A Perspective on Video and Image Compression in Cable Networks

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Digital Cable is a Great Success Story

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o Introduced approximately ten years ago

o Capital build out intensive, started paying off

o Services

- Broadband Data, Digital TV,

- Voice

- High Definition TV (HDTV)

- Video on Demand (VoD)

o New services based on core MPEG technology are still being introduced

- e.g. Digital Commercial Program Insertion

However, Services Are Evolving...

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o Rise of On-Demand Services

- "My 500 channels"

o High Definition TV comes of age

- Channels offering both Standard Definition (SD) and High Definition (HD)

o Other services need more bandwidth space too

More and more services putting bandwidth pressure on cable networks

Bandwidth Reclamation Strategies

o Higher QAM constellations

o Move analog Pay-Per-View to digital

o Statistical Multiplexing on current VOD streams

o Convert some channels to switched broadcast
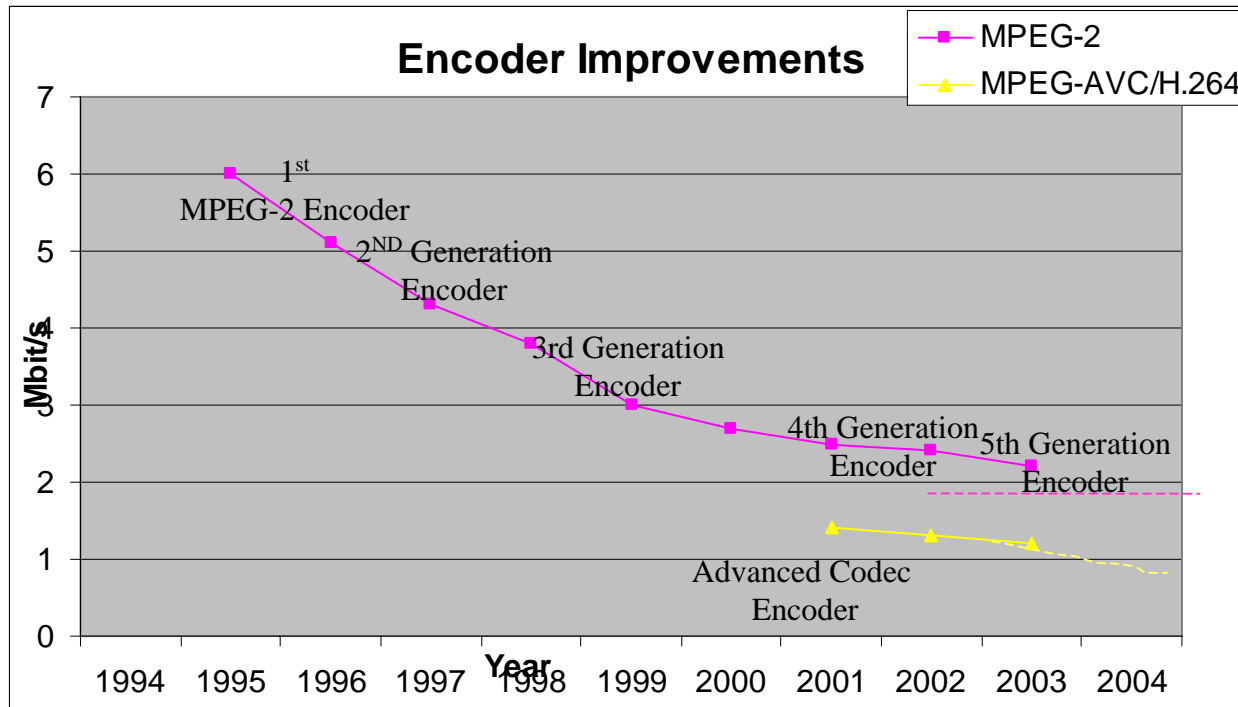
o Convert most analog channels to digital

Lastly...

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More Efficient Video Compression Schemes

o MPEG-2 encoding algorithms have improved over the years

Encoder Improvements

Legend: MPEG-2, MPEG-AVC/H.264

1st MPEG-2 Encoder
2ND Generation Encoder
3rd Generation Encoder
4th Generation Encoder
5th Generation Encoder
Advanced Codec Encoder

Y-axis: Mbit/s (0, 1, 2, 3, 4, 5, 6, 7)
X-axis: Year (1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004)

Additional bandwidth savings with MPEG-2 compression is hard to come by
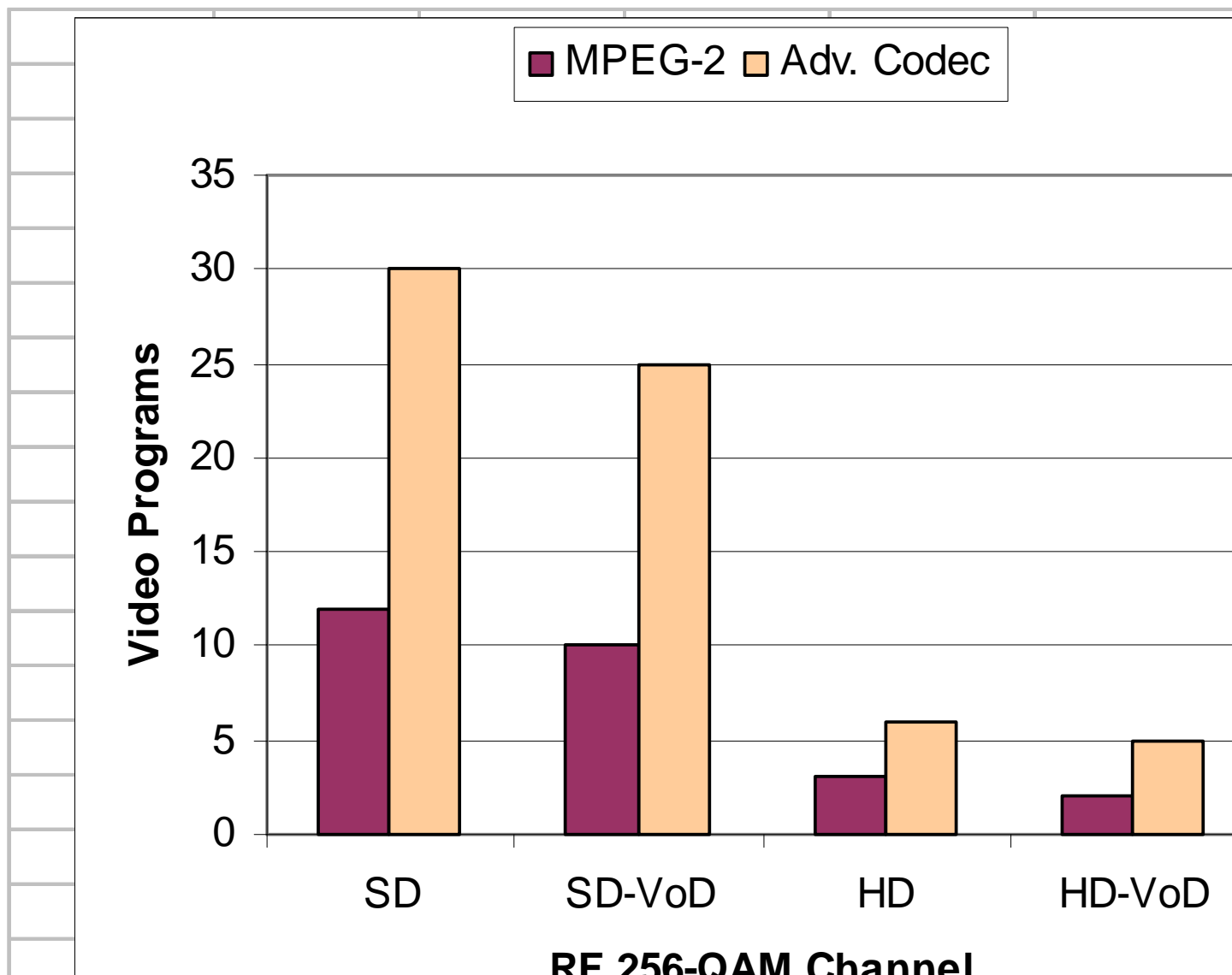
Active Research in Video Compression Beyond MPEG-2

o Multiple reference frames for prediction

o Variable block size for motion estimation

o Spatial Prediction modes

o Special prediction modes for fades

o ¼th pixel motion estimation

o Multiple directions of prediction for I-macroblocks

o Loop filter to control propagation of error

o Usage of arithmetic coding

New Advanced Video Codecs give 2-3 better compression performance than MPEG-2 - <MPEG AVC/ H.264, VC-1>

How Much More?

Bar chart titled with legend: MPEG-2, Adv. Codec. Y-axis: Video Programs (0 to 35). X-axis categories: SD, SD-VoD, HD, HD-VoD. RF 256-QAM Channel.

- SD: MPEG-2 ≈ 12, Adv. Codec = 30
- SD-VoD: MPEG-2 = 10, Adv. Codec = 25
- HD: MPEG-2 = 3, Adv. Codec = 6
- HD-VoD: MPEG-2 = 2, Adv. Codec = 5

Don't Throw Out The MPEG-2 Baby Yet

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o MPEG-2 Codec & Transport are separable

o MPEG-2 Transport has multiplexing, Quality of Service (QoS), Program IDs (PIDs), Program Association Table (PATs), Program Map Tables (PMTs), jitter control, etc.

o A value chain of existing equipment

o Inexpensive end-user devices

o There are millions of existing SD boxes and already a large number of HD boxes

...Add To It

o Advanced Codec can co-exist with MPEG-2 Video on an MPEG-2 transport

o Advanced Codec has better subjective quality

o Advanced Codec compatible to other applications

o No new cable plant physical infrastructure required

- except for adding new Advanced Codec encoders and Advanced Codec/MPEG-2 boxes where necessary

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Advantages to Co-Existence

o Allow gradual transition from MPEG-2 without significant capital expense

o Can transition a Video Service to new codec as demand picks up

o Only target services, areas, neighborhoods in the network that can really benefit from Advanced Codecs

- Transport/Storage

- IP services

- VoD and HD-VoD

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More Advantages

o **Gradual introduction can**
  - Mature this technology
  - Reduce costs
  - Become part of the bandwidth reclamation strategy

o **Initially deploy Advanced Codec/Boxes in services and areas where makes sense**

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What Still Needs to be Done in Cable Standards

- o Development of Cable Constraints documents on advanced codecs
  - • Development of a video constraints document for each advanced video codec used
  - • Development of a multiplex & transport constraints document for carriage over cable systems
- o Work on this is already taking place in **SCTE- DVS** (Society of Cable & Telecommunications Engineers- Digital Video Subcommittee) with Cablelab's involvement

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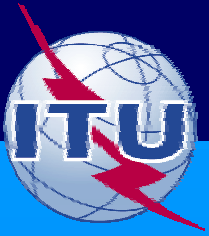
MPEG-2 does not have to be removed but could actually ease cable's transition to a new video codec

Thank You