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Compressed NTSC on Cable

- **"Compressed NTSC" on cable is potentially an important opportunity**
  - General Instruments is pushing their approach
  - CableLabs will try to obtain industry concencus and voluntary standards

- **Why is GI interested?**
  - a major opportunity to sell new set-top converters
  - "compatible" with the installed cable plant
  - "compatible" with the installed base of receivers

- **Why are cable system operators interested?**
  - more channels = more $
  - digital offers truly robust encryption security
  - "near video-on-demand" is a new service
  - "compatible" with the installed cable plant
  - "compatible" with the installed base of receivers

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TCE Interests

- **"16x9 NTSC" capability**
  - GI and CableLabs are only thinking 4x3...
  - "compressed 16x9 NTSC" is a good match to TCE display
- **Keep decompression as a receiver function**
  - lest the receiver of the future become a monitor
- **Move decryption functions into the receiver**
  - good for TCE, more value-added in receivers (bad for GI)
  - good for cable system operators (no investment in boxes)
- **Maintain compatibility with future HDTV standards**
  - tuners, RF, IF, modem, FEC, packet format, decompression, memory architecture...
- **Make sure that it will be possible to design a range of receivers with different cost/performance**

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Digital Hierarchy

- **The basic concept:**
  - different levels of picture quality at different bit rates
  - each successive level is a subset (or superset) of the preceeding one

- **The opportunity for "compressed 16x9 NTSC" on cable means that it is a critical member of the digital hierarchy**

- **Our goal is to allow one 6 MHz channel to carry:**
  - 1 HDTV (with an embedded NTSC-level), *or*
  - 4 "NTSC quality" (16x9 and/or 4x3), *or*
  - 8 "VHS quality" (16x9 and/or 4x3)

  that a single receiver can economically decode

- **Issues are how to encode and multiplex**

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ADTV Background

Glenn Reitmeier & Bill Beyers

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Possible Hierarchy and Multiplexing Approaches

Glenn Reitmeier & Bill Beyers

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1. Dual Transmission (Packet Mux)

- **Separately encode NTSC-level and HDTV pictures**

- **Merge them into the same bit stream as separate video service packet types**
  - this basic capability is already in the ADTV protocol

- **This approach is a *pseudo-hierarchy***
  - HDTV and/or NTSC are sub-optimal (total bits in the channel are a constant)
  - but it is very simple!

- **Not the most desirable approach, but better solutions must be proven**

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2. Hybrid Subband/MPEG Encoding

- **Split an HDTV picture up into subbands**
  - Laplacian Pyramid?
  - QMF?
- **MPEG encode the low-low subband**
- **MPEG (or simpler) encoding of the highs**
- **This approach is an *upward hierarchy***
  - HDTV should get most of the penalty of any inefficiency (more quantization noise)
  - NTSC-level may also be penalized if required to fit entirely in 3.84 Mbps HP cahnnel of Twin-QAM
- **Potentially has both speed and memory savings**
- **Not yet proven effective, work in progress**

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3. Quantization Bin-Splitting

- **Encode lower level as an MPEG++ stream**
- **Refine DCT coefficient quantization for higher levels**
- **This is also an *upward hierarchy***
  - HDTV gets all of the penalty of inefficiency (more quantization noise)
  - this approach maintains full resolution at lower hierarchy levels, but with more quantization noise
- **Appropriate for VHS -> NTSC or HDTV -> HDTV levels**
  - no memory savings are realized

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4. DCT Coefficient Decimation

- **Encode full HDTV as an MPEG++ stream**
- **Extract low DCT coefficients to obtain NTSC level**
- **This approach is a *downward hierarchy***
  - lower-level gets artifacts (blockiness, or softness if postfiltered)
- **Probably needs a hierarchical motion representation**
- **NTSC level may not have acceptable quality**
- **Work is in progress**

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5. Temporal Approaches

- **Lowest level has a reduced frame rate**
- **May be combined with other approaches**
- **Both *upward* and *downward hierarchy* are possible**
- **Probably acceptable only for VHS --> NTSC levels**
- **Detailed approaches not well defined**

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Possible Multiplexing Approaches

1) Packet Level Multiplex

- independently encode 4 NTSC level pictures
- merge their data as different video service types (basic capability is already in ADTV protocol)
- receiver simply discards unwanted packets
- requires industry acceptance of ADTV packet approach

2) Space-Division Multiplex

- treat a single HDTV channel as a composite of 4 different NTSC pictures (like a quad-PIP)
- macroblock address (quadrant) determines sub-channel selection
- simple, but not desirable due to inefficiencies of motion coding at picture boundaries

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Conclusions

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Our Proposed Plan

- **Use related QAMs for cable and terrestrial**
  - 64-QAM (30 Mbps) for cable-only transmission
  - Twin-QAM for terrestrial broadcast and/or cable
  - receiver must detect which QAM it is receiving
  - basic capability already exists in ADTV modem

- **Use same FEC, packets, etc. for cable and terrestrial**
  - basic capability already exists in ADTV hardware

- **Build "16x9 NTSC-level" MPEG++ compression hardware for cable demonstrations ASAP**
  - show 4x3 extraction capability

- **Determine best approach to compression hierarchy through simulation, and introduce as updated ADTV**

- **Promote "forward-compatible" approach for 16x9 NTSC-quality today, ADTV tomorrow...**

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