

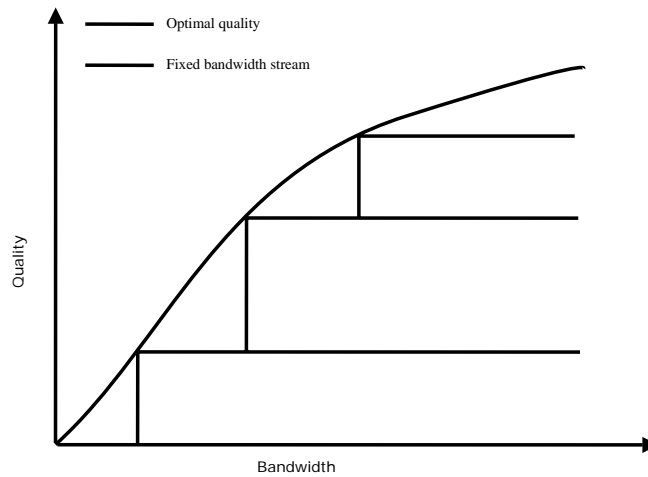
Scalable Video Codecs: SPEG and MPEG-4 FGS

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Why Scalable?

- Today: fixed rates
- Does not adapt to heterogenous networks and devices, or changes in the network environment
- Pseudo-scalable solutions with stream switching
- Coarse granularity
- We want optimal quality for any given bandwidth, at any time

Quality vs Bandwidth



Video Scalability Techniques

- SNR scalability
 - Layers have same frame rate and spatial resolution, but different quantization accuracy
- Temporal scalability
 - Layers have same spatial resolution but different frame rates
- Spatial scalability
 - Layers have same frame rate but different spatial resolutions

SPEG and MPEG-4 FGS

- Goal: Encode once, stream anywhere
- Both use same basic principle: partition data with bit-plane coding, then prioritize data
- Fine granularity
- Layers or hierarchy of data

SPEG

- Part of the QStream framework
- Simple implementation for testing purposes
- Based on MPEG (reversible)
- Only SNR scalability
- Hierarchy of layers, base layer and 3 enhancement layers
- Data is partitioned in units, and given priority

SPEG – Bit-Plane Coding

- Base layer is Most Significant Bit (MSB) to Least Significant Bit (LSB) minus 3, the rest are enhancement layers
- Strict hierarchy, lower levels need higher ones

MSB to LSB-3
LSB-2
LSB-1
LSB

MPEG-4 FGS

- One Base Layer (BL), one Enhancement Layer (EL) (variations are possible)
- Scales by truncating the bit-plane coded EL
- More efficient than SPEG, but more complex
- Supports temporal scalability, and hybrid temporal-SNR (FGST)
- F = FGS frame, T = FGST frame
 EL F T F T F T F
 |/ \|/ \|/ \| ...
 BL I - P - P - P

FGS Bit-Plane Coding

- *The values of the 8x8 DCT blocks are ordered into arrays by bit position*
- *4,0,1,2,3 (absolute)*
0,x,1,0,0 (sign)

1,0,0,0,0 (MSB)
0,0,0,1,1 (MSB-1)
0,0,1,0,1 (MSB-2)
- *Bit-planes are efficiently coded in the stream using variable-length code*

FGS Advanced Features

- Frequency weighting
 - Low frequency DCT coefficients are usually more important than high, and can be put earlier in the bitstream
- Selective enhancement
 - Important macro blocks can be bit-plane shifted
- Error resilience
 - Resynchronization markers to isolate errors
- More layers (i.e. separate for temporal and SNR)

References

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- “**FGS+: Optimizing The Joint SNR-Temporal Video Quality In MPEG-4 Fine Grained Scalable Coding**”, Raj Kumar Rajendran, Mihaela van der Schaar, Shih-Fu Chang