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IP Video
Industry Overview Review

May 2010

What is IPTV?

- "Pure" IPTV is the delivery of video services over a managed network via Internet Protocol to a TV/screen through a broadband access network:
    - HFC (via DOCSIS)
    - xDSL (e.g. ADSL2+, VDSL2)
    - FTTx (e.g. GPON, MetroE, RFoG)
    - Wireless (e.g. 4G, WiMax)
- Screens include:
    - Personal Computers in the Home
    - Hand-Held Devices (cell phones & PDAs) in the Home
    - TVs with IP STBs in the home
- Services typically include:
    - SD and HD video services
    - Digital Video Recorder services
    - Video-on-Demand services
    - Electronic Program Guide
    - Interactive TV applications
    - Targeted and Personalized Advertising
    - Blending of internet and video services - widgets

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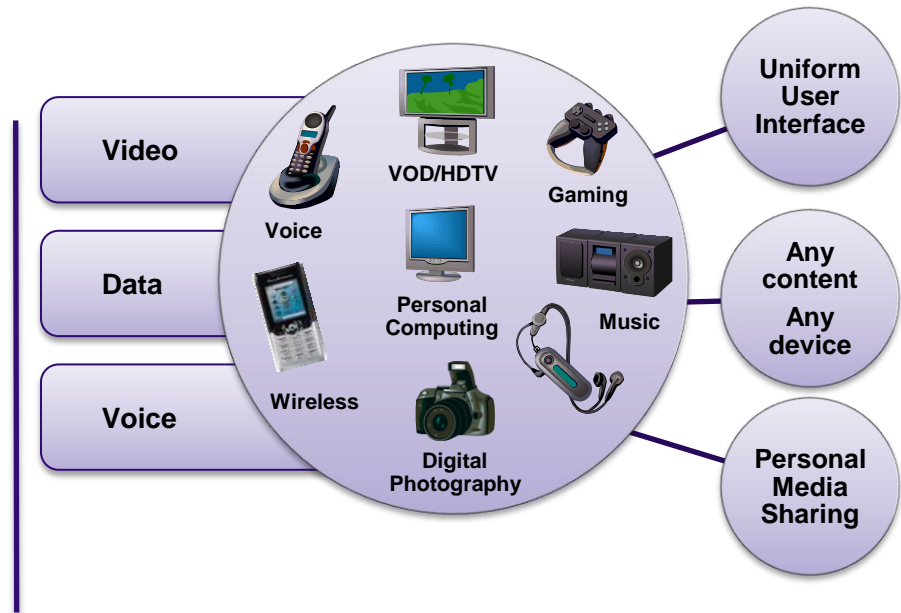
Examples of IP Video Services

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MSO IP Video
Over-The-Top (OTT) vs. MSO-Managed IP Video

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- IPTV typically describes the Telco's competitive offer to MSO video services

- IP Video is the transport of MPEG video in the payload of an IP packet... there are 2 types:
  - Over-The-Top (OTT) IP Video
  - MSO-Managed IP Video

- OTT IP Video = Delivery of Video from an Internet-based server to a PC-based client (such as Hulu or YouTube, Boxee, Netflix, CinemaNow)

- MSO-Managed IP Video = Delivery of High-Quality Video Services over Internet Protocol from an MSO-Managed Server to any one of the following 3 Screens:
  - Personal Computers in the Home
  - Hand-Held Devices (cell phones & PDAs) in the Home
  - TVs with IP STBs in the Home

- MSO-Managed IP Video might include one or both of the following:
  - <u>On-Net Transmission</u>: over the HFC Plant
  - <u>Off-Net Transmission</u>: over the Internet in or out of the home

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Telco IPTV status

- IPTV video service revenues will grow at a 27% compound annual growth rate from $8.7 billion in 2009 to $22.6 billion, or 9.8% of the global pay-TV revenues, by 2013.

- U.S. will remain the most lucrative IPTV market, accounting for 51.9% Of global IPTV video service revenues through 2013.

- The top five operators accounting for nearly 44% of the global IPTV subscriber base at year-end 2009.
  - The U.S. telcos AT&T and Verizon, France's Iliad and France Telecom, and China's Shanghai Media are among the largest IPTV providers, each with at least 1.9 million TV

- Latin America and Eastern Europe will see subscriber increases at 119.5% and 31.1% compound annual growth rates, respectively, through 2013.
  - At year-end 2009, Telefónica reported 840,600 IPTV subscribers in Europe, translating into a 15.6% YoY increase since 2008, and since 2007, it has launched several IPTV trials in Latin America, including Argentina, Brazil and Chile.

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Top 20 WW IPTV Service Providers

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Rank	Operators	Subscribers (2009 YE)	Country
1	Iliad	3,564,800	France
2	Verizon	2,861,000	US
3	China Shanghai Media Group (BesTV)	2,623,000	China
4	AT&T	2,065,000	US
5	France Telecom	1,923,000	France
6	Neuf Cegetel	1,899,999	France
7	Deutsche Telekom	1,054,000	Germany
8	NTT	1,040,000	Japan
9	KT Corporation	1,007,000	South Korea
10	PCCW	710,700	Hong Kong
11	Telefónica España	703,000	Spain
12	Chunghwa Telecom	667,892	Taiwan
13	SK Broadband	402,501	South Korea
14	Telus	148,000	Canada
15	Telefónica O2	137,600	Czech Republic
16	Comstar	128,000	Russia
17	TPSA	109,000	Poland
18	Elion 100,000	100,000	Estonia
19	Manitoba Telecom Service	86,520	Canada
20	SaskTel 78,893	78,893	Canada

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Telco IPTV Deployments

Source: Kagan March 2010

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IPTV Subscribers:

Top 5 Countries by IPTV Subscribers (000)

2009 Rank	Country	2009	2013	CAGR '09-'13
1	France	7,297	8,178	2.9%
2	U.S.	5,664	12,239	21.2%
3	China	4,300	10,764	25.8%
4	South Korea	1,740	4,350	25.7%
5	Germany	1,095	3,614	34.8%
	Total	20,096	39,145	18.1%
	Global Total	29,888	59,600	18.8%

Top 5 by Share of Total Global IPTV Market

2009 Rank	Country	2009	2013	CAGR '09-'13
1	France	24.4%	13.7%	-13.4%
2	U.S.	19.0%	20.5%	2.0%
3	China	14.4%	18.1%	5.9%
4	South Korea	5.8%	7.3%	5.8%
5	Germany	3.7%	6.1%	13.4%
	Total Top 5	67.2%	65.7%	-0.6%

Top 5 by IPTV Share of Multichannel Households

2009 Rank	Country	2009	2013	CAGR '09-'13
1	Hong Kong	44.1%	37.0%	-4.3%
2	France	42.8%	43.3%	2.9%
3	Greece	25.7%	51.1%	18.7%
4	Estonia	25.3%	29.8%	4.2%
5	Singapore	23.0%	28.3%	5.3%

IPTV Video Service Revenues:

Top 5 Countries by IPTV Video Service Revenues ($000)

2009 Rank	Country	2009	2013	CAGR '09-'13
1	U.S.	4,009,176	11,733,709	30.8%
2	France	1,715,216	2,436,484	9.2%
3	Japan	343,320	1,003,827	30.8%
4	Hong Kong	259,112	246,800	-1.2%
5	China	258,387	909,796	37.0%
	Total	6,585,212	16,330,616	25.5%
	Global Total	8,688,920	22,619,352	27.0%

Top 5 by Share of Total Global IPTV Market

2009 Rank	Country	2009	2013	CAGR '09-'13
1	U.S.	46.1%	51.9%	3.0%
2	France	19.7%	10.8%	-14.1%
3	Japan	4.0%	4.4%	2.9%
4	Hong Kong	3.0%	1.1%	-22.2%
5	China	3.0%	4.0%	7.8%
	Total Top 5	72.8%	68.2%	-1.6%

Top 5 by IPTV Share of Multichannel Revenues

2009 Rank	Country	2009	2013	CAGR '09-'13
1	Hong Kong	56.6%	38.8%	-9.0%
2	Estonia	28.2%	32.4%	3.5%
3	France	22.5%	24.2%	5.9%
4	Belgium	18.7%	24.2%	6.7%
5	Lithuania	13.8%	20.5%	10.4%

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Online Video Drives Bandwidth Growth…

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U.S. Online Video Viewed on Major Video Properties*

83% of the total U.S. Internet audience viewed online video

Y-axis: Videos Viewed (Billions), scale 0 to 35

X-axis: Mar-07, May-07, Jul-07, Sep-07, Nov-07, Dec-07, Jan-08, Feb-08, Mar-08, Apr-08, May-08, Jul-08, Oct-08, Nov-08, Dec-08, Jan-09, Feb-09, Mar-09, Apr-09, Jun-09, Jul-09, Aug-09, Sep-09, Oct-09, Nov-09, Dec-09, Jan-10, Feb-10
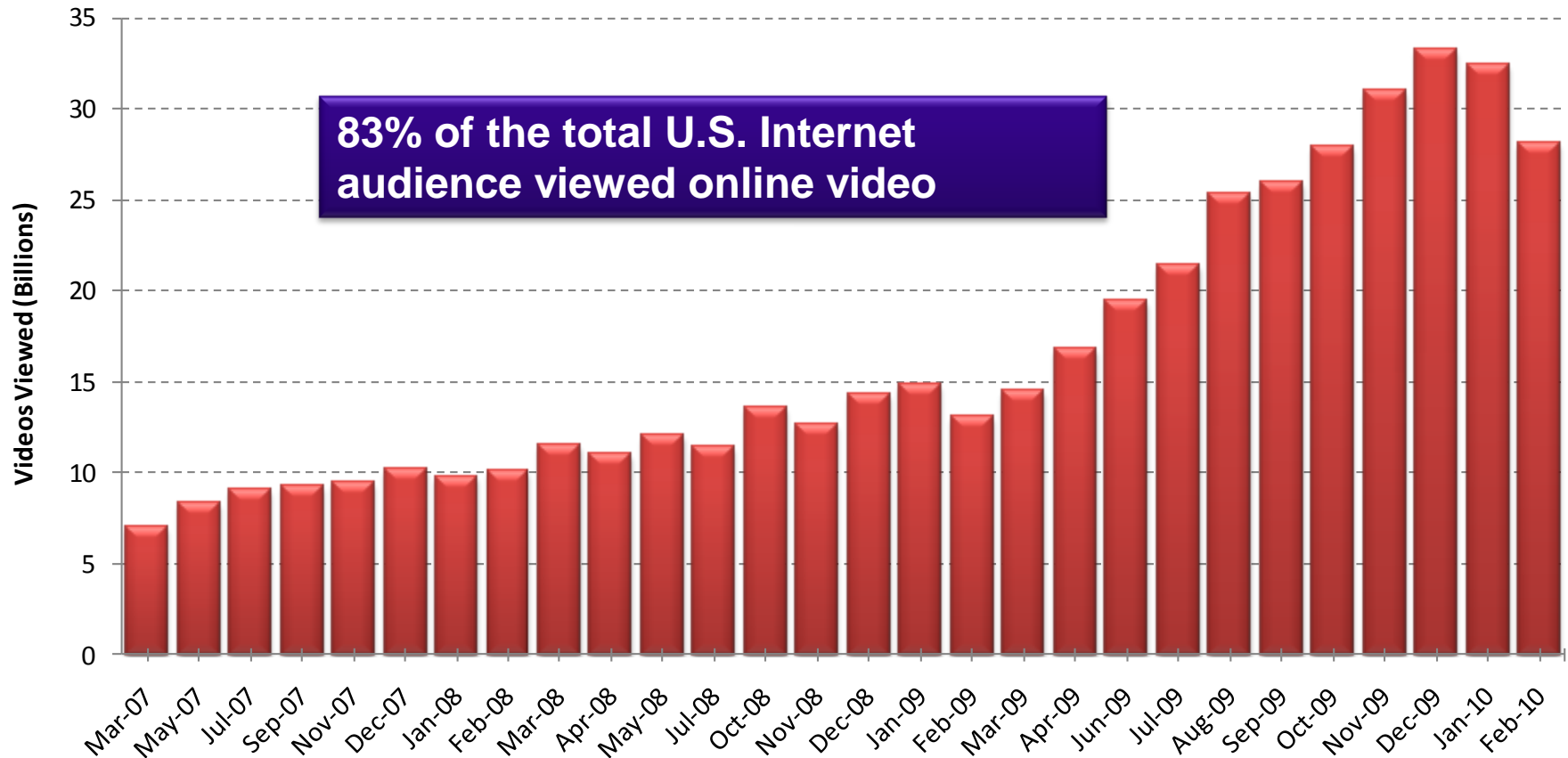
Source: comScore Video Matrix

* **Based on video content sites: excludes video server networks. Online Video includes both streaming and progressive download video, total U.S.-Home/Work/University Locations**

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OTT Notable Findings

- 83% of the total U.S. Internet audience viewed online video
- 132M viewers watched 11.9B videos on YouTube
  - 89.5 videos per viewer
- Avg. Hulu viewer watched 23 videos
  - Totaling 2.4 hours of video per viewer
- The duration of the average online video was 4.3 minutes
- The top video ad networks in terms of their actual reach delivered were:
  - Joost Video Network (by Adconion Media Group) with 38.3% penetration
  - BBE with 18.3% penetration
  - BrightRoll Video Network with 18.1% penetration

Cable IP Video Deployments

- Future Deployments by Cable MSOs

    - Guangzhou Digital Media Group

        • Public Announcement of ITPV Service

        • Launch Name is Zhujian Digital

        • Microsoft Mediaroom IPTV over DOCSIS

        • 2.5 M Analog Customer to Transition to IPTV

        • China Mandate to transition TV to all Digital

    - Other MSOs are Analyzing – No Announcements …

Competitive Comparison

	Multi-room DVR	Personal Media Share	Advanced OTT
AT&T U-verse	**5 TV's + PC**	✔	✔
Verizon FiOS TV	**4 TV's + PC**	✔	✔
dish NETWORK	**2 TV's + PC**	✔	✔
DIRECTV	**PC ONLY**	✔	✔
comcast			✔ FANCAST xfinity tv

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Rogers Curve – aka Subscriber Adoption Curve

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IP Video is ~ here

Market share %

100

75

50

25

0

| Innovators 2.5 % | Early Adopters 13.5 % | Early Majority 34 % | Late Majority 34 % | Laggards 16 % |
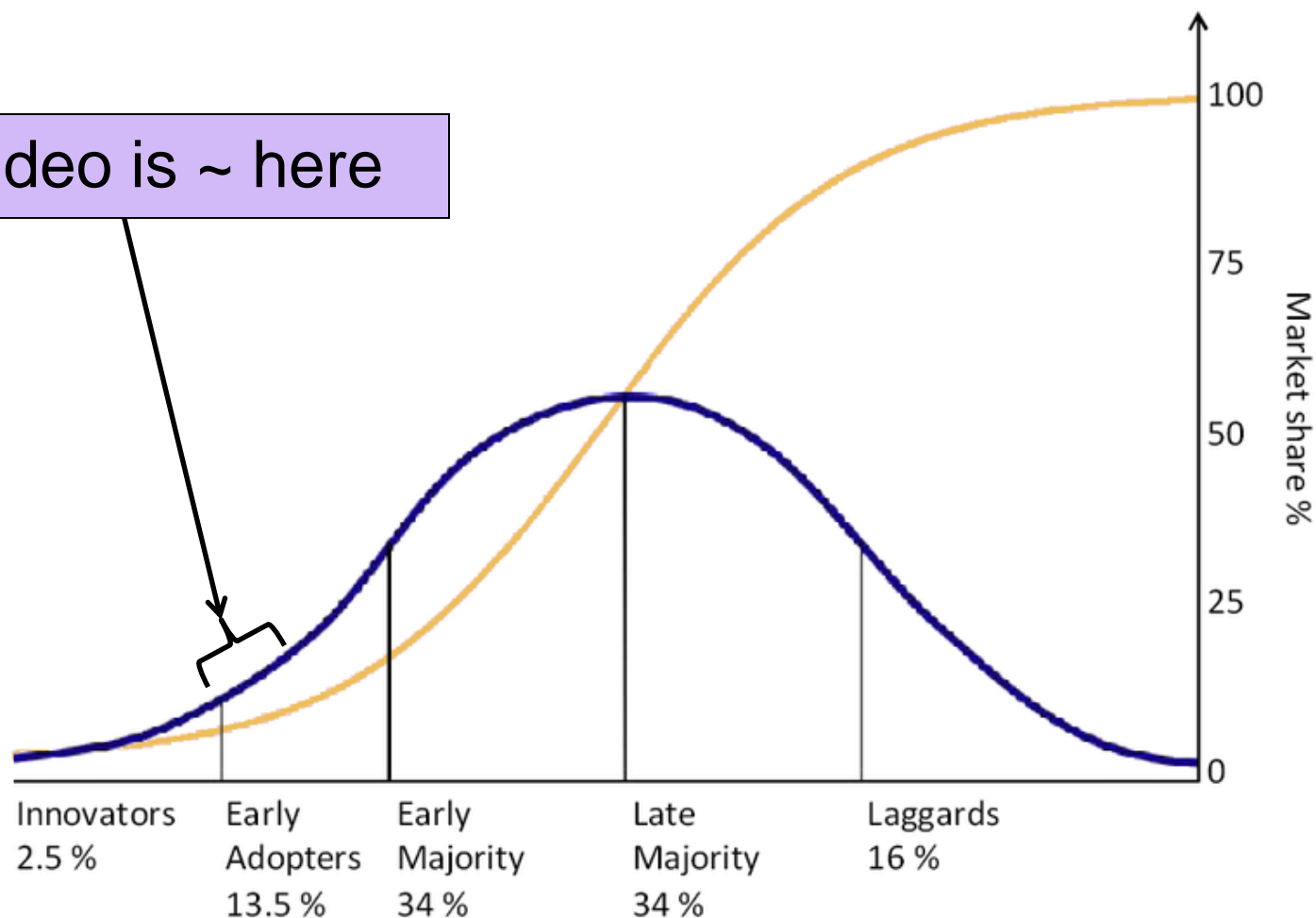
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Typical Technology Lifecycle

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Concept ——————————→

Design ——————————→

Proprietary Solutions ——————————→

Standards ——————————→

Certification ——————————→

Single Vendor Std Into ——————————→

Interoperability ——————————→

Customer Learning Curve ——————————→

Volume Deployment ——————————→

Telco IP Video
OTT IP Video

Cable Centric IP Video

DOCSIS™ **3.0 HSD**

PacketCable™
DOCSIS™ **2.0 HSD**
MPEG Video
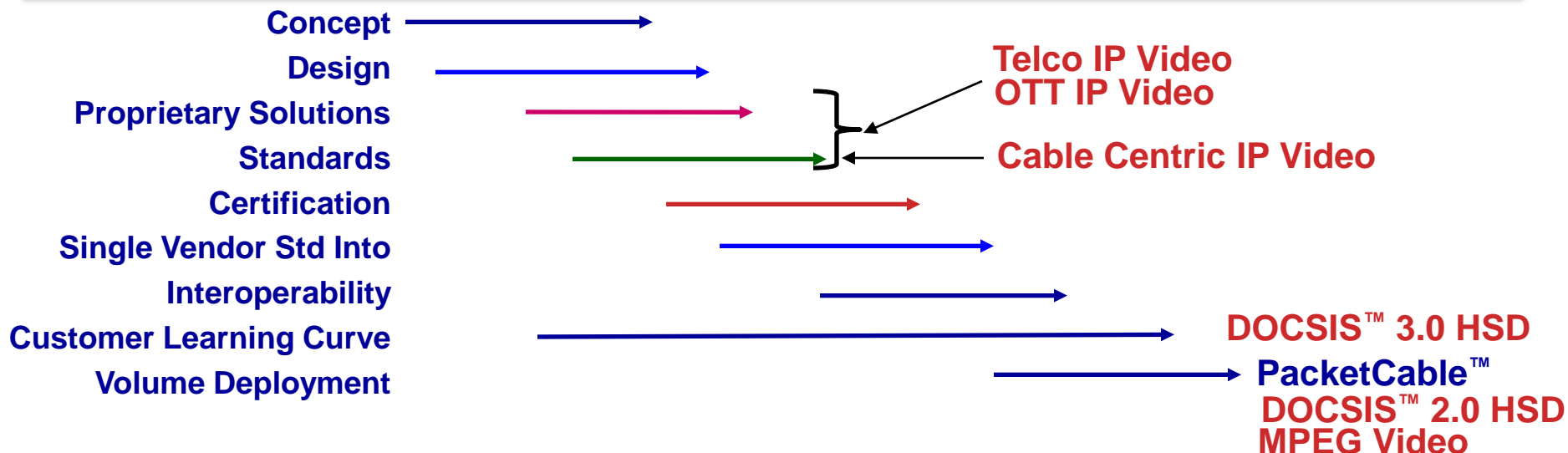
Technology Status Summary
- Telco's
    - Deploying integration intensive solutions
    - Developing standards via IPTV Forum & ATIS IIF
- Over The Top
    - deployments are significantly proprietary
        - player and streaming specific to provider
- Cable
    - Evaluating architecture options
    - Developing standards

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The NCTA's proposed consumer principles are:

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1. Consumers should have the option to **purchase video devices at retail** that can access their multichannel provider's video services without a set-top box supplied by that provider.

2. Consumers should also have the option to purchase video devices at retail that **can access any multichannel provider's video services** through an interface solution offered by that provider.

3. Consumers should have the option to **access video content from the Internet** through their multichannel provider's video devices and retail video devices.

4. Consumers should have the option to purchase video devices at retail that can **search** for video **content across multiple content sources**, including content from their multichannel provider, the Internet, or other sources.

5. Consumers should have the option to easily and securely **move video** content **between and among devices** in their homes.

6. Consumers should be assured the benefits of **continuous innovation** and variety in video products, devices and services provided by multichannel providers and at retail.

7. To maximize consumer benefits and to ensure **competitive neutrality** in a highly dynamic marketplace, these principles should be embraced by all video providers, implemented **flexibly** to accommodate **different network architectures and diverse equipment options**, and, to the maximum extent possible, serve as the basis for private sector solutions, not government technology mandates.

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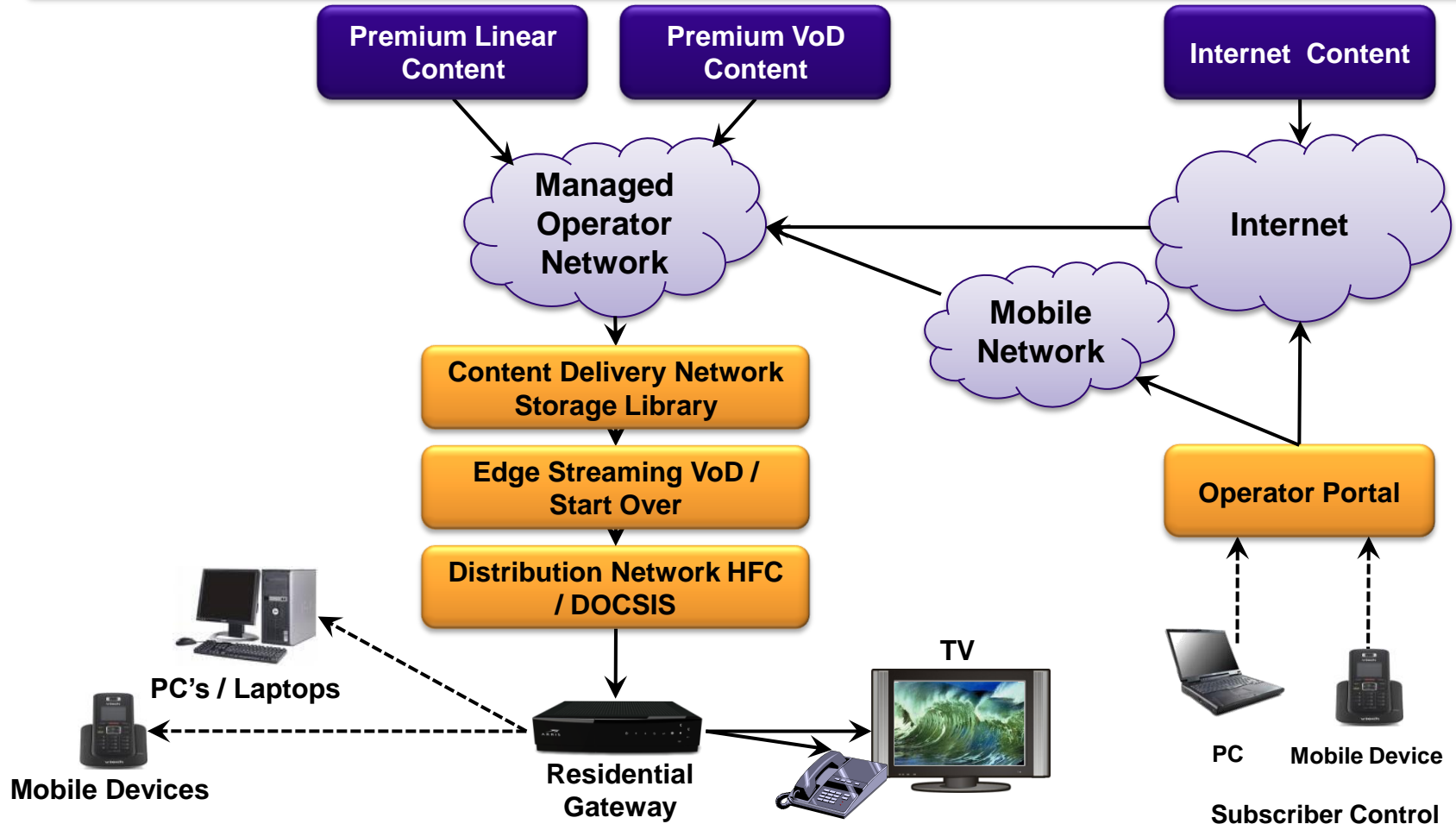
Implementation by Cable Operators

- Recognize the subscriber experience and content availability are what is in demand and not technology
- Comcast launched Xfinity OTT service
- Comcast & Time Warner partnering on TV Everywhere
- MSOs can reuse current investments & migrate toward IPTV
  - DOCSIS CMTS, provisioning systems
  - Encoding, VoD
  - Access and Transport
  - training, etc
- MSOs adopting open standards & web tools to develop applications
  - OpenCable, Tru2way, etc
- DOCSIS 3.0 offers:
  - Bonded RF channels (4 today going to 8 and beyond), IPv6, Multicast QoS, High Asymmetry
  - A future-proof platform that will cost effectively support IPTV

IP Convergence at the Edge, in the Distribution Network and in the Home

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Premium Linear Content

Premium VoD Content

Internet Content

Managed Operator Network

Internet

Mobile Network

Content Delivery Network Storage Library

Edge Streaming VoD / Start Over

Distribution Network HFC / DOCSIS

Operator Portal

PC's / Laptops

Mobile Devices

Residential Gateway

TV

PC

Mobile Device

Subscriber Control

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What Other Reasons Do MSOs Have For Supporting IP Video?

- It provides access to a broader audience through all 3 screens in the home (TV, PC, Handheld)

- It provides a direct conduit to 15-30 year-old demographic (through their Handheld devices)

- It creates a means of further monetizing their high-quality video content partnerships

- eliminate the high costs demanded by the current STB duopoly

- provides a means to meet the increase in bandwidth and content options without breaking the bank

- It creates a means to further enhance the subscriber experience thru service mash ups and reach mass market

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Conclusions

- The Cable Industry is entering a decade of rapid change in services offerings & bandwidth trends

- Most of these changes are occurring because of the "New Kid On The Block"... IP Video

- MSOs & vendors must work together to ensure that the capacity and flexibility required by subscribers in the next decade will be available

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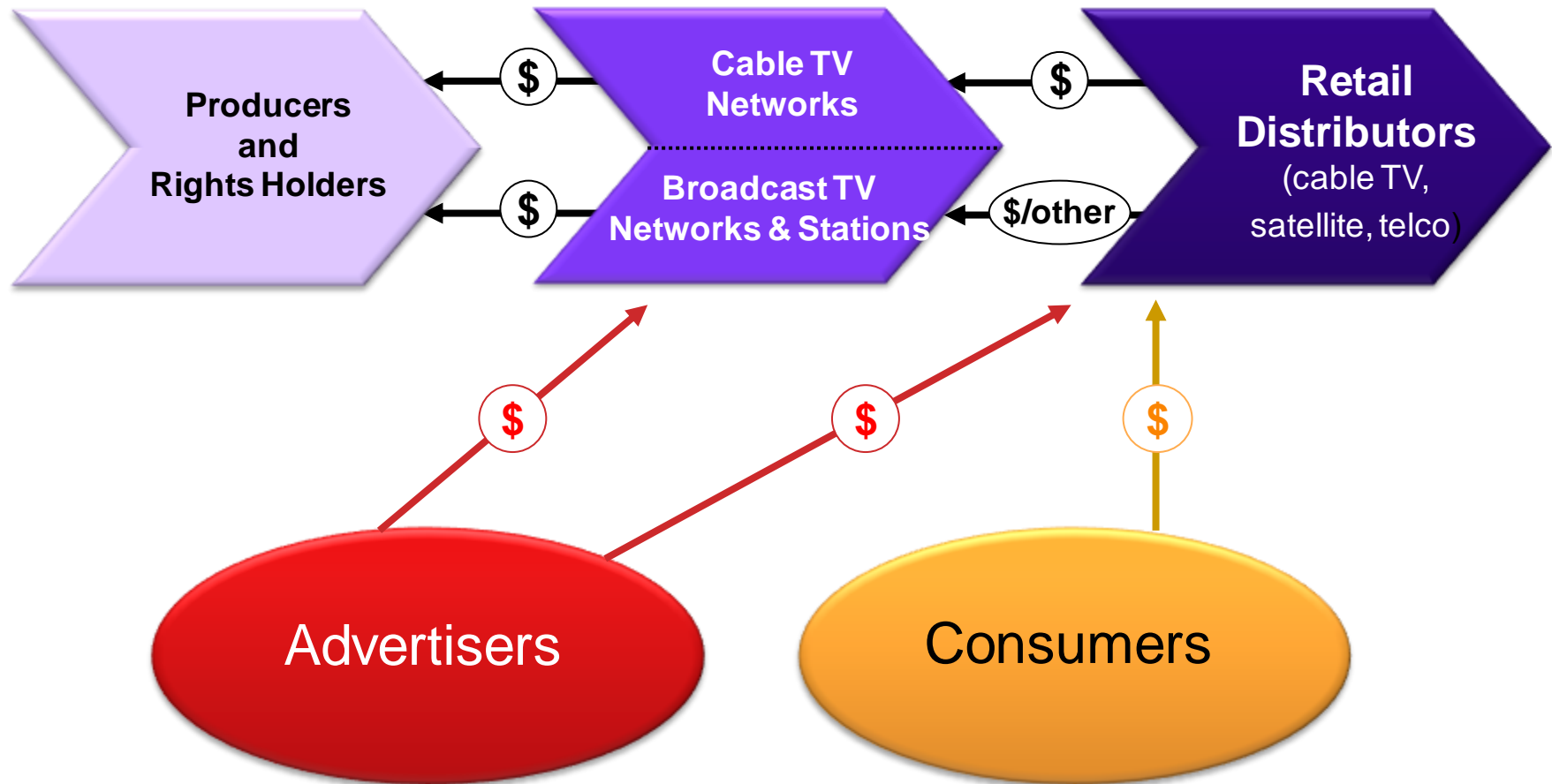
The MSO Video Value Chain Under Attack

Market Analysis & Business Case impact

May 2010

Introduction

- The Cable Industry is entering a decade of rapid change in services offerings & bandwidth trends

- Most of these changes are occurring because of the "New Kid On The Block"... IP Video

- MSOs & vendors must work together to ensure that the capacity and flexibility required by subscribers in the next decade will be available

Why Are MSOs Interested In IP Video?

- The threat from Over-The-Top content providers is growing...

  - 84.4% - the % of U.S. Internet users who viewed online video in one month

  - 10.8 hours - the average time each online video viewer watched content during one month

  - 125.3 million viewers - the number of viewers who watched YouTube in one month

  - 10.4 billion videos - the number videos viewed on YouTube in one month

  - Nearly 37% of broadband households in North America are extremely or very interested in viewing Over-the-Top video content on the home TV, according to market research firm, In-Stat

- MSOs realize they must change to remain the content distributor of choice
  - The market demand and distribution challenges for OTT parallel those experienced by the introduction of DVR services.
  - The cable industry can make this easy to deploy and an affordable experience, repeat the DVR success and ultimately own the consumer experience for OTT

Source: comScore, INstat

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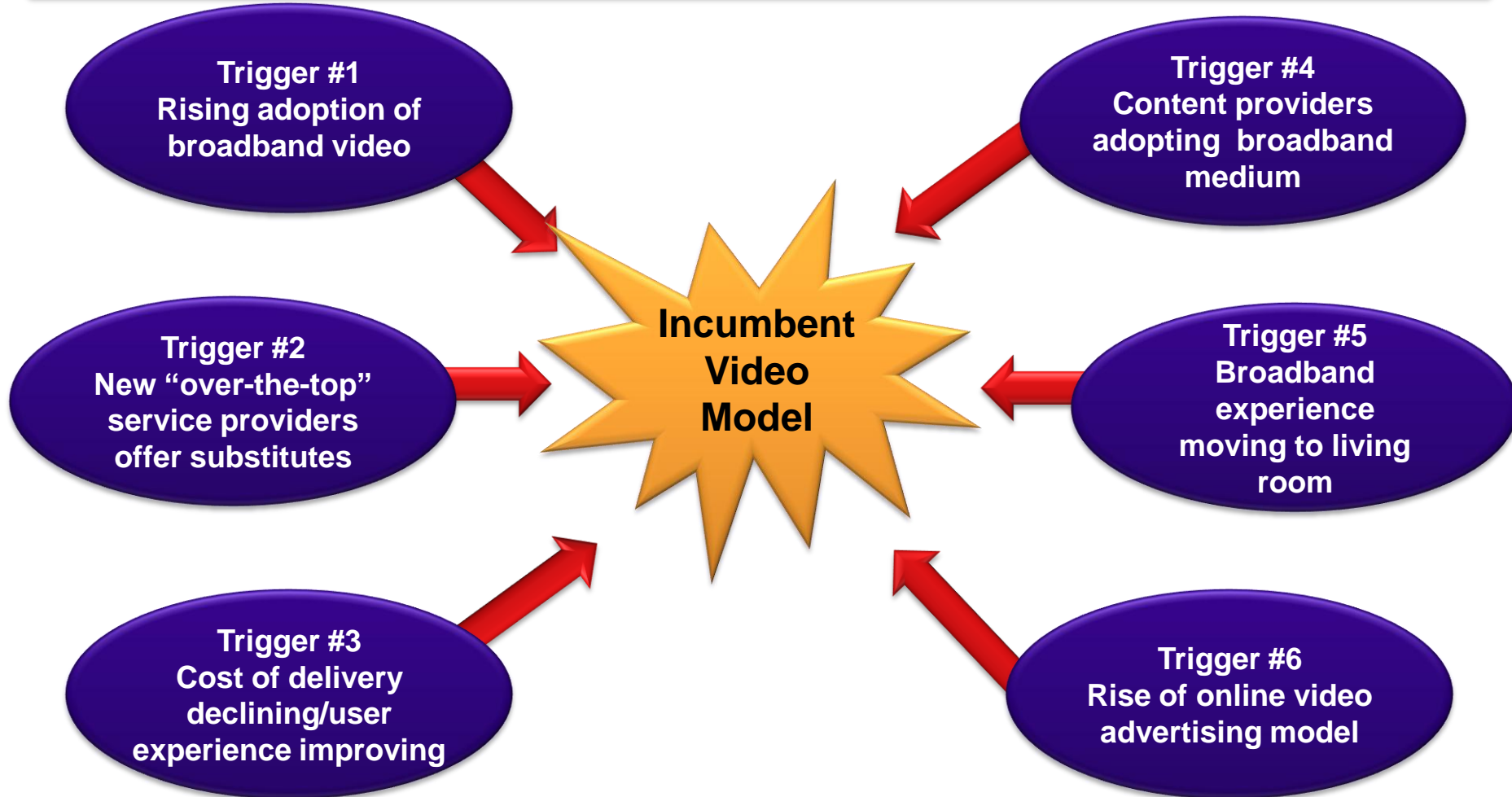# Traditional Video Distribution Value Chain

Producers and Rights Holders ← $ ← Cable TV Networks ← $ ← Retail Distributors (cable TV, satellite, telco)

← $ ← Broadcast TV Networks & Stations ← $/other ←

Advertisers → $ → (Cable TV Networks / Broadcast TV)

Consumers → $ → Retail Distributors

Source: Broadband Directions LLC

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Video Nūze

BROADBAND DIRECTIONS

6 Key Market Triggers to Watch

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Trigger #1
Rising adoption of broadband video

Trigger #4
Content providers adopting broadband medium

Trigger #2
New "over-the-top" service providers offer substitutes

Incumbent Video Model

Trigger #5
Broadband experience moving to living room

Trigger #3
Cost of delivery declining/user experience improving

Trigger #6
Rise of online video advertising model

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Convergence – In the User Experience

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Video

Data

Voice

Voice

VOD/HDTV

Gaming

Personal Computing

Music

Wireless

Digital Photography

Uniform User Interface

Any content

Any device

Personal Media Sharing

Any Media, Anywhere, Any Time

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Video Services Trends
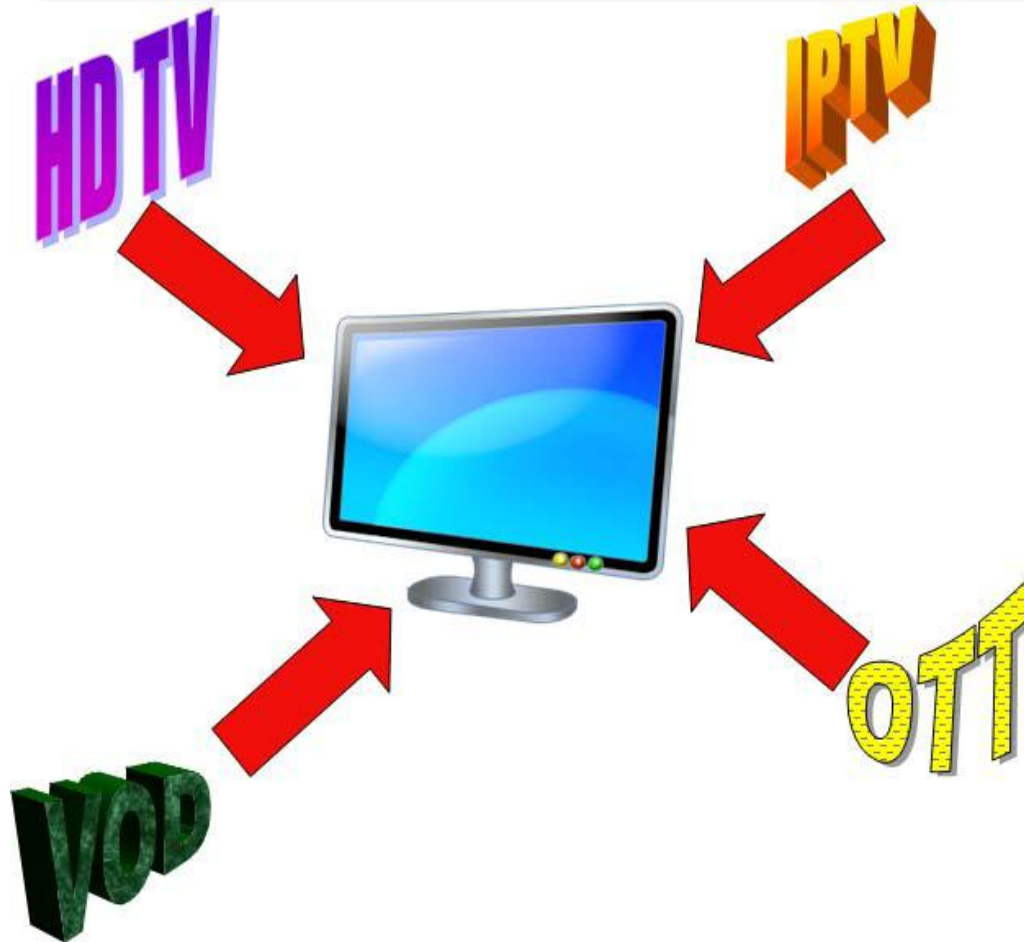
Connected Televisions will push video over the top

TV Everywhere: for a fee, cable operators will give subscribers multi-platform access to whatever is on the cable

Mass consumption of video will transcend beyond media and entertainment into other markets, such as enterprise, education, healthcare and government

By virtue of increased competition and increasingly diverse forms of video delivery, video is becoming ubiquitous.

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Transition to IP Video Has Begun
- Driving Increases in IP Traffic

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U.S. Online Video Viewed on Major Video Properties*
2009 – An Inflection Year

Videos Viewed (Billions) — x-axis: Mar-07, Jul-07, Sep-07, Nov-07, Dec-07, Jan-08, Feb-08, Mar-08, Apr-08, May-08, Jul-08, Oct-08, Feb-09, Mar-09, Apr-09, Jun-09, Jul-09, Aug-09, Sep-09, Oct-09, Nov-09, Dec-09, Jan-10

Source: comScore Video Matrix, January 2010

IP Worldwide Traffic 2008-2013

40% CAGR, 2008-2013

Petabytes per Month — x-axis: 2008, 2009, 2010, 2011, 2012, 2013
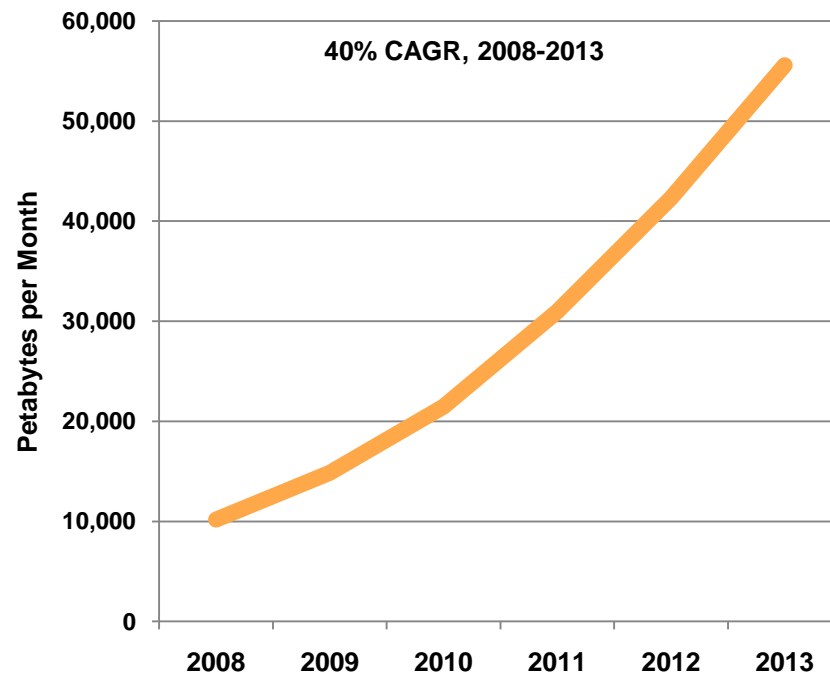
Source: Cisco Visual Networking Index: 2009

Jan. 2010: Average Hulu Viewer Watched 23.5 Videos
(Comscore)

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Value Chain Revenue Distribution

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'08 Cable networks ad revenue = $21B[1]
'08 Cable networks affiliate fee revenue $21.9B[2]

'08 Cable video residential video = $51.8B[3]
'08 Cable local spot advertising = $4.3B[4]

**Producers
and
Rights Holders**

**Cable TV
Networks**

**Broadcast TV
Networks & Stations**

**Retail
Distributors
(cable TV,
satellite, telco)**

'08 Broadcast TV network revenue = $25.5B[5]
'08 Local broadcast station revenue = $20.9B[5]

'08 Telco revenue (U-Verse + FiOS ~ $1.8B[8]

'08 Satellite revenue (DirectTV + DISH) = $29B[7]

**Current Value Chain participants want to maintain their share
New entrants see a GIANT opportunity**

Sources: 1, 2 – SNL Kagan, 3,4 - NCTA, 5, 6 – Television Bureau of Advertising,
7 – DirectTV and DISH Financial Statements, 8 – AT&T and Verizon Financial Statements

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Over the top Service Providers Reconstitute Value Chain
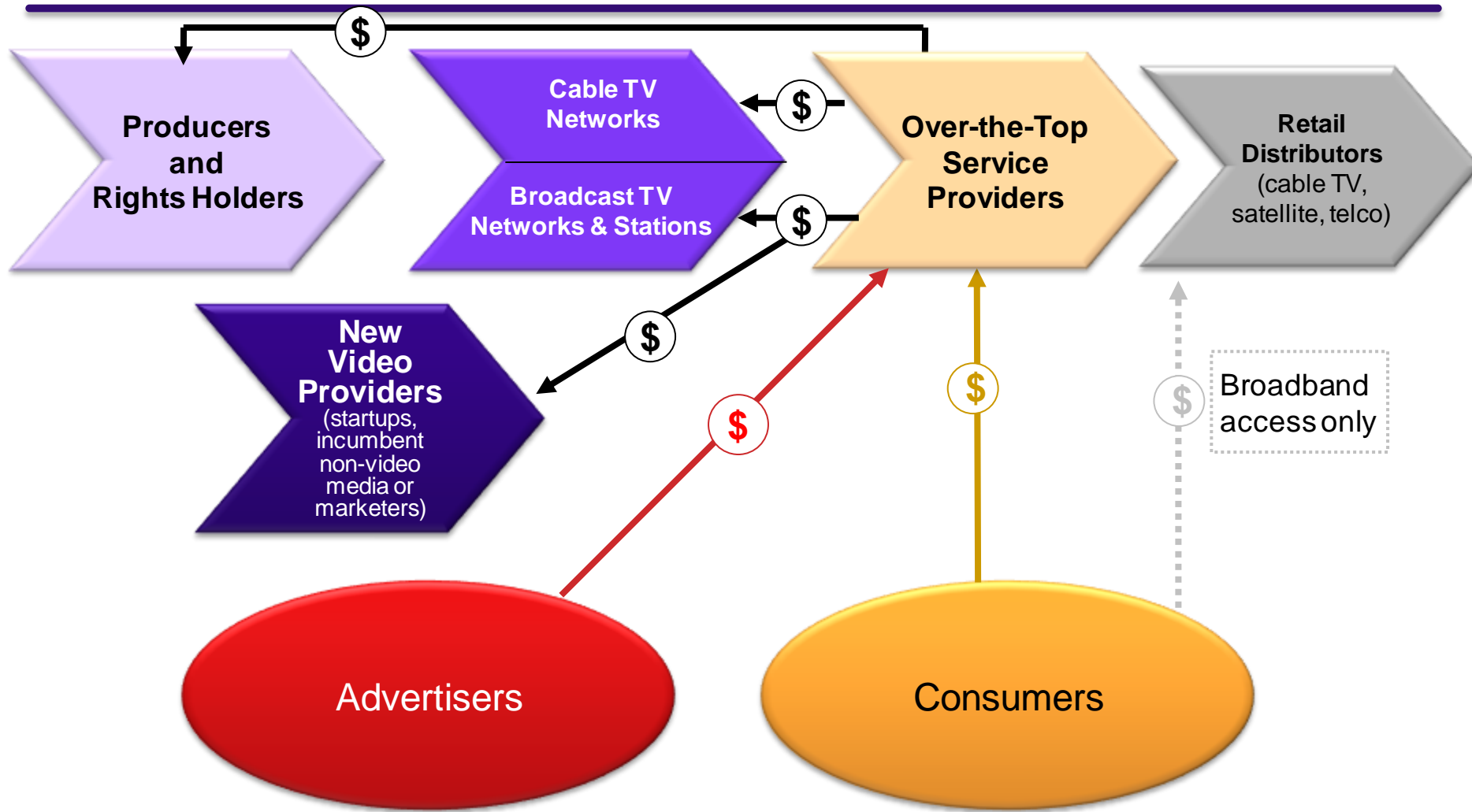
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Producers and Rights Holders

Cable TV Networks

Broadcast TV Networks & Stations

Over-the-Top Service Providers

Retail Distributors (cable TV, satellite, telco)

New Video Providers (startups, incumbent non-video media or marketers)

Broadband access only

Advertisers

Consumers

Source: Broadband Directions LLC

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BROADBAND DIRECTIONS℠

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Revenue models matter

- Just ask newspapers
  - Bankruptcies
    - 2008:   35
    - 2009:   96
    - 2010 to date: 3

    - Source: McClatchy Watch Blog

- Just as music industry
  - 1999 $14.6B
    - Peak revenue year
    - CD albums at ~$14.99
  - 2008 $8.4B
    - Peak unit year
    - MP3 singles at ~ $0.99

    - Source: Recording Industry Association of America

Timing Analysis for Cable TV Cord-Cutting

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"Tipping Point" for Voice Cord Cutting 2002 – 2003

"Tipping Point" For Cable TV Cord Cutting 2012 – 2013

Legend: Landline Voice, Cable TV
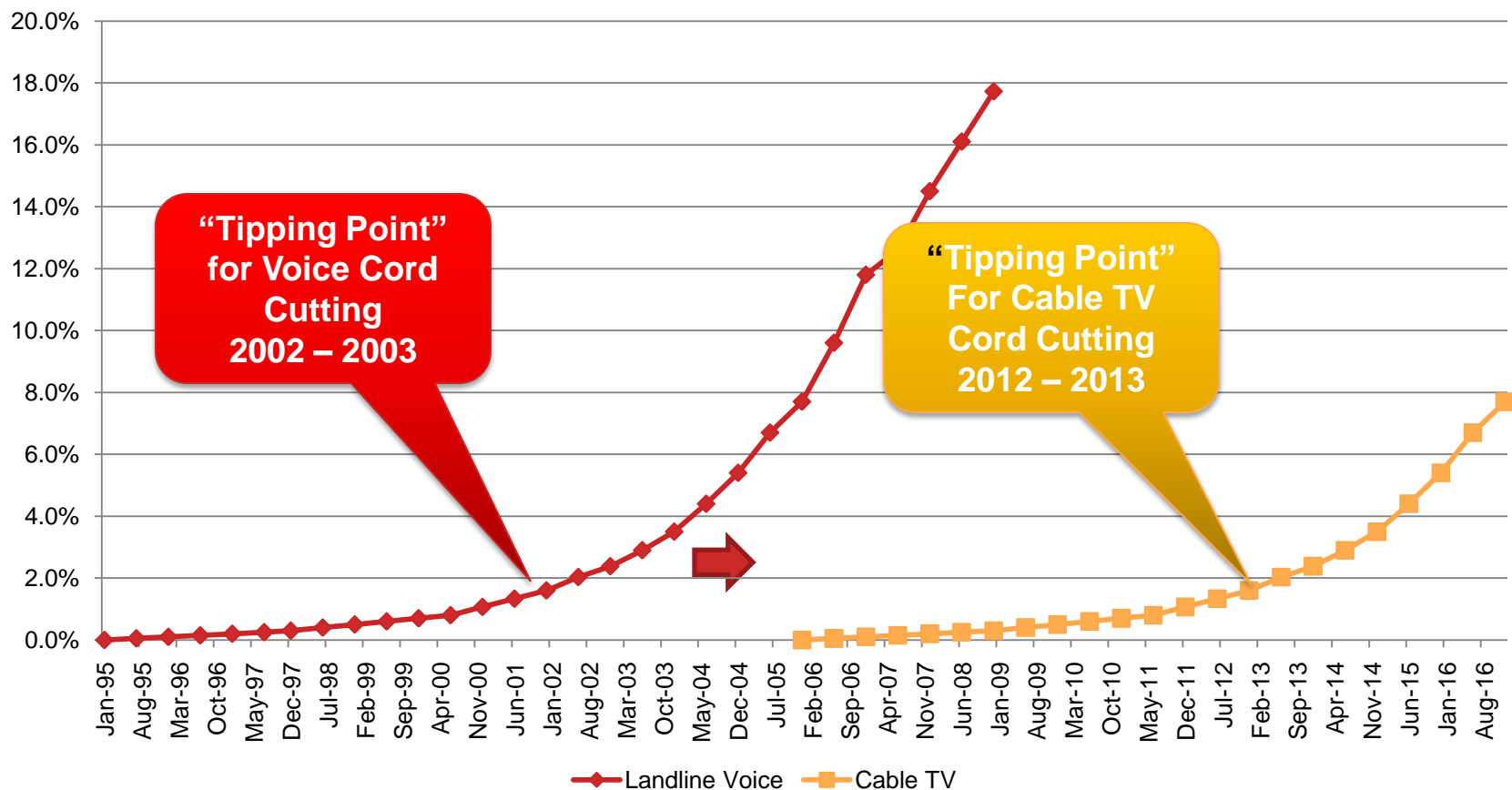
If OTT video indeed starts a small migration away from Cable TV, what would this mean for NA Cable Operators?

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NA MSO Revenue impact due to Over-the-Top Video

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NA MSO Revenue Impact due to OTT

Phase 1: Young demo, students, YouTube, Facebook generation, PC experience

Phase 2: Hulu, Netflix, YouTube provides compelling OTT TV/movie alternatives to TV viewing. Many IP connected Video devices available

Phase 3: OTT replicates TV experience in HD and offers more content, interactivity and social networking for less than Cable with lots of free content
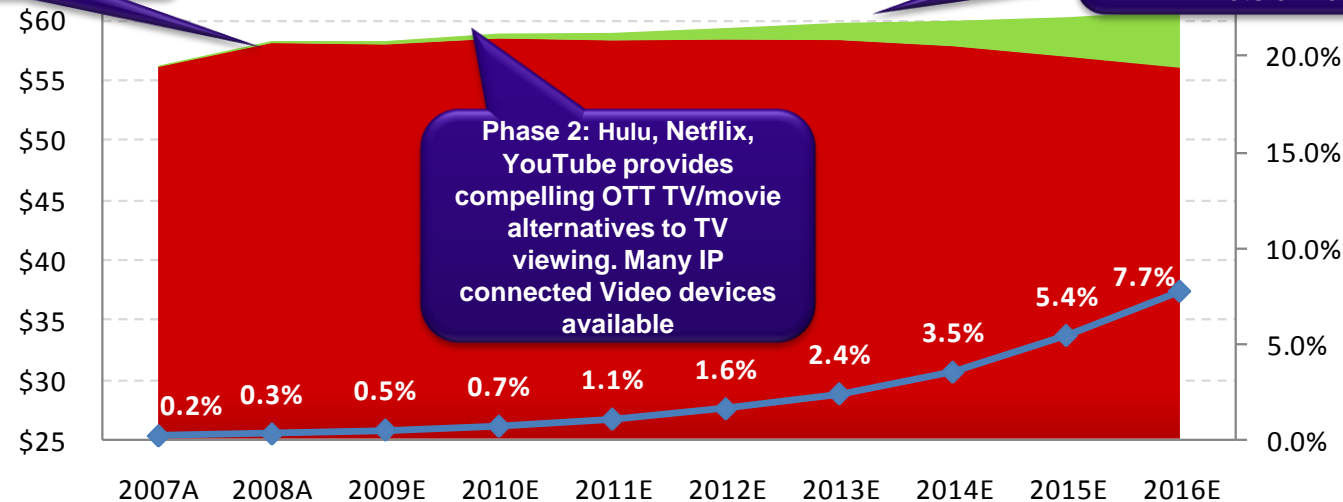
~ $13B potential revenue loss over the next 7 years

Chart data points (% Lost to OTT based alternative):
- 2007A: 0.2%
- 2008A: 0.3%
- 2009E: 0.5%
- 2010E: 0.7%
- 2011E: 1.1%
- 2012E: 1.6%
- 2013E: 2.4%
- 2014E: 3.5%
- 2015E: 5.4%
- 2016E: 7.7%

Legend:
- Revised Video Revenue
- Lost Revenue due to Cord Cutting
- % Lost to OTT based alternative

Source: DIGIT, Kagan, Company Financial Reports, Broadband Directions and ARRIS Estimates

IDC — *Analyze the Future*

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Analyst's Research

"Cable is now under threat from two sides: Telco and Over-the-top"

IDC, Consumer Predictions 2009

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Conclusions

- Viewer behavior changes will drive operators to introduce new service models embracing IP Video
- Increases in network capacity and new architectures will be required to deliver these new services
- These new architectures will require long transition periods where traditional and IP delivery systems co-exist
- Longer term the network must be consolidated into one converged IP transport and delivery architecture
- ARRIS is emerging as a clear leader in some of the fundamental building blocks required
  - Converged IP and MPEG video storage and streaming
  - Converged HFC and PON distribution architectures
  - Converged DOCSIS and MPEG delivery systems
  - Converged CPE
  - Converged Management & Monitoring Systems

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MSOs can remain the content provider of choice

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Service Provider
- Broadcast Video
- Narrowcast Video
- Video on Demand
- Voice over IP
- Video over IP

TIME WARNER CABLE

Charter COMMUNICATIONS

comcast

suddenlink *Life Connected*

WOW! INTERNET · CABLE · PHONE

COX COMMUNICATIONS

flickr

You Tube

Rhapsody

MOXI Portal/SDP
- 3rd Party Content
- Subs self mgmt
- Usage & diagnostic data collection

Google Video BETA

MPEG & IP

IP

Video

Data

Voice

Voice

Wireless

VOD/HDTV

Gaming

Personal Computing

Music

Digital Photography

Uniform User Interface

Any content Any device

Personal Media Sharing

- **Improved Subscriber Experience**
- **Lower Costs**
- **Simplified Integration**
- **Bandwidth Efficiencies**
- **Cross-platform Features**

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IP Video...
An Evolution
Into the Next Decade

May, 2010

Service Provider Objectives

- 4 'Anys'
  - Any content
  - Any device
  - Any time
  - Any place
- Simpler, easier for subscribers
- High quality
- More services, faster
- Cost effective
- Focus on New over Legacy

Drivers for IP Video Adoption

- Consumer
    - Any content, Anywhere, Anytime
    - Content sharing across multiple devices
    - Personalized and integrated services – one provider
    - Exponential growth of internet video usage
- Cable Operator
    - Competition on user experience and variety of services
    - Additional revenue streams such as targeted advertising
    - Competition on price – new CAS architectures to reduce set-top box (STB) costs
    - Improved network efficiency – bandwidth
- Technology
    - DOCSIS® 3.0 (IPv6, Multicast, High Asymmetry, M-CMTS)
    - Emergence of systems on chip for home devices that are capable of "blending" traditional TV with IP video content
    - Network support for higher security and end-to-end QoS
    - Advancements in processing and memory – Moore's Law

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MSO Transition to IP Video

- Settop installed base will be replaced by IP-Cable STB & gateways
  - Hybrid devices (MPEG2 and IP) provide for smooth transition and CAPEX/OPEX efficiencies
- IP-Only Gateways will eventually dominate
  - complemented by IP STBs and IP-enabled display devices in the home
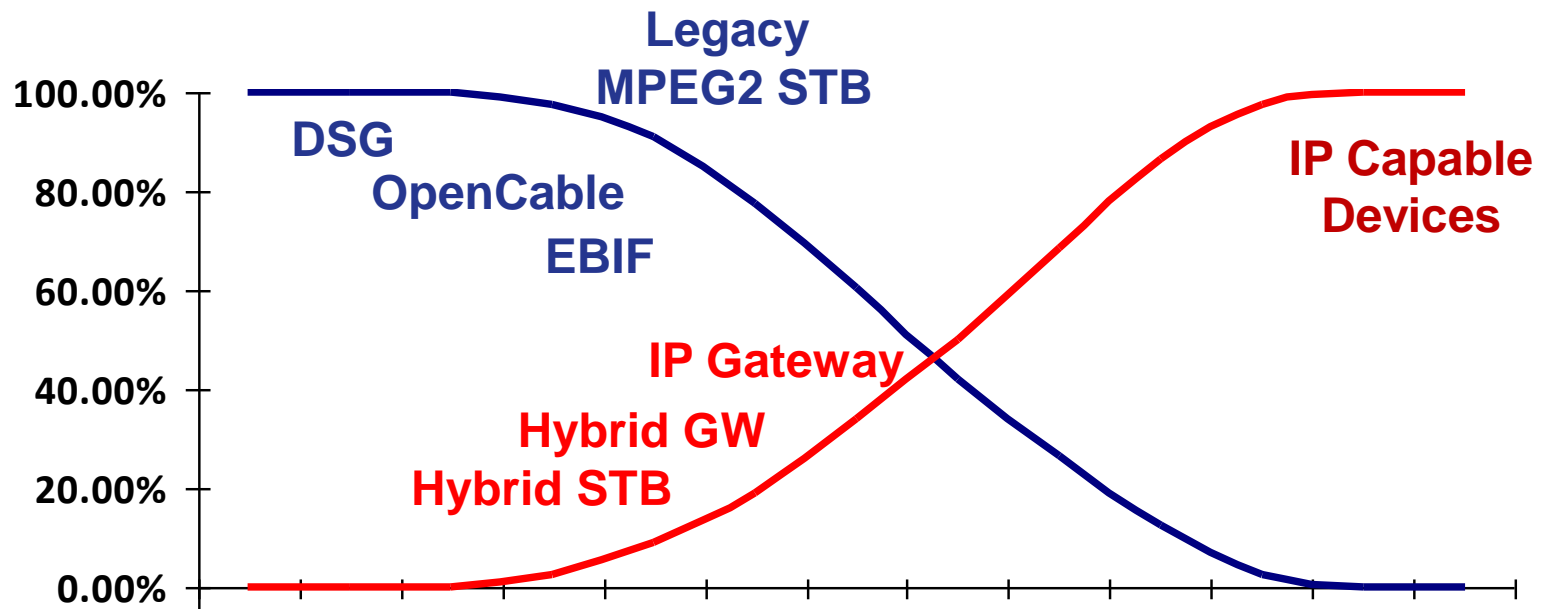
The Vision….
IP Convergence at the Edge, in the Distribution Network and in the Home

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Premium Linear Content

Premium VoD Content

Internet Content

Managed Operator Network

Internet

Mobile Network

Content Delivery Network Storage Library

Edge Streaming VoD / Start Over

Operator Portal

Distribution Network HFC / DOCSIS

PC's / Laptops

TV

Mobile Devices

Residential Gateway

PC

Mobile Device

Subscriber Control
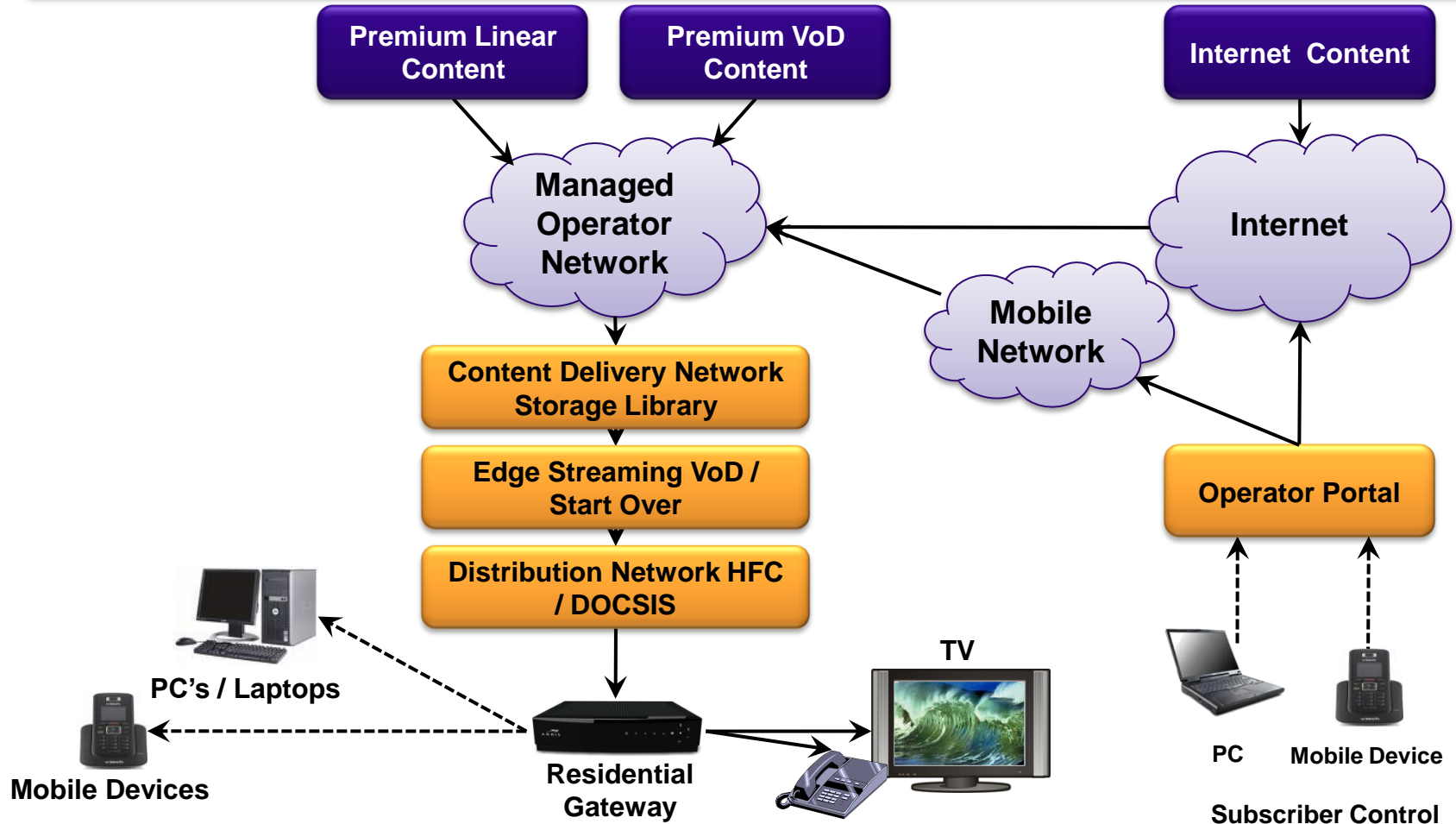
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MSO Delivery of IP Video to their Subscribers

- IP Video delivery requires careful design of many network "hops":
  - Hop 0: Ingest to Server (ex: encode and file prep ↔ CDN)
  - Hop 1: Server to HFC Edge device (ex: Server ↔ CMTS or E-QAM)
  - Hop 2: HFC Edge device to HFC CPE device (ex: CM or STB)
  - Hop 3: HFC CPE device to client (ex: PC, handheld and IP-STB)
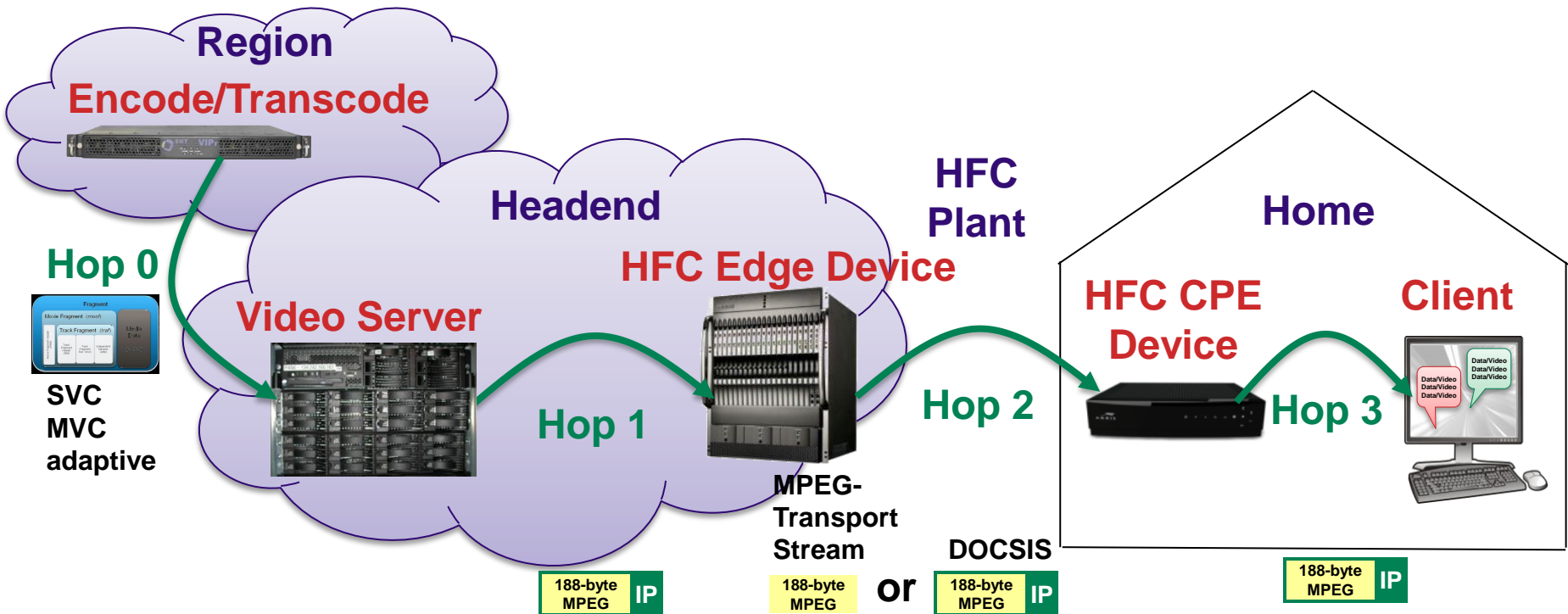
Convergence Enabled.

End-to-End IP Video Architecture

Video Management (Simple Control of Content for all 3 screens, Monitoring, Advertising, Billing)

ARRIS ServAssure

Subscriber Management and Billing

ARRIS Portal Server

Video CPE (QoS, DRM, Bandwidth, Encryption, Metrics)

ARRIS Media Player

Content Acquisition

DRM

ARRIS ConvergeMedia™ Management Suite

PC Portal

Mobile Portal

ARRIS EGT VIPr Transcoder

ARRIS XMS Video Server

ARRIS C4® CMTS

ARRIS Media Gateway

Video Access (QoS, Capacity, Metrics)

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IP Video...
An Architecture in Transition

May, 2010

ARRIS

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IP Video Architectures

- MPEG core & IP Encapsulation in the home
- Hybrid IP Encapsulation & IP Video Over DOCSIS
- IP Video over DOCSIS

IP Video Architectures – IP Encap

- IP Encapsulation in the Home
  - Network Overview
    - Current Elements
      - Video Network
      - Data Network
    - New Elements
      - Gateway: Termination device in the home
        - Voice, Video, Data
      - IP Set Top
      - Video Player (software client)
      - Video Security for in home distribution: Digital Rights management
      - User Interface (Middleware)
      - Subscriber Portal (Back Office Data & Control)
  - Features Delivered
    - New User Interface
    - Internet Information (Widgets)
    - Over the Top Video subscriptions
    - Visual Call Log
    - Home Network (Whole Home DVR)
    - Others ….
  - Network Benefits
    - Little or No change to existing infrastructure
    - Consolidate Network Monitoring via DOCSIS CPE
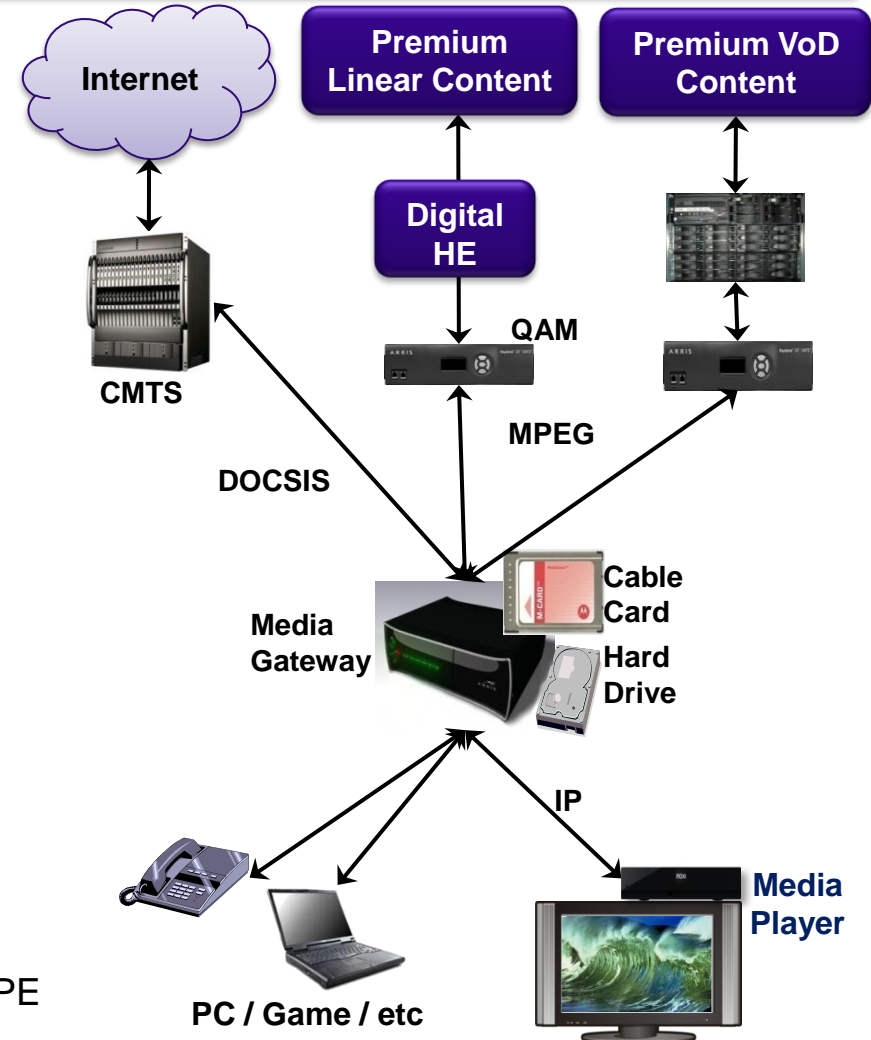
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Accelerated Evolution – "RF to IP"

E-MTA to Home Gateway

HD DVR

Home Gateway
- **Multi-screen Video**
- **Voice**
- **High Speed Data**
- **Home Networking**

E-MTA
- **Voice**
- **High Speed Data**

Cable Modem
- **High Speed Data**

User Friendly Interface

Convergence Enabled.

Convergence in the Home

Service Provider
- Broadcast Video
- Narrowcast Video
- Video on Demand
- Video over IP
- Voice over IP

MPEG IP

Internet OTT
- 3rd Party Content
- Subs self mgmt
- Complementary Service Offerings

Phone

Multimedia

IP Client

Home Network
- Ethernet
- 802.11
- MoCA®

Media Gateway

IP Client

Data/Video
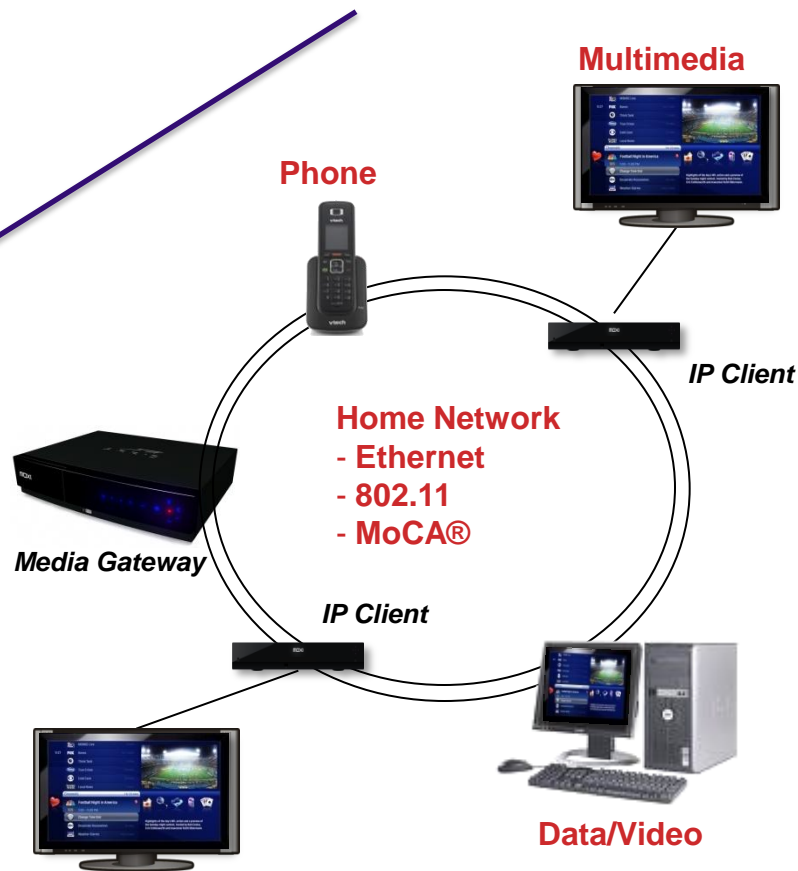
Seamless Integration of Traditional Video and OTT Services to ALL Screens Increased ARPU, Customer Satisfaction, Advertising, etc..

Convergence Enabled.

User Friendly Interface

- Enhanced TV Viewing Experience – More Control over When, Where and How Subscribers Consume Content
  - Enriched Interactive Program Guide and DVR user interface with video navigation, mosaics
  - On any TV in the Home – Pause, Record, and Replay with trick modes
  - Pause recorded or live content on one TV, resume on another TV
  - View live TV or recorded assets on the PC
  - Schedule recordings and manage assets on any TV – or remotely over the internet
  - Increased personalization and control of content
  - Blending of broadcast, on-demand, and internet content into menus and searches

- Share digital photos, music, and home movies to TVs, PCs and players in any room within the home
- Listen to music collection or internet radio simultaneously in multiple rooms
- Seamless integration of Internet Premium Services - Flickr™, CinemaNow, and Rhapsody®
  - Future services include Netflix®, Pandora®, Facebook, etc..
- Easy access to Internet content - news, sports scores, entertainment, financial information, and weather
- Caller ID on TV
- Home Automation and Security
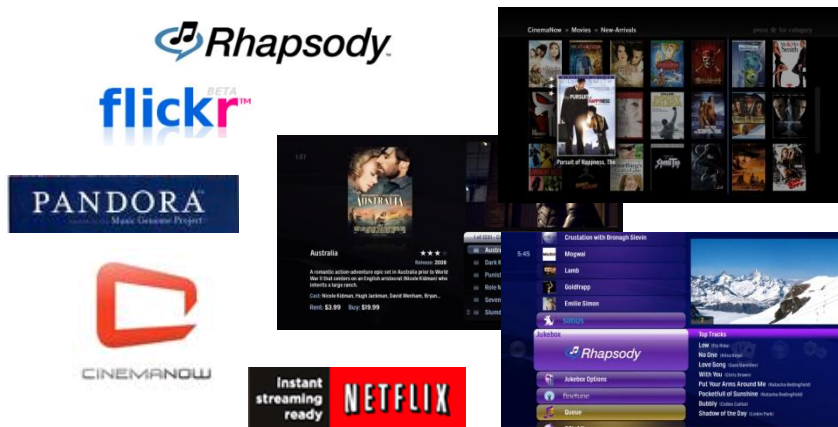
Convergence Enabled.

The IP Back Office Engine

ARRIS

Network Management & Diagnostics

MSO's Web Portal

Subscriber Provisioning & A/C Mgmt

Firmware version & Download Management

EPG Data Acquisition

Other 3rd Party Content Acquisition

TRIBUNE

DOWJONES REUTERS ACCU WEATHER® The World's Weather Authority™

Abstraction of interfaces and services

← **Secure Web Svcs APIs** →

← **Various 3rd Party APIs** →

SNMP v2c/3

Secure Web Services Platform

Pre-processing and optimization of data formats

Head-End Based SNMP Proxy Service

Head-End Based Caching Service

Optimization and scheduling of traffic flows

Data Warehouse

Multimedia Gateway

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IP Video Architectures - Hybrid

ARRIS

- IP Encapsulation in the Home & MPEG over DOCSIS
  - Network Overview
    - Current elements
      - Video Network
      - Data network
    - New Elements
      - Gateway: Termination device in the home
        - Voice, Video, Data
      - IP Set Top
      - Video Player (software client)
      - IP Session Manager
      - Video Security for in home distribution: Digital Rights management
      - User Interface (Middleware)
      - Subscriber Portal (Back Office Data & Control)
    - Other Possible Network Updates
      - Encoding / packaging format
      - Video/Streaming server format
      - Multicast Servers / Control
  - Features Delivered
    - New User Interface
    - New/Additional linear channels
    - New/Additional On Demand streams
    - Internet Information (Widgets)
    - Over the Top Video subscriptions
    - Visual Call Log
    - Home Network (Whole Home DVR)
    - Others ….
  - Network Benefits
    - Bandwidth efficiency gains
    - First step to a single network for all services
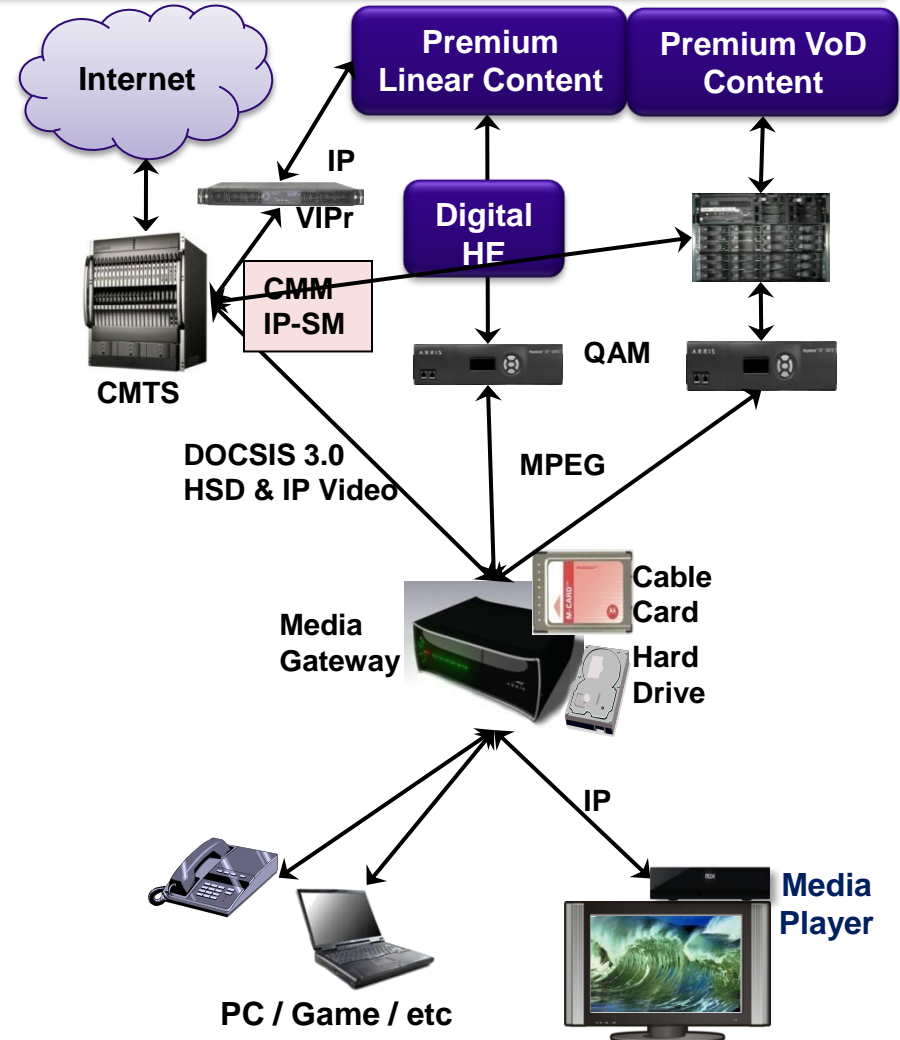
Convergence Enabled.

Benefits Of IP Video Over DOCSIS

- Fully converged architecture for Voice, HSD, and Video → Lowers Capex & Opex in future
- Based on a proven (& trusted) architecture
- Channel-bonding → Stat-Mux gains → more than 30% extra programs (see next slide)
- Load-balancing can be easily managed between Video and HSD tiers
- Advanced QoS is available for Video Content from Internet Partners
- High availability is intrinsic in many CMTSs
- DOCSIS naturally offers all the shared resource benefits of Switched Digital Video
- CMTS schedulers are naturally good at the optimized combining of Unicast VoD streams (with large jitter buffers at the client) and Multicast Linear streams (with very short jitter buffers at the client)
- CMTS Price/DS is dropping quickly due to Moore's Law, Multicore chips, DRFI Channel Multiplexing (the "Car-Pooling Effect"), and IPTV packet size
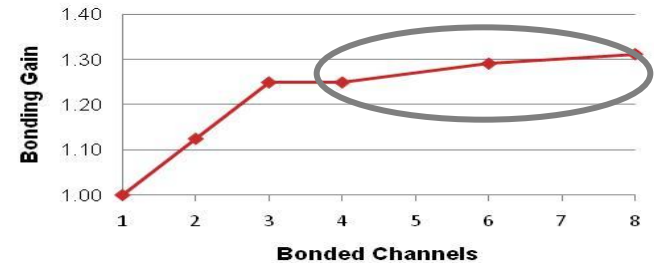
@ 93.6% Utilization
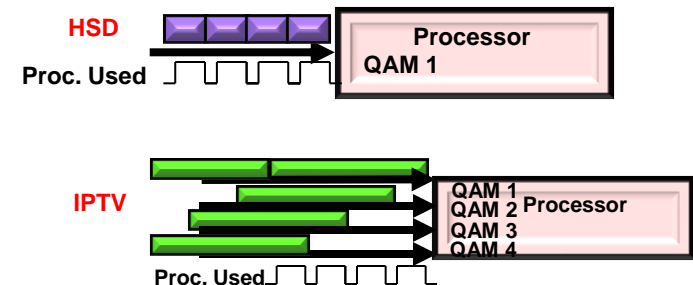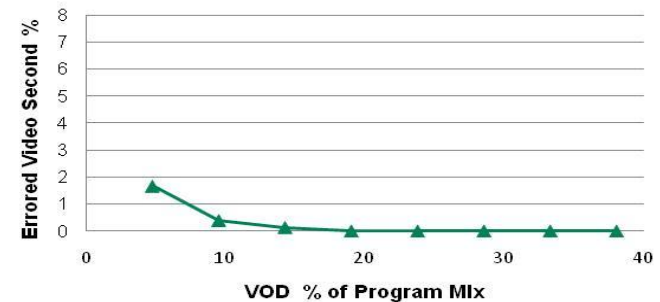
Convergence Enabled.

IP Video Delivery Proposals
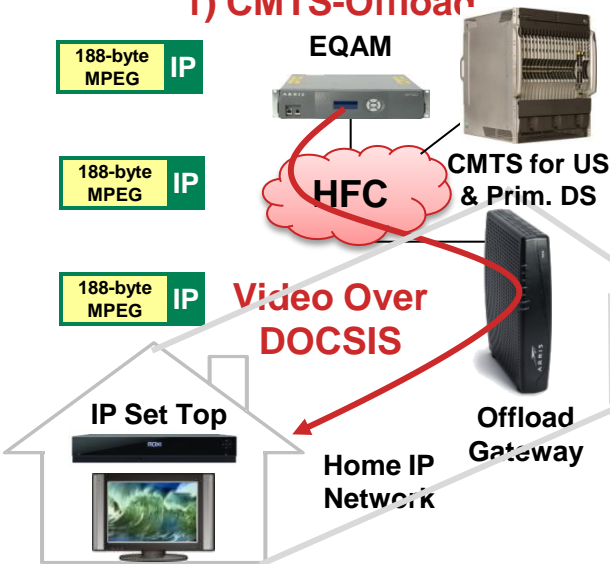
ARRIS

1) CMTS-Offload

188-byte MPEG	IP
188-byte MPEG	IP
188-byte MPEG	IP

EQAM

CMTS for US & Prim. DS

HFC

Video Over DOCSIS

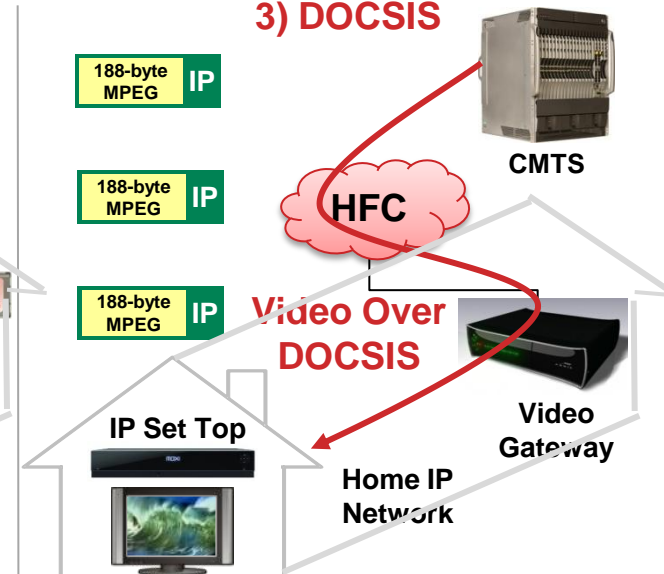**IP Set Top**

Offload Gateway

Home IP Network

Potential Issues:
- Doesn't have proc. power to support HSD
- Excludes advanced QoS needed to work with un-trusted 3rd-party content providers
- May not offer stat-mux gains of bonding
- Creates 3rd delivery structure to manage
- Proprietary solutions w/ no standard
- May require CM & CMTS customization
- Precludes the Capex/Opex benefits of a single converged network for HSD/Video
- Must simulcast MPEG video on DOCSIS

A few MSOs will use this

2) Hybrid MPEG/IP
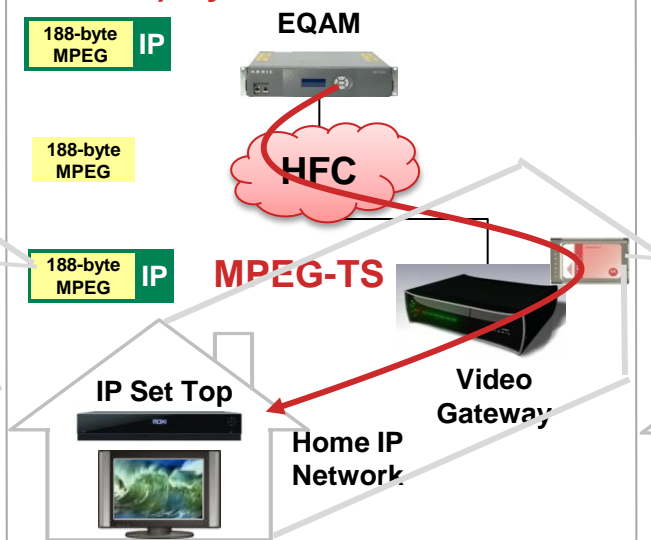
188-byte MPEG	IP
188-byte MPEG	
188-byte MPEG	IP

EQAM

HFC

MPEG-TS

IP Set Top

Video Gateway

Home IP Network

Potential Issues:
- Doesn't have proc. power to support HSD
- Excludes advanced QoS needed to work with un-trusted 3rd-party content providers
- No stat-mux gains of bonding
- Requires new CPE devices
- Costly Cable card required for most CAS-oriented content
- Precludes the Capex/Opex benefits of a single converged network for HSD/Video

Some MSOs should/will use this as an interim solution

3) DOCSIS

188-byte MPEG	IP
188-byte MPEG	IP
188-byte MPEG	IP

CMTS

HFC

Video Over DOCSIS

IP Set Top

Video Gateway

Home IP Network

Potential Issues:
- Must simulcast MPEG video on DOCSIS
- Higher per-downstream pricing for another year or so (which is prior to most major deployments)

Most MSOs should/will use this as a final solution

Convergence Enabled.

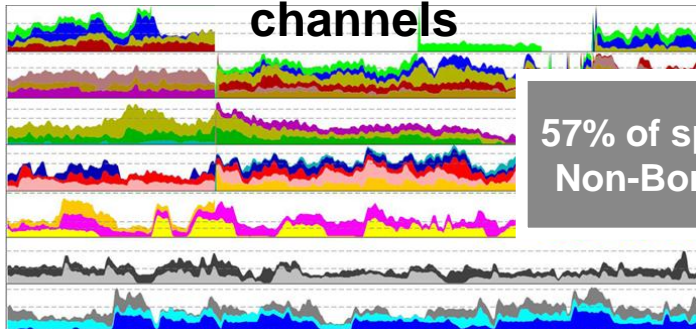# Stat-Mux Gains for CBR & VBR Streams in Non-Bonded and DOCSIS Bonded Channels

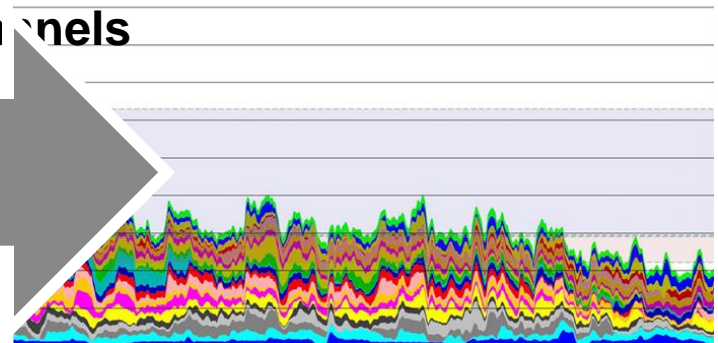**21 MPEG4 CBR streams peaking at ~ 20 Mbps each require 11 Non-Bonded Channels**
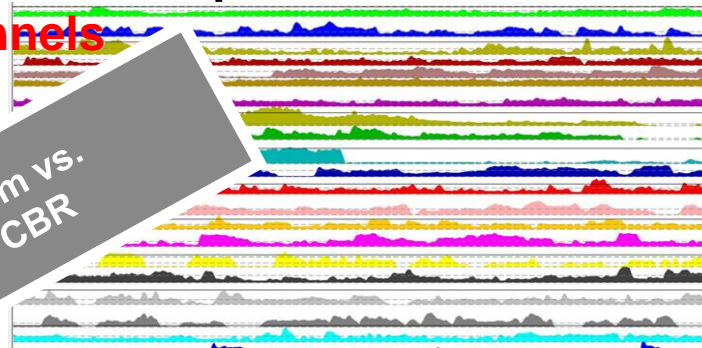
63% of spectrum vs. Non-Bonded CBR

21 VBR Streams combined into Non-Bonded Channels require 7 channels

57% of spectrum vs. Non-Bonded VBR

21 VBR Streams combined into Bonded Channels require only 4 channels

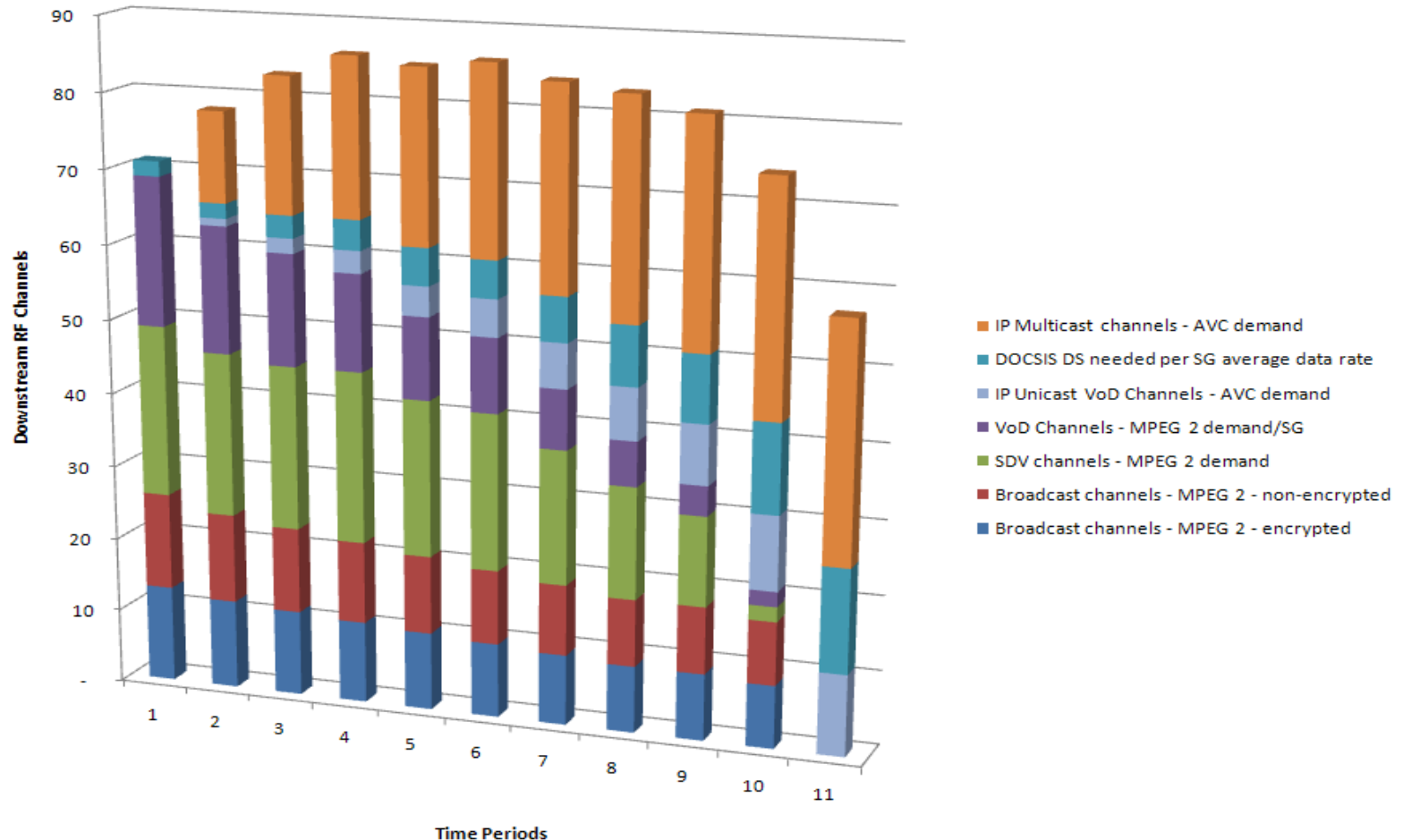**Note:** Captures are not on the same scale

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Potential Bandwidth Profile
Hybrid IP Transition

Scattered Deployment of Demarcation GW - Bandwidth Estimates

Legend:
- IP Multicast channels - AVC demand
- DOCSIS DS needed per SG average data rate
- IP Unicast VoD Channels - AVC demand
- VoD Channels - MPEG 2 demand/SG
- SDV channels - MPEG 2 demand
- Broadcast channels - MPEG 2 - non-encrypted
- Broadcast channels - MPEG 2 - encrypted

Y-axis: Downstream RF Channels
X-axis: Time Periods

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Video Access Multicast Control Plane: IGMP vs. PCMM

Capability	IGMP[1]	PCMM
Dynamic Creation of Multicast Flows	Yes	Yes
Attribute-based Resource Selection	Yes	Yes
QoS (Traffic Priority, Token Bucket Rate Shaping/Limiting, Guaranteed Data Rate, Latency and Jitter Guarantees)	Yes	Yes
Service-Class Name QoS Specification	Yes	Yes
Request-defined (customized) QoS Specification (also provides ability to not provision Multicast QoS per CMTS)	No	Yes
Modification of Dynamically-created Multicast Flows	No	Yes
Control Plane Acknowledgements	No	Yes

NOTES
1. Group Management Protocol refers to either IGMPv3 or MLDv2 – depending on the version of IP protocol.

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Universal Transcoding

MPEG-4 AVC HD

MPEG-4 AVC SD

MPEG-2 HD

MPEG-2 SD

VIPr

Quality Metrics

MPEG-2 HD → Linear & SDV

MPEG-2 SD → Linear & SDV

MPEG-4 AVC HD → Linear & IP-Video

MPEG-4 AVC SD → Linear& IP-Video

MPEG-4 AVC PC Res → Over-The-Top 3-Screen
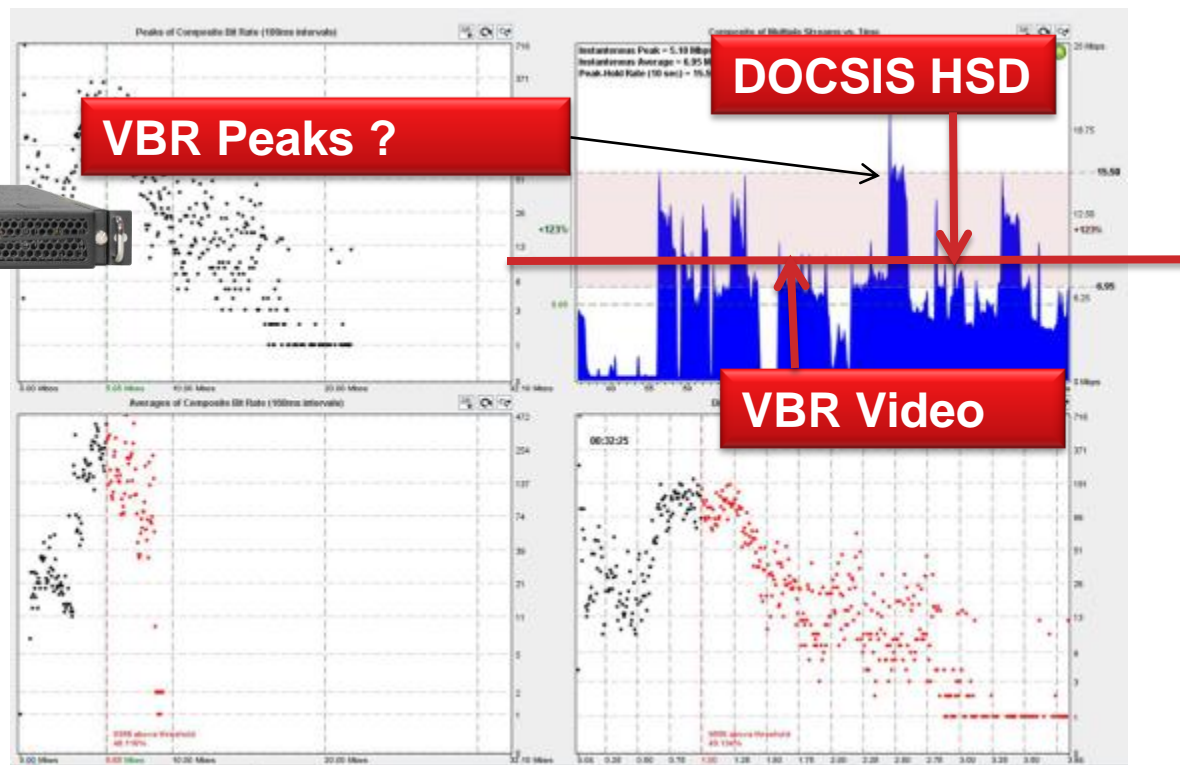
MPEG-4 AVC Mobile → Mobile

MPEG-4 MVC 3D →
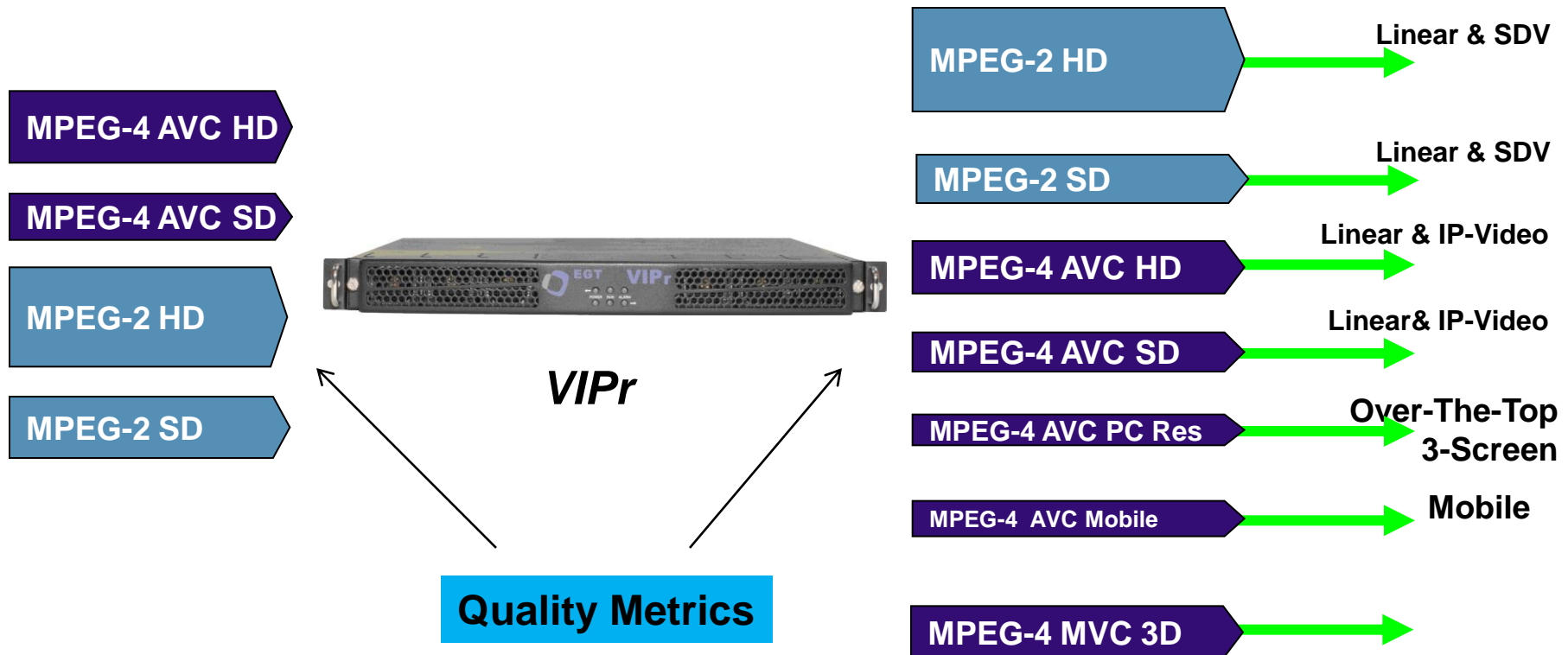
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Other Encapsulations Required?

- Fragmented MPEG4
- Multiple bitrate output for adaptive streaming
- Support for SVC (Scalable Video Coding) and MVC (multi-view Coding for 3D)
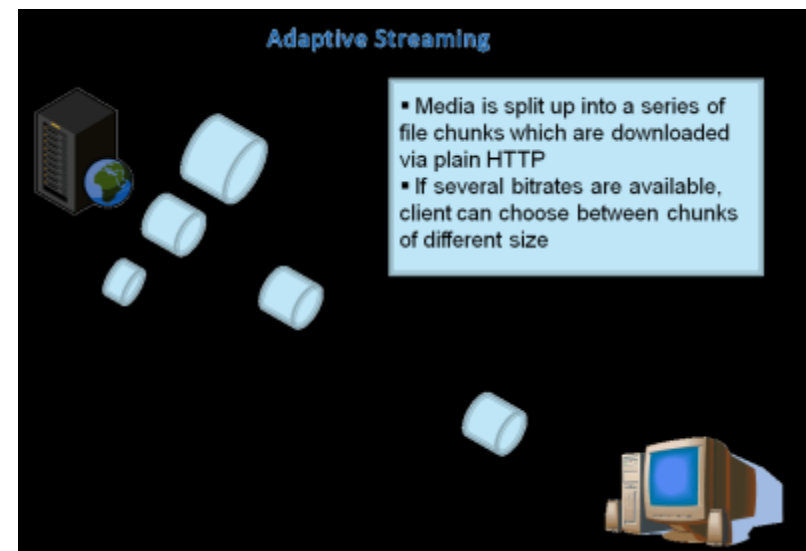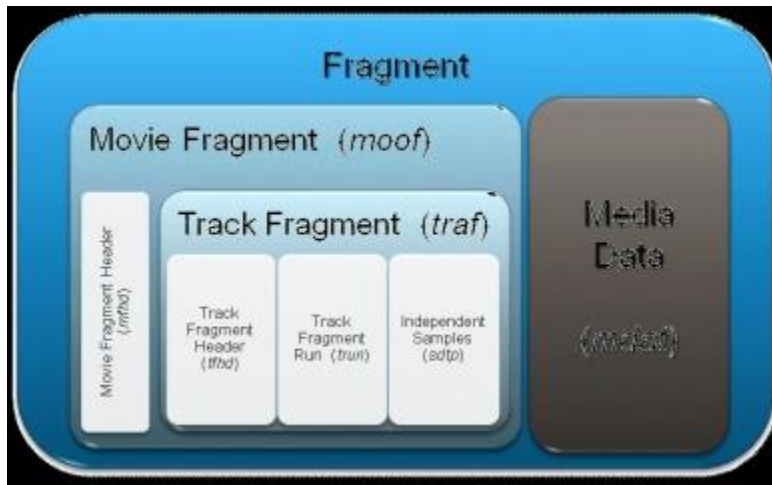
Conditioning Video Streams for IP Video

- Static pre-conditioning CBR/VBR video streams compliant to BW profiles for DOCSIS CAC
- CMTS feedback based dynamic VBR transcoding

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IP Video Architectures

- IP Encapsulation in the Home & MPEG over DOCSIS
    - Network Overview
        - Current elements
            - Data network
        - New Elements
            - Gateway: Termination device in the home
                - Voice, Video, Data
            - IP Set Top
            - Video Player (software client)
            - Content Delivery Network
            - IP Session Manager
            - Video Security for in home distribution: Digital Rights management
            - User Interface (Middleware)
            - Subscriber Portal (Back Office Data & Control)
            - Encoding / packaging format
            - Video/Streaming server format
            - Multicast Servers / Control
    - Features Delivered
        - New User Interface
        - Complete Video line up
        - Internet Information (Widgets)
        - Over the Top Video subscriptions
        - Visual Call Log
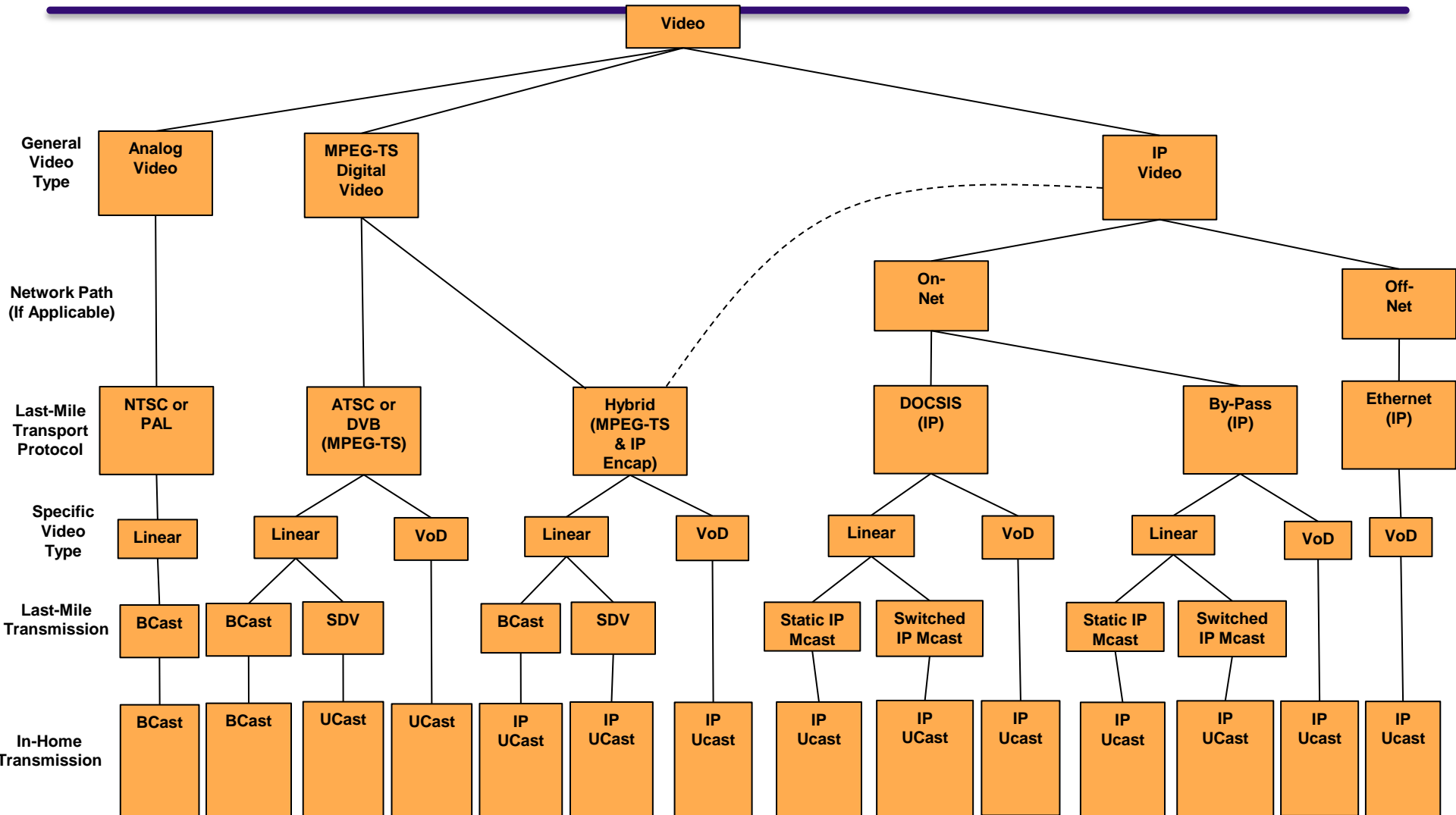   - Home Network (Whole Home DVR)
        - Others ….
    - Network Benefits
        - Significant Bandwidth efficiency gains
        - single network for all services
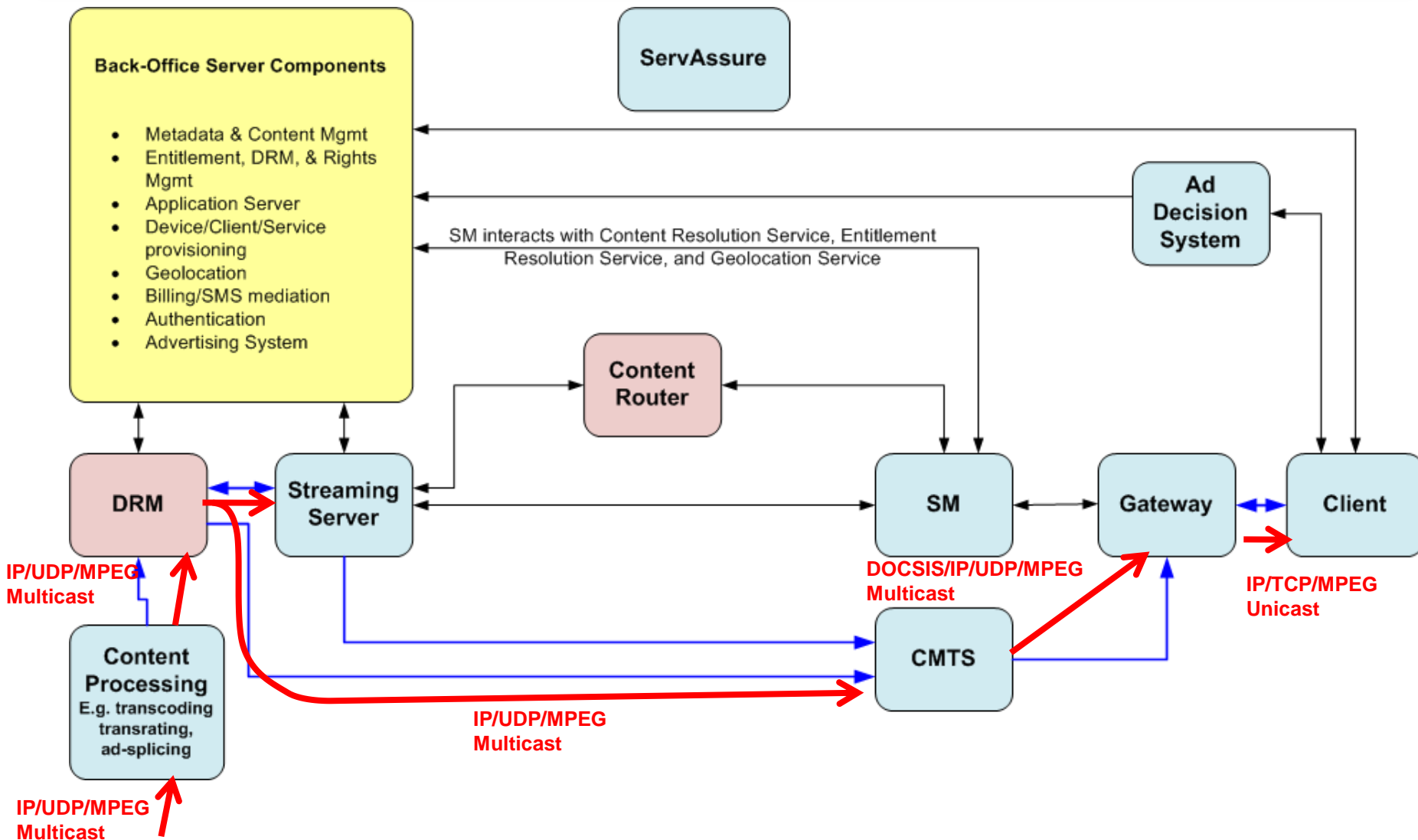   - Flexible IP service creation environment

Premium Linear Content

Premium VoD Content

DOCSIS 3.0

Transport Gateway

Hard Drive

IP

Hard Drive

Media Player

PC / Game / etc
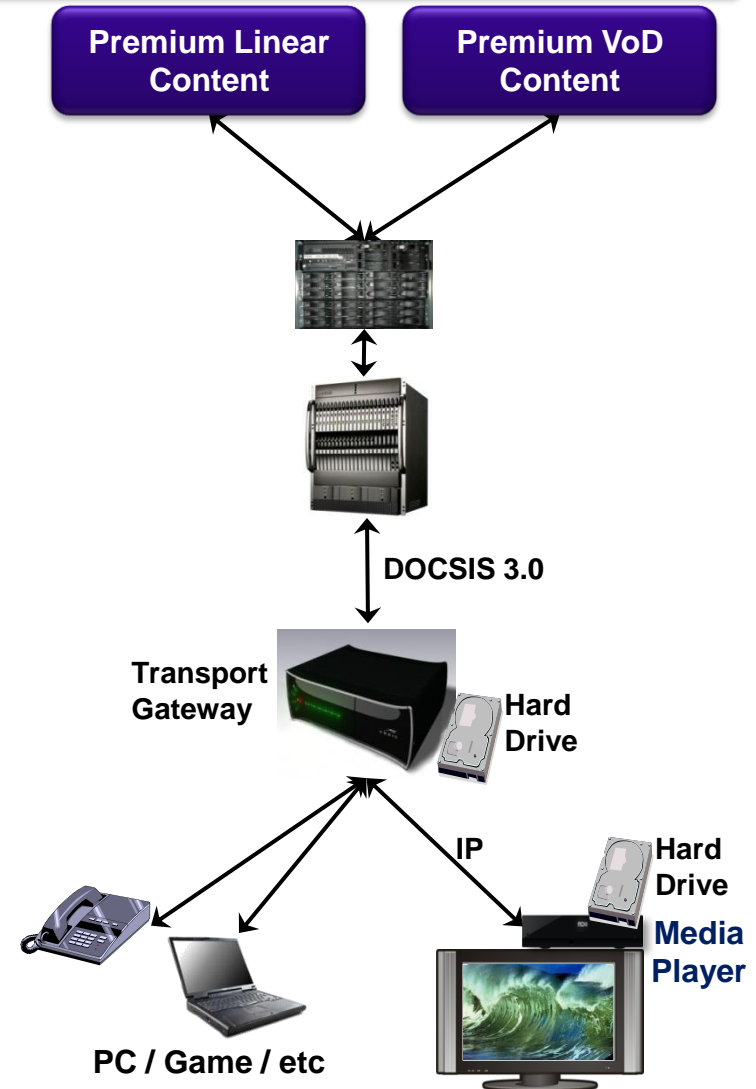
Convergence Enabled.

A Taxonomy of Video Types
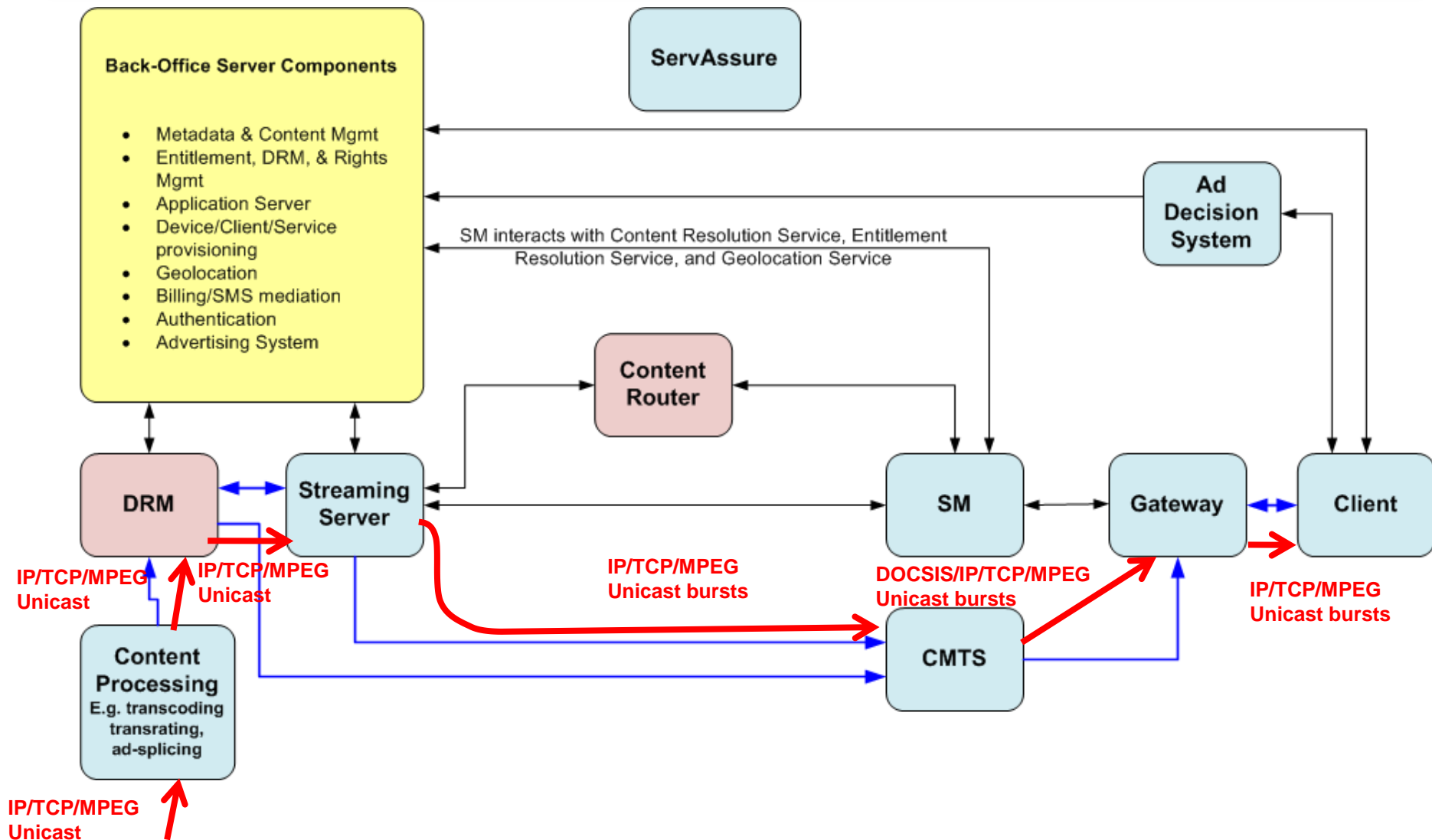
Dataflow ("On-Net" Linear Multicast IP Video)
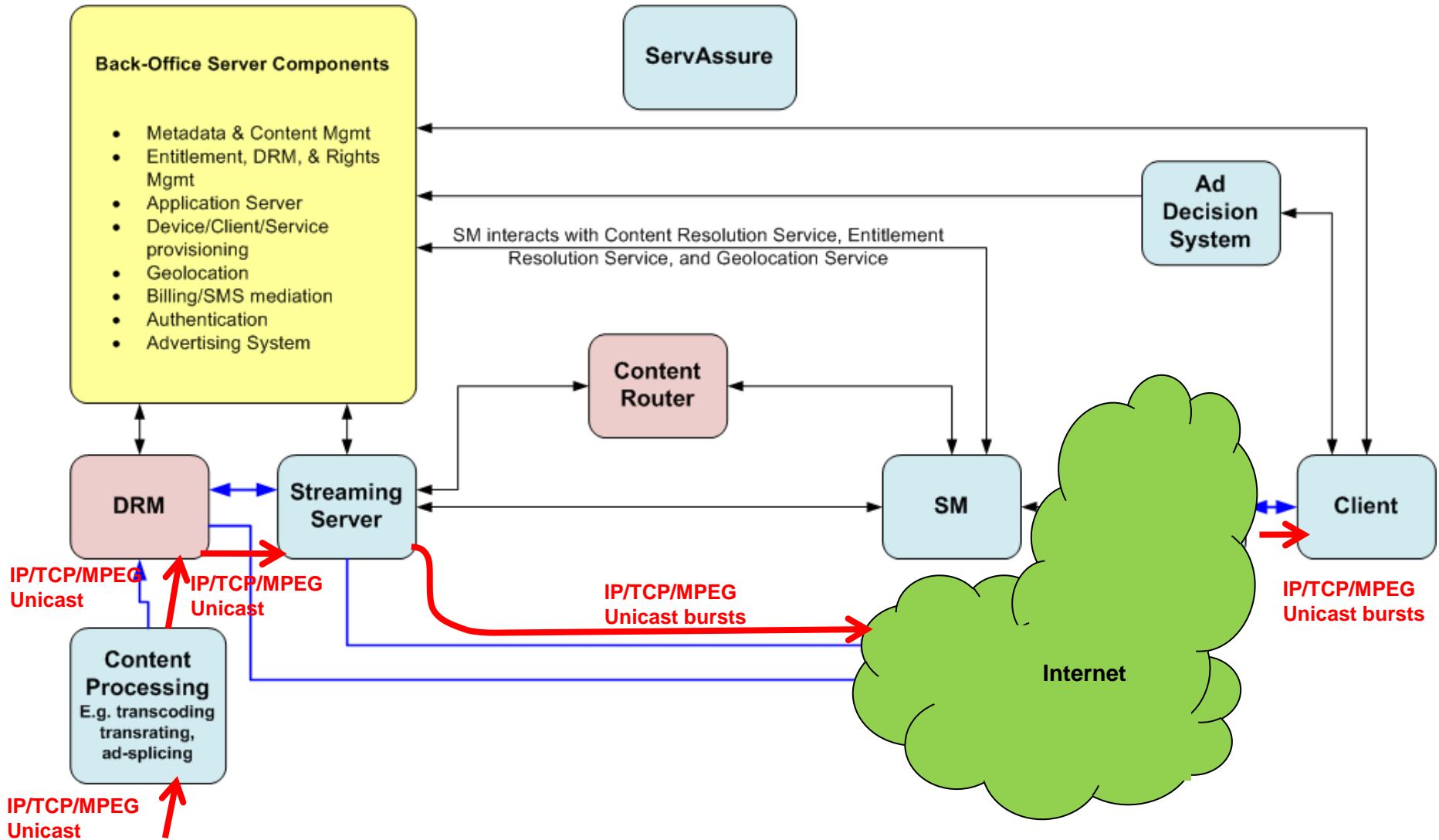
Dataflow
("On-Net" VoD Unicast IP Video)

Convergence Enabled.
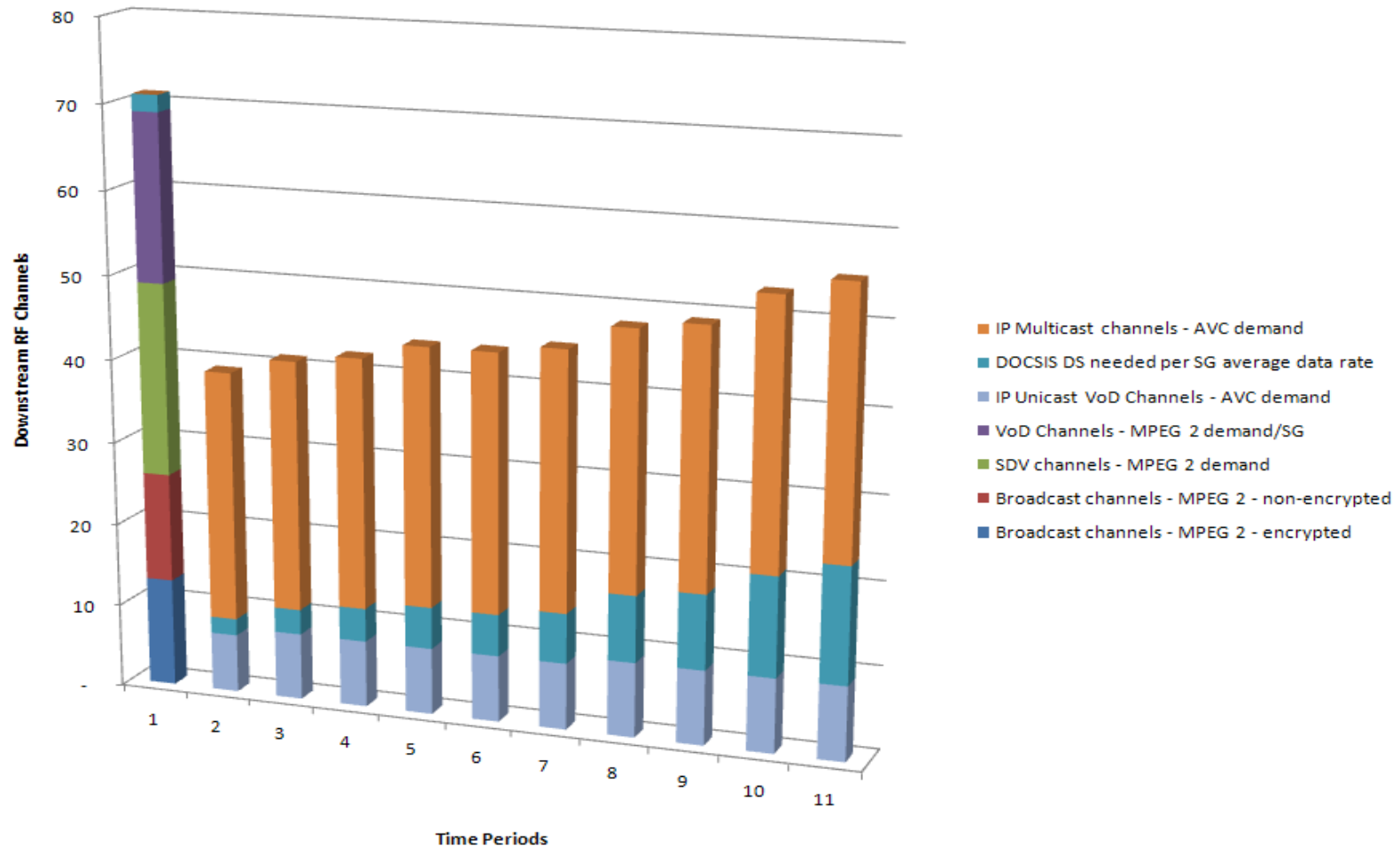
Dataflow
("Off-Net" Unicast IP Video)

Convergence Enabled.

Potential Bandwidth Profile
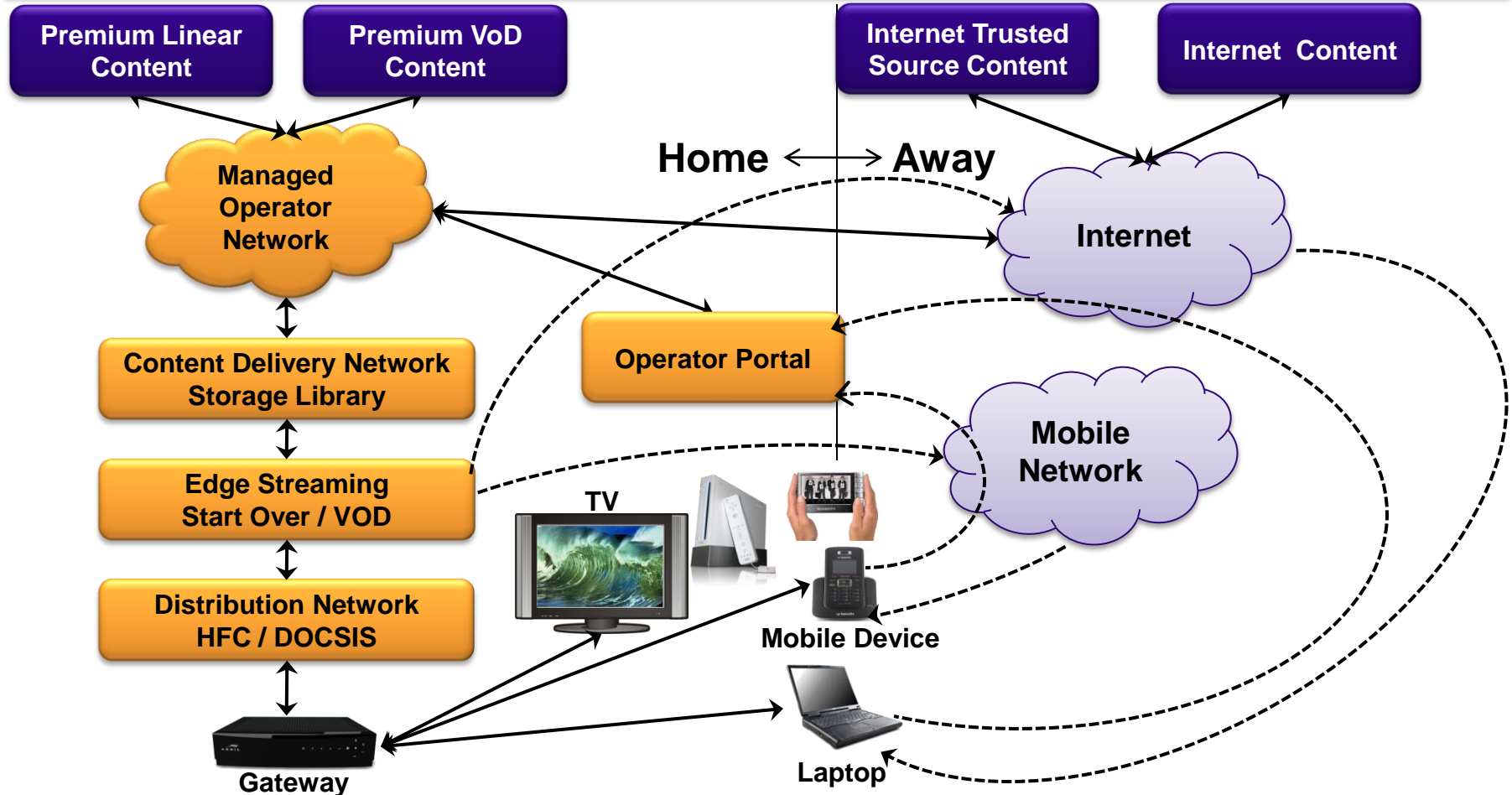# E2E IP Transition

Node by Node Deployment of Demarcation GW - Bandwidth Estimates

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The Vision....

One Source, One Protocol between the Client and Network regardless of location

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Summary
Benefits of E2E IP Video?

- Subscriber access to a broader audience through all 3 screens in the home (TV, PC, Handheld)
- Subscriber Access to a broader audience through On and Off-Net connection
- Provides a direct conduit to 15-30 year-old demographic (through their Handheld devices)
- Provides access to the growing "Internet advertising market" through directed advertising in IP-based videos
- Allows MSO to become the "organizers" of all IP Video content (MSO-based and Web-based)
- It could eliminate the high costs demanded by the current STB duopoly
- Provides reduction in training, spares, failure points, support systems, etc associated with todays separate networks
- Leverages the world wide pool of IP development for new technology and services

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Thank You

Convergence Enabled.