SCTE ISBE CABLE-TEC EXPO '16

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Configuration Recommendations for DOCSIS Transport of IP Video Service

William T. Hanks

Director, Systems Broadband Architecture Engineering

ARRIS

SCTE Society of Cable Telecommunications Engineers

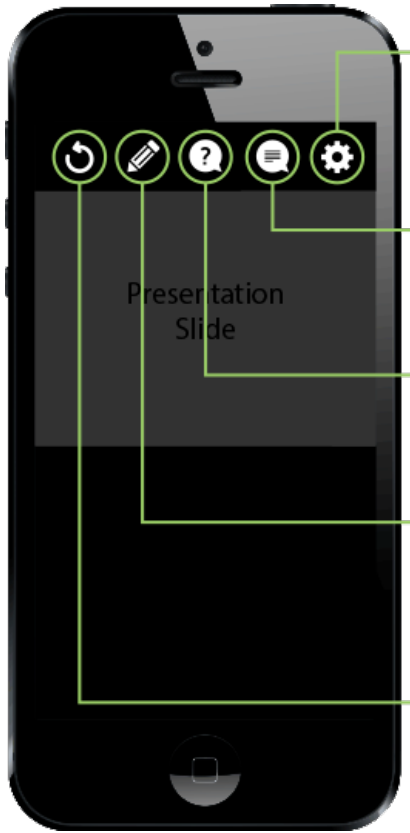
ISBE International Society of Broadband Experts

#CableTecExpo

Essential Knowledge for Cable Professionals™

This Session Will Be Interactive!

FXP | touch



Personalize

Chat

Ask questions

Take notes

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AUDIENCE SURVEY:
What is your primary background expertise?

A CATV & Analog Video

B Digital Video & SDV

C RF and/or HFC plant

D IPTV over traditional Networks

E DOCSIS Services

Summary of topic:

Top 100 words from paper

Purpose of Paper

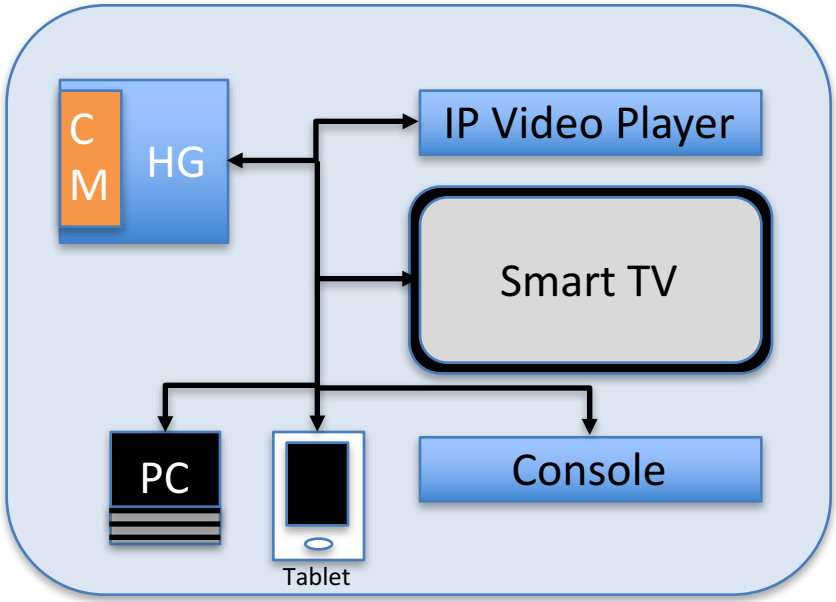
To help answer commonly-asked cable industry questions about configuring managed IP Video service over DOCSIS.

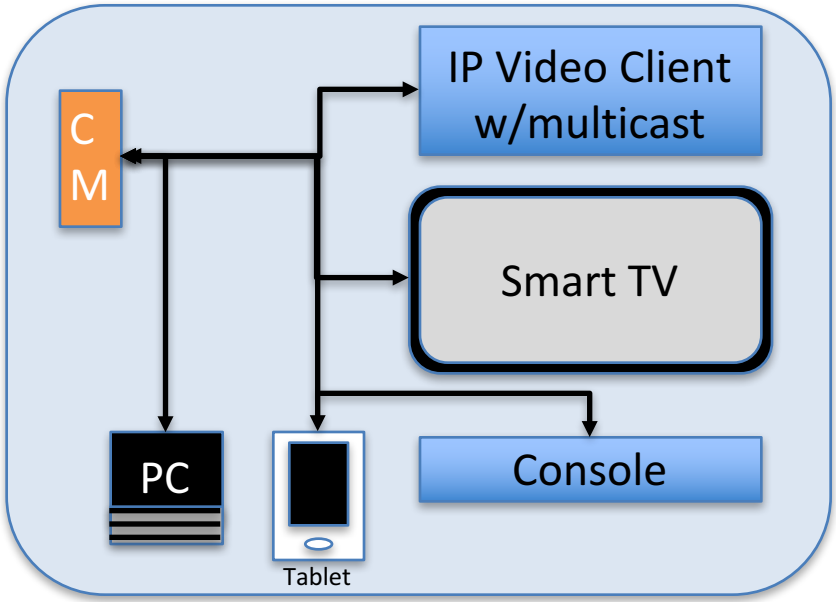
Included	Not Included
• Overview of many interconnected topics	• Customer-specific optimizations
• General configuration recommendations	• Traffic engineering calculations

Vendor and Product Disclaimer

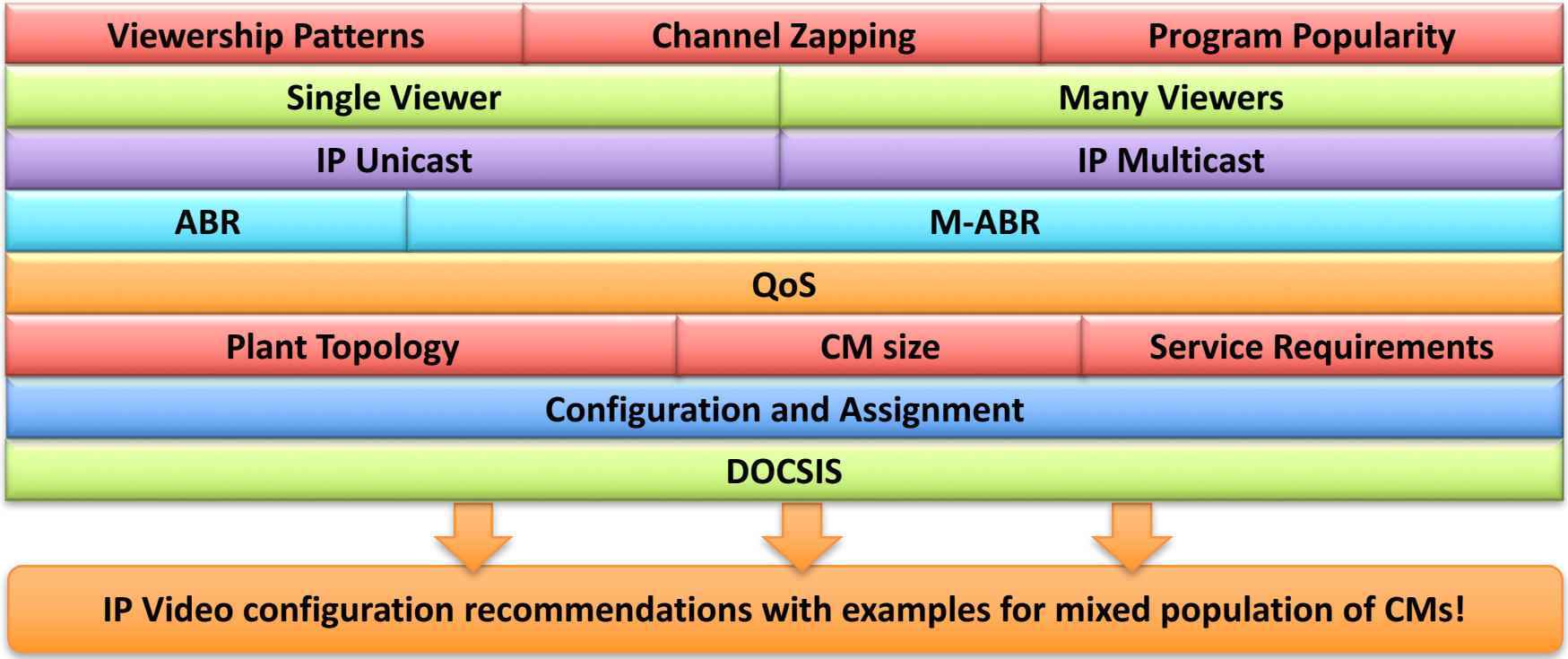
- The ideas and recommendations expressed in this work are believed by the authors to be applicable on most products from most industry vendors.
- Some background assertions may prove to be untrue on some products and some recommendations may be unrealizable on some products.
- If issues arise when attempting to tune an IP video system, please refer to product information and contacts from the component equipment vendors.
- NOTE: While this presentation is focused on M-ABR solution using home gateway products, some alternate IP Video architecture solutions (especially IP Video applications that sit behind a CM) may benefit from these recommendations too.

Home Networking Use Cases





Many Technology Topics to be Carefully Considered

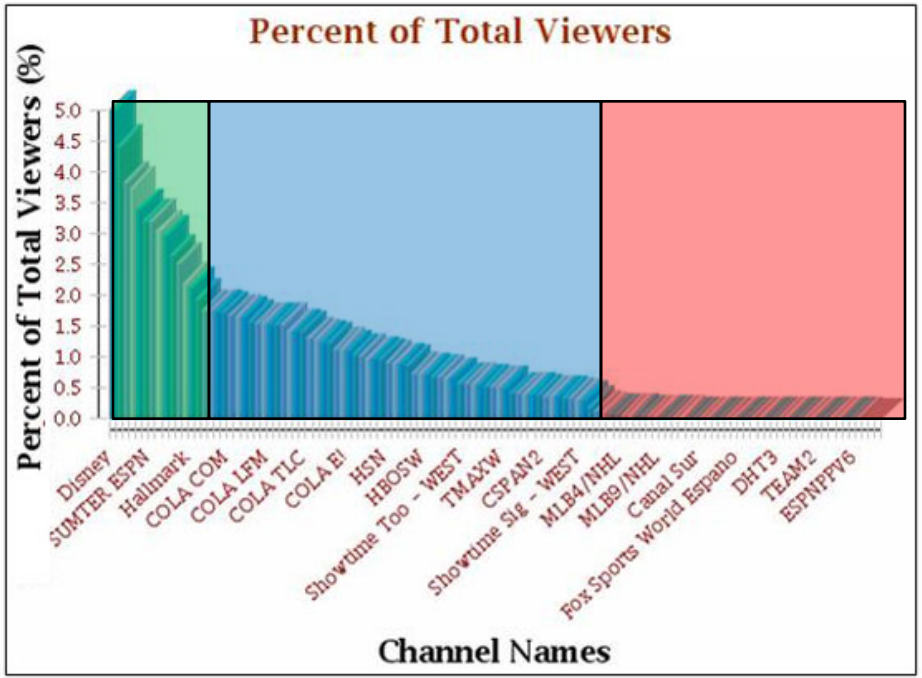


Some Background Topics

Evolution of cable video technology

- Community Antenna TV: Analog broadcast video over coax cable
- HFC: Analog broadcast video over fiber and coax cable
- Digital HFC: Digital broadcast video over fiber and coax cable
- VOD: Digital Video-on-demand – digital video for single user
- SDV: Switched digital video over fiber and coax (when viewed)
- IP over DOCSIS: cable system carries IP services
- IPTV over DOCSIS: Over-the-top services use IP over DOCSIS to deliver video
- Managed multicast-assisted adaptive bitrate (M-ABR) IP video: Leverage best of all technologies to efficiently carry high quality video

Relative Popularity of Linear Programs



short-tail:

- Many viewers similar to traditional broadcast
  - Static Multicast: always on; CM JOINs at registration and stays JOINed.
  - Dynamic Multicast: Multicast signaling protocol (IGMP/MLD) used to JOIN/LEAVE as user changes channels

medium-tail:

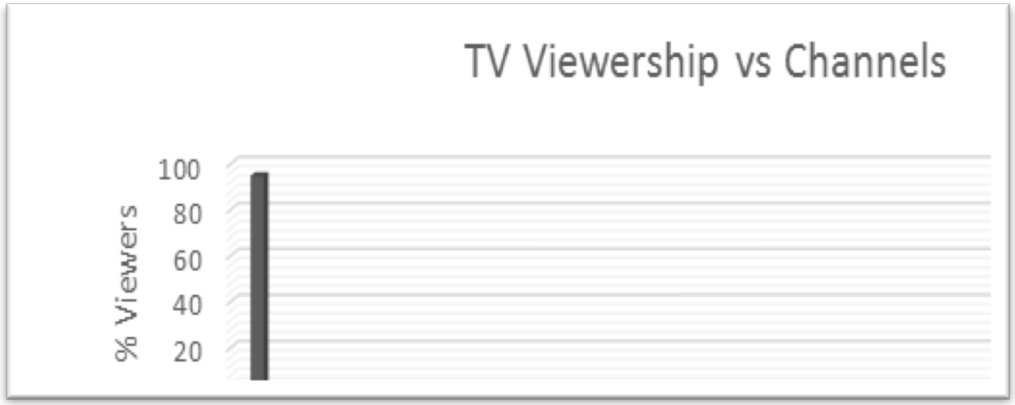
- program streams expected to be switched in/out depending on demand
  - Either IP unicast (similar to VOD) or IP multicast (similar to SDV); depending on MSO plan

long-tail:

- program streams expected to be watched rarely
  - Usually IP unicast as these programs would not see benefit from IP multicast

Viewership snapshot

U.S. Metro Area; Dec.2015



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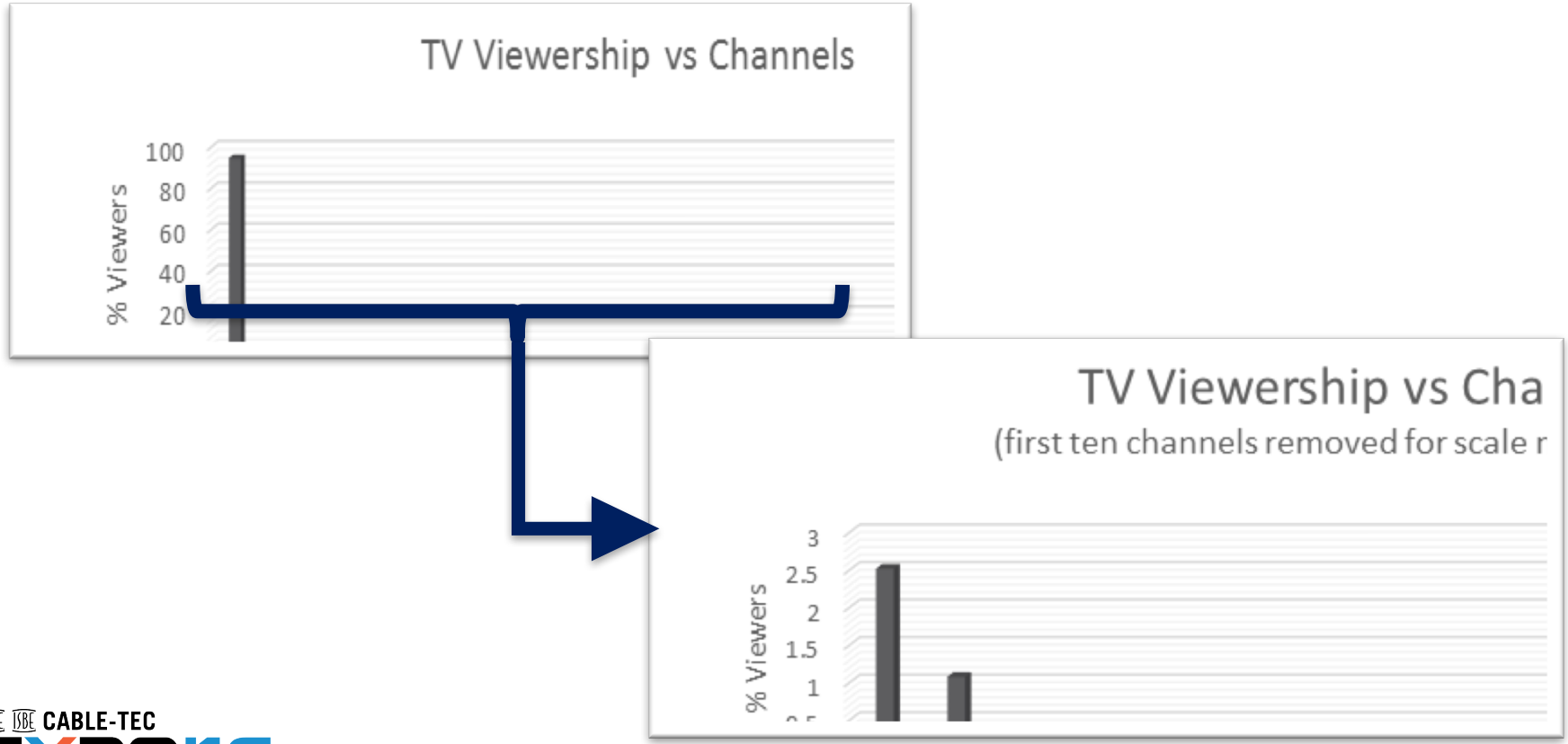

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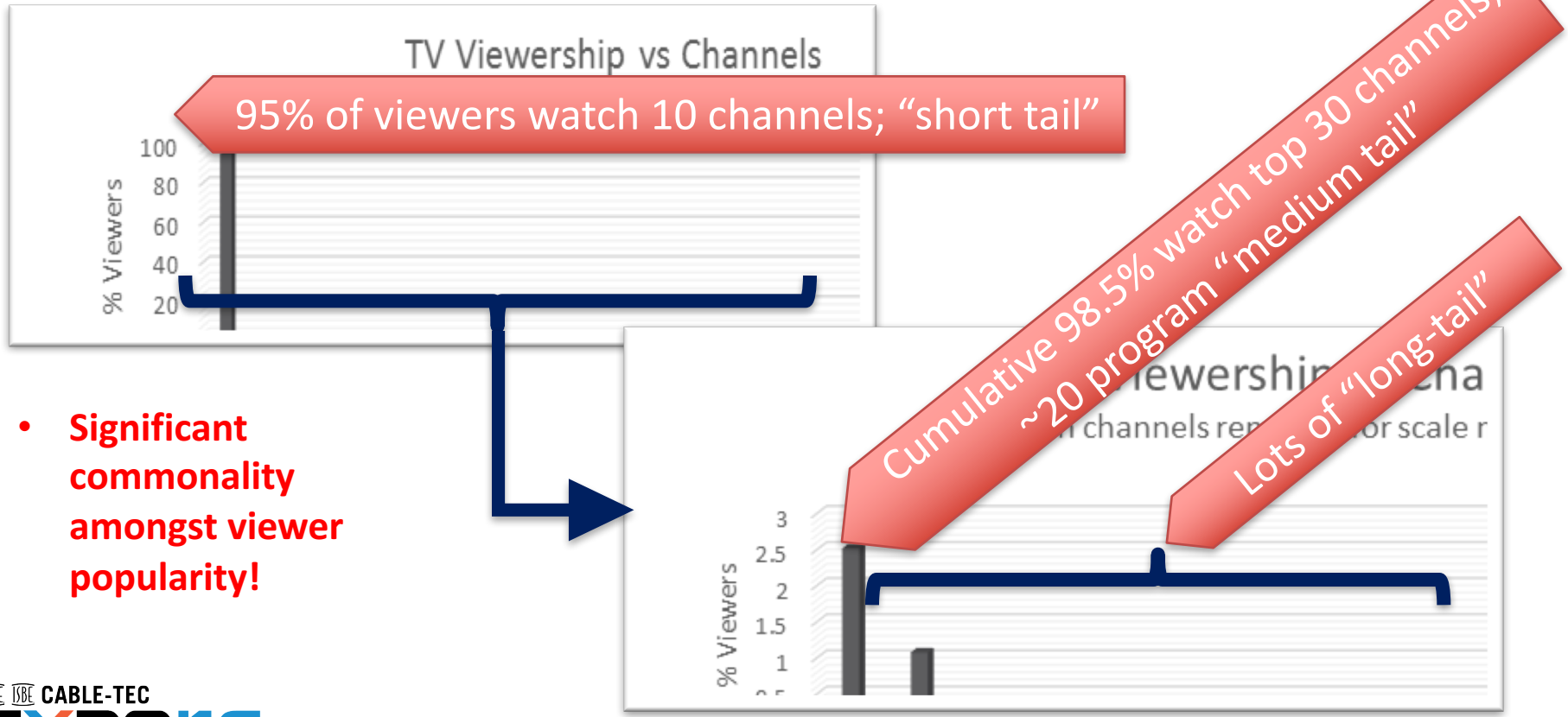


- **Significant commonality amongst viewer popularity!**

Channel Zapping

- Rapid television channel changes (a.k.a. “zapping”) can create problems with any digital video format where entire packets and frames must be received with valid checksums and then rendered.

- With IP video, individual program streams are typically placed onto packet flows that use different IP header or flow identification information.
  - This header information needs to be communicated to the CPE devices in real-time as customers rapidly press channel “up”, ”down” and “previous” buttons on their remote.

- Some studies have shown that a channel change needs to happen in 430 milliseconds.[1]

1. Kooij, Robert et.al.; “Perceived Quality of Channel Zapping”, 2006

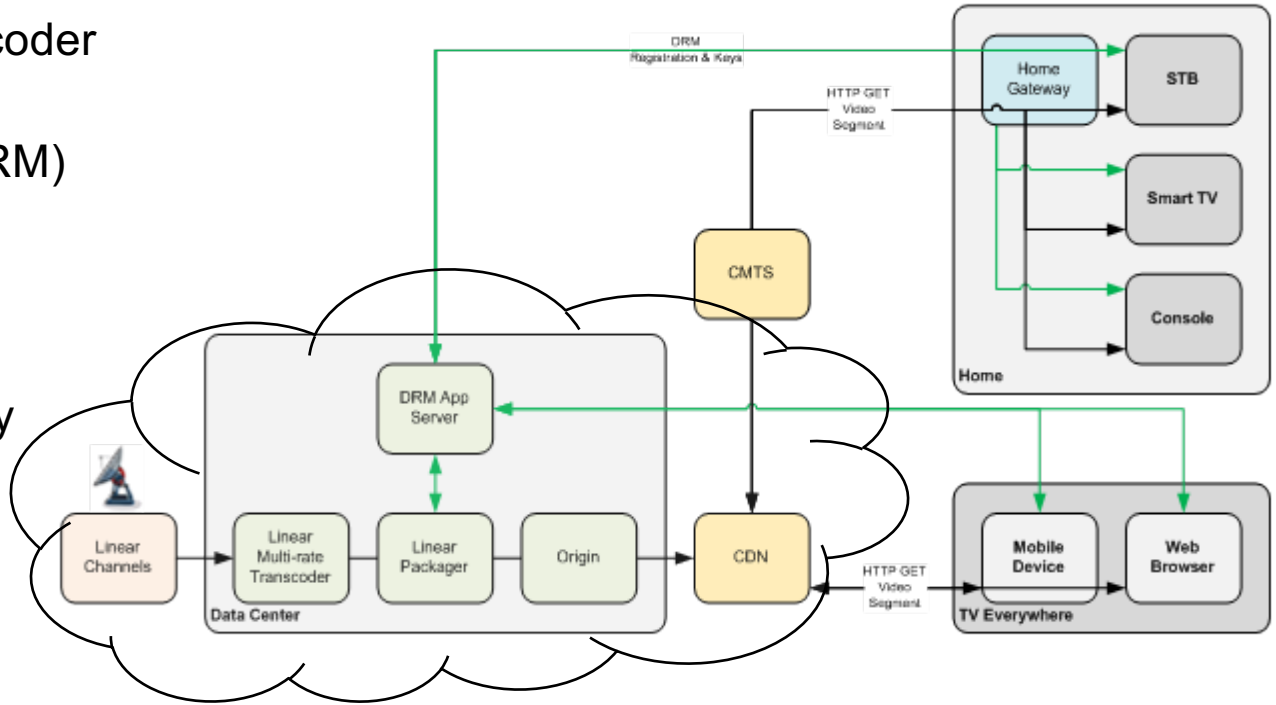
Adaptive Bit Rate Television

- Adaptive Bit Rate (ABR) Protocols work across all devices
  - Set-top video players, tablets, smart-phones, gaming devices, smart TVs, PC, etc.
  - Works through NAT and firewalls!
  - Unicast HTTP based (over TCP/IP)
    - Simple Clients with URL-based Playlists
    - Easily traverses home firewalls
    - Leverages standard CDN transport

- Adapts to changing network conditions
  - ABR is a superset of several different protocols:
    - MPEG-DASH, HLS, Smooth Streaming, HDS, . . .
  - Program is broken into chunks and encoded with multiple resolutions (and transmission sizes) into files which are all stored
    - Client bases next chunk request on reception time of last chunk

Traditional (unicast) ABR Infrastructure

- ABR Components
  - Multi-rate transcoder
  - Digital Rights Managment (DRM) Server
  - Packager
  - Origin Server
  - Content Delivery Network (CDN)
  - ABR Client



What is M-ABR?

- Multicast-assisted ABR (M-ABR) is an important optimization of Traditional ABR
  - Similar to standard ABR system that uses transparent caching proxy in Home Gateway
  - Transparent cache can be filled via multicast or unicast
    - Multicast – optimizes network bandwidth utilization
    - Unicast – used for quick channel changes and lost segments

- Improved QoE for highly-valued linear TV services
  - Provides guaranteed Quality of Service for multicast streams

- May be used with reliable multicast transmission protocols (like NORM)

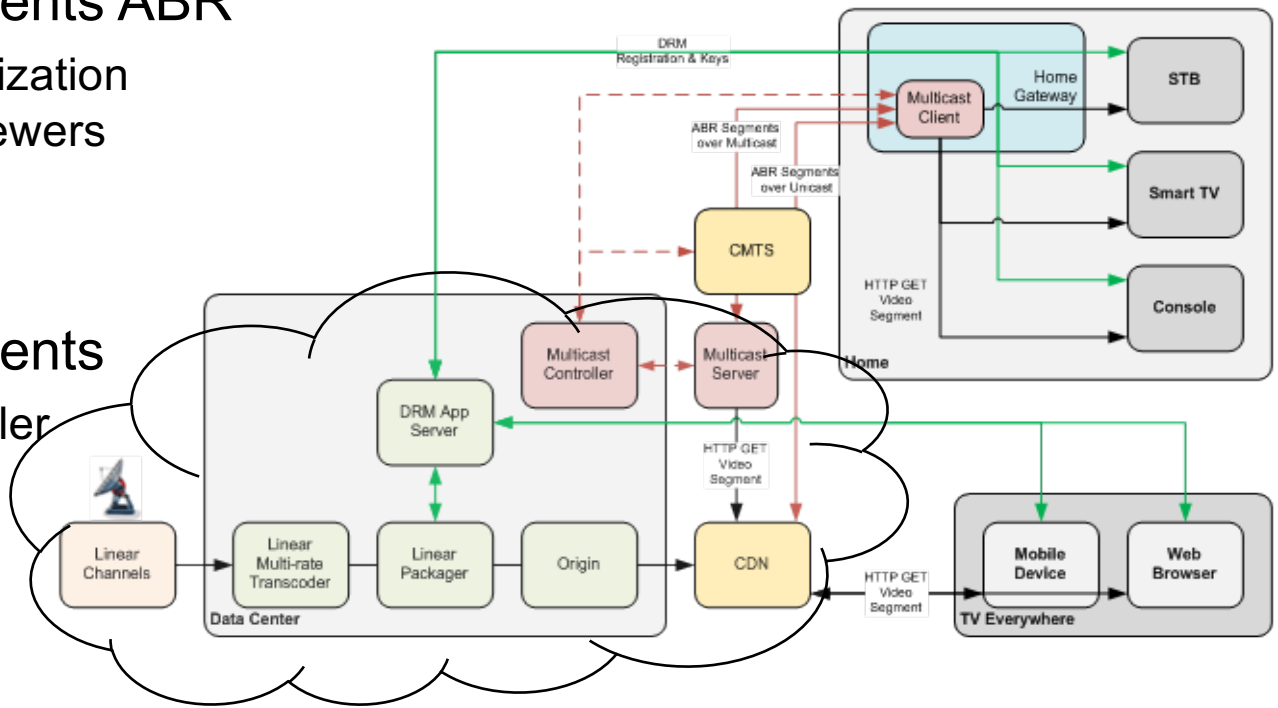
NACK-Oriented Reliable Multicast (NORM)

- IETF RFC 5740
- Protocol adds some reliability to UDP-based multicast transport
- Recommended multicast transfer protocol by *IP Multicast Adaptive Bit Rate Architecture Technical Report*[1]
- Can be configured to add FEC capability to the content to reduce the potential for multicast/unicast retransmission and increase overall efficiency.
- Many excellent NORM configuration recommendations can be found in [1].

1. OC-TR-IP-MULTI-ARCH-V01-141112, Cable Television Laboratories (CableLabs).

M-ABR Infrastructure

- M-ABR supplements ABR
  - Bandwidth optimization when multiple viewers
  - QoE guarantees
- M-ABR Components
  - Multicast Controller
  - Multicast Server
  - Multicast Client



AUDIENCE SURVEY:
Should loads always be balanced?

Load balancing is not always good!

- **IP multicast transmission is intended to be shared – most efficiently when many group listeners share the exact same media (pseudo-broadcast)**

- MSOs have diverse plans for target HG/CM devices to carry IP video; not all MSOs will use only large HG devices with many receivers
  - For all HG/CM devices of differing size to share the same IP multicast transmission, (and avoid replication) the multicast group streams must be **consolidated** onto a bonding group that even the smallest HG/CM can use while allowing other services.
  - HG/CM devices may continue to grow in capability to cause today's large HG/CMs to become the smallest HG/CM in the future.
  - **The channels in the common IP video multicast bonding group are intended to have a high utilization (carrying short-tail programing) at all times. This actually improves overall bandwidth efficiency!**

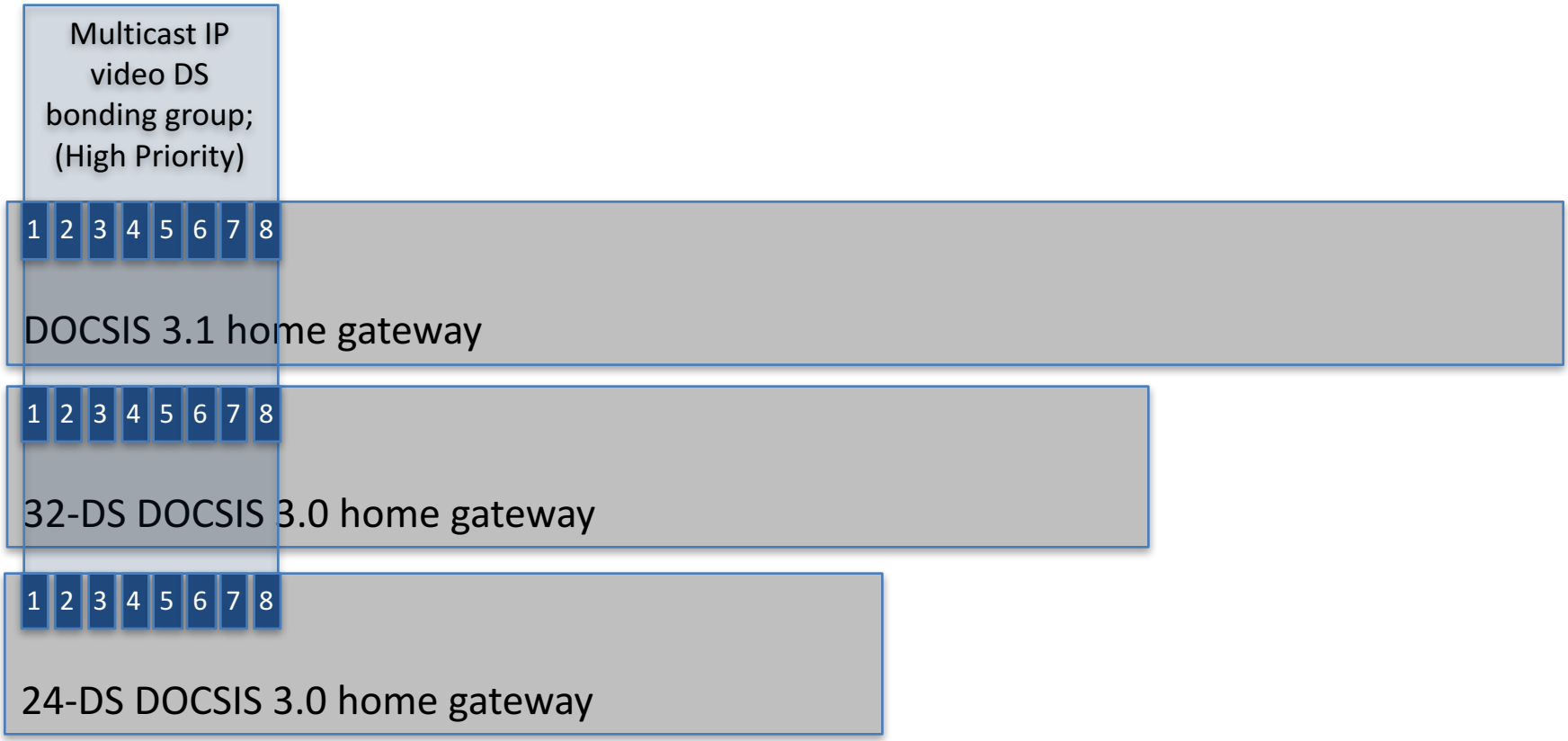
Example DS channel configurations

DOCSIS 3.1 home gateway

32-DS DOCSIS 3.0 home gateway

24-DS DOCSIS 3.0 home gateway

Example DS channel configurations



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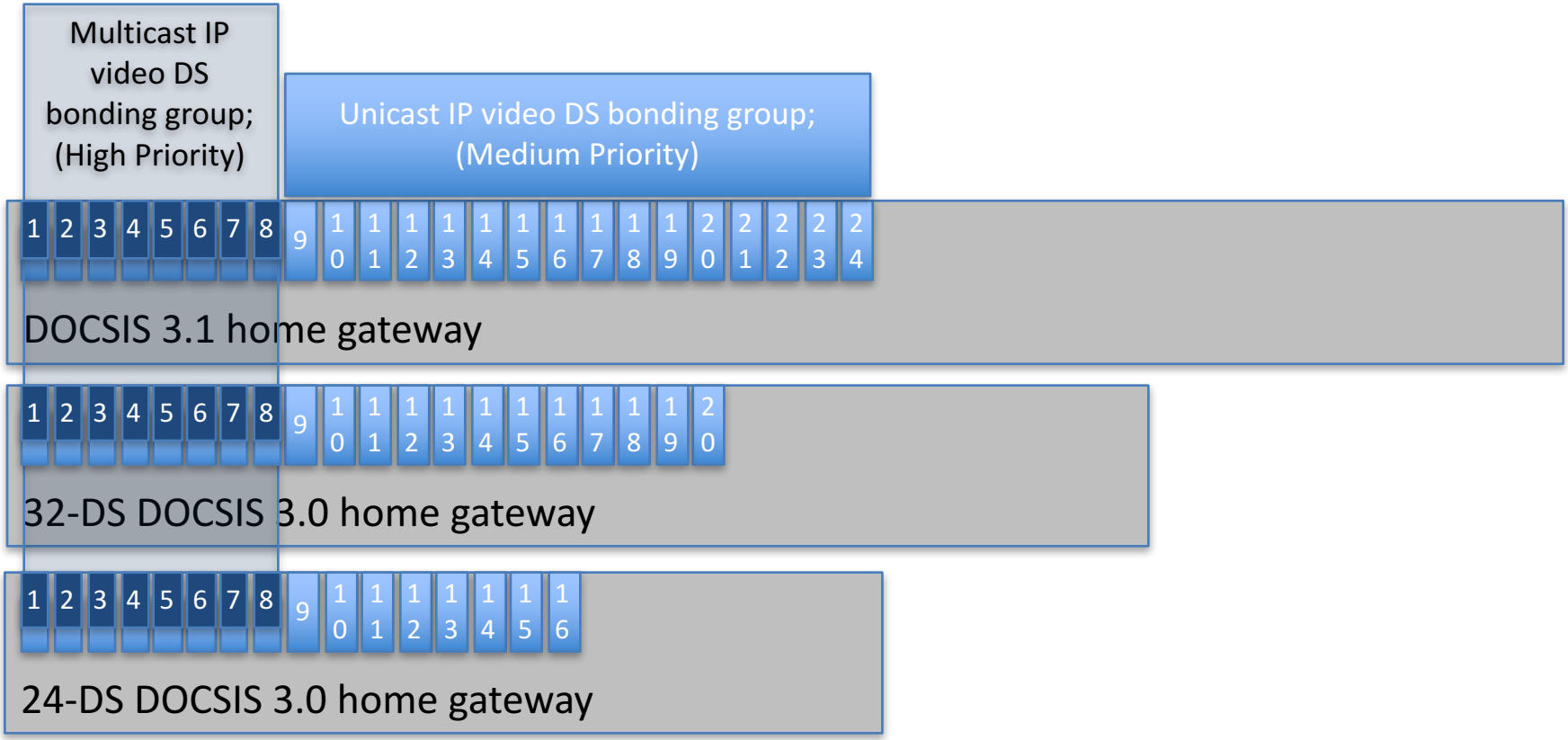

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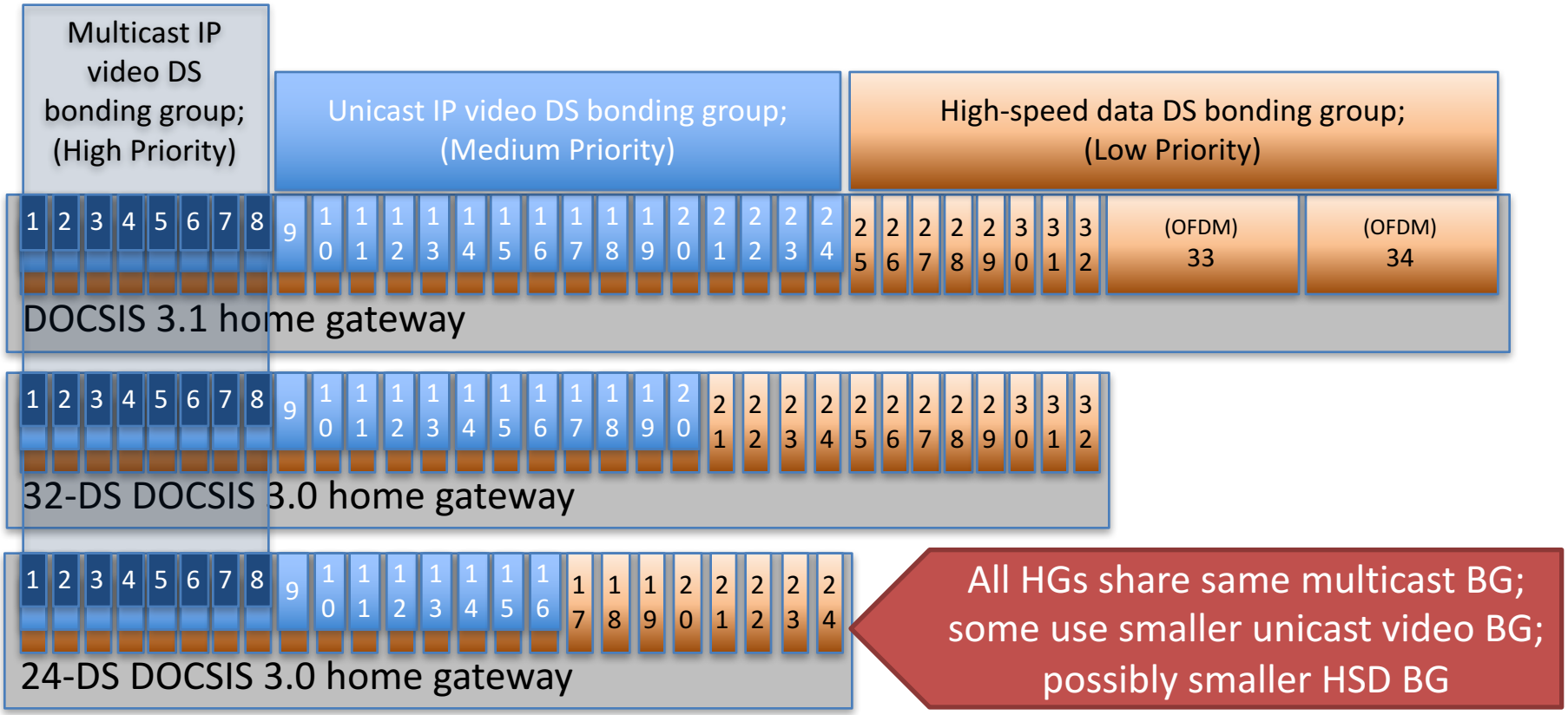

IP Video Signaling Plane Alternatives

- None – Use static settings from HG's CM configuration file
  - DOCSIS CMTS Static Multicast Session Encoding (TLV Type 64) for short tail always-on multicast channels
  - Unicast best-effort service flows for signaling
  - Unicast best effort service flow for unicast portion of M-ABR media

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- ~~PacketCable Multimedia (PCMM)~~
  - **NOT RECOMMENDED (see next slide)**

Why Not Use PacketCable Multimedia for IP Video?

- Dynamic bonded unicast flow creation requires at least two 3-way DOCSIS MAC Management Dynamic Services transactions (DSA to add) + (DBC to add bonding info) to succeed in serial.
  - Only one dynamic services transaction may be active at a time per CM

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  - Problem is magnified when web-based service application managers assume that the same transaction can be resent multiple times “to ensure success”
    - New PCMM Gate Set request messages do not have identification that allow CMTS to determine whether request is a duplicate.
  - PacketCable Multimedia does not scale well for rapid channel changes due to significant processing on CMTS/CCAP device

Summary

- M-ABR is generally the industry standard.
- Use NORM to provide some robustness to connectionless IP multicast sessions.
- IP multicast transmission is intended to be shared. Maximize efficiency by packing multicast on as few channels as can carry the short (and possibly some medium) tail content.
- Avoid using PacketCable Multimedia signaling for IP video – signaling backup is likely with channel zapping behavior.

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Thank You for Listening!

ARRIS
www.arris.com

Bill Hanks
Director, Broadband Systems Architecture

bill.hanks@arris.com
2400 E. Ogden Avenue • Suite 180 • Lisle, IL 60532
Phone: 1-630-281-3112

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