



# 46th Annual Taxation Conference APPRAISAL for AD VALOREM TAXATION

of Communications, Energy and  
Transportation Properties

July 24 - 28, 2016

## **The Internet of Things (IoT) and the State of Communication Services Industry Address**

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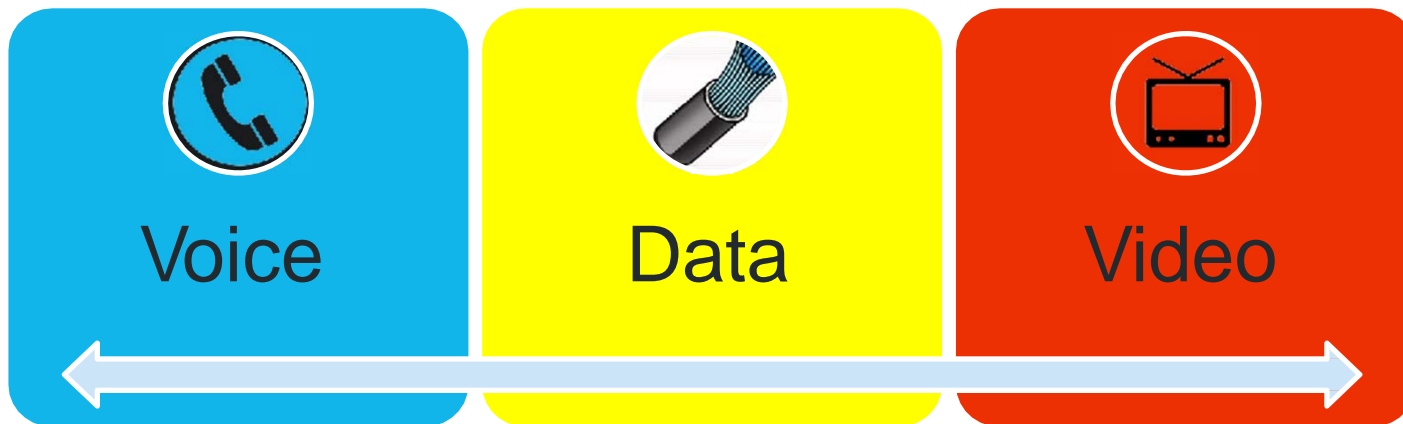
# 17<sup>th</sup> Report by the FCC on the status of competition in the market for the delivery of video programming

The most significant trends since the last report are *“the continuing development, and consumer usage, of time and location shifted viewing of video programming, the expansion of digital and high definition programming, and the progress of the online video industry.”*

# The State of Communications Services Industry Address

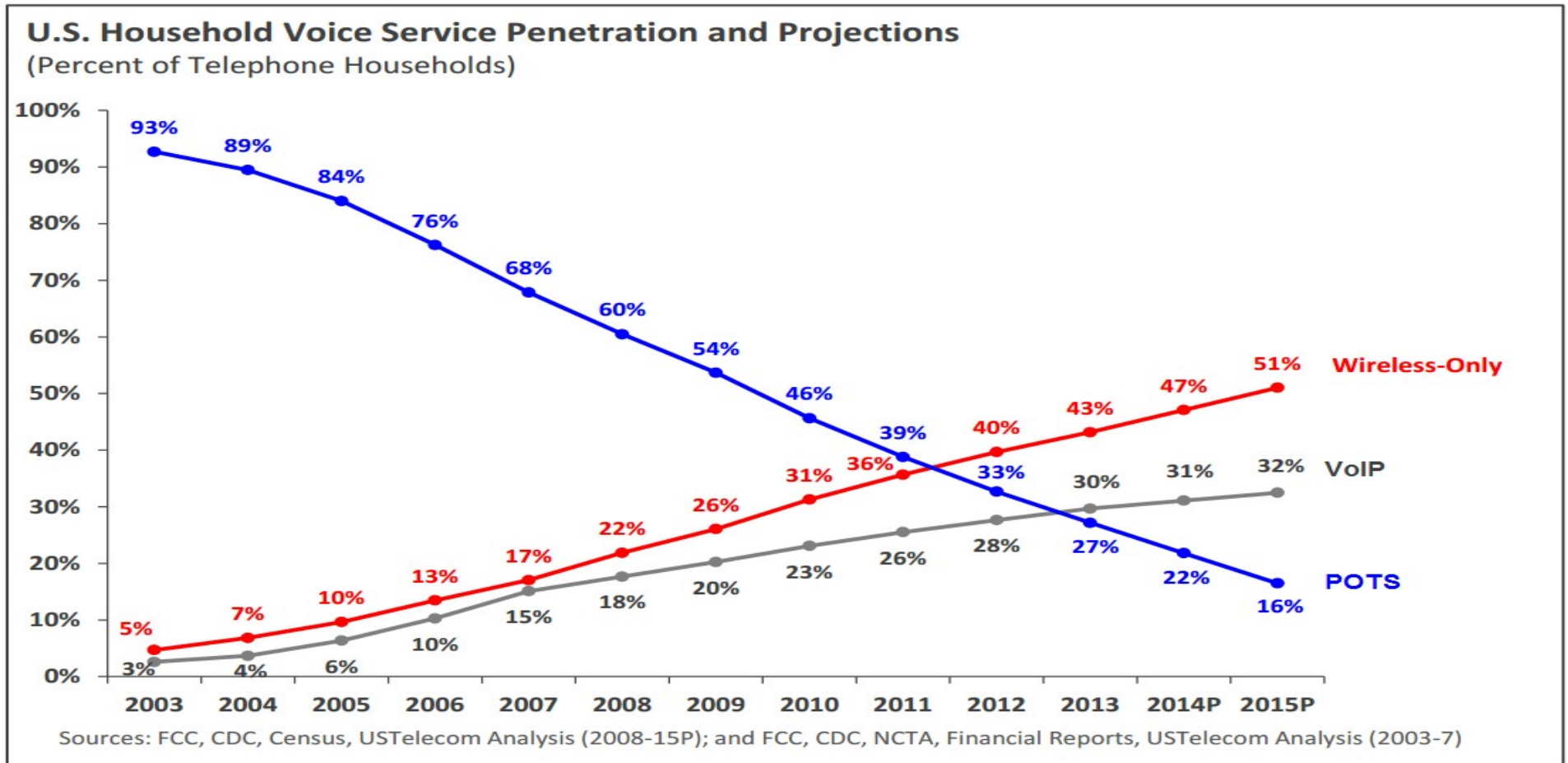
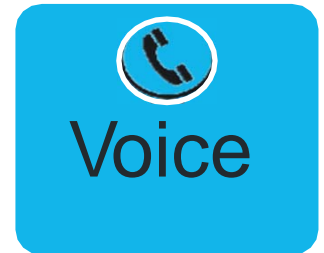
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## Financial Trends by Service



# Communications Services Industry

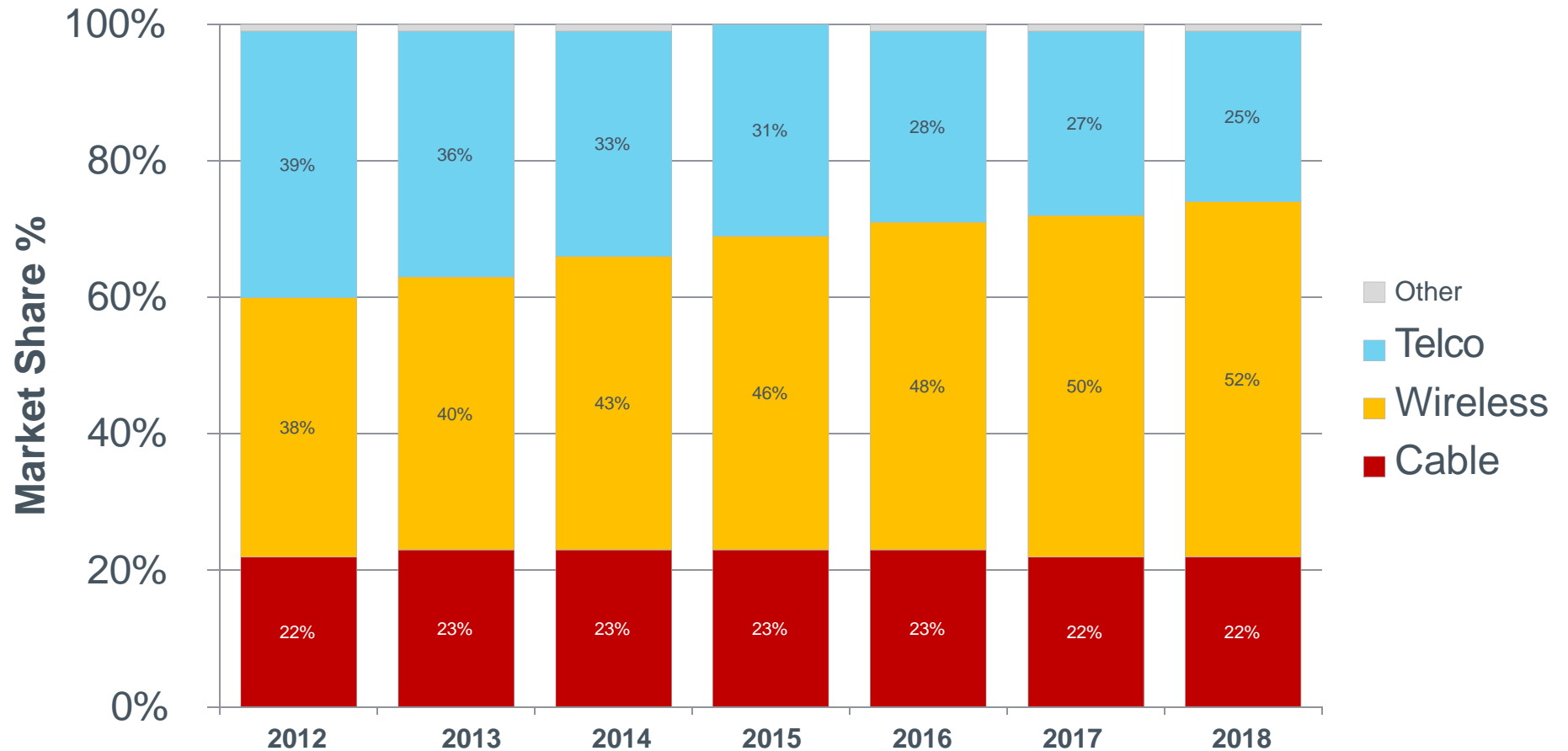
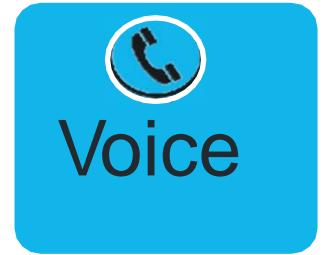
## Voice – Penetration by Technology



[1] – CTIA.org, Wireless quick facts. Accessed on July 19, 2016.

# Communications Services Industry

## Voice – Telco Market Share Continues to Dwindle<sup>[1]</sup>



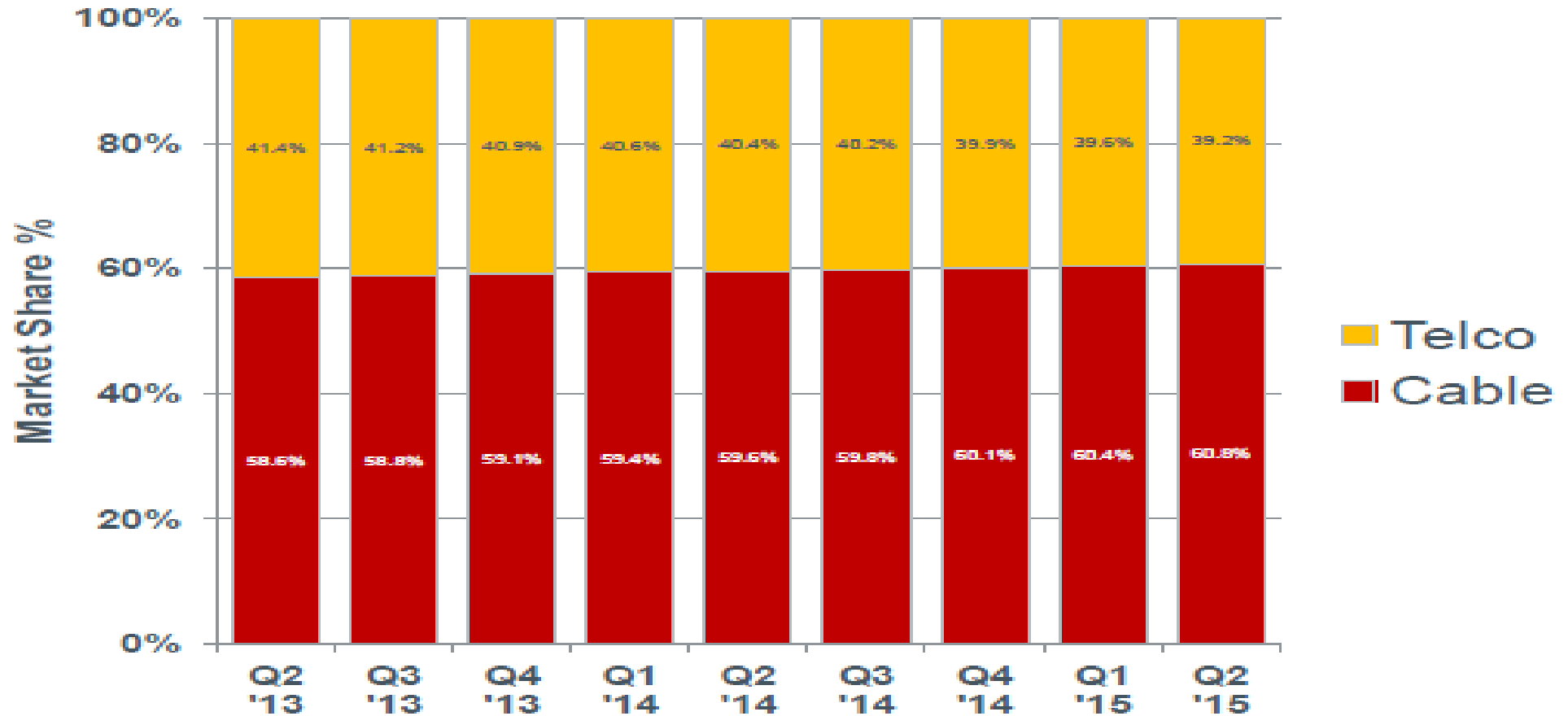
[1] – SNL Kagan Estimated Market Share of US Residential Telephone Service, April 2014

# Communications Services Industry

## Broadband – Cable and Telco Subscriptions



Data

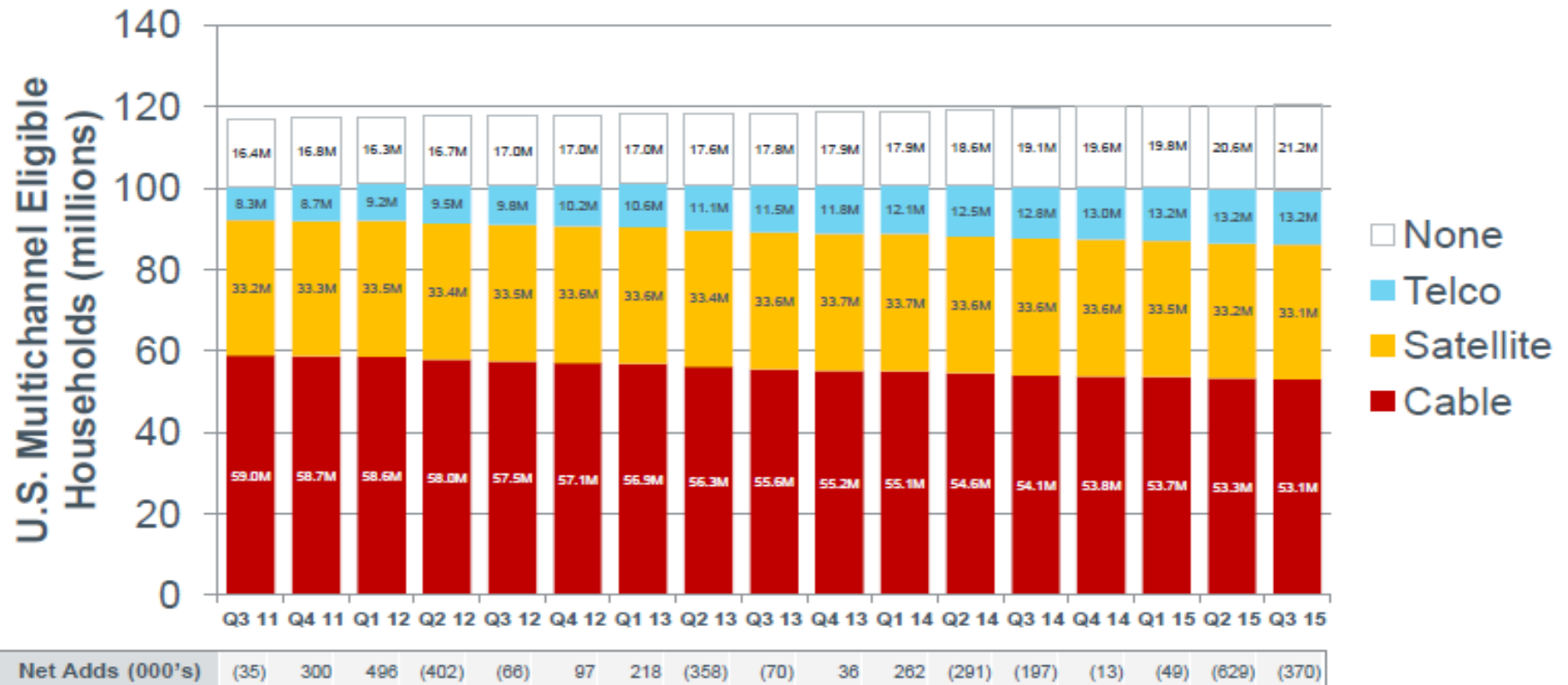


# Communications Services Industry

## Video – Multichannel Penetration By Provider Type <sup>[1]</sup>



- Telco multichannel (known as *linear*) video first introduced in 2006 and has incrementally gained market share at the expense of cable
- Overall, U.S. multichannel subscriber base has stalled at 100 million subscribers as more households choose no service



[1] – Source: SNL Cable & Multichannel Overview – Nov 2015



Chart Sources: SNL Kagan

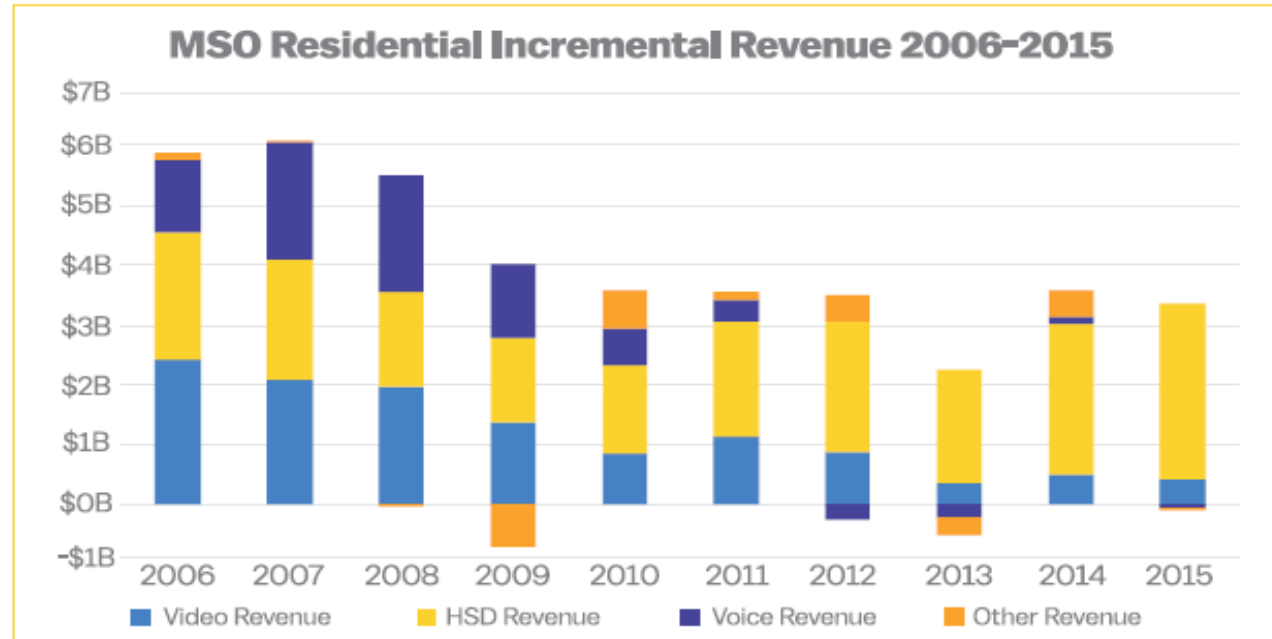
## MSO Residential Revenue

By 2010, residential growth was slowing. In fact, MSO revenue growth from 2010–2015 slowed to just 3.2% CAGR, due to slowing subscriber growth for Internet and voice services and the completion of the video digital tier transition by most MSOs.



# Incremental Revenue

- Incremental revenue peaked at \$6B in 2007;
- Nothing exceeding \$3.5B since 2010
- HSD clearly driving growth
- Voice revenue is flat or negative
- Video revenue has been \$500M per year or less since 2013.



## North American Pay-TV Providers Shedding More Video Subs

Industry	Year-end 2015 Subs	Change	Change %	Market Share
Cable TV	53.2 million	-599,000	-1.1%	53.5%
Satellite TV	33.1 million	-478,000	-0.5%	33.3%
Telco TV	13.0 million	+0.0 million	+0.0%	13.1%
<b>Total Pay-TV</b>	<b>99.4 million</b>	<b>-1.1 million</b>	<b>-1.1%</b>	<b>100%</b>

Source: SNL Kagan

## NA Pay-TV Providers Shedding More Video Subs

Provider	Total Video Subs	Net 2015 Change
Comcast	22,247,000	-36,000
Time Warner Cable	11,055,000	+43,000
Charter	4,430,000	+11,000
Cablevision	2,594,000	-87,000
DirecTV	19,784,000	+167,000
DISH	13,897,000	-81,000
AT&T U-verse	5,640,000	-303,000
Verizon FiOS	5,827,000	+178,000
<b>TOTAL TOP PROVIDERS</b>	<b>94,208,150</b>	<b>-383,467</b>

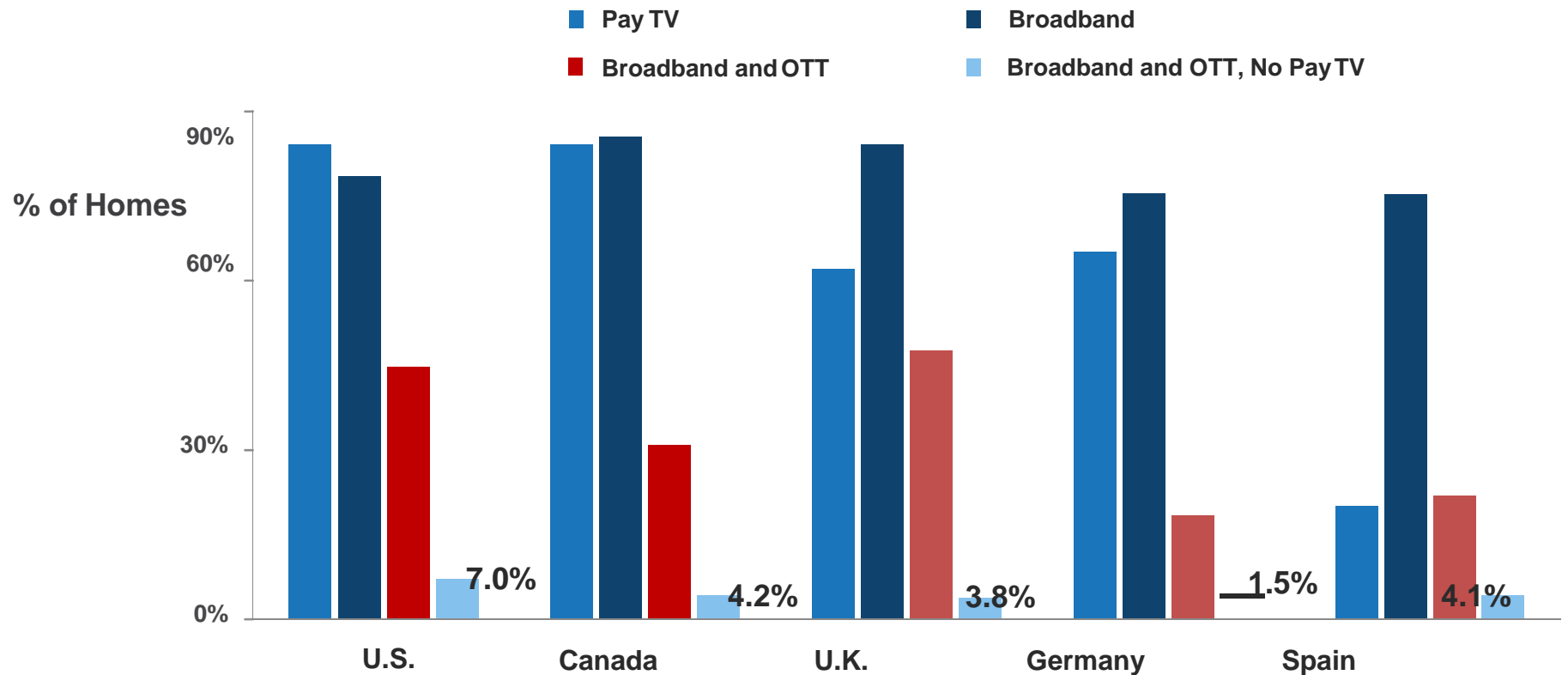
# More Consumers Are Cutting or Shaving the Cord

- US pay-TV providers lost an estimated 145,000 video subscribers in the first quarter, more than double the number of the year-ago period (MoffettNathanson)
- Collectively they lost 1.1 million video subscribers in 2015, more than four times as many as in 2014 (SNL Kagan)
- Loss marked the **third consecutive annual decline for the pay-TV industry** (SNL Kagan)

# OTT Take Rates Keep Climbing

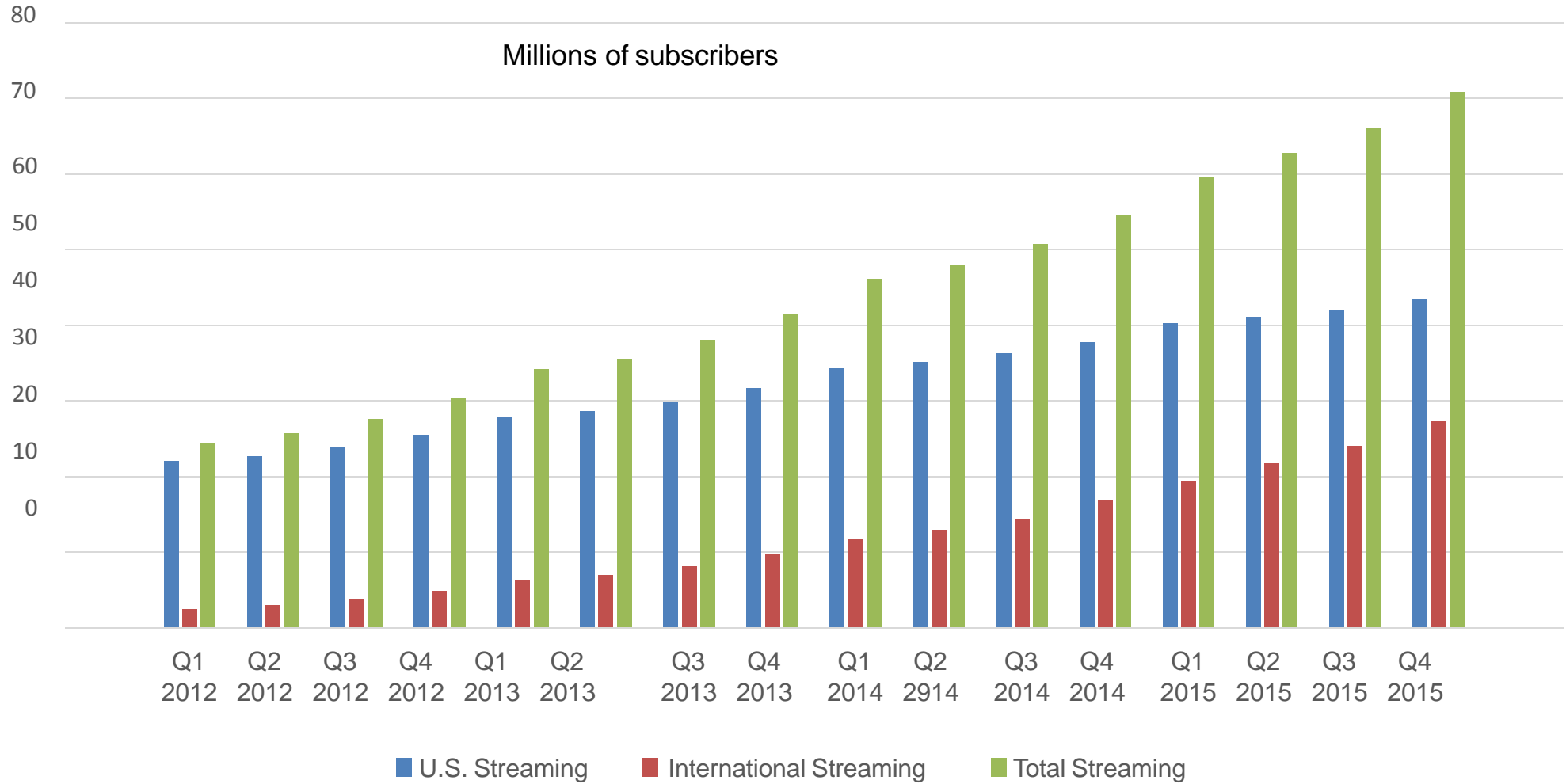
## Penetration of Services

Among All Households



Source: Parks Associates 2014 Surveys in U.S., Canada, U.K., Germany, and Spain | © 2015 Parks Associates

# While Netflix Moves Towards Global Rule



## So Major Content Players Are Now Going OTT

Content Provider	Launch Date
WWE Network	Feb. 2014
Tennis Channel Plus	May 2014
CBS All Access	Oct. 2014
Nickelodeon - Noggin	March 2015
Sony - PlayStation Vue	March 2015
HBO Now	April 2015
A&E Networks - Lifetime Movie Network	June 2015
Showtime	July 2015
AMC Networks - Shudder	July 2015
Univision Now	Nov. 2015
Turner Networks	Coming Soon
Starz	April 2016

## While Pay-TV Players Are Adding OTT Services

Pay-TV Provider	OTT Services
Dish Network	Netflix
Cablevision Systems	Hulu, HBO Now
Atlantic Broadband	Netflix, Hulu
RCN	Netflix
Grande	Netflix
WideOpenWest	Netflix, Hulu
Suddenlink	Netflix, Hulu
Mediacom	Netflix, Hulu
Midcontinent	Netflix, Hulu
Armstrong	Hulu
Cogeco Cable	Netflix
CableOne	Netflix

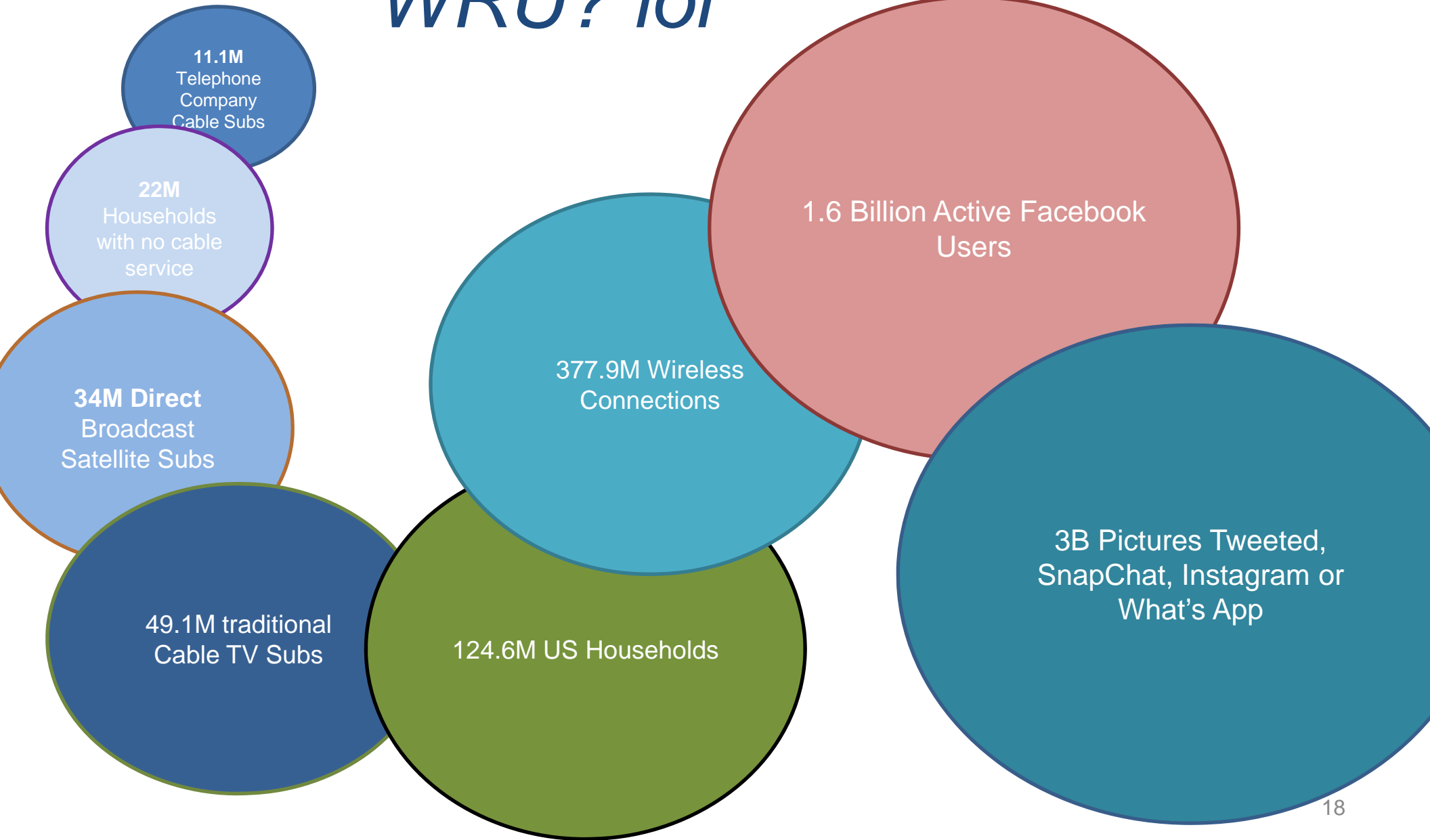


## Or Starting Their Own OTT Brands

Pay-TV Provider	Launch Date
Rogers & Shaw - Shomi	Nov. 2014
Bell Media - Crave TV	Dec. 2014
Dish - Sling TV	Feb. 2015
Comcast - Stream TV	July 2015
Verizon - Go90	Oct. 2015
Charter - Spectrum TV	Nov. 2015
CenturyLink - Prism Stream	March 2016
AT&T - DirecTV Now, Mobile & Preview	Late 2016



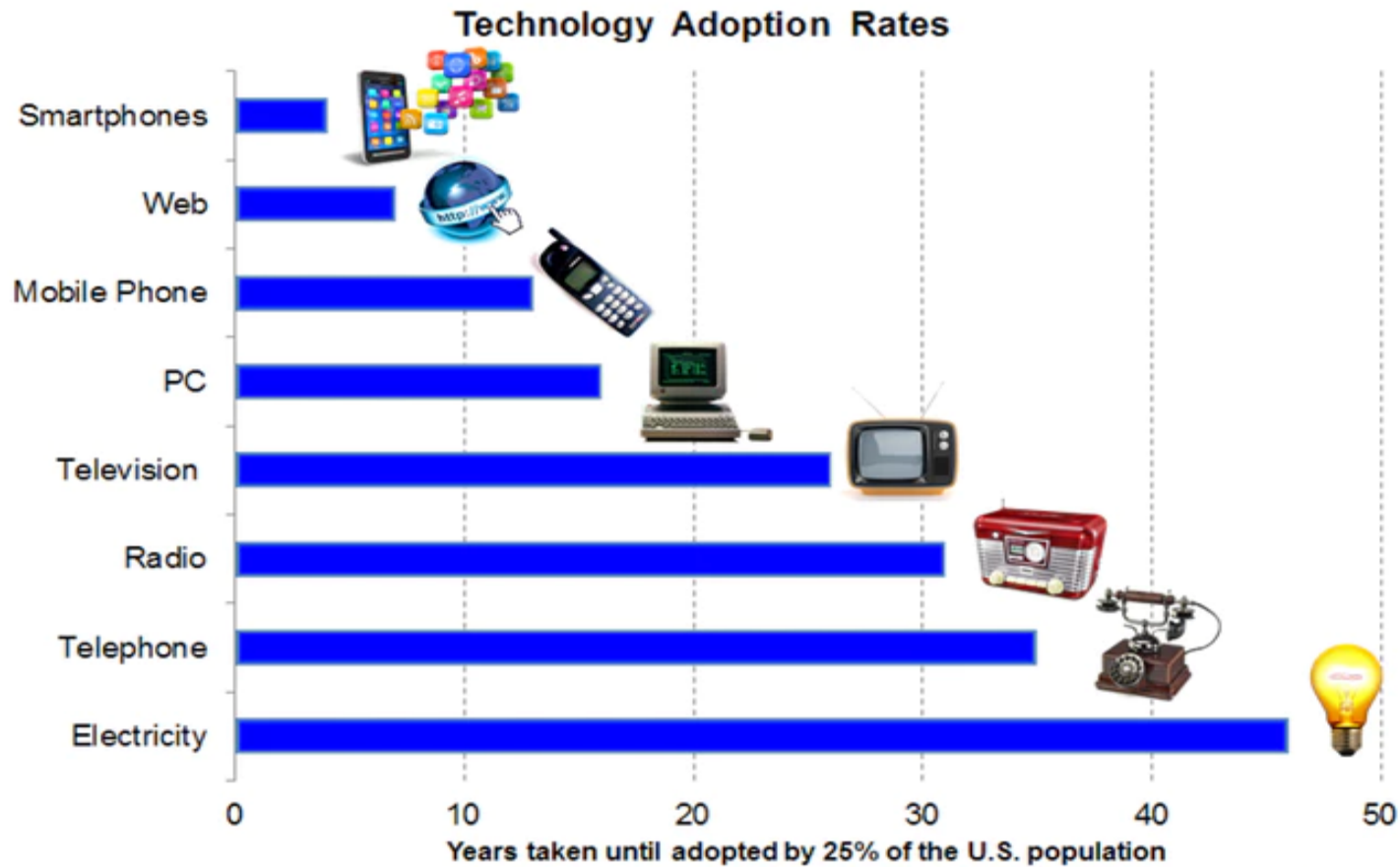
# WRU? lol





100 billion apps were  
downloaded from Apple's  
app store from July 2008 to  
June 2015.

# Technology Adoption



***The American Society of Appraisers states, in part, that:***

***“The most economical new substitute property may have many advantages over an old property:***

- such as longer life expectancy,***
- lower annual disbursements for operation and maintenance,***
- increased receipts from sale of new products and services.”***

***“The depreciation deduction of the hypothetical new substitute property should be measured in money terms:***

- all of these are disadvantages of ownership of the existing old property.”***



# Internet of Things (IoT) & Bandwidth Utilization

A cable company's perspective

# WHAT IS THE INTERNET OF THINGS?

Network-connected devices that communicate with each other



Vehicle, asset, person & pet monitoring & controlling



Agriculture automation



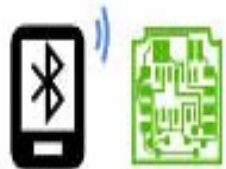
Energy Consumption



Energy Surveillance



Building Management



Embedded Mobile



Everyday things get connected  for smarter tomorrow



M2M & wireless sensor network



Everyday things



Smart homes & cities



Telemedicine & healthcare

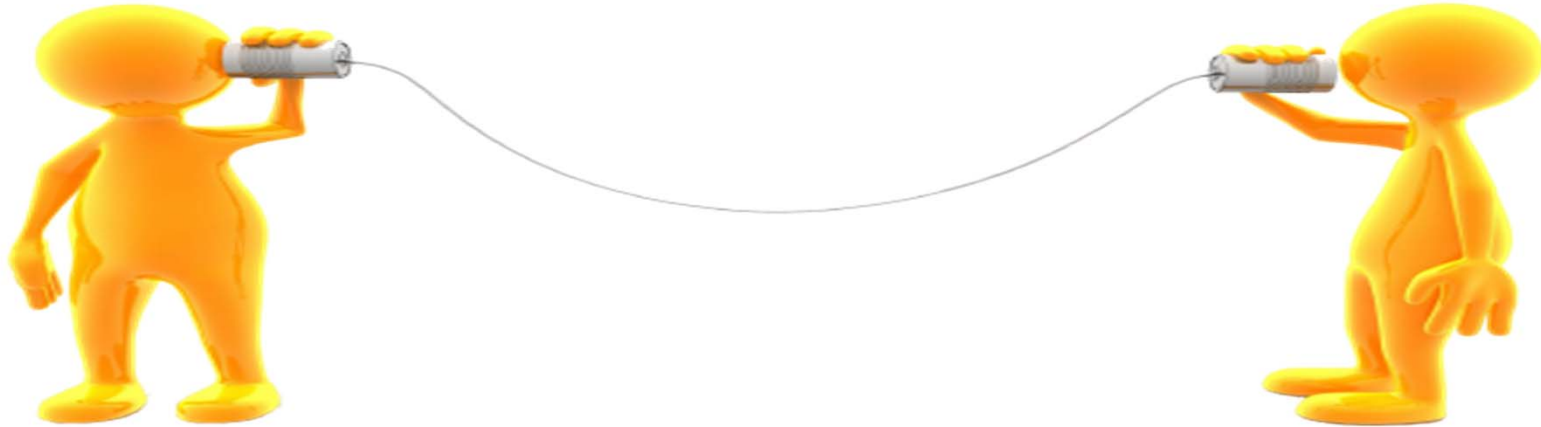
# BACKGROUND



- Term first coined in 1999 by a UK businessman
- Approximately 6 billion connected devices currently in service
  - Up 30% from 2015
  - Estimate 20-30 billion devices in service by 2020
- Average American currently has 8 devices connected to the Internet
- Estimated by 2020 average that the home will have  $\approx$ 200 devices



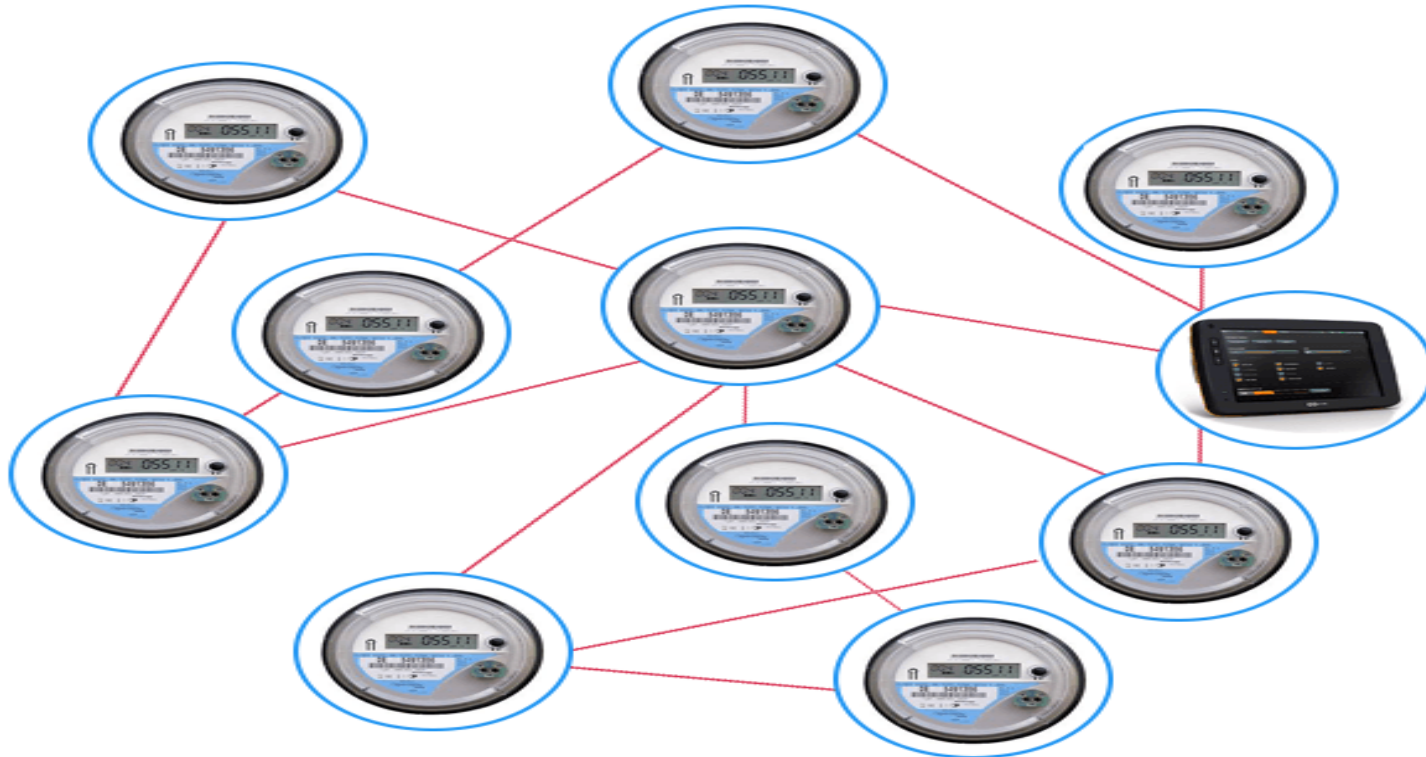
# HOW DO IOT DEVICES COMMUNICATE?



Devices have a radio that sends and receives wireless communications. These devices:

- Operate on low power
- Work on a mesh network
- Use low bandwidth throughout the day

# MESH NETWORK



In a mesh network every single node is connected to multiple other nodes. Data jumps from one node to the other until it reaches the server.

- New nodes can be added to the network without disturbing the existing architecture
- Nodes are generally located inside the customer's premises

# LOW BANDWIDTH



Despite the volume of connections (and market buzz) IoT applications aren't expected to have a significant impact on traffic in the near-term.

- Devices consistently consume low capacity throughout day; and
- Currently account for less than 1% of global IP (Expected to represent less than 2.8% of global IP traffic by 2018)

# WHAT DOES IOT MEAN TO CABLE INDUSTRY?

## Pros:

- Increased internet dependency
- No incremental capital expenditures
- Expanded business offerings (Connected Home, Cars, Home Security, Medical Monitoring)

## Cons:

1. Who owns technical issues?
  - No standardized IoT protocol
  - Produced by numerous manufacturers
2. Requires additional redundancies/backups to account for network outages



# IF IOT DOESN'T IMPACT US WHAT DOES?



## Thirst for BANDWIDTH

- ❖ Demand is doubling every 18 months. Primary driver?
- ❖ Streaming Video - Streaming video accounts for approximately 70% percent of peak period downstream traffic on North American fixed networks

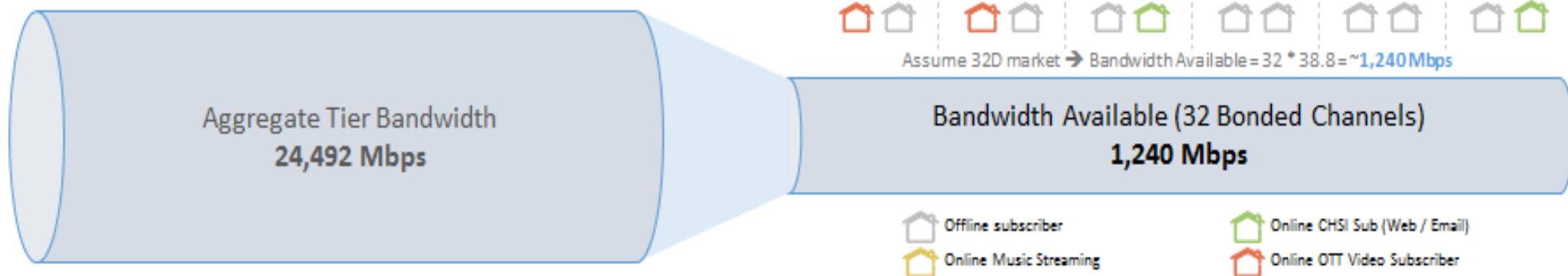
# Oversubscription & Concurrency

We manage bandwidth on the predication that not all users will be active at the same time during peak hours.

## Oversubscription\*

Speed Plan	Speed	Mix	Users	BW(Mbps)
Starter	20	30%	145	2,892
Middle	150	50%	110	16,500
Ultimate	300	20%	17	5,100
<b>Total</b>		<b>100%</b>	<b>282</b>	<b>24,492</b>

(\* HHP = 470, Penetration = 60% → Subs per SG = 282



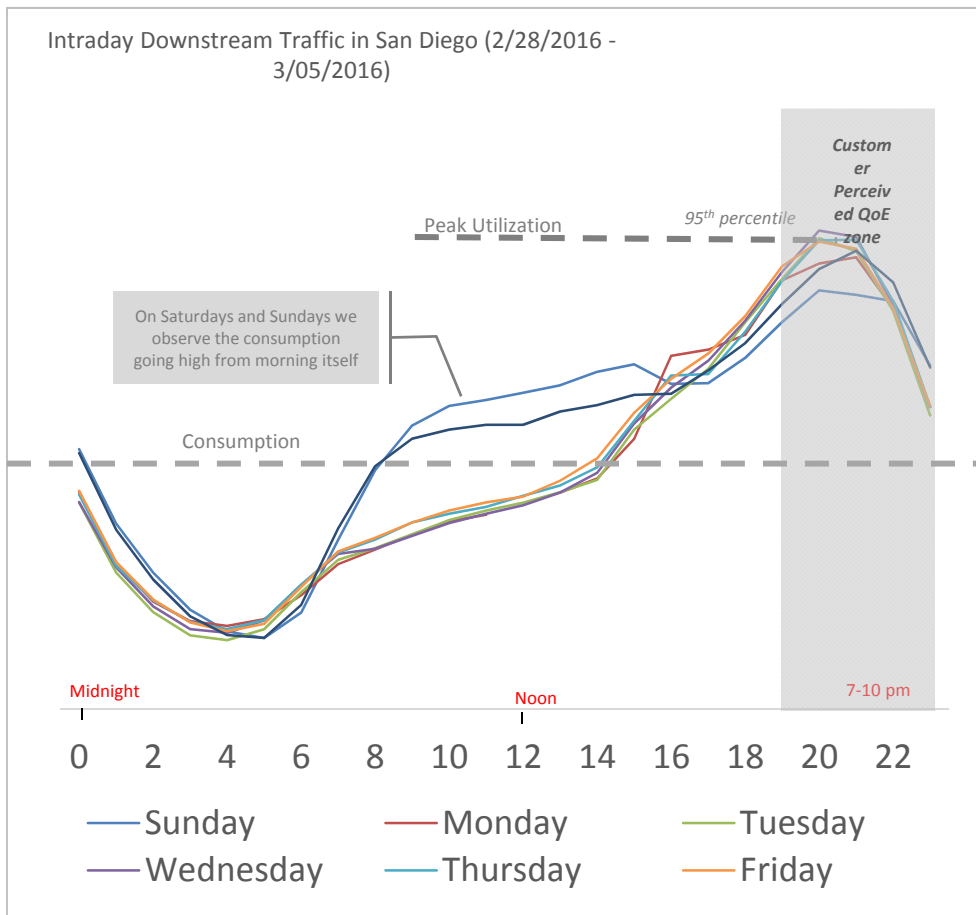
Oversubscription = Aggregate Tier BW / Bandwidth Available = ~20X

Active customers and bandwidth utilization varies greatly

Oversubscription leverages the variability in consumer usage patterns, enabling more efficient use of network resources

# Growth Driven Investment Strategy

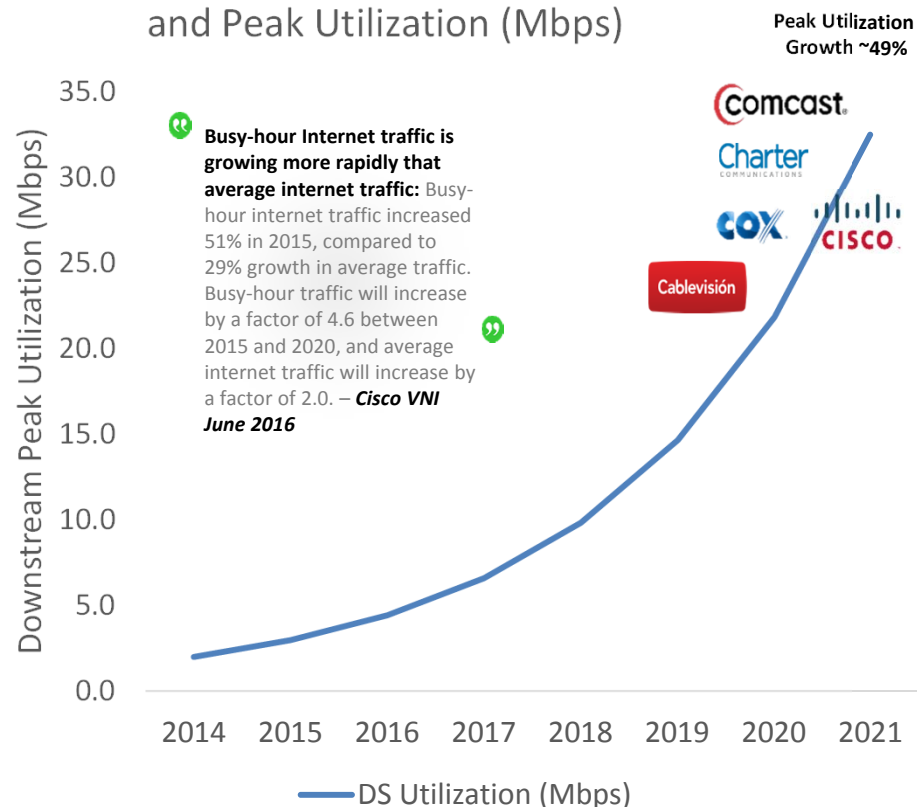
## San Diego Intra Day Hourly to Peak Traffic



- Peak time performance influences customers Quality of Experience
- Consumption is the average data in a day as compared to utilization is the peak time data rate

## Consumption versus Peak Utilization Growth Rates

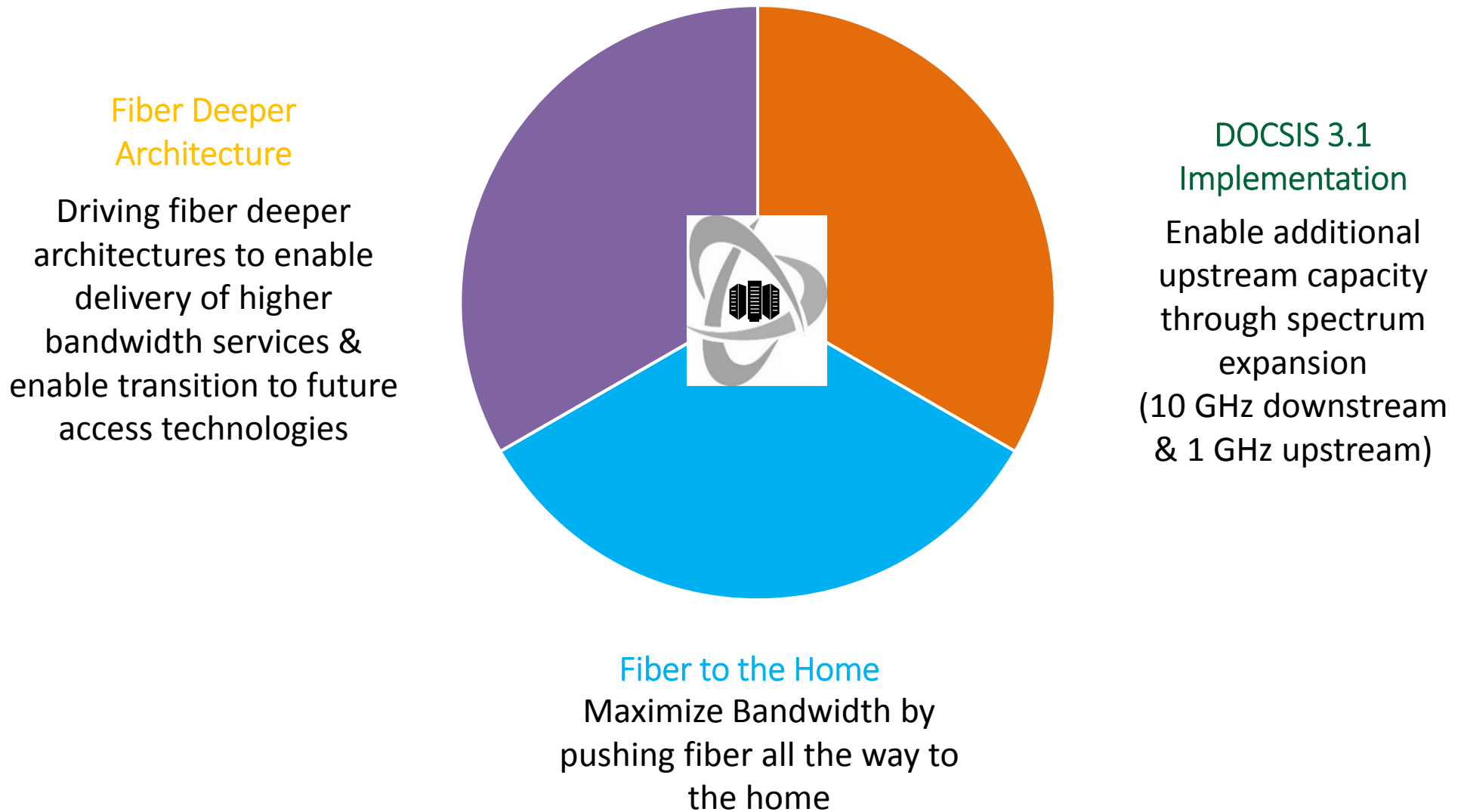
### Downstream Per Month Consumption (GB) and Peak Utilization (Mbps)



- Consumption, which is not important for planning, will grow at a lower rate than utilization

Peak time utilization and consumption are growing at different rates. We plan our network to meet peak time demand to offer superior customer experience

# Strategies to Increase Bandwidth



## Fiber Deeper Architecture

Driving fiber deeper architectures to enable delivery of higher bandwidth services & enable transition to future access technologies

## DOCSIS 3.1 Implementation

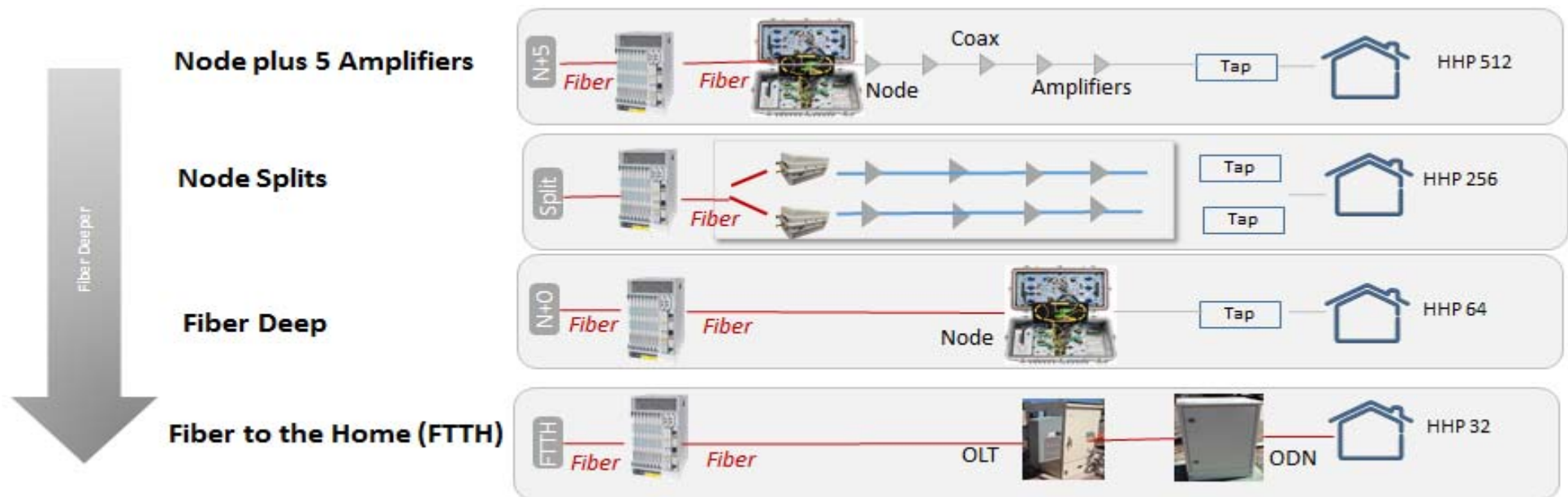
Enable additional upstream capacity through spectrum expansion (10 GHz downstream & 1 GHz upstream)

## Fiber to the Home

Maximize Bandwidth by pushing fiber all the way to the home



# FIBER DEEPER & FIBER TO THE HOME ARCHITECTURE



- Currently one node covers approx. 500 homes
  - Results in more users sharing a common pipe
  - Less bandwidth available/user
- Node Splits reduces homes passed to 256/Fiber Deep to 64
- Running Fiber all the way to homes reduces homes passed to 32

# IMPLEMENTATION PLAN

## New Projects:

- Build all greenfield projects using FTTH

## In Competitive Markets:

- Start migrating to fiber deep
- Extend fiber, but continue to leverage HFC network.  
Transition to DOCSIS 3.1

## All other Markets:

- Continue with node splits with a focus on Fiber Deep end state



# INFRASTRUCTURE IMPACT



## Switching to Fiber Deep:

- Replace all network electronics (Amps & Taps)
- Significant investment in Fiber & Nodes.
- Anticipated cost >\$5 billion over next 10 years

## FTTH Infrastructure Changes:

- Additional Fiber Expenditures
- Replacement of Nodes with OLT and ODN Equipment
- Not as significant cost because only affects greenfield projects

# BANDWIDTH MAXIMIZATION STRATEGIES

## All Digital

- Removed analog channels from line-up in 2014-2016
- This freed-up approximately 35% of existing spectrum

## Switched digital

- Only push programming to a customer's home when program requested
- Migration occurred in 2016
- Allows bandwidth to be shared among channels with low viewership

## **What's Next?**



# DOCSIS 3.1 IMPLEMENTATION



## Background

- DOCSIS is The international standard used for transferring data over cable TV systems
- DOCSIS 3.1 is latest version of this standard
- Developed in 2015. Field trials in 4Q 2016. Anticipate deploying in 2017.

## Why is 3.1 significant?

- DOCSIS 3.0 allowed IP traffic to crossover channels. D3.1 deploys a new modulation method that allows for higher bandwidth availability and faster speeds (10G downstream & 1G upstream)

# IMPLEMENTATION CONSIDERATIONS



## **Changing to DOCSIS 3.1 Requires:**

- Replacing headend equipment that transmits data (i.e. CMTS Equipment)
- Migration of customer modems to achieve higher speed
- DOCSIS 3.1 is backward compatible. Customers can continue using existing modems but won't get additional bandwidth benefits

1 Million seconds = 12 days

1 Billion seconds = 32 years

**1 Trillion Seconds = 32,000 years**



# WebScale Giants

<b>App</b>	<b>Average number of users</b>	<b>First released</b>
Facebook	126.7 million	2008
YouTube	97.6	2011
Facebook Messenger	96.4	2011
Google Search	95	2008
Google Play	89.7	2008
Google Maps	87.7	2012
Gmail	75.1	2011
Instagram	55.4	2010
Apple Music	54.5	2015
Apple Maps	46.4	2007



# Key Terms

## Cloud computing:

the use of data center servers and software networks to **dynamically allocate resources and run applications for remote end users**

## Virtualization:

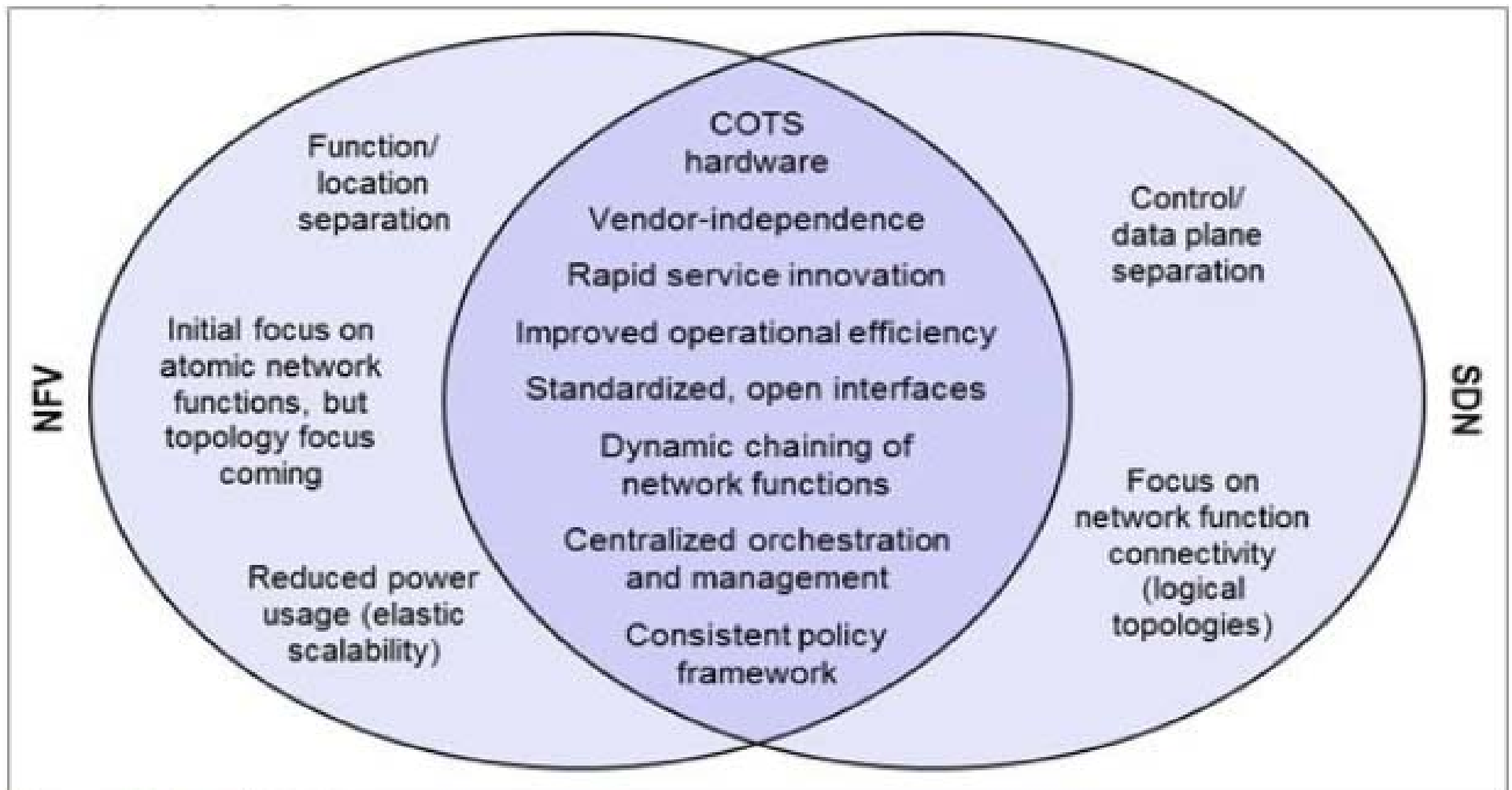
This is **key for cloud computing**

**Allows physical servers to run one or more virtual machines on demand, cloud architectures offer rapid scaling and efficient allocation of server resources on the fly**

NV is part of the movement toward **software-defined networking (SDN) and network functions virtualization (NFV)**.

Source: SDXCENTRAL.COM

# Synergies Between SDN & NFV



Source: Heavy Reading

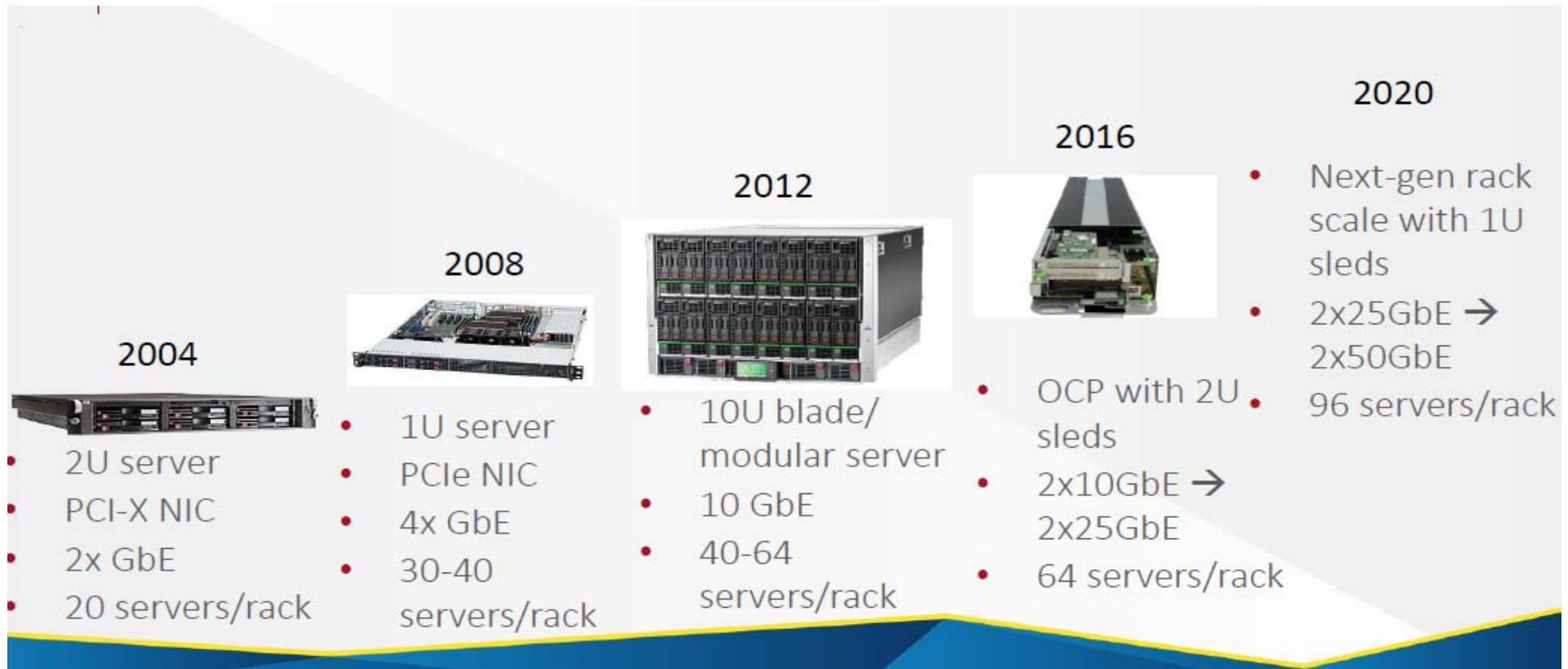
# Future of the Network

- **SDN/NFV are moving functions from network hardware to software**
- **Software will now execute network functions as applications while the hardware will become more homogeneous**
- **Use of open source software may reduce costs**
- **Potential savings from active sharing of network equipment with second operator on the same network**
- **Adoption of homogeneous and simpler hardware (cheaper), “white box”, (COTS) or “commoditized off the shelf hardware”**

# ...Future of the Network (continued)

- Reduction of entry threshold for Telco arena
- New, pure software, players adding to competition
- New innovation at the edge
- Open application program interfaces (APIs) and interoperability can result in significant decreases in end-to-end cost
  - For example, in PCs, hardware compatibility of the Intel-Microsoft platform resulted in 25% cheaper systems compared to the “closed” Apple platform in the 1980s

# Developing Data Center Architecture



# CapEx Savings for NFV

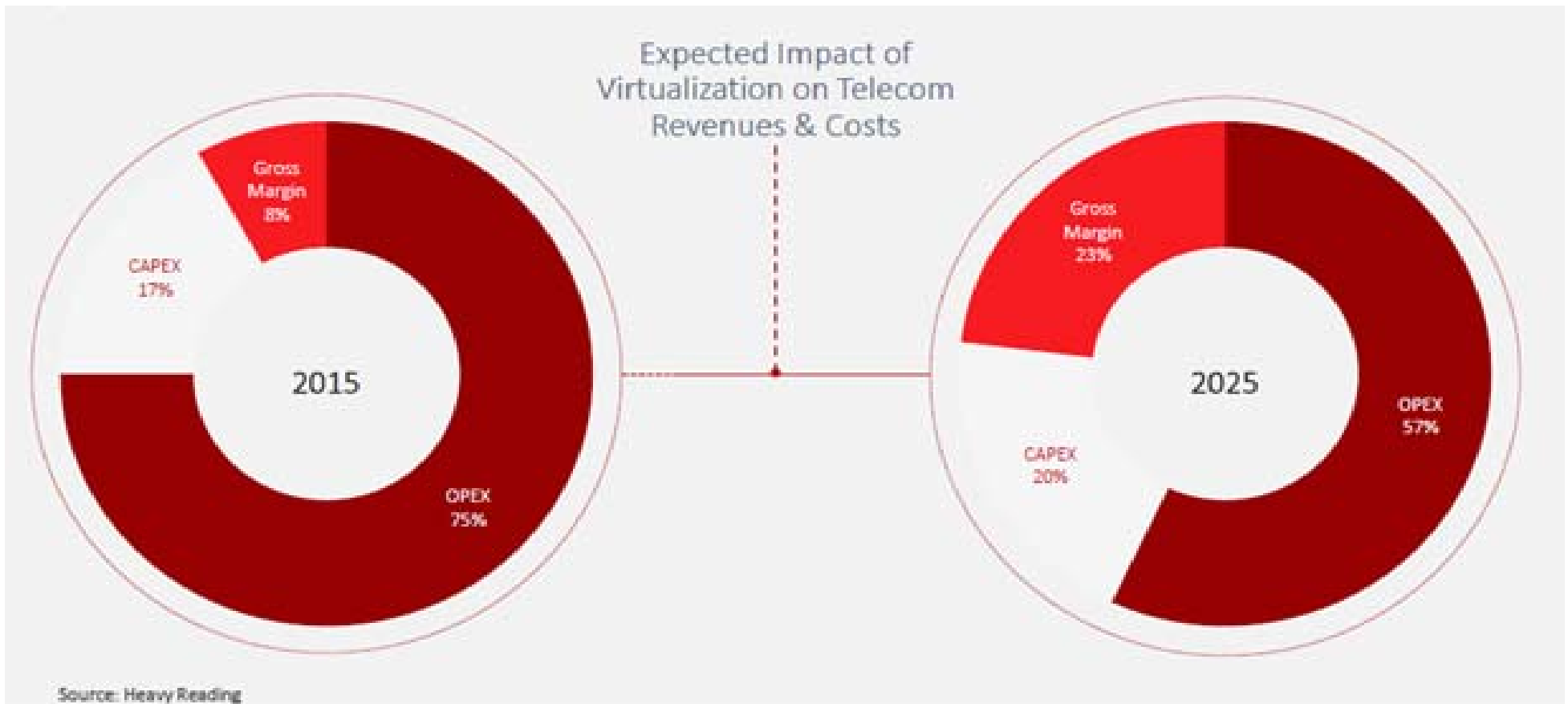
- **Continued increase in processing** and I/O capabilities of commercial (x86) server and OS software.
- **Improved capabilities and performance** of NFV applications.
- **Improved efficiency of capacity utilization in a virtual environment** – reduction in capacity growth, better capacity planning.
- Ability to **consolidate hardware** boxes.
- Doyle Research estimates that NFV can provide **CapEx savings in the range of 20 to 35 percent** of certain network elements.
- Leading system integrators estimate that operators **can save 20 to 30 percent on OpEx** via telecom transformation driven by NFV.

# Potential OpEx Savings

- **Potential OpEx savings come from a number of areas depending on the type of service transformed by NFV/SDN, including:**
  - Elimination of a significant percent of truck rolls
  - More efficient network planning and design
  - Ability to turn-up services and fix service problems more rapidly
  - Savings from reduced power consumption and facilities costs
- **The new revenue drivers include:**
  - Faster time to revenue
  - Ability to enter new market opportunities (e.g., Internet of Things)
  - Upselling existing customers (e.g., SD-WAN, vCPE, security)

# Service Provider Benefits

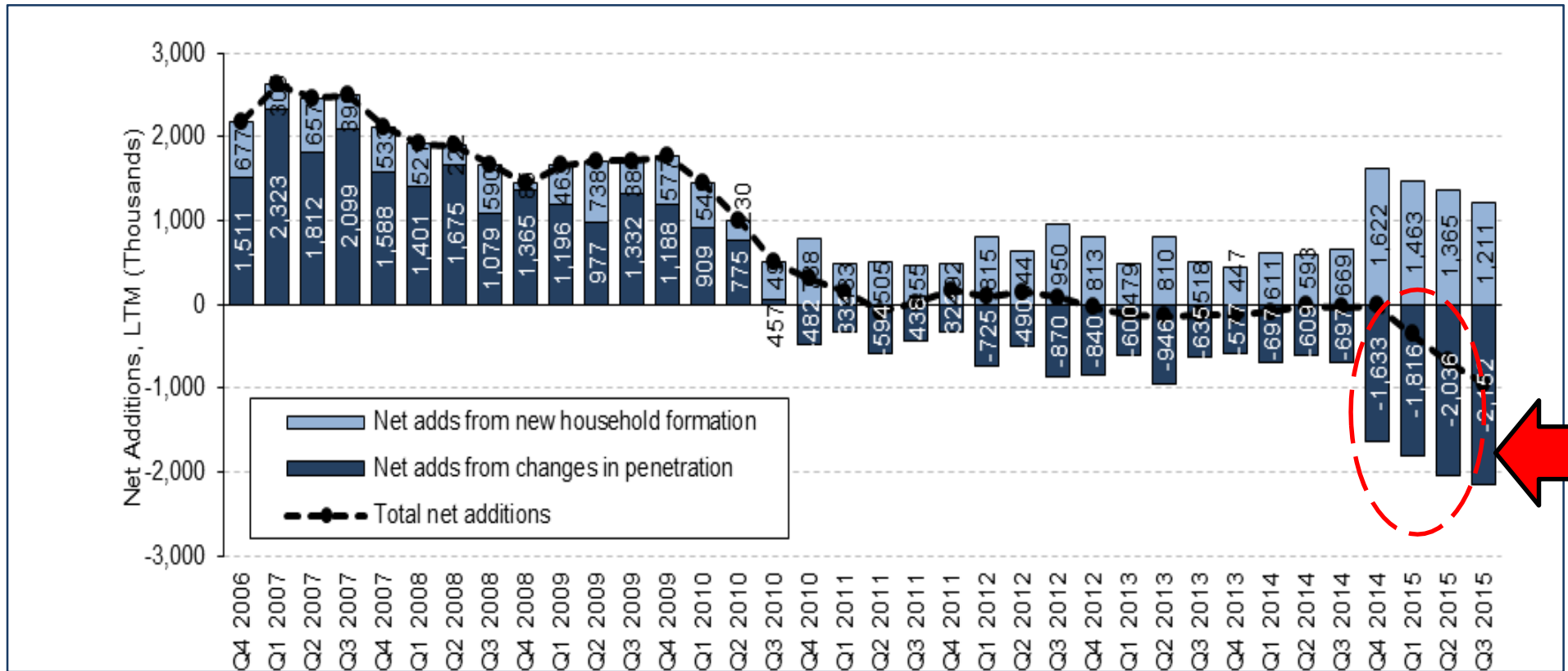
Ultimately, virtualization will deliver significantly improved operating margins for network operators while also delivering the benefits of greater flexibility and richer set of services to business and consumers.





# Cord-Cutting Makes the Financial Charts

## Changes in Pay-TV Subscriberhip Attributable to Household Formation and Pay-TV Penetration



Source: Census Bureau Housing Vacancies and Homeownership Survey, Company reports, MoffettNathanson estimates and analysis



# at&t Big Blue and SDN-NFV

- **AT&T** notes it currently **operates what it thinks is the largest software-controlled optical network of its kind in the world.**
- Software-defined network (SDN) technology is behind the AT&T Network on Demand platform, which simplifies network operations, offers security and scalability, and helps improve total cost of ownership.
- AT&T has rolled out the third service on its Network on Demand platform, **which uses a single universal piece of equipment at a customer's premise to deliver virtualized functions** and enables businesses to flexibly manage their network services.
- The first capabilities offered on the carrier's Network Functions on Demand service come from Juniper Networks (virtual routing), Cisco (virtual router), Fortinet (virtual security) and Riverbed (virtual WAN optimization).

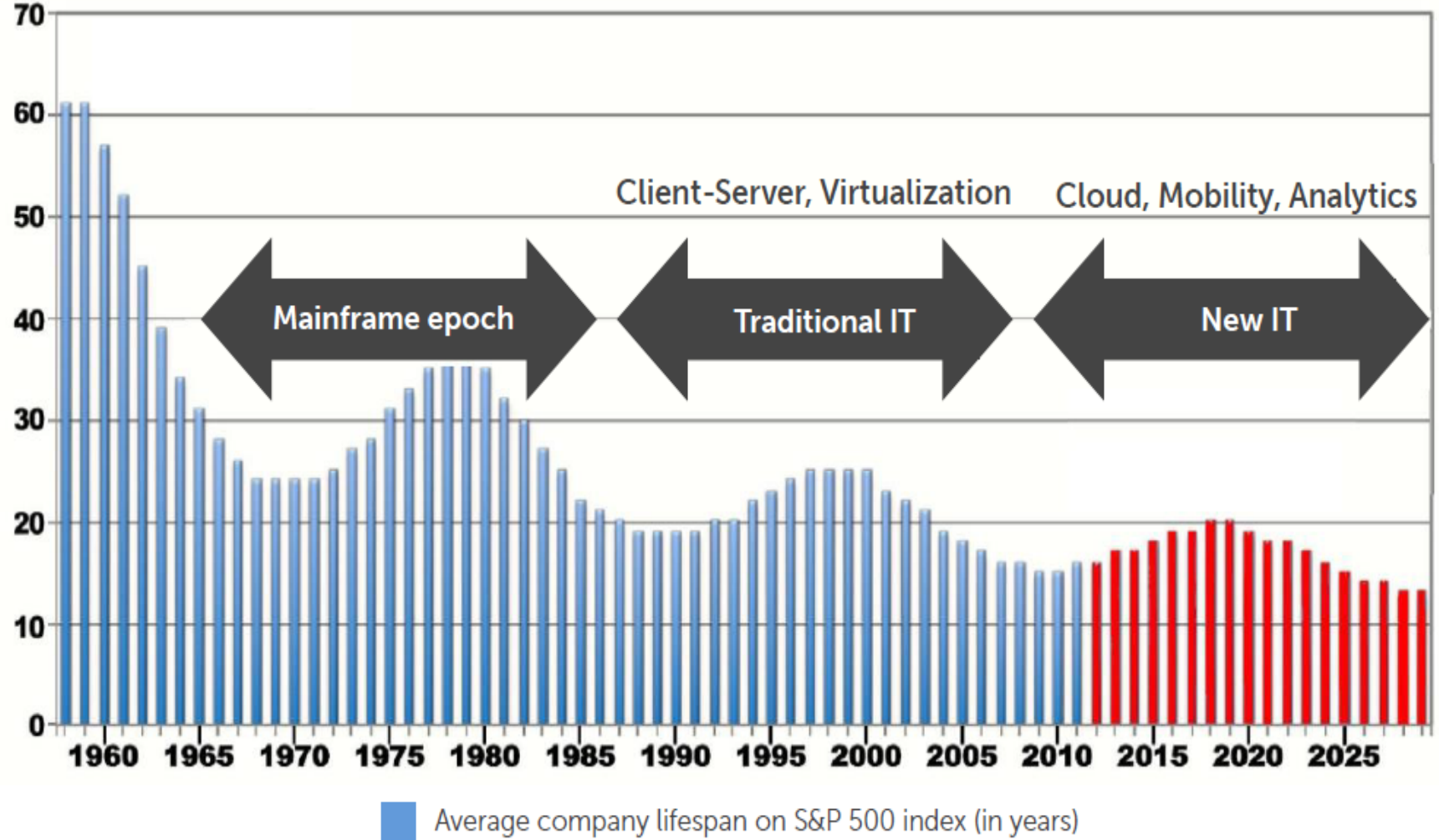
# Big Red and SDN-NFV

- With its open NFV architecture, **Verizon** is building a next-generation, automated, software-defined network based on open source solutions, including OpenStack, giving them the ability to **build a network that changes at the pace of software, not at the pace of hardware.**
- “We are thrilled to collaborate with Verizon on its SDN-NFV architecture plan, which includes both Red Hat OpenStack Platform and Red Hat Ceph Storage at the core of its open and highly scalable next-generation infrastructure.” Darrell Jordan-Smith, vice president, Worldwide Information and Communications Technology, Red Hat.



# Technological and Service disruption begets Financial disruption

75% of the S&P 500 will be replaced by 2027



# Property Tax and Broadband

- During their last legislative session, Oregon state lawmakers quickly put together laws that mitigated so-called "central assessment," which taxes companies, including telecom operators, based on the value of their brands.
- Comcast is being accused of using its pricey, 2 Gbps "Gigabit Pro" service to try to exploit Oregon tax laws that were originally put on the books to lure Google Fiber.

# The Telco Revolution

- The shift from Central Office or Head End to Telco Data Center
- Change from private enterprise networks to virtualized clouds
- Change from vendor specific equipment to open (white box/"COTS") generic platforms
- Shift from hardware to software (and hardware away from software)
- Shift of services away from networks (aka OTT)
- "Cloudification, Virtualization & Webification"
- For example, FCC's Wheeler's "**Unlock the Box**" plan aimed to enable third-party devices to enter into the pay-TV ecosystem. \$21B Captive revenue, Industry counter "**Ditch the Box**"

# How the 'Internet of Things' will impact consumers, businesses, and governments in 2016 and beyond

- Nearly \$6 trillion will be spent on IoT solutions over the next five years
- Businesses will be the top adopter of IoT solutions because they will improve their bottom line by:
  - 1) lowering operating costs;
  - 2) increasing productivity; and
  - 3) expanding to new markets or developing new product offerings

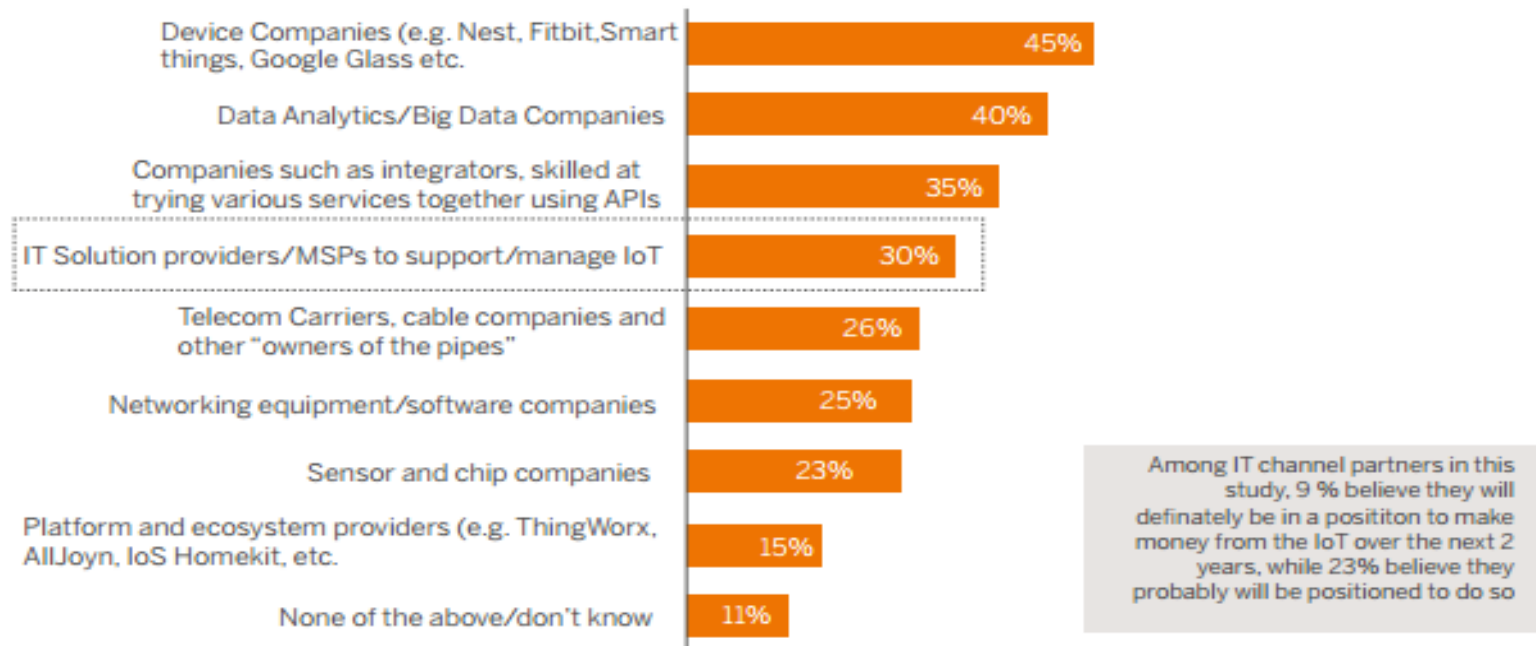
# ...Impact (continued)

- We believe Government will be the second-largest adopters of IoT ecosystems, because they are focused on
  1. increasing productivity,
  2. decreasing costs,
  3. and improving their citizens' quality of life
- Consumers will lag behind BUT;
  1. they will purchase a massive number of devices
  2. invest a significant amount of money in IoT ecosystems.



# Show me the Money\$!\$

Perception of Who Will be making money with the Internet of Things



The Internet of Things (IoT) has been called the next Industrial Revolution — it will change the way all businesses, governments, and consumers interact with the physical world

# Quick Breakdown

<b>DOCSIS Progression</b>	<b>Year</b>	<b>Mbps Down</b>	<b>Mbps Up</b>
1.x	1997	38	9
2.0	2001	38	27
3.0	2006	152	108
3.1	2015	10,000	1,000

- 10,000Mps = 10Gbs;      1000Gbs = 1Terabyte... Petabyte

# Dramatic Changes in How Video is Being Consumed

- SDN/NFV in conjunction with the Cloud can enable traditional Cable TV Operators to compete in the new IP of OTT. The removal of all analog to increase the spectrum band for additional services related to IoT, home grown OTT. OTT Video Surpasses Broadcast by 2019.
- Switched digital and routing are two of the key functions most often being “virtualized” now.
- Virtualization may slow the need to go Fiber Deep?
- Data Channels for High Speed Data can be optimized with Cloudification. Yet Cloudification is still a few years away.

# The Big Video Explosion

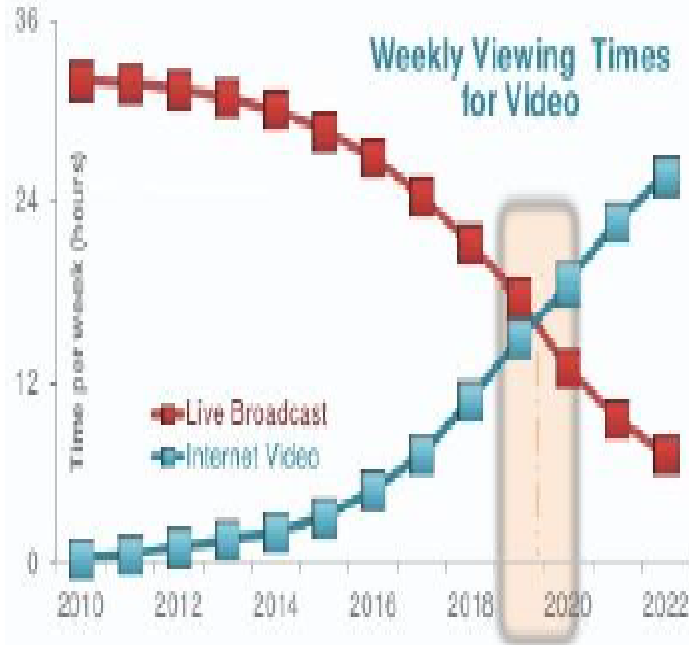
- Video consumption has changed.... Forever. Any content/place/time/real-time/device
- “Either we virtualize or vaporize” Anand Singh, Director of Architecture, CenturyLink
- “Future architectures. Where is this going... Given the REIT transformations of late...
- Heading to a world where Verizon, AT&T, T-Mo own Spectrum. And everything else is leased, outsourced, rented, whatever....” Iain Gillot with IGR at TFI 2015

For cable will that asset be a “dump pipe” or “a content app”?

# The Future of TV is Apps

## OTT Video Surpasses Broadcast by 2019

By the end of this decade, more people will be watching OTT video than broadcast TV.



Source: The Diffusion Group & GDI WorldPress

## Why OTT Wins - *Cost of Customer Acquisition*

- Traditional Pay TV Subscriber Acquisition Cost = \$850
- OTT (Sling, Hulu etc..) Subscriber Acquisition Cost = Almost \$0

## Why OTT Wins - *Mobility of Content*

- OTT Apps are available and portable across most platforms, allowing the consumer to "context switch"

## Why OTT Wins - *Shared Revenue Models*

- *Ultimately, the key to OTT's success is shared advertising revenue & access to Rights Holders Content Catalogs*

# Questions?

# Definitions

- **API:** Application program interface (API) is a set of routines, protocols, and tools for building software applications. An API specifies how software components should interact and APIs are used when programming graphical user interface (GUI) components.
- **Cloud Computing:**
  - the use of data center servers and software networks to dynamically allocate resources and run applications for remote end users
  - Typically divided into three categories (private, public, and hybrid)
  - cloud deployments have grown rapidly in recent years, promising cost savings and greater flexibility over traditional private data centers
- **Virtualization:**
  - is key for cloud computing
  - By allowing physical servers to run one or more virtual machines on demand, cloud architectures offer rapid scaling and efficient allocation of server resources on the fly

# Definitions

- **Private cloud:**
  - refers to cloud infrastructure dedicated to a single company and accessed by a private network connection, operating on servers managed either internally or by a third-party provider.
  - For many organizations in highly regulated industries, private clouds remain the solution of choice.
  - Cloud infrastructure platforms such as OpenStack offer a framework for private cloud deployment and management, and a bevy of vendors have begun releasing supported versions of the open source platform.
- **Public cloud:**
  - refers to services such as Amazon Web Services, which sell server resources (rather than dedicated physical servers) accessed over a public network such as the Internet.
- **Hybrid cloud:**
  - the combination of multiple clouds. For example, a company could use public cloud services to handle temporary bursts of activity that exceed private cloud capacity.



# Definitions

- **Network virtualization (NV)**

- abstracts networking connectivity and services that have traditionally been delivered via hardware into a logical virtual network that is decoupled from and runs independently on top of a physical network in a hypervisor. Beyond L2-3 services like switching and routing, NV typically incorporates virtualized L4-7 services including fireballing and server load-balancing. NV solves a lot of the networking challenges in today's data centers, helping organizations centrally program and provision the network, on-demand, without having to physically touch the underlying infrastructure. With NV, organizations can simplify how they roll out, scale and adjust workloads and resources to meet evolving computing needs.
- Leading companies are rapidly adopting NV in an effort to take advantage of the flexibility offered by software-defined computing and storage resources within the data center. NV is part of the movement toward software-defined networking (SDN) and network functions virtualization (NFV).

# Definitions

- **Software-defined networking (SDN):**
  - a way to manage networks that separates the control plane from the forwarding plane. SDN is a complementary approach to network functions virtualization (NFV) for network management. While they both manage networks, both rely on different methods.
  - SDN offers a centralized view of the network, giving an SDN Controller the ability to act as the “brains” of the network. The SDN Controller relays information to switches and routers via southbound APIs, and to the applications with northbound APIs.
  - One of the most well-known protocols used by SDN Controllers is OpenFlow, however, it isn't the only SDN standard, despite some using “SDN” and “OpenFlow” interchangeably.

# Definitions

- Centralized, programmable SDN environments can easily adjust to the rapidly changing needs of businesses. SDN can lower costs and limit wasteful provisioning, as well as provide flexibility and innovation for networks.
- SDN introduces a layer of software between bare metal network components and the network administrators who configure and set them. This software layer gives network administrators an opportunity to make their network device adjustments through a software interface instead of having to manually configure hardware and actually physically access network devices.

# Definitions

- Virtualized networks, cloud computing and the data center will play a vital role in making the Internet of Things a success. The vision for IoT is that millions (and potentially billions) of devices will be connected to each other and the Internet allowing people to communicate with machines, and machines to communicate with other machines. But that vision is currently hindered by a complicated ecosystem and fragmented platforms.
- The data from those devices is critical to existing data center infrastructure because it will represent a massive increase in the amount of data and connected nodes to the network.
- The cloud will play a key role in IoT because it can connect many of these devices, some of which will have very low intelligence or functionality.
- Data analytics will be vital because all the data collected from these devices will lead to the development of smarter applications for industrial and consumer businesses.