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## *An overview of Intraframe codecs*

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# Background (1/2)

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**Increasing interest in intra codec due to the following requirement in production:**

- Migration to Tapeless workflows implying file exchange
- Fast editing capability
- High quality requirement specially for HDTV
- Robustness to multigenerations
- Low coding latency for fast content backhauling during live events
- ...

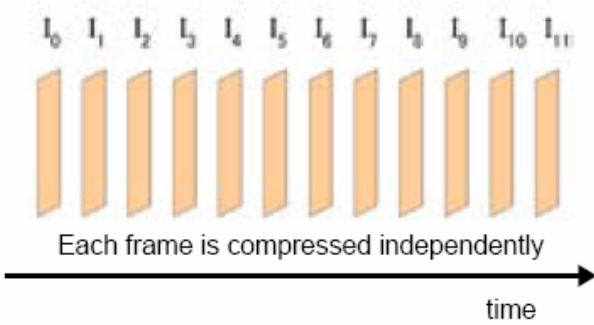
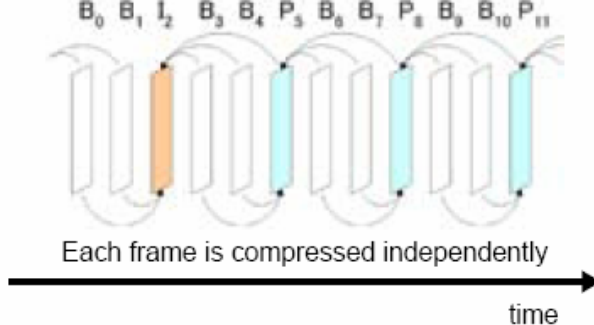
**Intra Coded pictures means compression based solely on the picture's self information.**

**Several technologies...**

- H.264/AVC-I
- JPEG2000
- Dirac



# Background (2/2)

	Intra-only compression		Long GOP compression	
Compression Scheme	<p>Individual frame</p>  <p>Each frame is compressed independently</p> <p style="text-align: center;">time →</p>		<p>Multiple frames (e.g. 15 frames)</p>  <p>Each frame is compressed independently</p> <p style="text-align: center;">time →</p>	
Bit rate saving	Smaller	Use spatial correlation only	Greater	Use spatial and temporal correlations
Processing delay	Smaller	1 frame	Greater	Multiple frames
Editing easiness	Easier	frame by frame	More Difficult	GOP
Multi-generation deterioration	Smaller	Intra structure	Greater	Long GOP structure
Error propagation	Smaller	Max. 1 frame	Greater	Multiple frames
Parallel processing	Easier	Max. 1 frame	More Difficult	Multiple frames

# H.264/AVC - I

## ISO 14996 – 1

### Intra Prediction mode of H.264/AVC system

- Restricted Slice type : I only
- Intra prediction only for macroblock sizes
  - 16x16, 4x4 or (8x8)
- Entropy coding
  - CAVLC or CABAC
    - CAVLC - Variable length coding – dictionary based coding – low complexity
    - CABAC – higher efficiency than CAVLC – higher complexity
- Follows AVC profiles and levels.



### AVC Intra – panasonic trademark for aquisition format

- Only implementation in use
- 2 Profiles
  - High quality HD - 100Mbps (1080i/25, 720p/50)
  - Economic HD - 50 Mbps (1440i/25 )
- Only using CAVLC for complexity issues



# JPEG2000

## ISO/IEC 15444-1

### Scalable wavelet based codec successor of JPEG.

#### Preprocessing

- Tiling of image
- Colour conversion to YCrCb
  - Reversible (RCT) integer coefficients.
  - Irreversible (ICT) normal RGB to YCbCr.

#### DWT – Discrete wavelet transform

- Set of low/high pass filters applied on the image resulting in subbands
  - 9/7 Lossy filters (floating point)
  - 5/3 lossless filter (integer )

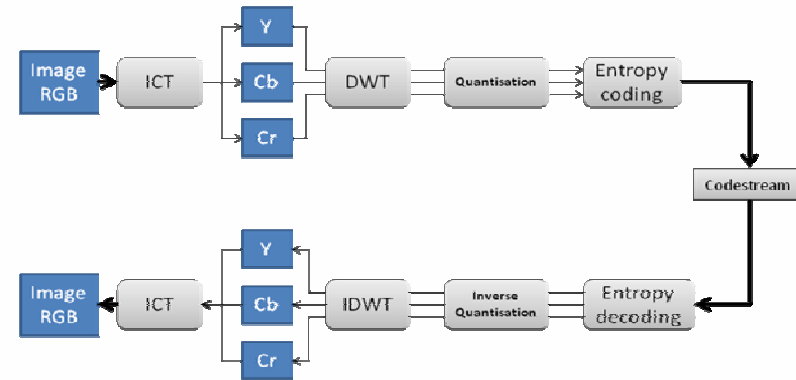
#### Quantization

#### Entropy coding

- Code-blocks : set of subband coefficients are encoded independently
  - Improving error resilience
- Context adaptive binary arithmetic coding (MQ coder) IPR free.

#### Bit Stream organisation

- Compressed data belonging to particular Resolution, component, quality layer is aggregated into packets.



# JPEG2000

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## Pros

- Scalable in Resolution, Quality, Component
  - *embed several spatially different streams in the same feed avoid simulcast.*
  - *Fast browsing of content*
- Strong error resillience of the codestream
  - *useful for backhauling of high quality content in error prone channels (e.g. wireless camera )*
- Strong sustainability to multigenerations
- High bit depth range *up to 16 bit but most systems up to 12.*
- I frame only – no interdependence between frames
  - *valuable for editing fast access to frames*
- Low latency
- Part – 1 of the standard IPR free – no license fees

## Cons

- Need very High bit rates to provide very good visual quality (over 80Mbps)
- Variability between implementation performances.



# Dirac Pro : An open source solution...

<http://www.bbc.co.uk/rd/projects/dirac/diracpro.shtml>

## SMPTE VC - 2

Mixing the advantages of the wavelet transform and motion compensation.

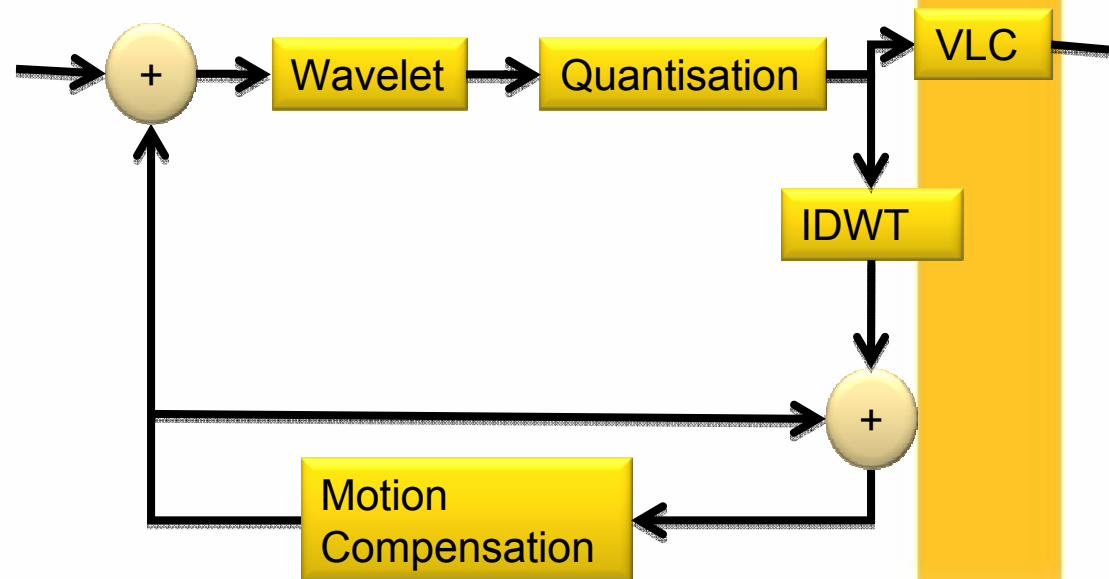
- Dirac Pro – Intra only – aimed at professional applications
- Dirac – aimed at distribution

Similar wavelet filters to JPEG2000

Developped by BBC Research.

Open Source.

Spatially scalable due to the wavelet.



# Dirac Pro: An open source solution ...

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## Pros

- Open source and License free – no commercial risk.
- Very low latency
  - *use variable length coding for entropy coding.*
- Support for 10 bit depth 4:2:2
- Product available (Hardware & software )
  - Handles formats from 720p/50, 1080i25, 1080p/50, to 4K. (Futureproof.)
- Lossless and visually lossless compression

## Cons

- No comparison with other systems made till now.





# Conclusion

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- **Rising interest in intraframe codecs**
  - Mainly used over high capacity links or intra facility as mezzanine codecs
- **JPEG2000 or Dirac provide additional features such as scalability**
- **Latency ( below a frame) may vary as a function of :**
  - Entropy coder in use (CAVLC vs CABAC)
  - Transform complexity
- **Operational rates too high for satellite contribution**
  - JPEG2000 > 80Mbps
  - AVC – Intra 100Mbps
  - Dirac - 270Mbps (at the moment)
- **No formal comparison between JPEG2000, AVC-I and Dirac done yet.**

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**Thank you**

