

# MPEG-4 AVC and Application

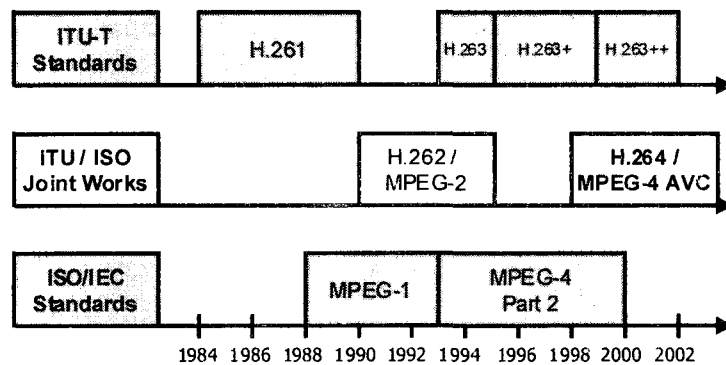
2004년 방송공학회 기술워크샵

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MPEG-4 AVC의 응용

## History: ITU/ISO video codec

- Timeline of video codec standards
- Collaboration of ITU and ISO



## History: MPEG-4 AVC schedule

- VCEG (video coding experts group)
  - Name for ITU-T Q.6/SG16
- JVT (Joint Video Team)
  - Name for ITU VCEG + ISO/IEC MPEG

Issue Call for Paper	Jan. 1998	Geneva, CH
Basic Feature Appearance	Nov. 1998	Seoul, KR
Basic Feature Adoption	Feb. 2000	Monterey, US
JVT Set-up	Nov. 2001	Pattaya, TH
FDIS	Mar. 2003	Pattaya, TH
Recommendation H.264	May 2003	Geneva, CH
FPDAM for FRExt	July 2004	Redmond, US

## Application

- Wireless/wired VOD
- File storage for video
- Video conferencing
- TV broadcasting and IP TV
  - DMB, DVB-H, ISDB-T
- High-density media storage
  - HD-DVD, BD-DVD

## Standardization and Licensing

- Standardized as
  - ISO/IEC 14496-10 Advanced Video Coding
  - ITU-T Recommendation H.264
- Licensing Pool<sup>[1]</sup>
  - VIA (<http://www.vialicensing.com>)
    - “Final” terms announced April 20, 2004
    - No fees for small deployments (<50k devices)
    - 0.25\$ per device for encoding and/or decoding
  - MPEG-LA (<http://www.mpegla.com>)
    - Preliminary terms announced Nov. 17, 2003
    - No fees for small deployments (<100k devices)
    - 0.20\$ per device for encoding and/or decoding

## MPEG-4 part.2 vs. MPEG-4 AVC

- Functional comparison

	H.264   MPEG-4 Part 10	MPEG-4 (part2)
Block size	4 x 4	8 x 8
Transform	Integer transform	Floating point
ME	VBS ¼ pel resolution	16x16 / 8x8, Half pel
VLC Table	EGC/CAVLC/CABAC	Separate Tables
Intra Prediction	Spatial Prediction	AC / DC Prediction
Residual Cod.	1-D Level / Position	3-D Run-Length

## MPEG-4 part.2 vs. MPEG-4 AVC

- Compression performance comparison [2]
  - In video streaming application (high performance)
  - In video conferencing application (low latency)

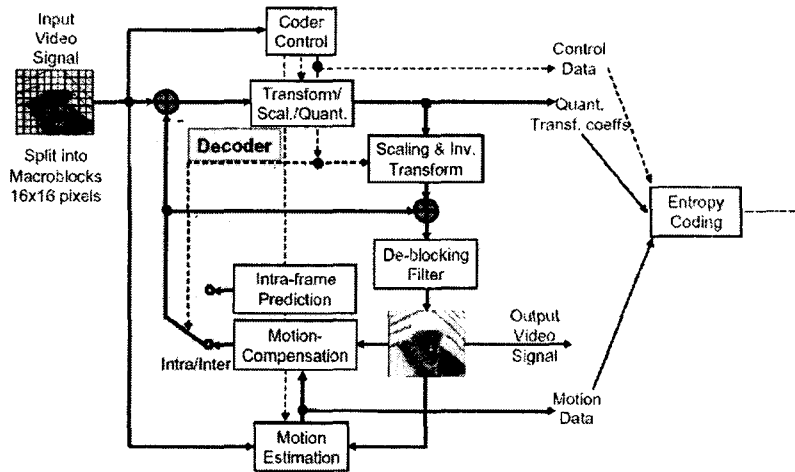
### In video streaming application

Codec	(B pictures used when in profile) Average rate savings relative to:		
	MPEG-4 ASP	H.263 HLP	MPEG-2
H.264/AVC	39%	49%	64%
MPEG-4 ASP	-	17%	43%
H.263 HLP High Latency Profile	-	-	31%

### In video conferencing application

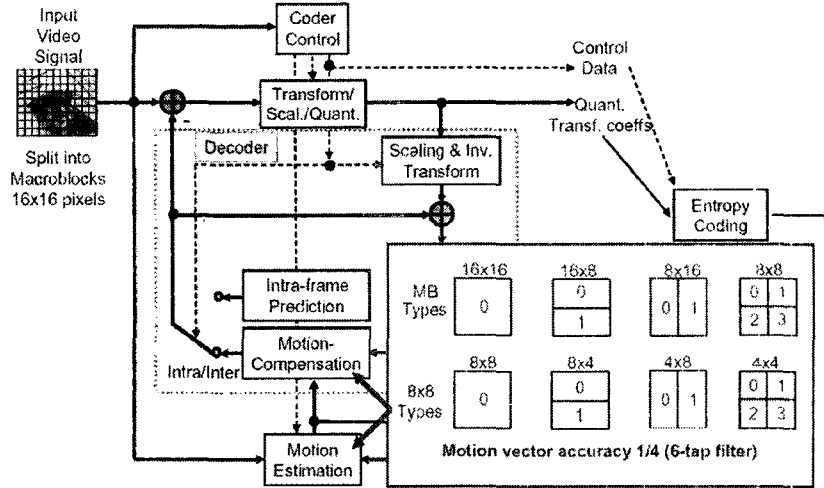
Codec	(No B pictures even if in profile) Average rate savings relative to:			
	MPEG-4 ASP	H.263 CHC	MPEG-4 SP	H.263 Base
H.264/AVC	28%	32%	34%	45%
MPEG-4 ASP	-	7%	10%	24%
H.263 CHC Optimized for High Compression	-	-	2%	18%
MPEG-4 SP	-	-	-	16%

## Coding structure [3]



## Improvement in motion compensation

- More accurate motion estimation

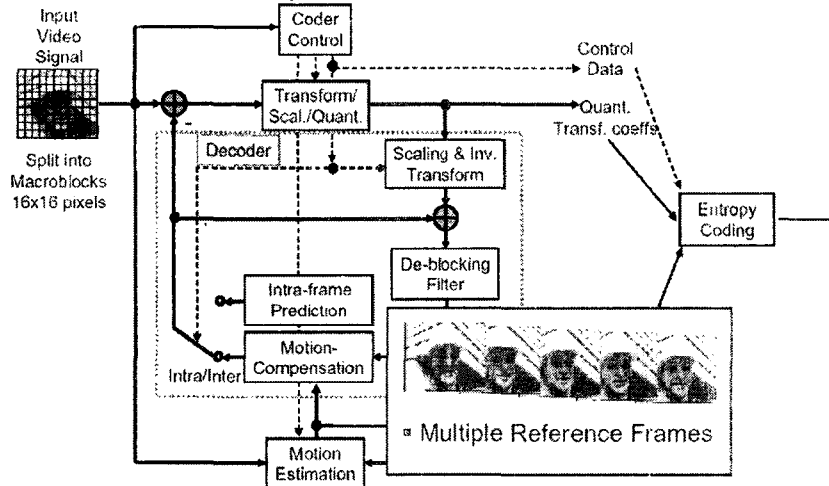


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## Multiple reference frame

- Pro: covered/uncovered, more accurate MC
- Con: too much memory, too slow encoder

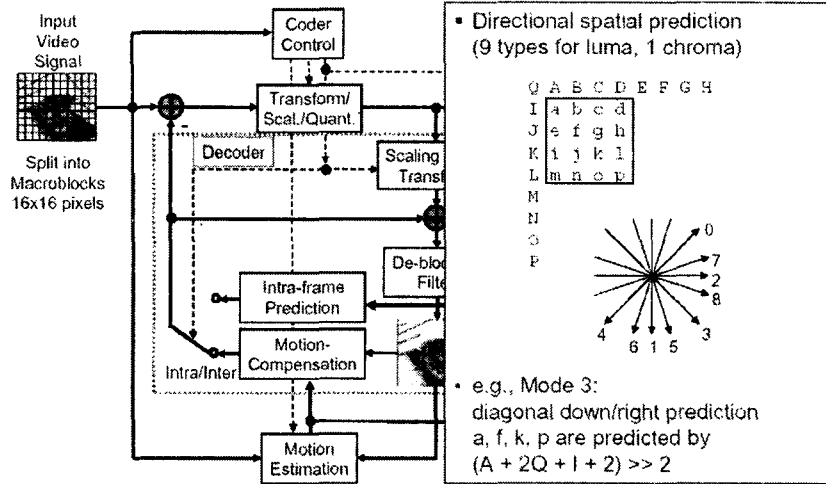


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## Improvement in intra prediction

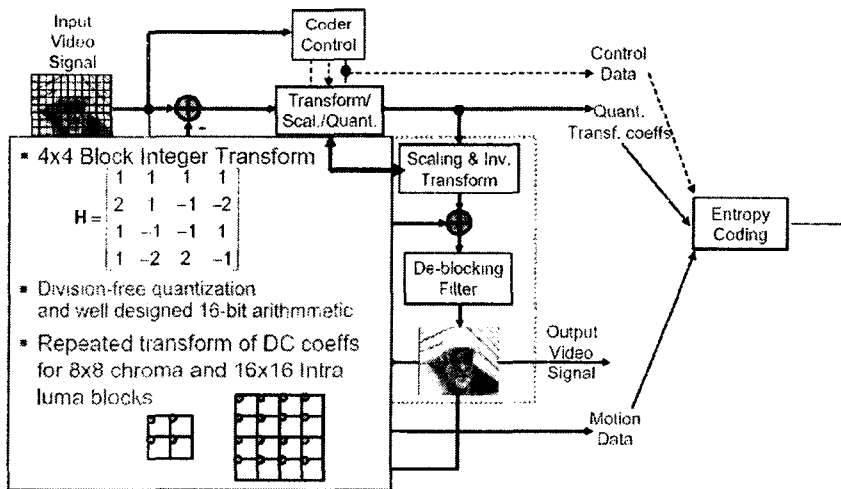
- More accurate spatial intra prediction



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## Improvement in transform and quant



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## improvement in variable length coding

- EGC + CAVLC
  - EGC (Exponential Golomb Code)
    - Almost syntax elements except residual data
    - Easy decoding with count-leading zero H/W
  - CAVLC (Context-based Adaptive Variable Length Coding)
    - reverse-order 1-D level and zero\_before coding
    - Covers wide range of compression ratio
    - Easy VLC code with leading-zero prefix and short suffix
- CABAC (Context Adaptive Binary Arithmetic Coding)
  - Very efficient compression scheme
  - Requires more computing power than CAVLC  
(However, the binarization of all the symbols makes CABAC feasible in real world)

## In-loop deblocking filter

- Gives better subjective and objective quality
- Prevents edges from propagating into blocks



## Error resilience

- Independent slice coding
- Data partitioning
- Flexible Macroblock ordering
- Redundant slices
- Smart referencing with multiple reference frames

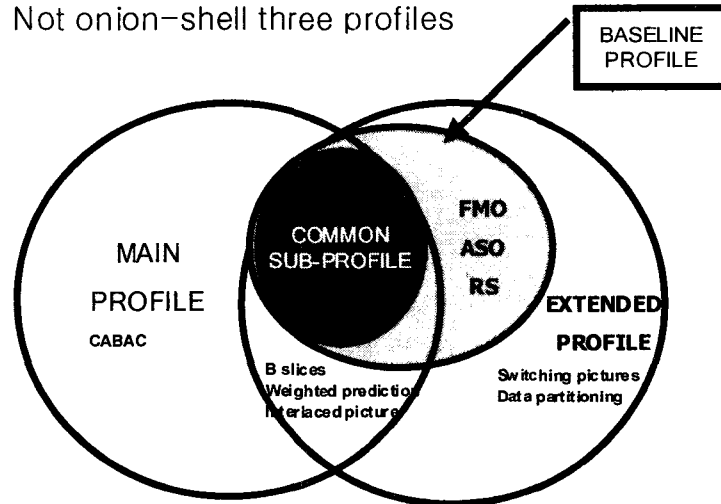
## NAL (Network Adaptation Layer)

- good to map H.264/AVC VCL data to transport layers such as:
  - RTP/IP conversational and streaming
  - File formats (E.g. MP4 file format for storage and MMS)
  - H.32X conversational services
  - MPEG-2 transport stream for broadcasting
- Packet-oriented abstraction layer
  - Excludes start code
  - H.264/AVC defines byte-steamed NALU



## Profile

- Not onion-shell three profiles



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## Other new techniques

- Improved skip and direct MB mode
- Decoupling display order and decoding order
- Weighted prediction
- Macroblock Adaptive Field/Frame selection
- Switching Picture

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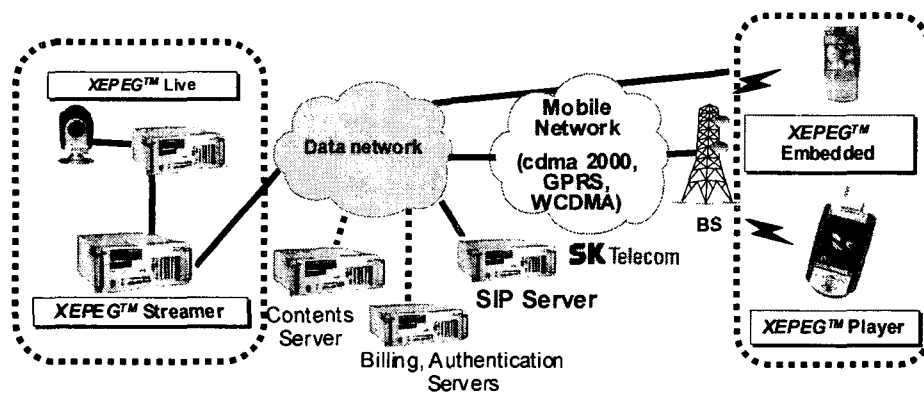
## FRExt (Fidelity Range Extension)

- completed in Redmond meeting, July, 2004.
- Supports more color format and sample precision
- Main profile + 8x8 transform + Q-weighting matrix
- Eager actions to be adopted in TV and Storage applications
- Adopted in HD-DVD and BD-DVD
- New profiles

Profile Name	Maximum Chroma Format	Maximum Sample Precision
"High" (HP)	4:2:0	8 bits
"High 10" (Hi10P)	4:2:0	10 bits
"High 4:2:2" (Hi422)	4:2:2	10 bits
"High 4:4:4" (Hi444)	4:4:4	12 bits

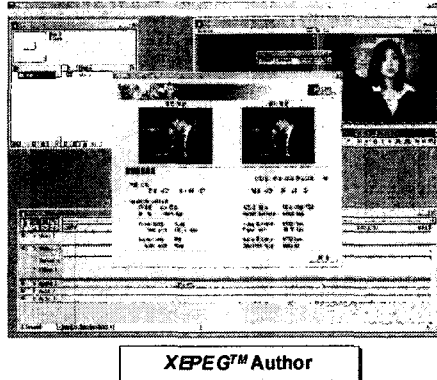
## Application: wireless/wired VOD/MMS

- Commercial VOD by SK Telecom in 1Q. 2004
- 3GPP Release 6 adopts H.264/AVC as optional



## Application: MPEG-4 AVC in file format

- Many vendors supply DirectShow filter for AVI
- ISO/IEC 14496-15 H.264 in MPEG-4 file format
- Many authoring tools are developed already

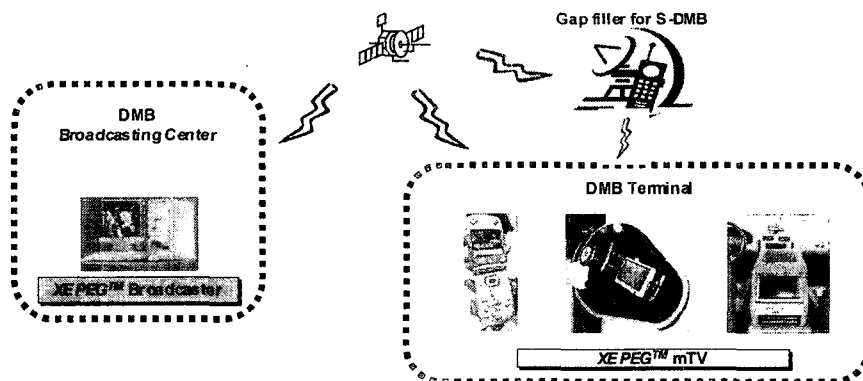


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## Application: Digital Mobile Broadcast

- Satellite DMB and Terrestrial DMB in Korea
- Baseline profile without FMO, ASO, and RS
- MPEG-2 Transport Stream and MPEG-4 Sync Layer

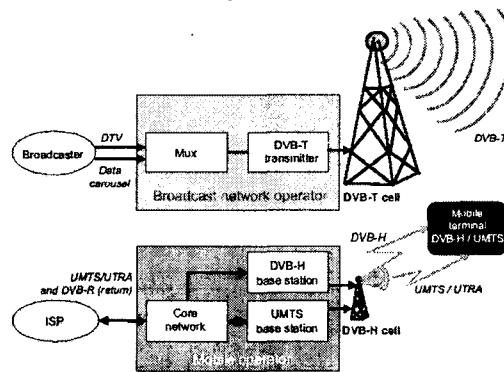


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## Application: TV broadcasting

- Japanese 6 broadcaster adopts H.264/AVC
- DVB-H (Handhelds) adopts H.264/AVC



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## Application: Next generation DVD

- HD(High Density)-DVD
  - Toshiba, NEC, and etc.
  - Approved by DVD Forum
  - Adopts H.264/AVC and VC-1 based on MS WMV9
- BD(Blue-ray Disc)-DVD
  - Developed by Blue-ray Disc Founders (Sony and etc.)
  - Adopts H.264/AVC FRExt and VC-1 based on MS WMV9

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## Application: Video conferencing

- 3GPP Release6 PSC (Packet Switched Conversational) adopts H.264/AVC as optional
- Many video conferencing systems are commercial
  - E.g. "iChat AV" in Mac Os X. adopts H.264/AVC



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## References

- [1] T. Wiegand et al., "Rate-Constrained Coder Control and Comparison of Video Coding Standards", IEEE Trans. Circuits Syst. Video Technol., Vol.13,NO.7,July 2003.
- [2] G. Sullivan, "Overview of Known H.264 / MPEG-4 pt. 10 / AVC Deployment Plans and Status", in JVT of ISO/IEC MPEG and ITU-T VCEG, July 2004, Docs. JVT-L009.
- [3] A. Smolic, "The Emerging H.264/AVC Video Coding Standard", <http://iphome.hhi.de/smolic/docs/Presentation%201%20-%20Aljoscha%20Smolic.pdf>

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