IPTV – an Overview
Outline

IPTV
- Not Just a STB
- Digital Content
- Bandwidth Considerations

IPTV Today
- Telco's
- Content Providers

IPTV for Cable
- Business Issues
- Problems
- Solutions - DIBA
What is IPTV?

**IPTV is:**
A managed network for delivering video, voice, and data with guaranteed Quality of Service.

**IPTV is not:**
Real time video services delivered over the public Internet.
IPTV and IP-Video are real!!!
What is the Next Generation of TV?

Converged Experiences
- Recommendations, Time Shifting, NDVR
- Search, Multi-Screen, Advertising

Mobility Across Networks

Deliver it Anywhere

Converged Content
- Rules, Rights, Control

Mobility Across Devices

Take it Anywhere

Motorola
Daily Usage of Media by Source

- **television**: 240.9 minutes per day
- **computer**: 135.8 minutes per day
- **internet**: 93.4 minutes per day
- **radio**: 80 minutes per day
- **music**: 65.1 minutes per day
- **phone**: 42.2 minutes per day
- **video (VCR, DVD)**: 32.6 minutes per day
- **game consoles**: 11.6 minutes per day

Sources: Bar graph from “How the Internet is Changing Consumer Behavior and Expectations,” by Lee Rainie, Pew Internet & American Life Project (5/9/06)
WHO’S HOGGING THE BANDWIDTH?

**VOICE**
(.120 Mbps per stream)

**DATA**
(1.5 to 5 Mbps)

**VIDEO**
(8 - 10 Mbps for HD in MPEG-4 or 14-16Mbps in MPEG2)
VIDEO IS FUELING DATA DEMANDS
# The Millennial Generation

## Watching TV on DVR

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quite a bit to almost all of the time</td>
<td>64%</td>
</tr>
<tr>
<td>Some of the time</td>
<td>27%</td>
</tr>
<tr>
<td>None</td>
<td>9%</td>
</tr>
</tbody>
</table>

- **Have DVR**: 40%
- **Would like to have DVR**: 42%

## Prime Time to My Time

- Having archived TV programs and movies on demand: 84%
- Ability to pause TV program in one room and resume play in another room of the house: 86%
- Ability to download TV programs from a DVR to a memory device for use on a mobile player: 83%

## HD on Demand

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have HD</td>
<td>46%</td>
</tr>
<tr>
<td>Would like to have HD</td>
<td>43%</td>
</tr>
<tr>
<td>Have Cable or Satellite</td>
<td>85%</td>
</tr>
</tbody>
</table>

## The Millennial Generation

- My lifestyle would change drastically without the internet: 76%
- My expectations and demands are far greater than my parents for rich media experiences and on-the-go broadband access: 70%
- I want to be able to have access to TV programs where I am, whenever I want: 70%

Source: Motorola Research, 2008
What is the Next Generation of TV?

Converged Experiences
- RULES, RIGHTS, CONTROL
- RECOMMENDATIONS, TIME SHIFTING, NDVR, SEARCH, MULTI-SCREEN, ADVERTISING

Mobility Across Networks
- Mobility Across Devices
- Deliver it Anywhere
- Take it Anywhere
AND DIGITAL CONTENT DEVICES ARE MULTIPLYING
Video Explosion

Internet – Hulu.com

- Total Video Streams per month on Hulu.com
  - Jun: 82M
  - Jul: 105M
  - Aug: 107M
  - Sep: 142M
  - Oct: 206M
  - Nov: 221M
  - Dec: 241M
  - Jan: 250M
  - Feb: 332M

- Sources: Nielsen VideoMetrix and comScore 2008

Internet Video

- 33% increase in online video watching in Nov 2008 than the previous year
- Average online video viewer watched 273 minutes of video
- Duration of average video viewed online at Hulu 11.9mins compared to all online videos at 3.1mins
- 52.3 videos per viewer on YouTube.com

Sources: comScore 2009
From Prime Time to “My Time”

**Audience for converged content viewing**

<table>
<thead>
<tr>
<th>Episode Title</th>
<th>Knight Rider</th>
<th>Kath &amp; Kim</th>
<th>The Office</th>
<th>30 Rock</th>
<th>Lipstick Jungle</th>
<th>Heroes</th>
</tr>
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<tbody>
<tr>
<td>Money</td>
<td>16,837,000</td>
<td>7,991,000</td>
<td>16,329,000</td>
<td>11,629,000</td>
<td>6,129,000</td>
<td>13,643,000</td>
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<tr>
<td>A Hard Day’s Knight</td>
<td>10/22/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/31/08</td>
<td>10/27/08</td>
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<tr>
<td>Employee Transfer</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/31/08</td>
<td>10/27/08</td>
</tr>
<tr>
<td>Do-Over</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/30/08</td>
<td>10/31/08</td>
<td>10/27/08</td>
</tr>
<tr>
<td>The Lyin’, the Bitch and the Wardrobe</td>
<td>10/31/08</td>
<td>10/31/08</td>
<td>10/31/08</td>
<td>10/31/08</td>
<td>10/31/08</td>
<td>10/27/08</td>
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<tr>
<td>Eris Quod Sum</td>
<td>10/27/08</td>
<td>10/27/08</td>
<td>10/27/08</td>
<td>10/27/08</td>
<td>10/27/08</td>
<td>10/27/08</td>
</tr>
</tbody>
</table>

**NBC Universal’s new Total Audience Measure Index (TAMi)**
1 DEVICE ≠ 1 STREAM

[Diagram with various sections labeled]

- MLB HD signal
- MLB MOSAIC SD signal 1
- MLB MOSAIC SD signal 2
- MLB MOSAIC SD signal 3
- EPG interactive trivia game & streaming stats
- HD PVR Recording

= 18 Mbps
The Internet connects content providers to playback devices
Next Generation Television: Service Provider Challenges

Managing "Infinite" Content
Content & Advertising Management, Billing & Settlement
- DRM
- Content Mgt
- Rules Obedience
- Usage Tracking
- Advertising
- Content Format Resolution
- Transcoding/Adaptation

Merchandising "Infinite" Content
Compelling & Effective Content Navigation On Multiple Screens
- 3 Screen Storefront
- Bundling & promotions
- Context Driven Navigation
- Recommendation, Search & 'Found'
- Subscription, Rental, Pay to Own
- Affiliate offers

Managing The End User Experience
Home & Mobile
- Managed Home Network
- Service Extension To CE Devices
- Mobilize The DVR Experience
- Link Home & Mobile Content Offers

Operator Network
Control
Metadata
CONTENT STORAGE
RULES DATABASE
STUDIOS
NEW AGGREGATORS
USER GENERATED CONTENT
MY CONTENT

iTunes 7
• DRM
• Content Mgt
• Rules Obedience
• Usage Tracking
• Advertising
• Content Format Resolution
• Transcoding/Adaptation

Context Driven Navigation
Recommendation, Search & 'Found'
Subscription, Rental, Pay to Own
Affiliate offers

Managed Home Network
Service Extension To CE Devices
Mobilize The DVR Experience
Link Home & Mobile Content Offers

MediaFLO™
Content to IP clients

*IP Clients = PCs, IP Set Tops, Handhelds*

*Central transcode*

*Transcode at the edge*

*Implement DRM*

*SIP/ISA conversion*
The Promise: A new Consumer Experience

Any content on any device . . .

. . . anywhere you want it
Content Providers
IPTV Content Providers

Who are they?
- Hulu, Netflix, Vudu, CNN, ABC, Sony, Disney……

What are they doing?
- Delivering content directly to consumers via the Public Internet
In July, 33.5 Billion Minutes per Month were Spent Watching Video Online

Total Minutes Watching Online Video per Month At Home, Work, and Universities (in Billions)

- YouTube accounts for over one-third of all time spent watching online video

Source: ComScore
Just 9% of Those Who Watch Video Online Strongly Agree that they Watch TV Less Often

Using a 1-10 scale with 10 being strongly agree and 1 being strongly disagree, how much do you agree or disagree with... since I began watching video online I now watch TV less often

Watch TV Less Often Since Watching Video Online (1-10)

- Strongly disagree (1-3) 74%
- (4-7) 17%
- Watch TV less often - strongly agree (8-10) 9%

- Results are similar to last year
- 16% of men age 18-34 who have watched video online strongly agree that they watch TV less often now – compared to 6% of all others

From LRG study Emerging Video Services II
IPTV Content Providers – Problems

- Content protection
- Content monetization models
- Diverse content format requirements
- Network performance
IPTV Content Providers – Business Issues

*Losing Ad revenue to online advertising*
- Thus Hulu

*Losing viewers to alternate consumption models*
- ie Netflix challenged by VOD

*Fragmented market with content explosion*
- The dreaded “long tail”
SO HOW MUCH CAPACITY DO WE REALLY NEED?
HOUSEHOLD SEGMENTED BY TECHNOLOGY ADOPTION

2006

- Tier 0: 9%
- Tier 1: 13%
- Tier 2: 16%
- Tier 3: 12%
- Tier 4: 9%
- Tier 5: 5%

Non-Internet Households: 36%

2011

- Tier 0: 6%
- Tier 1: 11%
- Tier 2: 8%
- Tier 3: 10%
- Tier 4: 20%
- Tier 5: 14%

Non-Internet Households: 31%

PEAK BANDWIDTH USAGE BY LAGGARDS (Tiers 0 – 2 = 25%)

PEAK BANDWIDTH USAGE BY EARLY ADOPTERS (Tiers 3 & 4 = 30%)

- HDTV (2) 16 Mbps
- SDTV (2) 4 Mbps
- HD DVR 8 Mbps
- HDTV (2) 16 Mbps
- Broadband 12 Mbps
- PIP 2 Mbps
- VoIP 1 Mbps

2006 - 2011

PEAK BANDWIDTH USAGE BY FRINGE
(Tier 5 = 14%)

- VoIP 1 Mbps
- Broadband 15 Mbps
- HD PIP 8 Mbps
- HD DVR (2) 16 Mbps
- HDTV (4) 32 Mbps

THE RESULT…

Estimate Bandwidth Usage by USA Household Segments

- **Tiers 3 to 5 = 44% of HHs (63 M)**
- **14% of HHs (17 M)**
- **30% of HHs (36 M)**
- **25% of HHs (29 M)**
BUT WAIT! THERE’S MORE…

Trends that will increase bandwidth consumption in U.S. households

- 2006: YouTube streams 100,000,000 video clips a day with users uploading about 65,000 new videos daily.
- 2007: Digital TV sales surpass analogue TV sales.
- 2007: FCC mandates all TVs and TV devices equipped with DTV tuners.
- 2007: DSL expected to overtake cable broadband in share of households.
- 2008: NetFlix finally delivers online movie downloads? estimated 50 HD channels with 50 - 75% of total programming in HD.
- 2008: U.S. users will download more than 3.6 billion paid music or video files.
- 2009: U.S. households sold will be HDTVs.
- 2009: Nearly 20% of video media will be viewed non-linearly.
- 2010: Full adoption of HD VOD.
- 2010: Digital streaming service revenues expected to outpace online movie revenues.
- 2011: BW will be driven by TV and Video.

Content and Services will Deliver customers: not access.

Source are listed in the notes.
**Why Ultra Broadband?**

**HDTV and HD-DVR becoming more common**
- Half of all TVs sold in US this year are HD capable
- The second HDTV or HD-DVR challenges typical copper deployments

**High upstream capacity**
- HD quality conferencing
- Online gaming

**Enabling Platform**
- DOCSIS 3.0 Channel bonding
- High-speed GPON (2.4G/1.2G) FTTP service
- Gigabit Ethernet interfaces on RFoG

<table>
<thead>
<tr>
<th>Service</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>VoIP</td>
<td>4</td>
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<tr>
<td>SDTV</td>
<td>2</td>
</tr>
<tr>
<td>HDTV</td>
<td>2</td>
</tr>
<tr>
<td>VOD/Gaming</td>
<td>1</td>
</tr>
<tr>
<td>HSI</td>
<td>1</td>
</tr>
</tbody>
</table>
Telco IPTV – Business Issues

Losing wireline customers to Cable
- ATT losing 4% per year

Need to Develop New Lines of Business
Telco IPTV - Problems

*Last mile network is bandwidth constrained*
  - DSL ~ 6Mbps to VDSL2+ > 48 Mbps

*No experience with video*

*No experience with programming acquisition*
BANDWIDTH IN THE BACKGROUND – THE DVR

DVR Penetration
Standard Definition Units vs. High Definition Units

HD DVRs begin to out sell SD DVRs

Able to record up to 4 steams concurrently

Source: IMS Research
IPTV for Cable

Does Cable need to jump on the IPTV bandwagon?

Is it “IPTV”, Video over IP, or Video over the internet?

What’s involved?

Where can we assist?
IPTV for Cable – Business Issues

Losing Subscribers to Telcos

Loss of revenue to Over-the-Top services

Limited number of suppliers / perceived cost issue

Slow addition of consumer applications
Comcast: “IPTV is coming and it will likely be big”*

- Comcast content (and Internet) to PC and eventually any IP client
- Comcast (and all MSOs) migrating to >> narrowcast
  - 80% of spectrum digital in 3-5 yrs
  - Considerable new spectrum for HD and SD digital services
  - At least 50% unicast + multicast
  - Serving group sizes continue to shrink
- 3-5 yr expectations
  - 80% of spectrum digital
  - >50% unicast & multicast
- IPTV via DOCSIS pipe requires up to 30x CMTS growth
  - Solution needed to match MPEG/QAM video costs
  - Unified CPE
    - MPEG/QAM and MPEG/IP
    - STB/Gateway converts QAM→IP

* July 2008 NGNA Kick-off
“The VIP architecture is intended to augment the existing video distribution network to allow the delivery of TWC video services to non-traditional devices (ie: PCs, personal media devices, cellphones, IP STBs, etc)”

“The intent is to deliver live broadcast/linear video and video on demand services to IP STBs where those IP STBs do not contain RF tuners but instead use only an Ethernet port”
Ecosystem Evolution

Internet applications via cable

MSO licensed content to IP clients
- PCs, IP STBs, Handhelds

Integration of IP Set Tops into the cable ecosystem

IPTV 2.0
- Sharing of content between networks and “three screen” devices
CableLabs Initiatives

Evolution of Home Networking in CableLabs and OCAP HN to an Overall Ecosystem

- OCAP HN1 Enables PC Content Sharing
- OCAP HN2 Enables Multi-Room DVR
- OCAP HN3 (now 2.5) Enables Tuner Sharing
- Other extensions to facilitate the Ecosystem over time
- Motorola is participating/contributing to the development of the all the HN extensions
HomeNet I

STB
Sharing App
Guide
OCAP
LAN Tnr CC

PC/HMG

Enables STB access to PC content
**HomeNet II**

- **Hub STB**: Sharing App, Guide, OCAP, LAN, Tnrs, CC, HD
- **Client STB**: Sharing App, Guide, OCAP, LAN, Tnr, CC, PC/HMG

**Adds Whole Home DVR**

- Client can get to PC content
- Client can get to DVR content
HomeNet II.5

- Enables LightWeight Client
- Client can get to PC content
- Client can get to DVR content
- Client can get to Tuner and Cable Card Resources
HomeNet II.5 Enables Single Triple-Play Box

SMG/HMG series

<table>
<thead>
<tr>
<th>Guide</th>
<th>Data</th>
<th>Voice</th>
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<tbody>
<tr>
<td>OCAP</td>
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<td></td>
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<tr>
<td>LAN</td>
<td>Tnsr</td>
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<td></td>
<td>HD</td>
<td>CM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLC</td>
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</table>

LW Client STB

<table>
<thead>
<tr>
<th>Sharing App</th>
<th>OCAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAN</td>
</tr>
</tbody>
</table>

Single box for triple play of services

Enables LightWeight Client

Client can get to PC content
Client can get to DVR content
Client can get to Tuner and Cable Card Resources
Transport Gateway

Current CPE development that can act as MPEG and DOCSIS termination

- 8 MPEG or DOCSIS tuners
- Multiple LAN and device interfaces
- DLNA protocols
- DRM bridge to IPRM or DTCP

Video distribution solutions within the Home Net exist for either MPEG or DOCSIS delivery of IP video

Solution could provide a flexible platform for serving both MPEG video and IP video/data with IP distribution over the over Home Net
DIBA is Essential to IP-VOD and IPTV for Cable

DOCSIS IP-video Bypass Architecture

- The standard digital broadcast is distributed over an IP backbone.
  - Video packets go a last-hop router/switch and then directly to the EdgeQAM and HFC plant

- Typically, IP/DOCSIS content goes through the CMTS core

- CMTS core processing is at least 4 times as expensive as EdgeQAM processing

- With DIBA, IPTV and IP-video same path as digital broadcast
  - DIBA bandwidth cost -> digital video bandwidth cost
Cable Network with IP Backbone, IP/DOCSIS service and Digital Video Service

DOCSIS 3.0 allows multiple downstream channels to single Cable Model

DOCSIS Channels
- Upstream
- Primary (MAC enabled)
- Non-Primary
- Non-Primary

DOCSIS: Data over cable service interface specification

Cable Modem Termination System (CMTS)

Video/IP Multicast

Digital Video Carriers

VOD Server

Internet

Local Network

TV feed

Common IP Backbone Network

Edge Router

MPEG Edge-QAM (RF modulator)

Digital Set-top

PC

TV

DOCSIS Cable Modem

Internet
DOCSIS Bandwidth via Modular CMTS

Architecture is more expensive than Digital Video

- Modular CMTS architecture introduces DOCSIS Edge-QAMs
  - Allows additional downstream channels to accommodate IP-video and IPTV without adding additional upstreams
- IP-video packets still transit the CMTS and edge router (twice)
  - Additional cost compared to digital video
  - Tunnel from CMTS to Edge-QAM
DOCSIS IP-video Bypass Architecture (DIBA) Reduces the cost of Digital Video

- IP-video packets follow the same path as digital video
  - Edge Router to Edge-QAM modulator to customer
  - Unicast flows tunnel from router to Edge-QAM (which is not a router)
  - Multicast IPTV sessions are joined by the Edge-QAM (just like in digital video)
- Edge-QAM performs the necessary DOCSIS encapsulation
  - DOCSIS channels from Edge-QAM are ‘non-primary’ meaning they do not have full MAC layer functionality
IPTV on DOCSIS with DIBA

• Similar issues to Switched-Digital-Video
Channel Popularity (i.e., ...NBC, CNN, ....TOON......)
To conserve Bandwidth, IPTV is ‘Switched’ just like Switched Digital Video

The MSO wants to offer more networks (CNN, FOX, ...) than will physically fit into the available bandwidth

- The most popular titles (FOX, CNN, etc) are transmitted across the entire plant from one set of ‘broadcast’ modulators. This is the standard approach to digital broadcast.

- In addition, the plant is divided into serving areas (MAC domains), with sets of dedicated modulators for each serving area. These dedicated modulators are used for the SDV titles.

- The less popular titles (TOON, TVLand, etc) are switched. These titles are only transmitted to a serving area (“switched on”) if at least one STB is tuned to that service.
All Broadcast – Requires Too Much Bandwidth

All services go to all service areas, regardless of whether anyone is watching those services.

IP Multicast over Metro Network

Digital video over HFC plant

Video from satellite feed and servers

Switch

All shows, all nodes, all the time
Switched Digital Video – Conserves Bandwidth

For switched services, only the services being watched in a particular service group are transmitted.
**Total SDV titles to each serving area, versus number of active subs.**

Comparison to all uni-cast transmission to each subscriber:
100 viewers require 100 separate transmissions

Saved spectrum = “benefit”

Having multiple viewers per ‘show’ saves spectrum compared to all unicast
- Drives network toward large serving areas
- Uses up more spectrum

More and smaller serving areas
"Cost" = Number of ‘extra’ QAMs required due to same SDV content being transmitted to multiple serving areas by different modulators

Limited spectrum for all ‘shows’ means size of serving area is also limited
- Less than the entire plant

More and smaller serving areas
Switched Digital Video Signaling

Switched Video Manager

Digital Storage Media – Command and Control

Response /w TV show info
• Carrier Freq
• Program ID (PID)

Request for TV show
• Set-top MAC address
• ServiceGroup ID
• Video SourceId

Digital Set-top

ERM
• Knows what video sessions are on what QAM carriers
• Assigns new video sessions to QAM carriers and Program IDs

Multicast Video Feeds

Digital QAM

• QAM joins multicast session
• Strips IP header
• Forwards video on given carrier and PID

Digital QAM

Edge Resource Manager

• Set-top MAC address
• ServiceGroup ID
• Video SourceId

• Carrier Freq
• Program ID (PID)
DIBA Encapsulation of IP Multicast

Metro Network
- Last Hop Router
- Local Network
- Edge-QAM
- DOCSIS RF HFC
- CM
- Home IP
- IP STB

MPEG-2 (SPTS)
- UDP
- IP Multicast
- Multicast MAC

MPEG-2 (SPTS)
- UDP
- IP Multicast
- Multicast MAC

MPEG-2 (SPTS)
- UDP
- IP Multicast
- Multicast MAC
- DOCSIS MAC DSID
- MPEG2-TS

MPEG-2 (SPTS)
- UDP
- IP Multicast
- Multicast MAC
Current E2E Video Ecosystem
Motorola’s Vision of the Evolved Ecosystem: Mostly IP today
MSOs Migrating to IP Core, QAM at the Edge

Purple is Guide Data
Red is Provisioning, Authentication
Gold is Signaling For Sessions
Green is Content

Guide Server
CA Controller
Billing System

IP Network

Edge QAM For Guide
DSG Or OOB

VOD Server
SVM
SRM

Encrypter

Broadcast Input

Edge QAM For VOD
Edge QAM For SDV
Edge QAM For Broadcast

QAM STB
RF Plant
Motorola’s Video Ecosystem

Goal: Add IPTV / DOCSIS. Solution: DIBA

Common Digital Video Headend
- Content Acquisition
- Live programs
- Content Server
- Internet Streams
- Metadata
- Internet
- Manual Authoring
- OSS/BSS
- Provisioning / Billing
- IMS - Optional
- Presence
- Converged Services

Core Services Framework
(Applications cluster/Back Office)

Digital Cable
(Hybrid Fiber Coax – HFC)

Telco IPTV QOS
(xDSL & GPON)

Wireless Access
(WiMAX, LTE, DVB-H)

Core Services Framework
(Applications cluster/Back Office)
Provider and Platform Independence at the NCTA ’09 Show in Washington, DC.