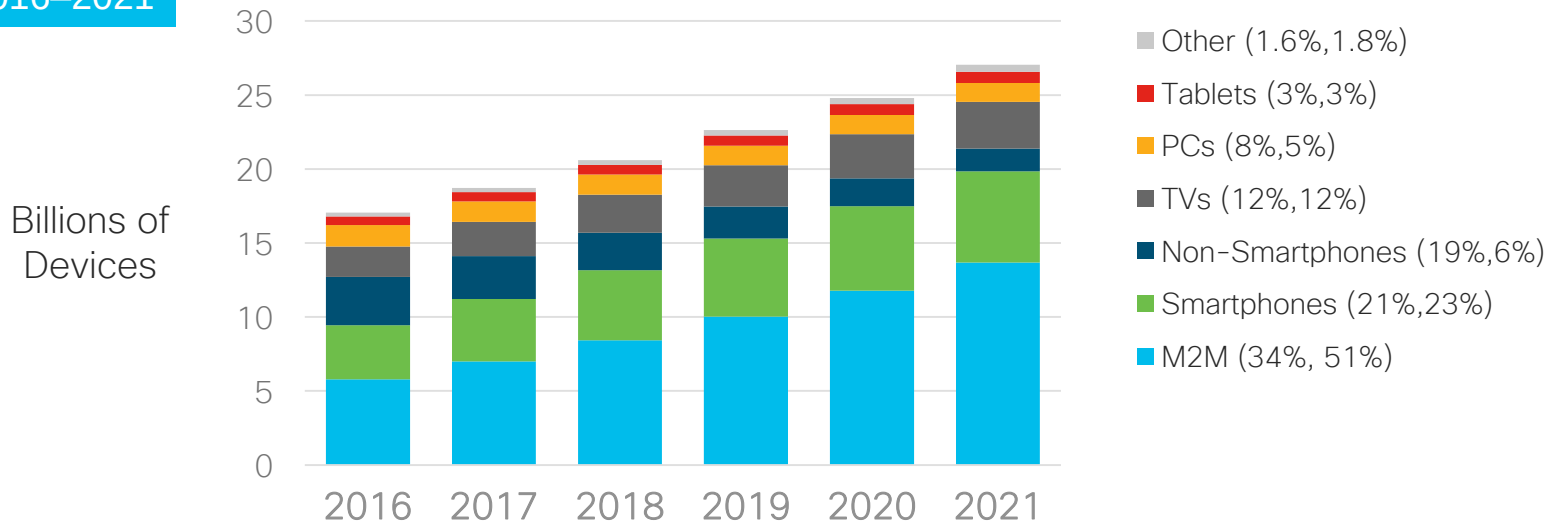
Global Device/Connection Growth by Type

By 2021, M2M connections will be more than half of total connections

10% CAGR
2016–2021



* Figures (n) refer to 2016, 2021 device share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Devices and Connections

Average per capita and per household

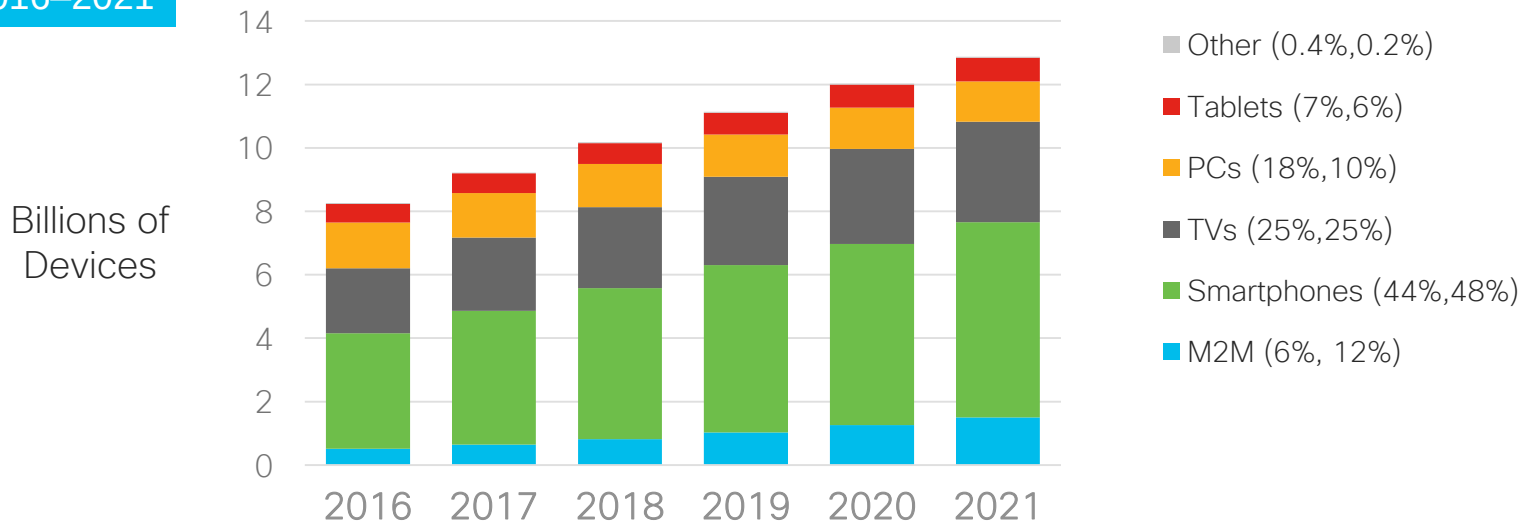
	2016	2021
Average Number of Devices and Connections per **Capita**	 2.3 Devices & Connections	 3.5 Devices & Connections
Average Number of Devices and Connections per **Household**	 6 Devices & Connections	 8.5 Devices & Connections

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Video Capable Device Growth by Type

By 2021, nearly half (48%) of total devices and connections will be video capable

9% CAGR
2016–2021

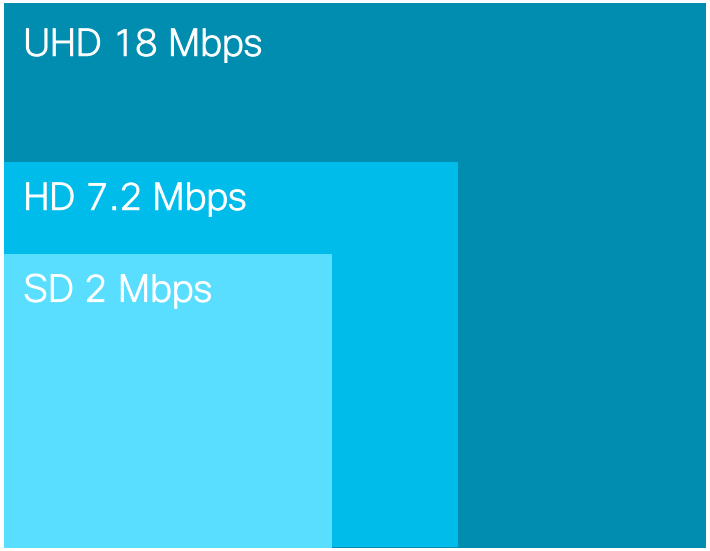


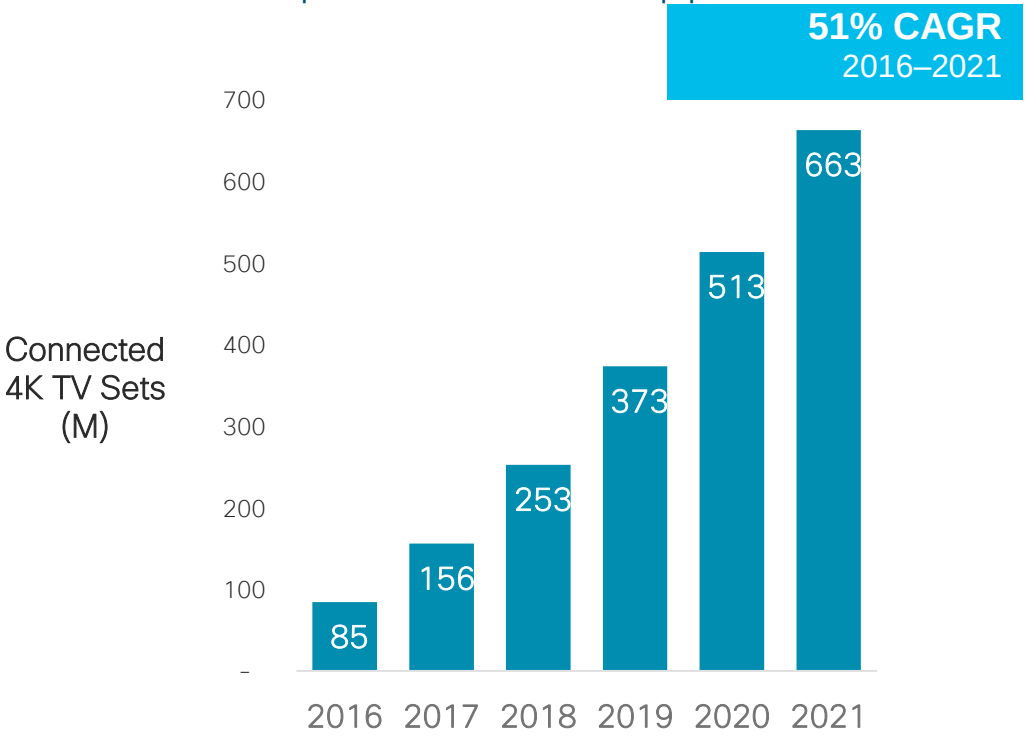
* Figures (n) refer to 2016, 2021 device share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Increasing Video Definition

By 2021, more than half (56%) of connected flat panel TVs will support 4K





Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Average IP Traffic Per Device

	2016 MBs per Month	2021 MBs per Month
M2M Module	328	1044
Smartphone	3,500	14,900
Tablet	9,100	25,600
Internet Set-Top or Dongle	15,882	27,731
Laptop / PC	30,600	55,100
Ultra High Definition TV*	27,375	47,804

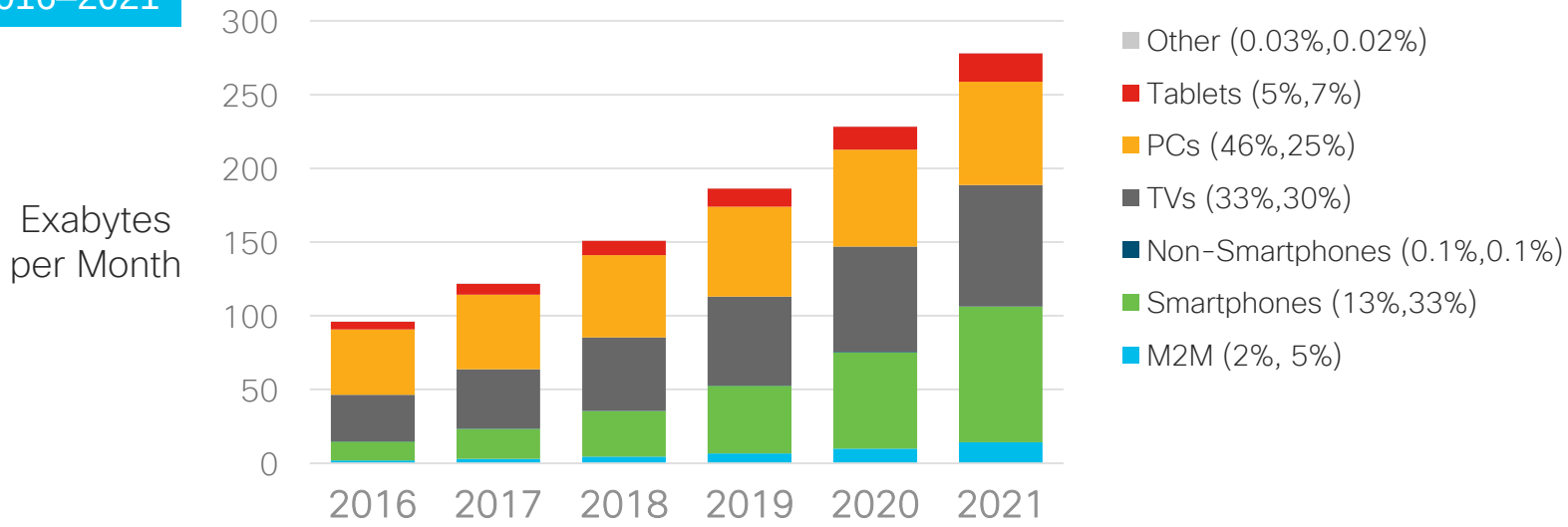
* Note: Includes IP VoD traffic

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global IP Traffic by Device Type

By 2021, non-PC devices will drive 75% of global IP traffic

24% CAGR
2016–2021



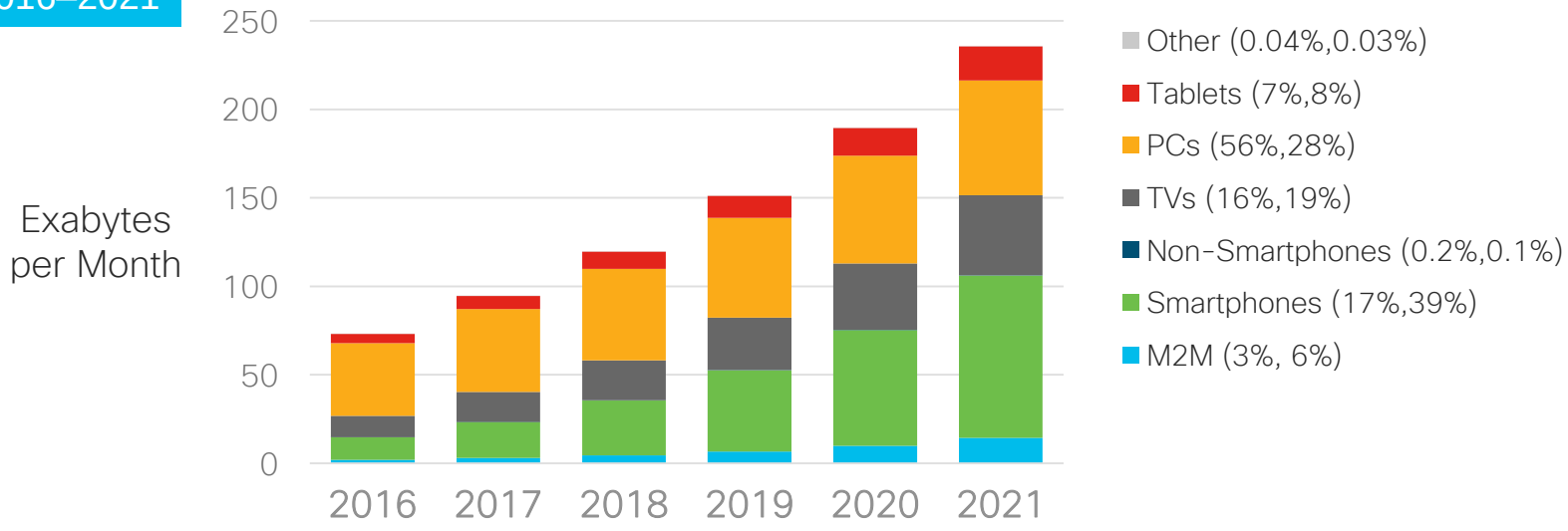
* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Internet Traffic by Device Type

By 2021, non-PC devices will drive 72% of global Internet traffic

26% CAGR
2016–2021



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Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

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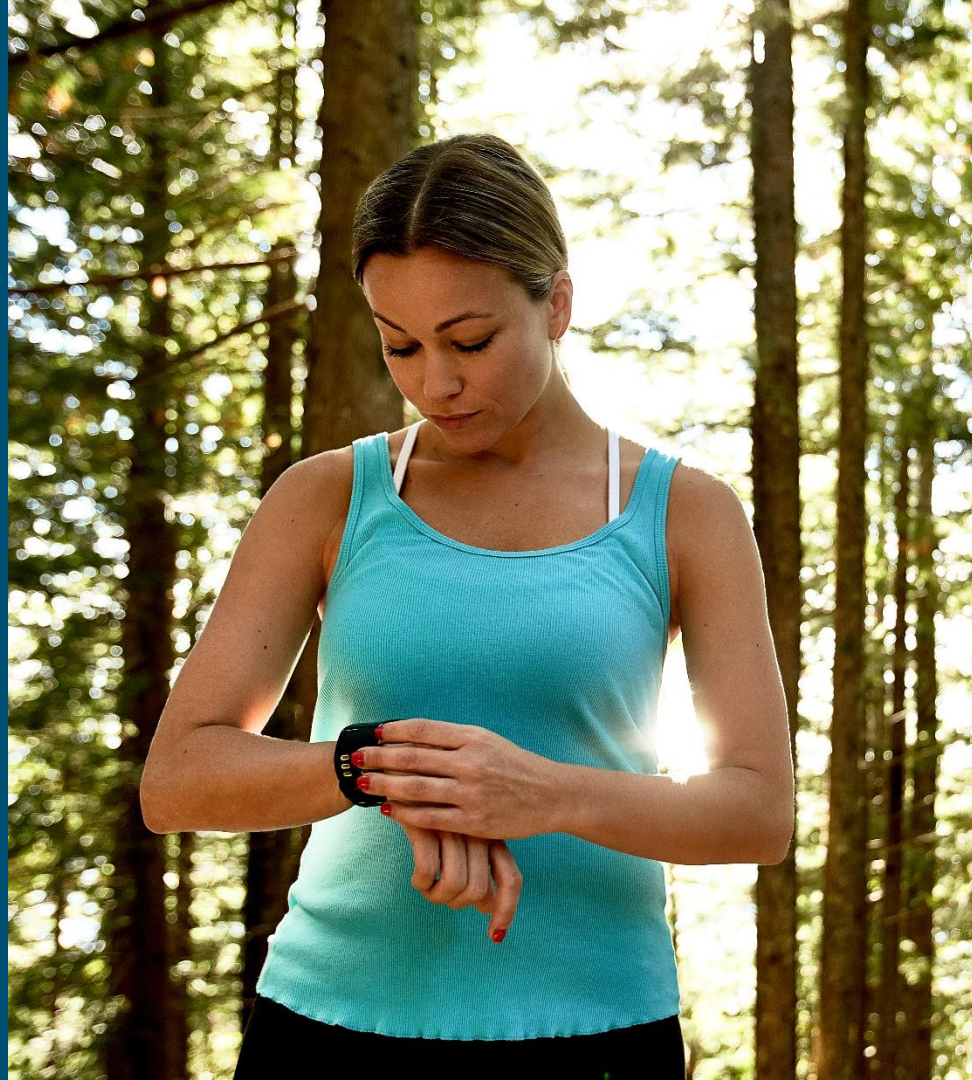
By 2021, M2M modules will be 51% (13.7 billion) of total global devices and connections and will account for 5% (14.3 EBs/month) of total global IP traffic.

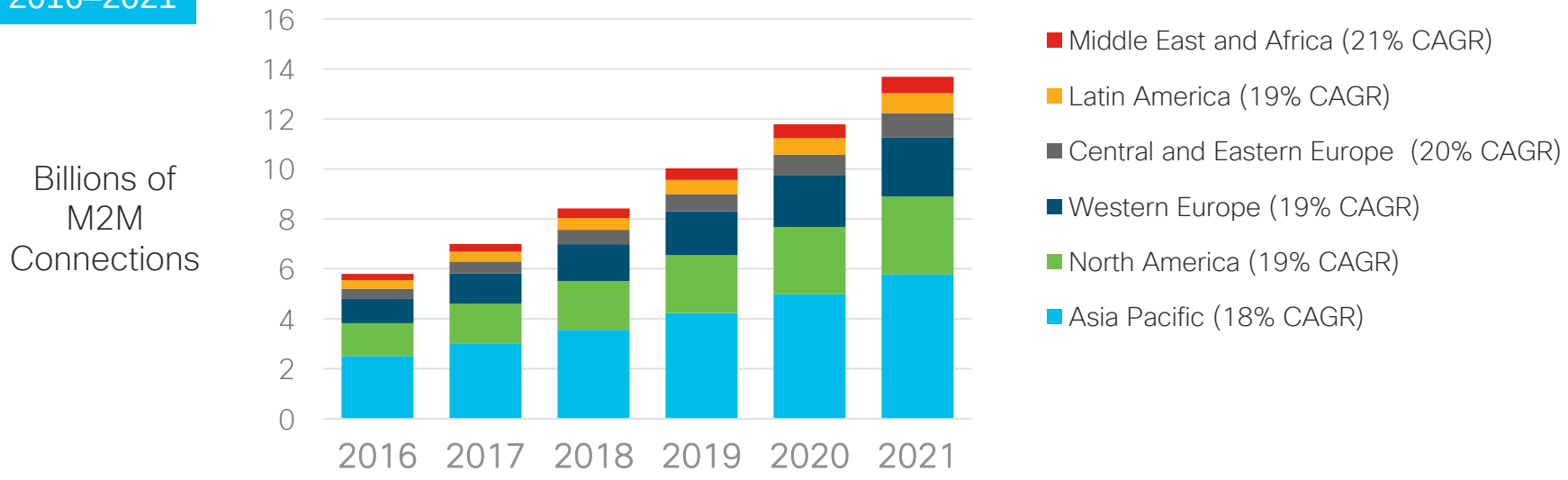
Source: Cisco VNI Global IP Traffic Forecast, 2016–2021



Global M2M Connections / IoT Growth

By 2021, 1.75 M2M connections per capita globally

19% CAGR
2016–2021

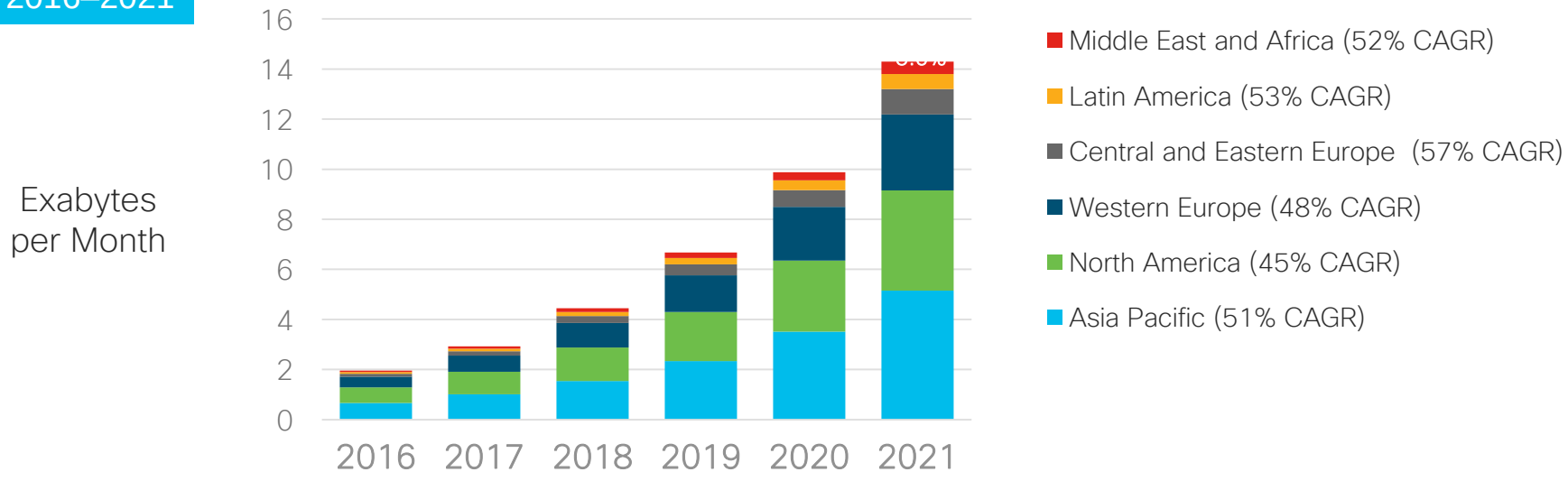


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global M2M Traffic Growth

M2M traffic will grow more than 7-fold from 2016 to 2021

49% CAGR
2016–2021

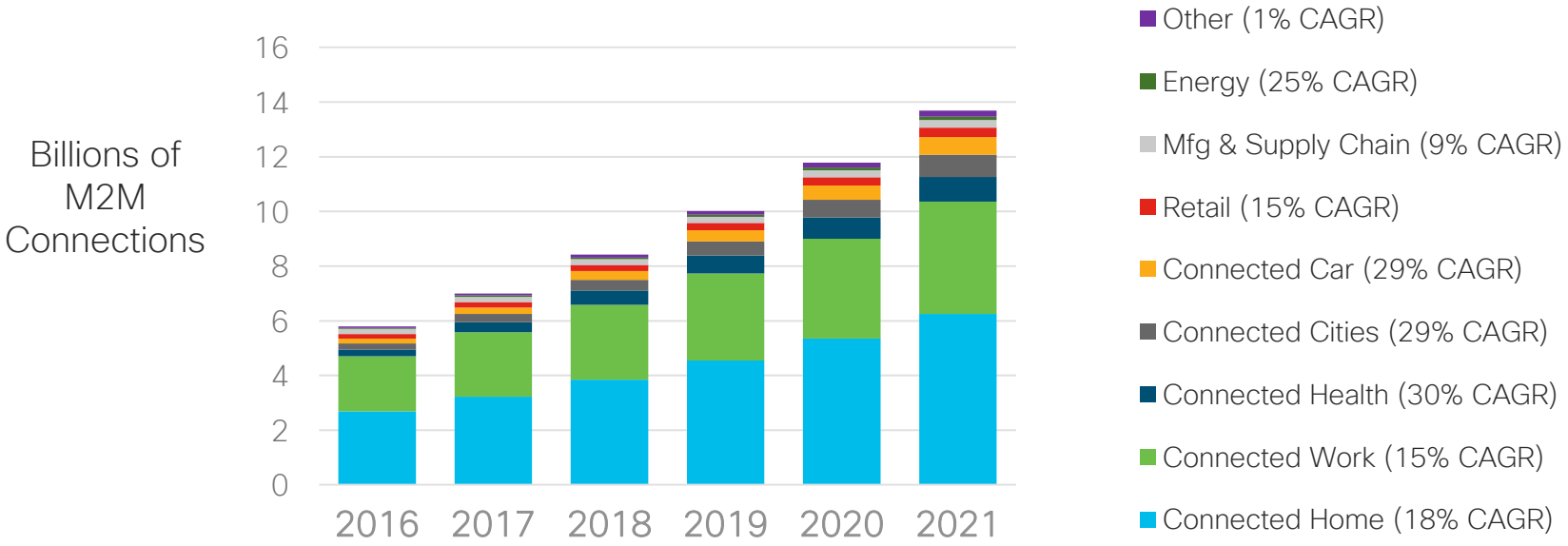


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global M2M Connections / IoT Growth by Vertical

By 2021, connected home largest, connected health fastest growth

19% CAGR
2016–2021



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

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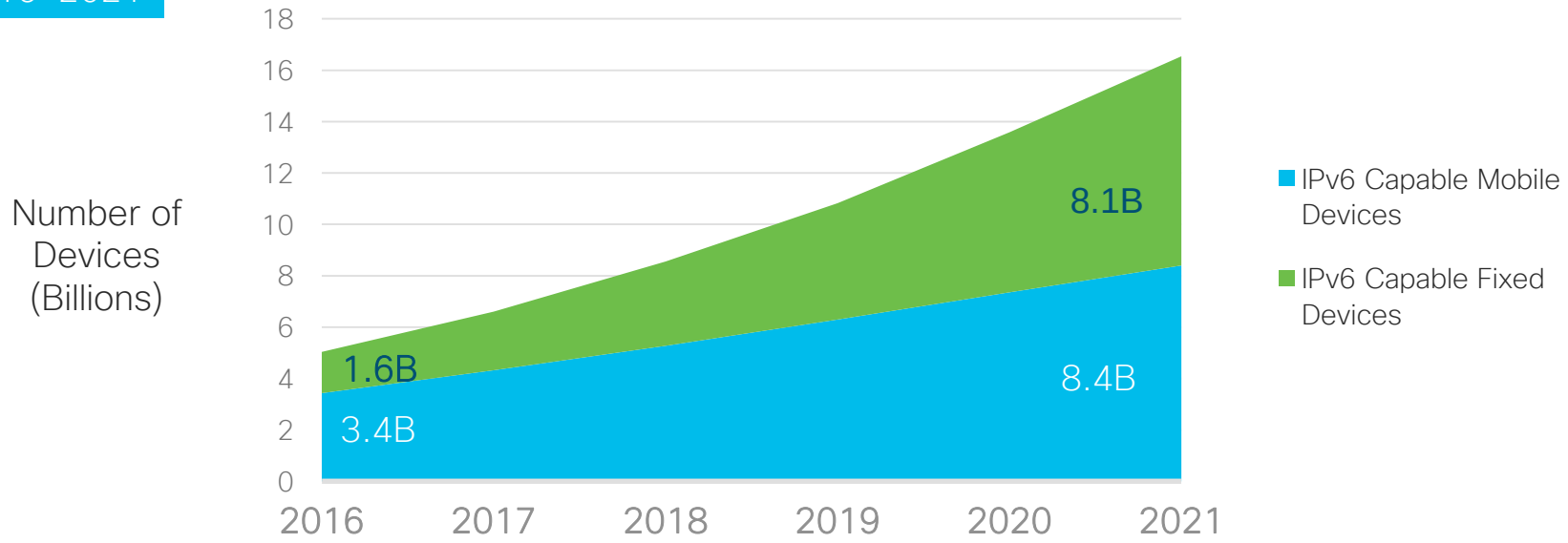
Global IPv6-Capable Devices/Connections

By 2021, 61% of devices/connections will be IPv6-capable

27% CAGR
2016-2021

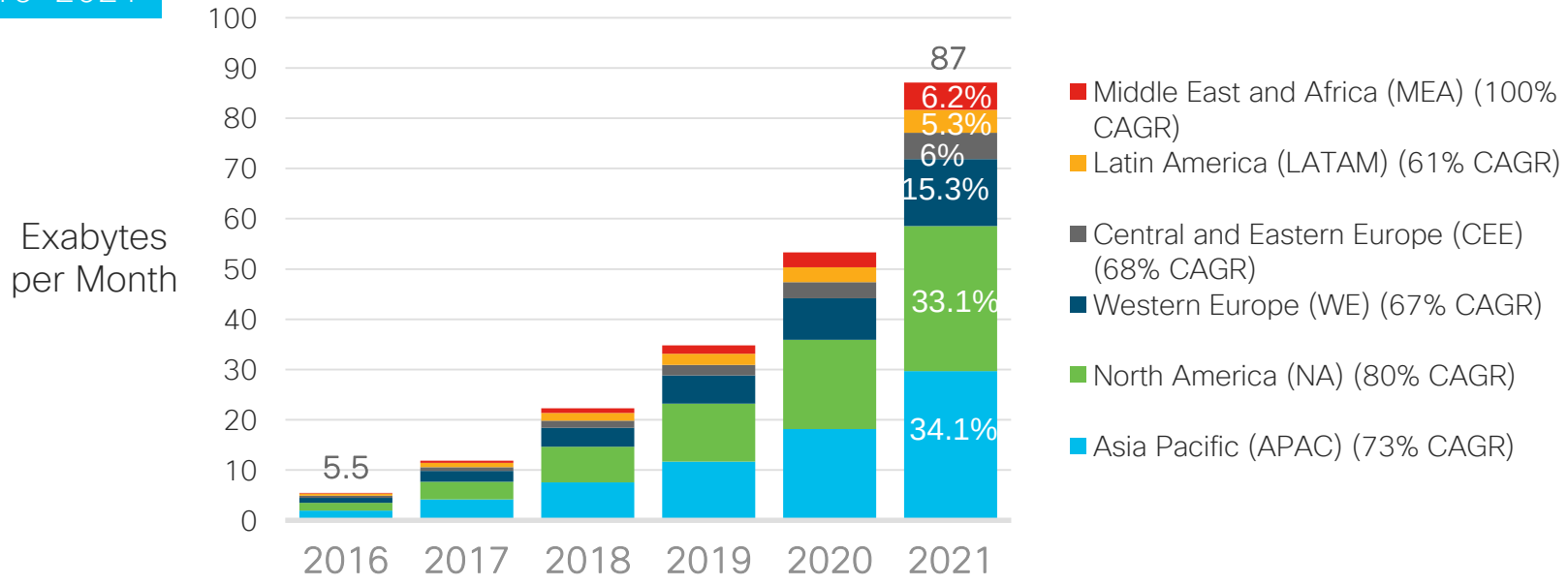


Source: Cisco VNI Global IP Traffic Forecast, 2016-2021

Global IPv6 Traffic Growth / Regions

By 2021, IPv6 will represent 37% of total Internet traffic

74% CAGR
2016–2021



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

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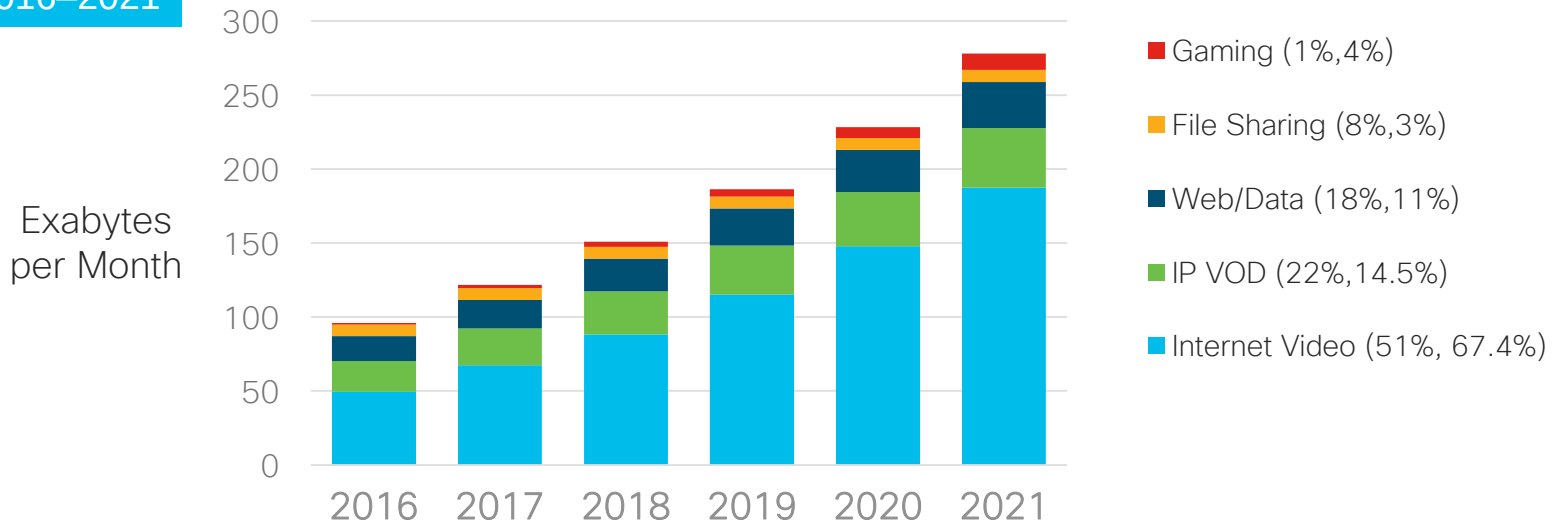
Global IP Traffic by Application Type

By 2021, video will account for 82% of global IP traffic
Gaming starts showing significant growth

24% CAGR
2016–2021



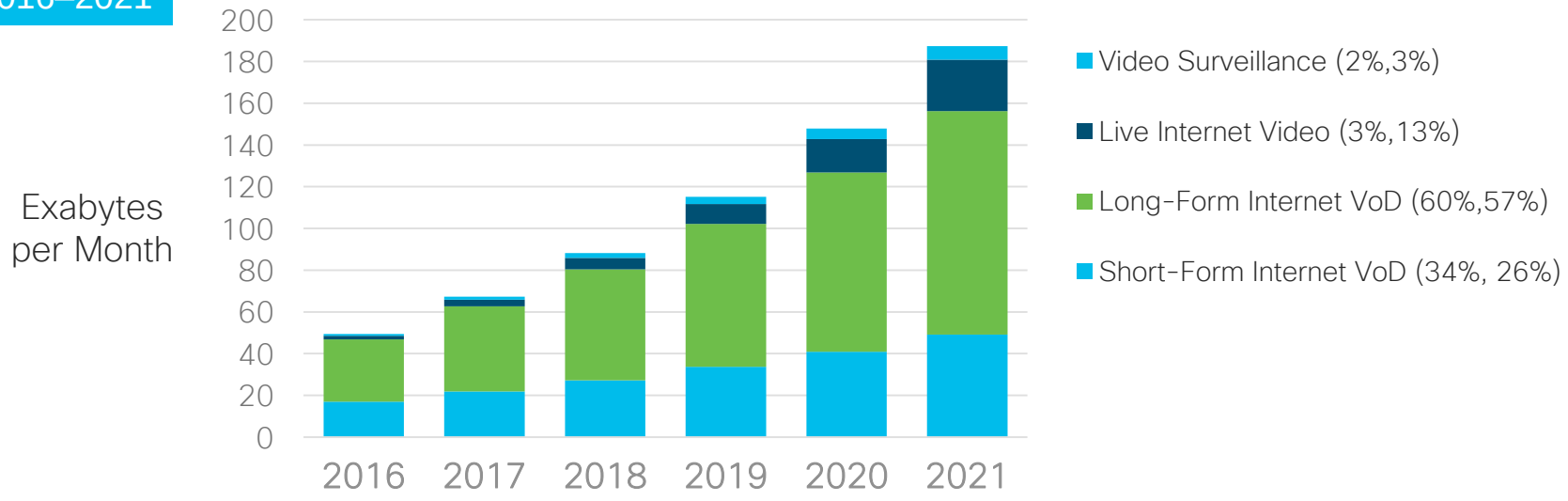
* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Internet Video Traffic by Type

By 2021, live video will increase 15-fold and reach 13% of Internet video traffic

31% CAGR
2016–2021

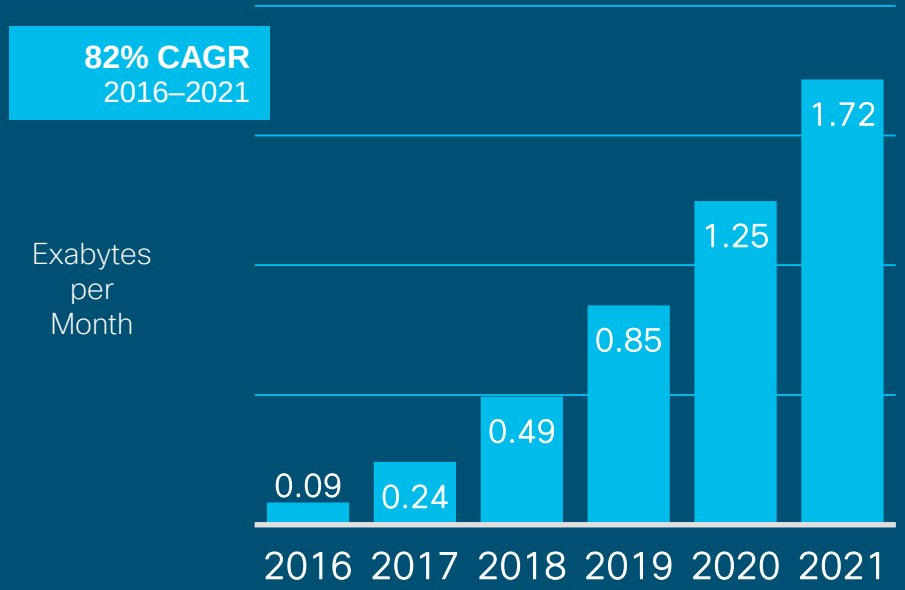


* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Virtual and Augmented Reality Traffic

By 2021, VR/AR traffic will increase 20-fold, 1% of Entertainment Traffic

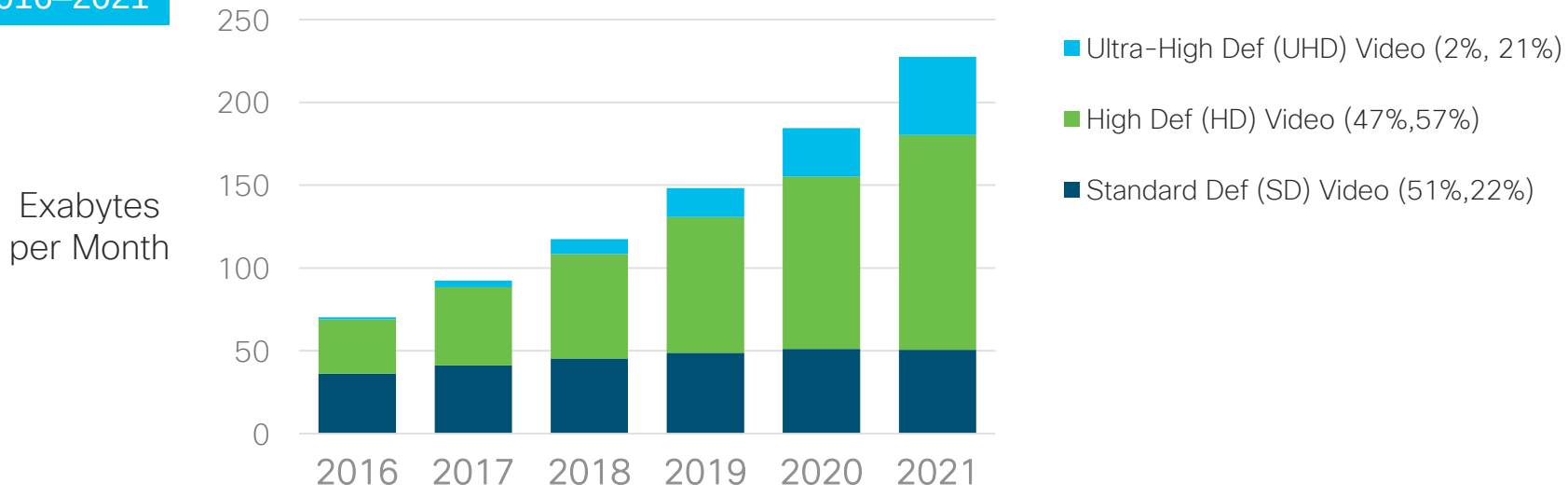


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

High Definition Content Impacts IP Video Growth

UHD IP video will account for 21% of global IP video traffic by 2021

26% CAGR
2016–2021



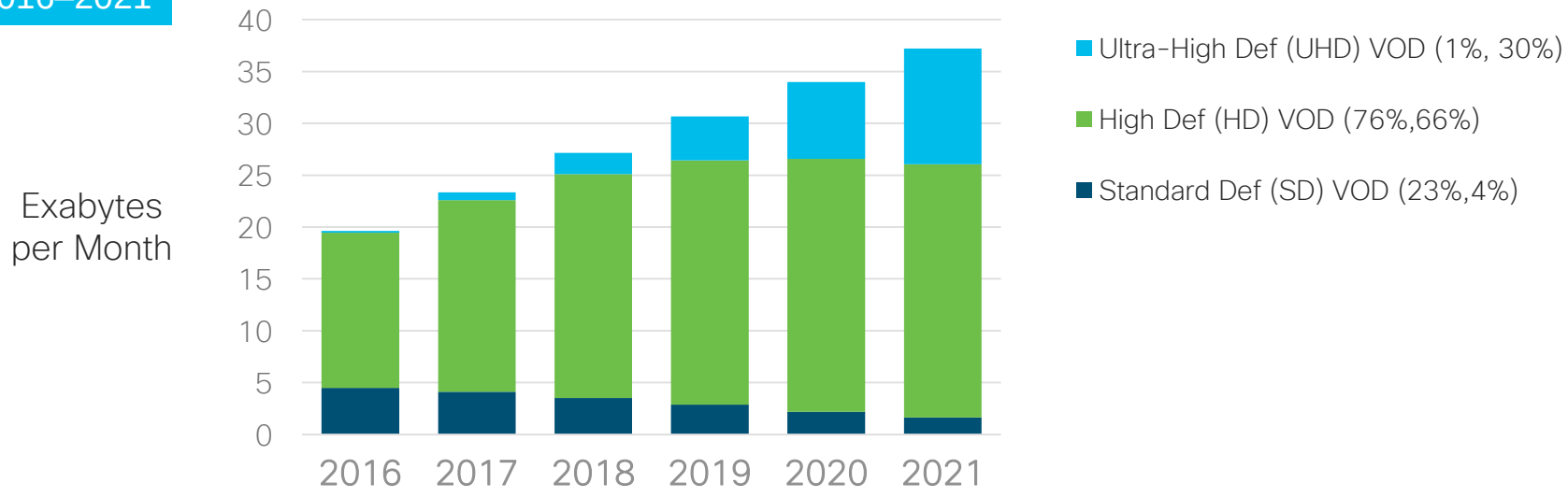
* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

High Definition Content Impacts IP VOD Growth

UHD VOD will account for 30% of global IP VOD traffic by 2021

14% CAGR
2016–2021



* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

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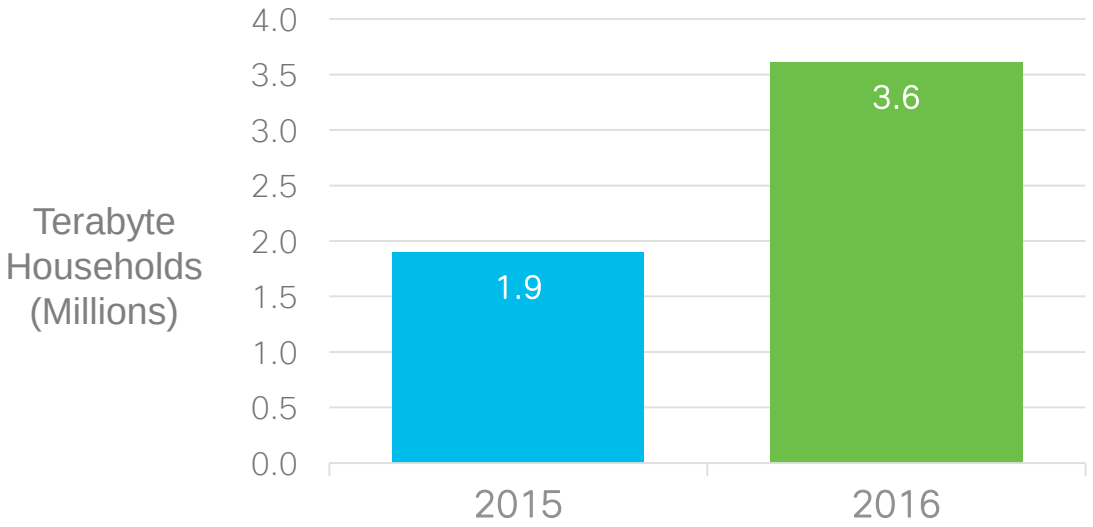
Average Global Internet Bandwidth Usage

	2016	2021	Future
Average Traffic per **User**			
	24 GB per month	**57 GB** per month	**200 GB** per month
Average Traffic per **Household**			
	63 GB per month	**155 GB** per month	**500 GB** per month

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Internet Households Reshape Usage Limits

Internet households exceeding 1 TB doubled in 2016



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Usage Limits: Fixed vs. Mobile

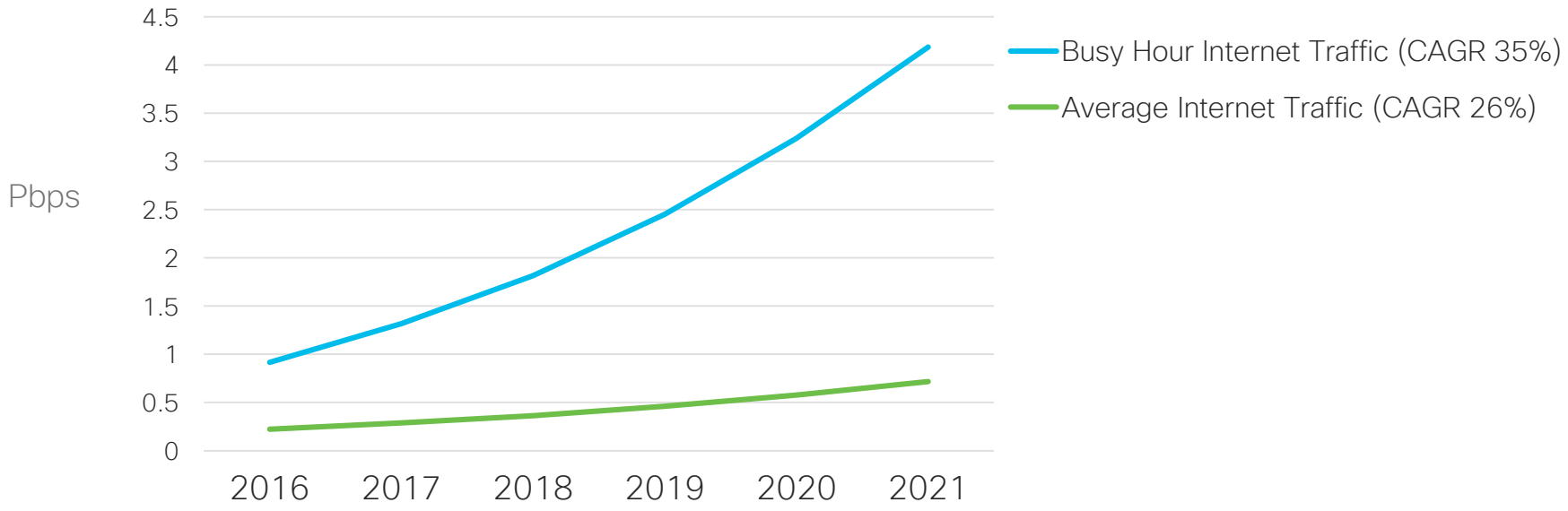
Historically, mobile caps affected a larger percentage of users than fixed
With unlimited mobile plans, top-end user ratio is similar to fixed

COUNTRY	% Broadband HH > 1 TB	% Mobile Users > 20 GB
Global	0.5%	0.8%
North America	1.9%	4.7%
Western Europe	0.3%	0.5%
Central & Eastern Europe	0.1%	0.6%
Latin America	0.4%	0.2%
Asia-Pacific	0.2%	0.7%
Middle East & Africa	0.1%	0.1%

Source: Cisco VNI Global IP Traffic Forecast, 2016-2021

Global Busy-Hour vs. Average Hour Internet Traffic

By 2021, busy Internet traffic will be 3X greater than average traffic (video driven)

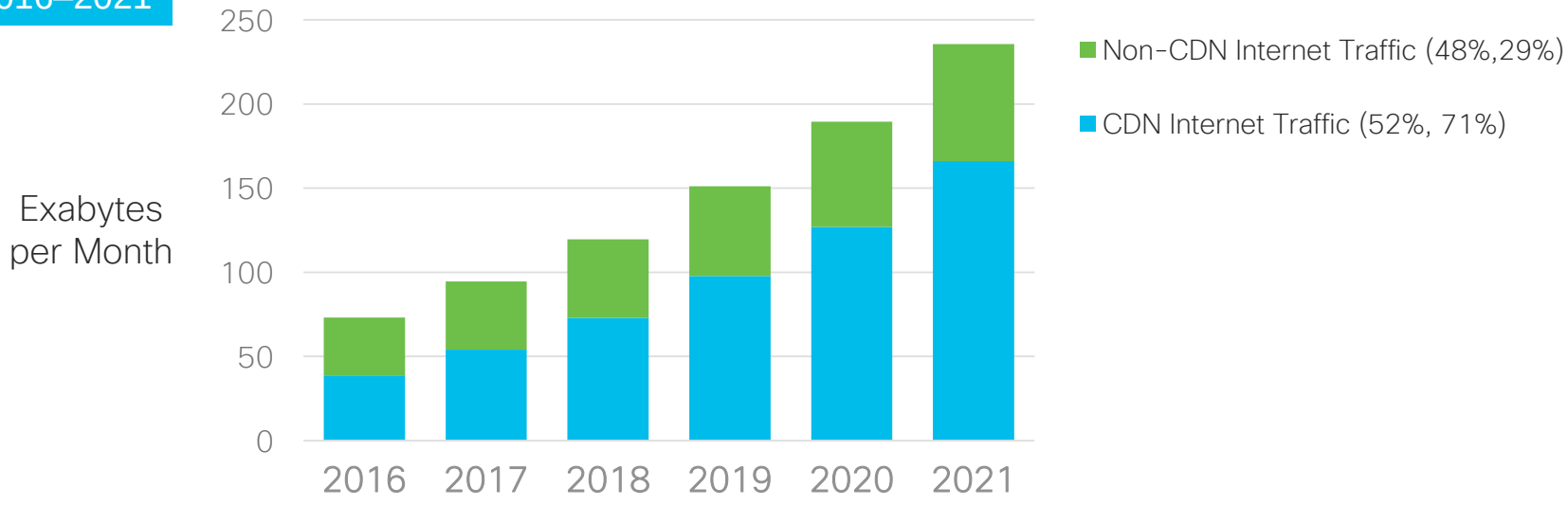


Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Content Delivery Network (CDN) Traffic

CDNs will deliver 71 percent of Internet traffic by 2021

26% CAGR
2016–2021

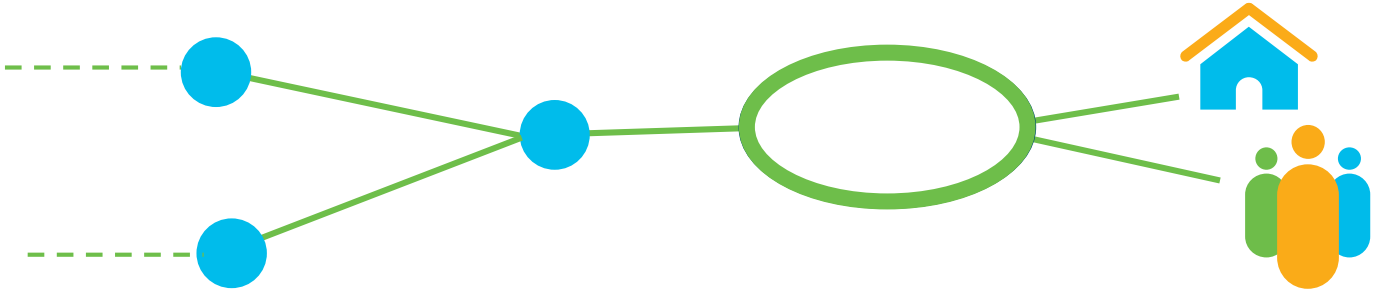


* Figures (n) refer to 2016, 2021 traffic share

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

End-User Internet Traffic Moving Closer to the Edge

Over one-third of traffic will bypass core completely by 2021

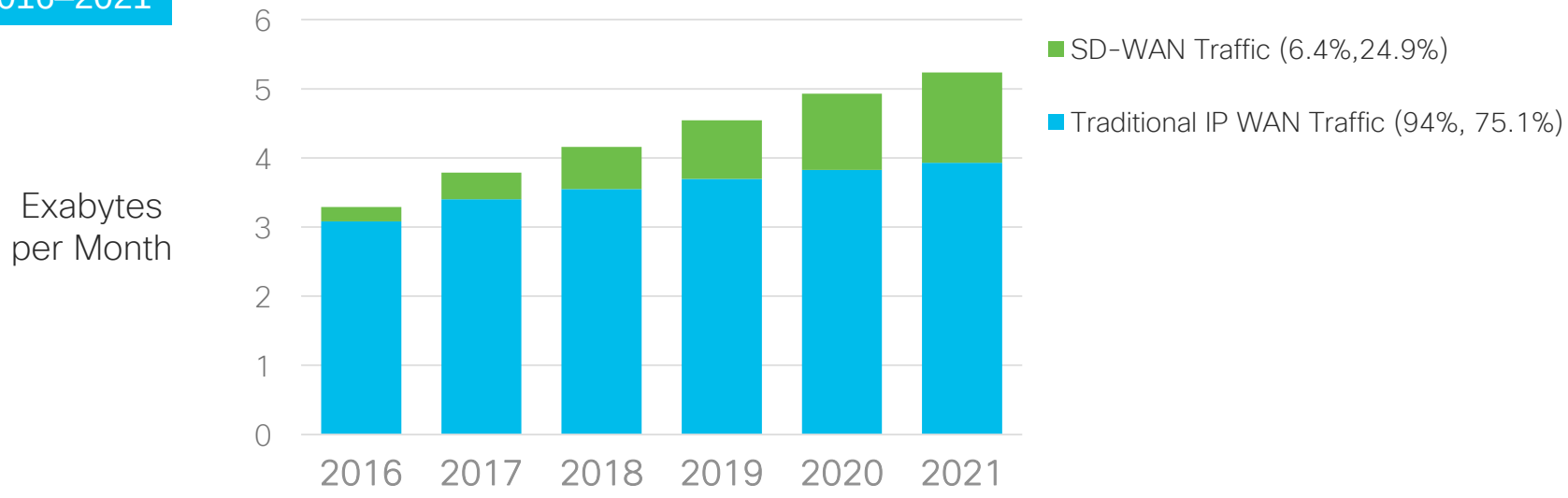


Core – Cross-Country	Core – Regional	Within Metro
58% in 2016	20% by 2016	22% in 2016
41% by 2021	23% by 2021	35% by 2021
	(64% cumulative)	(100% cumulative)

Global Enterprise SD-WAN Traffic

SD-WAN traffic will grow at a CAGR of 44% compared to 5% for traditional WAN
SD-WAN will increase 6x and will be 25% of WAN traffic by 2021

10% CAGR
2016–2021



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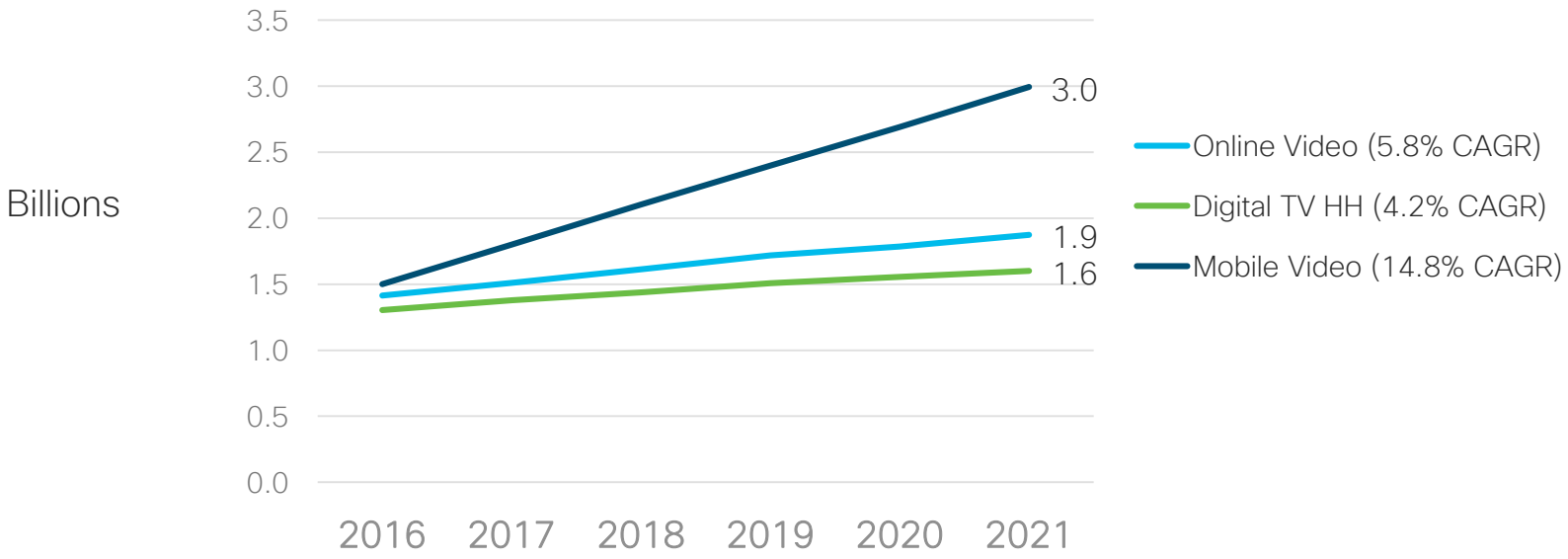
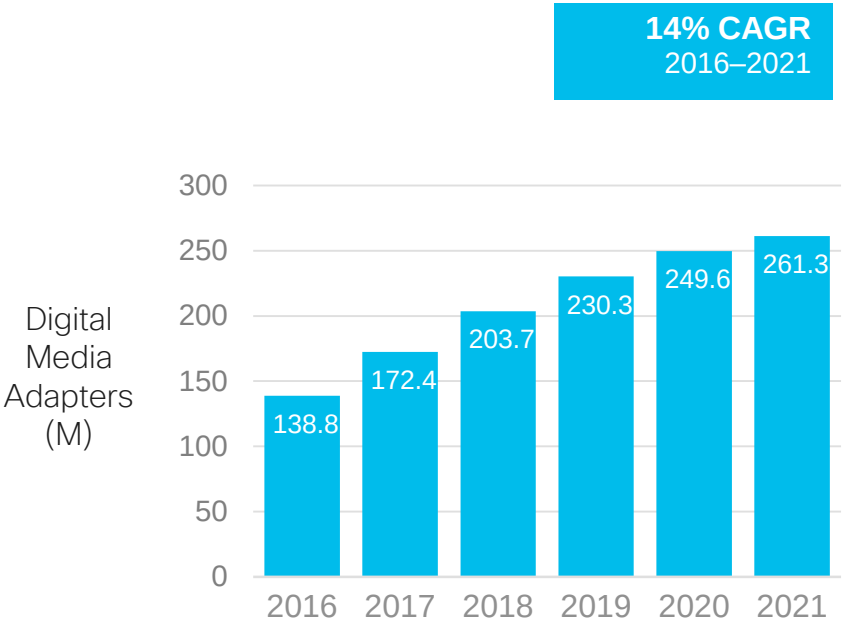
Global Video Users / Subscribers

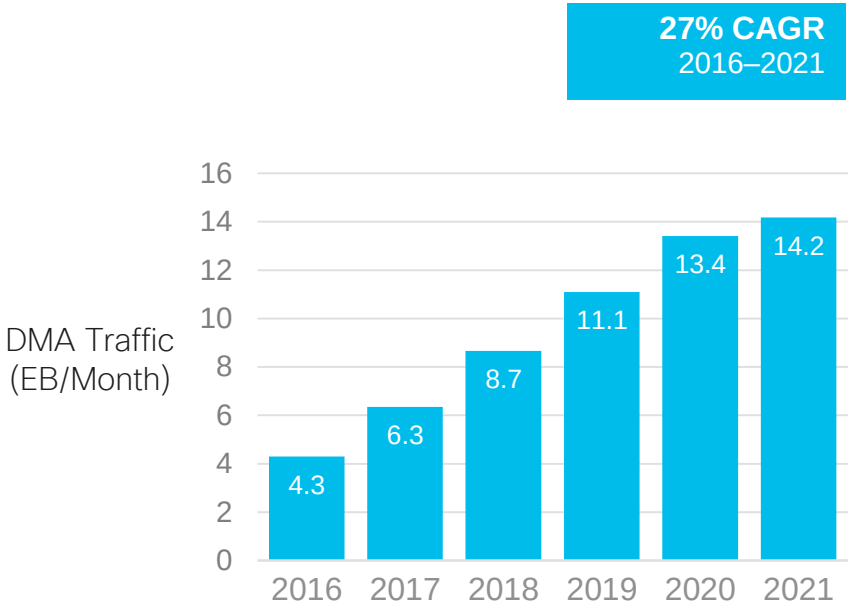
Mobile video growing fastest, followed by online video



Global Digital Media Adapters* Growth

By 2021, DMAs will represent 16% of global Internet set-top boxes (STB)
by 2021, DMAs will represent 34% of global Internet STB traffic



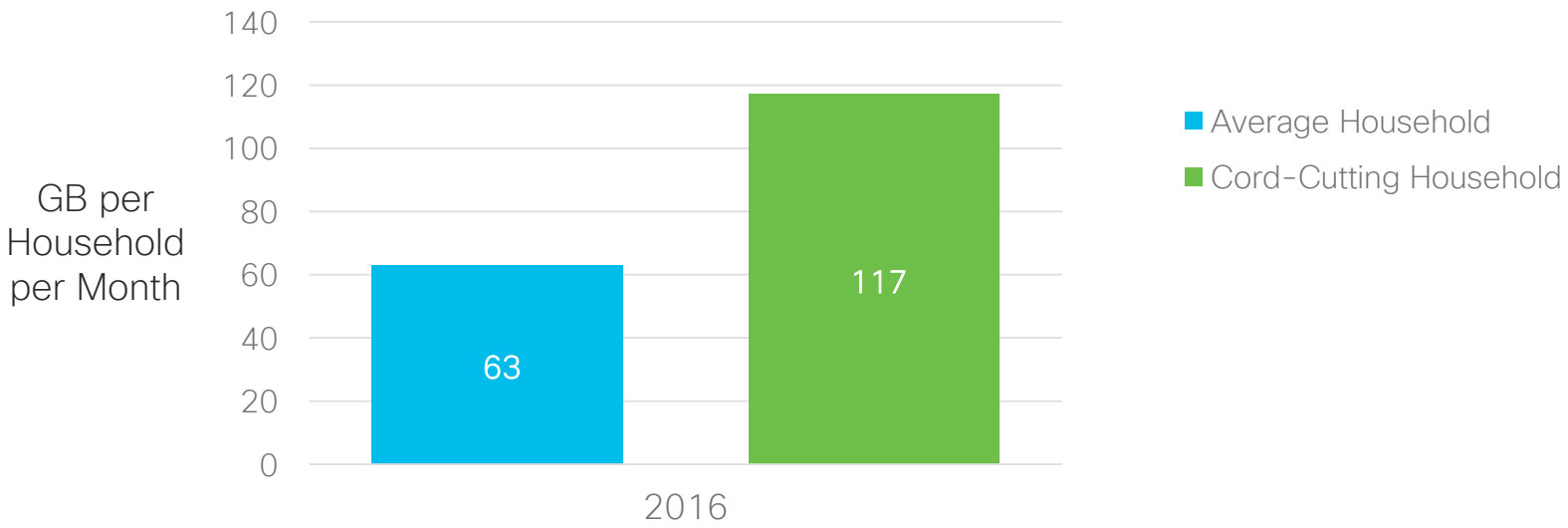


* DMAs include devices such as Roku, Apple TV, Chromecast

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Cord-Cutting Household Traffic Is 86% Higher

A global cord-cutting household generates 117 GB per month in 2017, compared to 63 GB per month for an average household



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Global Wi-Fi Hotspot Coverage and Availability

Existing

- Pay-as-you-go
- Free access promoting other services (Retail free Wi-Fi)
- Managed services (venues and outdoor)
- Cellular offload (user promoted)
- Added value for broadband subscription
- Advertising and sponsorship

Growth

- Cellular offload (carrier driven)
- Community Wi-Fi/ homespots
- Carrier-grade VoWiFi
- TV everywhere
- Large events
- Big data analytics
- Public transportation Wi-Fi

Future

- Wi-Fi Capacity trading
- Transaction platform
- Internet of things
- Context awareness
- HetNet Wi-Fi + mobile
- Connected car (in-car Wi-Fi)

	2016	2021
Total Public WLAN + Community Hotspots	94.0 M	541.6 M

Total Incremental Hotspots ?

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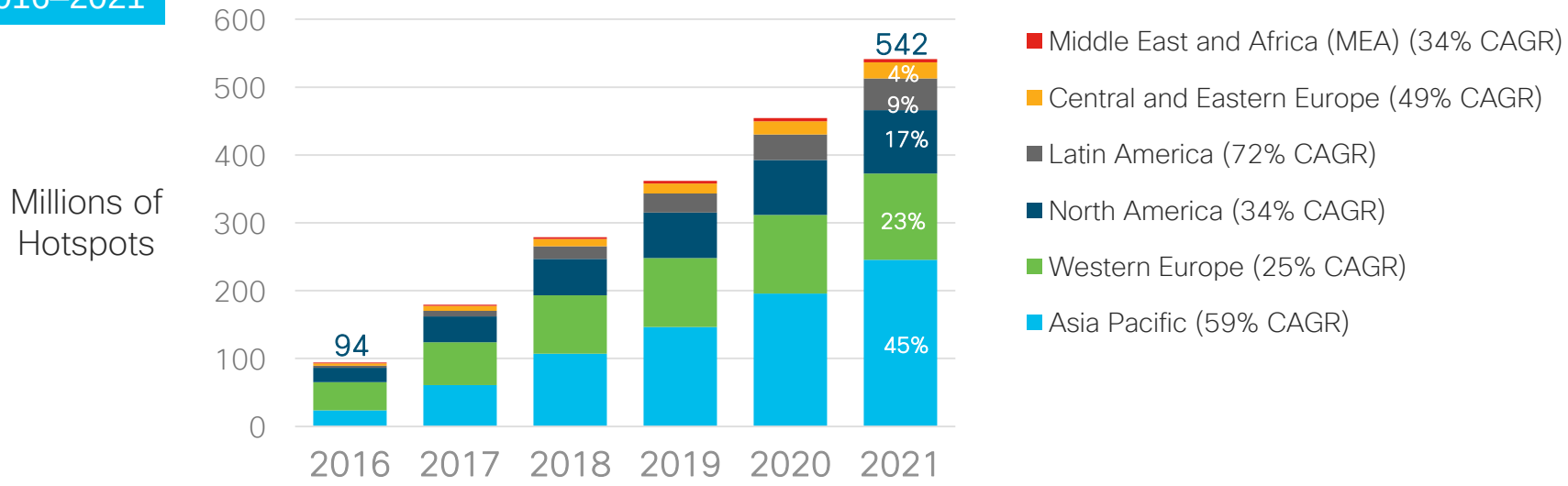
Source: Maravedis, Cisco VNI Global Mobile Data Traffic Forecast, 2016–2021

Global Public Wi-Fi Hotspots

Asia Pacific leads with 246 Million (45%) Hotspots by 2021

42% CAGR
2016–2021



* Middle East and Africa represents 1% of global public Wi-Fi hotspots by 2021

Source: Global Public Wi-Fi Hotspots Asia Pacific Leads with 246 Million (45%) Hotspots by 2021

Future of Wired and Wireless Technologies

By 2021, 98.1% of BB CPE will be equipped with 802.11ac
Future Wi-Fi Enables Virtualization, IoT, Speech Processing, Security, Data Analytics

802.11n
600 Mbps Max
Medium Resolution Video

802.11ac
3.6 Gbps Max
High Resolution Video
Wired Complement

802.11ax
10 Gbps Max
Dense IoT Deployment

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

DOCSIS 3.0
38 Mbps per channel

VDSL2
100 Mbps Max
Medium Resolution Video

DOCSIS 3.1
54 Mbps.

VDSL2-VPlus
300 Mbps Max

Full Duplex DOCSIS 3.1
10 Gbps symmetrical

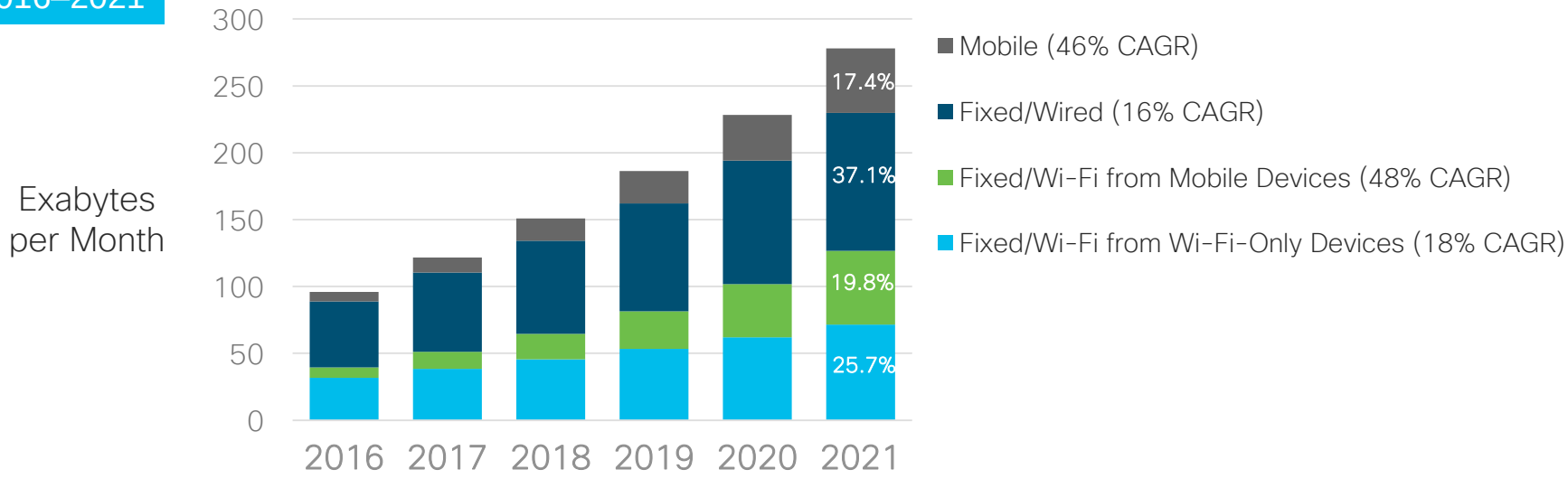
G.fast
150-1000 Mbps Max.

Inflection point for DOCSIS 3.1 in 2019
Future Wired Enables 4K, Immersive 360 video, VR, High Dynamic Range, High Frame Rate, 8K

Global IP Traffic by Local Access Technology

By 2021, 63% of total IP traffic will be wireless*

24% CAGR
2016–2021



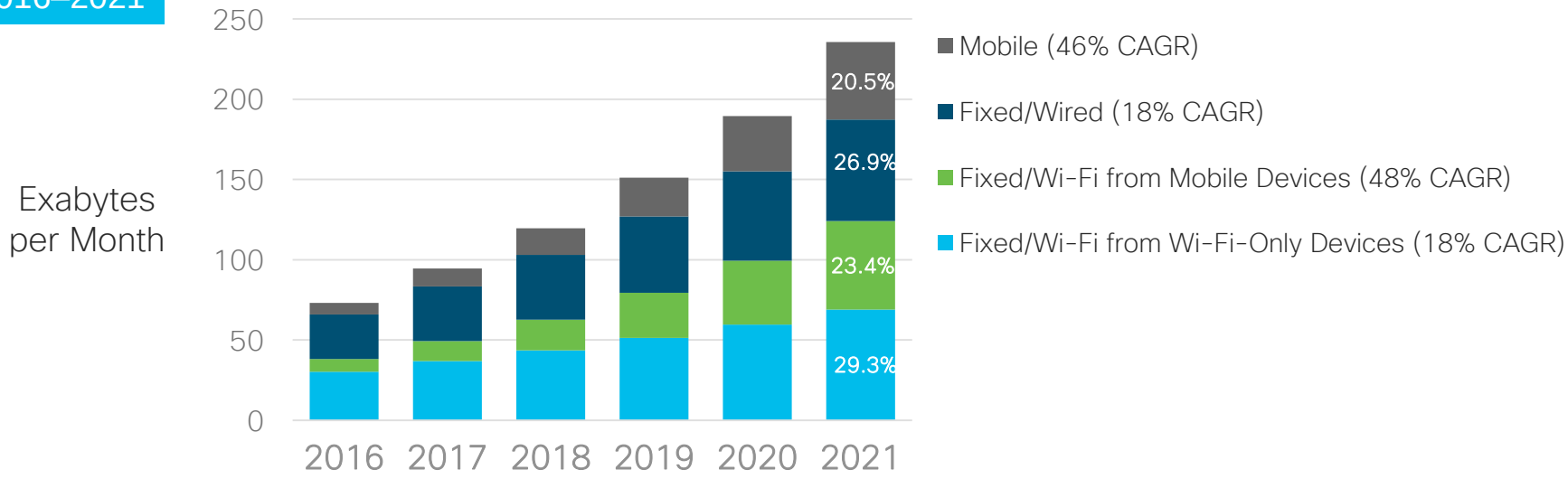
* Wireless traffic includes Wi-Fi and mobile

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Internet Traffic by Local Access Technology

By 2021, 73% of total Internet traffic will be wireless*

26% CAGR
2016–2021



* Wireless traffic includes Wi-Fi and mobile

Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Top Trends

Devices & Connections

1. Devices/Connections Mix
2. IoT/M2M by Verticals
3. IPv6 Adoption

Traffic Trends

4. Traffic Growth by App
5. Traffic Pattern Analysis
6. "Cord-Cutting"

Network Performance and User Experience

7. Wi-Fi Momentum
8. Accelerating Speeds
9. Security Analysis

Global Average Fixed Broadband Speeds

Doubling in speeds from 2016–2021

In Mbps	2016	2021
GLOBAL		
Global	27.5	53.0
BY REGION		
Asia Pacific	33.9	63.7
Latin America	9.3	20.5
North America	32.9	74.2
Western Europe	30.2	53.6
Central and Eastern Europe	29.2	45.5
Middle East & Africa	7.8	17.1

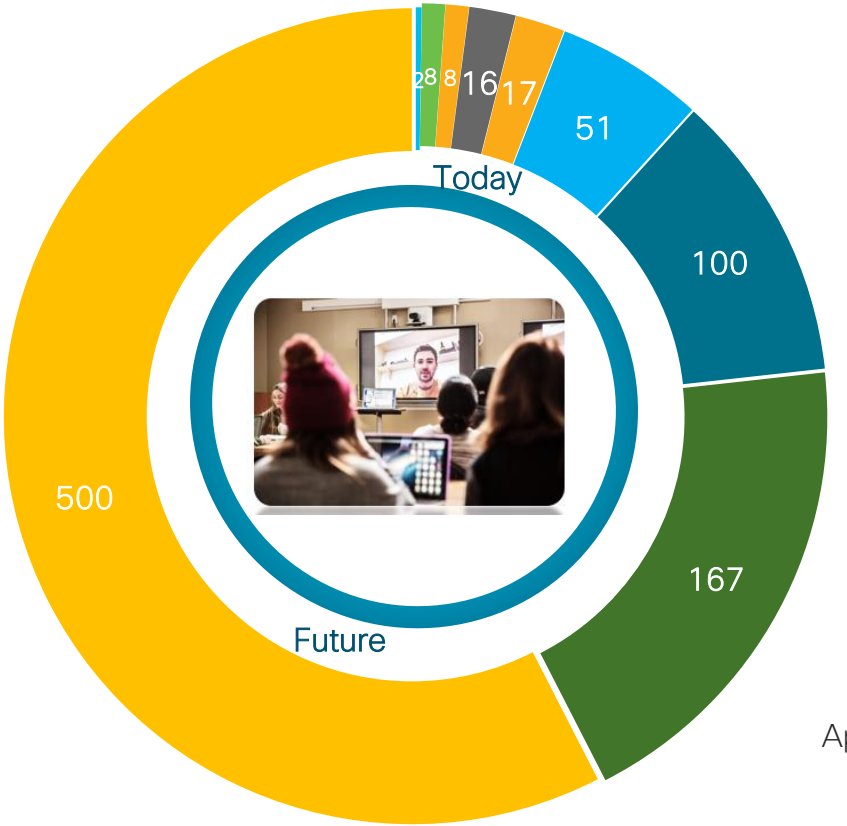
Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Global Faster Networks Enable *Better* Experiences

10 Mbps	25 Mbps	100 Mbps
		
85% of all broadband connections by 2021	**51%** of all broadband connections by 2021	**13%** of all broadband connections by 2021
Online Video (HD movie download) **22** minutes	Online Video (HD movie download) **9** minutes	Online Video (HD movie download) **2** minutes
(UHD movie download) **2** hours	(UHD movie download) **48** minutes	(UHD movie download) **12** minutes

Video in the Home of Today and the Future

Significant demand for video in the home of the future



- HD Camera
- IP Video
- 2 UHD Cameras
- UHD Streaming
- VR
- UHD IP Video
- 8K Wall TV
- HD VR
- UHD VR

Today → Future

Application requirements In Mbps

Global Average Wi-Fi Speeds

Wi-Fi speeds double from 2016-2021

In Mbps	2016	2021
GLOBAL		
Global	18.2	37.1
BY REGION		
Asia Pacific	19.5	40.7
Latin America	7.7	13.9
North America	27.4	52.3
Western Europe	20.3	35.1
Central and Eastern Europe	16.7	31.6
Middle East & Africa	4.9	9.0

Source: Cisco VNI Global IP Traffic Forecast, 2016-2021

Top Trends

Devices & Connections

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DDoS Attack Size and Traffic Increasing

Peak attack size increased 60% Y/Y.

DDoS attacks can represent up to 18% of a country's total Internet traffic while they are occurring.

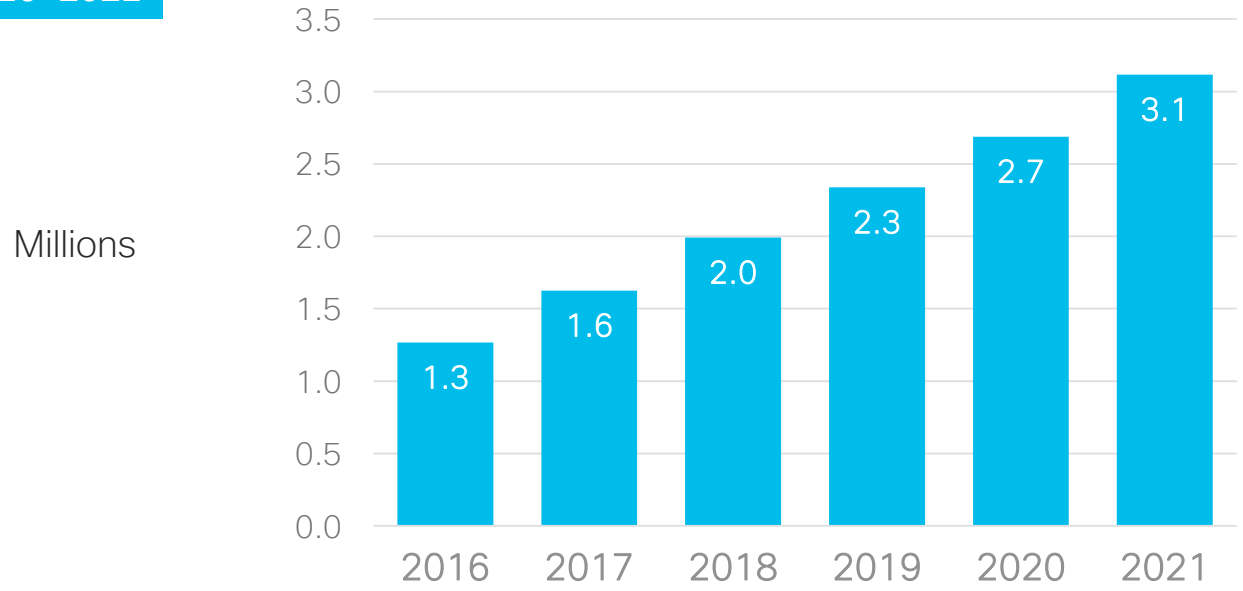
Average DDoS attack size increases at 22% which is relatively the same rate as Internet traffic at 29% Y/Y.

Source: Arbor Networks, Cisco VNI Global IP Traffic Forecast, 2016–2021

Number of DDoS Attacks Greater than 1 Gbps

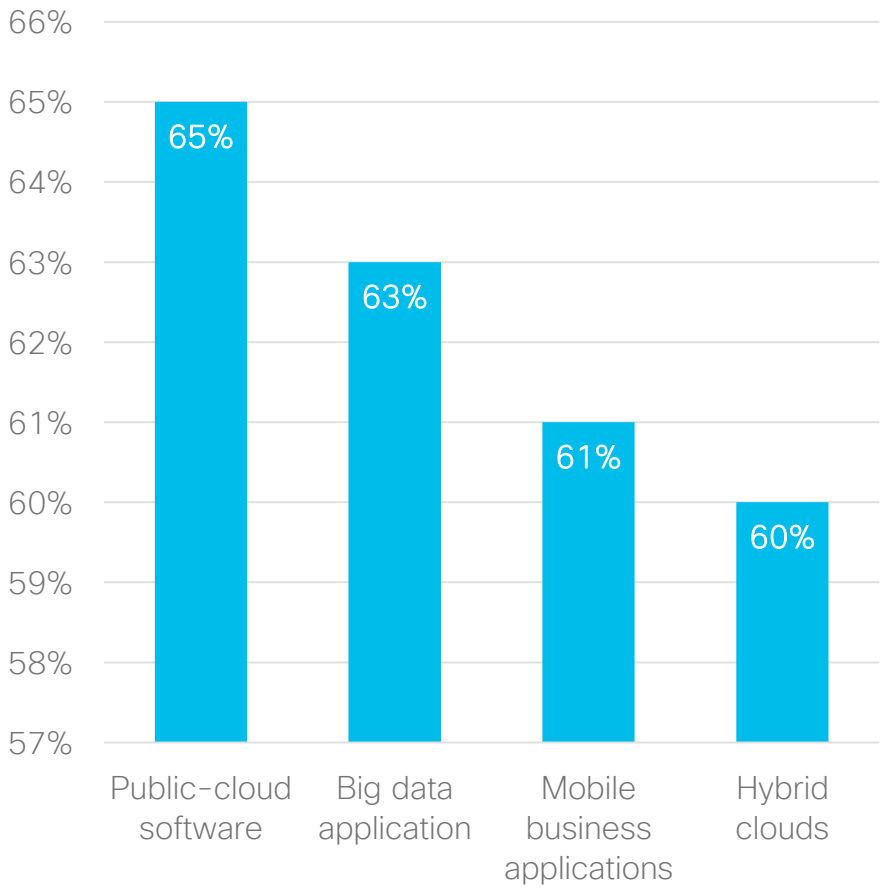
Attacks grew 172% in 2016, will increase 2.5-fold to 3.1 million by 2021 globally

20% CAGR
2016–2021



Source: Cisco VNI Global IP Traffic Forecast, 2016–2021

Technologies with the biggest security implications are public clouds, big data and mobile applications, each of which have seen high adoption rates in recent years.



Source: Forbes Insight with BMC, 2017

33,488 Records Exposed per Breach

Total Breaches: 1,093

Records Exposed: 36.6 Million

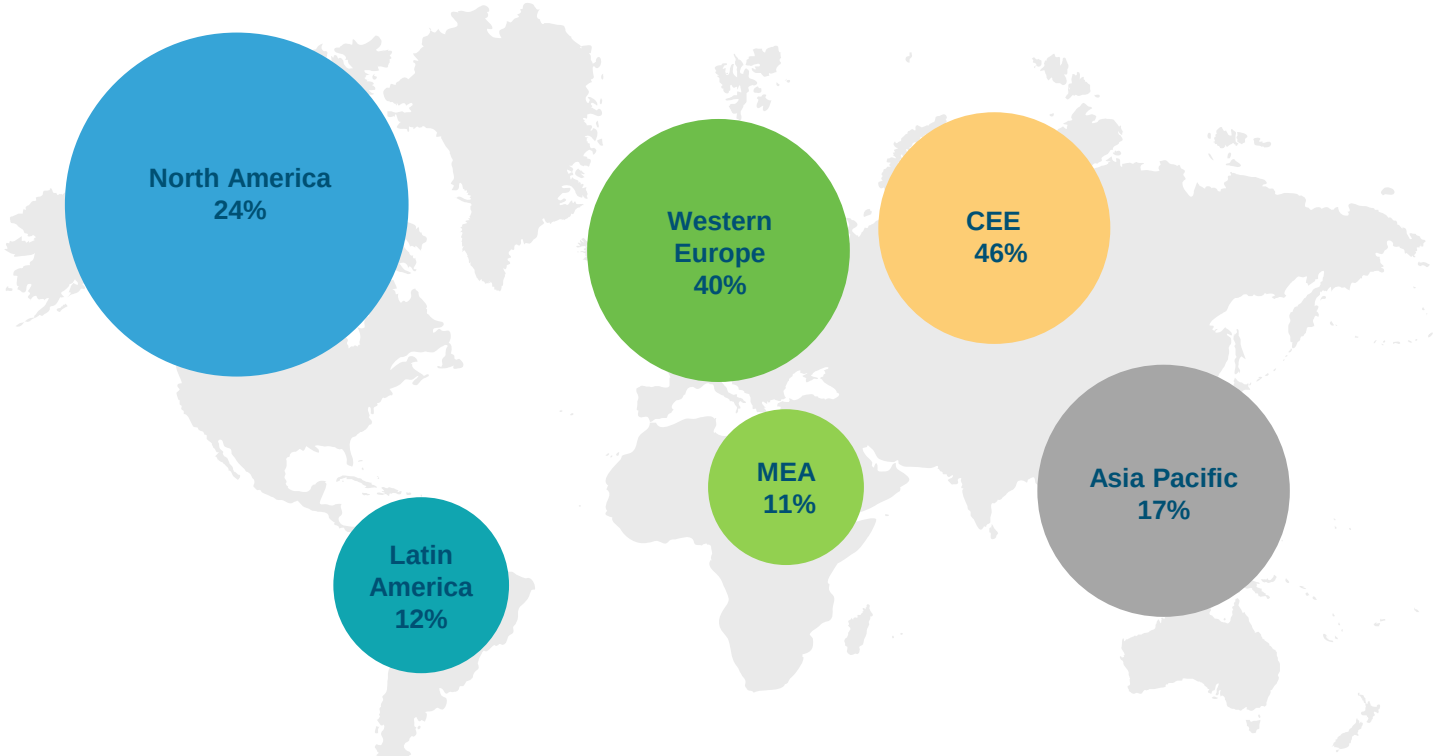
Highest in Business: 45.3%

Highest in Healthcare: 43.6%

Source: 2016 Identity Theft Resource Center, 2016 EoY Report

Enabling Authentication and Secure Internet

Percentage of secure Internet servers to all web-Facing Servers



Source: Cisco Visual Networking Index 2016-2021

Call to Action
Cisco VNI Web Site

Complete VNI Forecast: http://www.cisco.com/go/vni

- Press Release
- White Papers / FAQ
- Cisco VNI Web-based Tools

Cisco VNI Forecast inquiries: traffic-inquiries@cisco.com

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