

**Video Compression and Communications:  
From Basics to H.261, H.263, H.264, MPEG2,  
MPEG4 for DVB and HSDPA-Style Adaptive  
Turbo-Transceivers**

by

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<sup>1</sup>For detailed contents and sample chapters please refer to <http://www-mobile.ecs.soton.ac.uk>

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## **Part I**

# **Video Codecs for HSDPA-Style Adaptive Videophones**

## **Part II**

# **High-Resolution Video Coding**



**Part III**

**H.261, H.263, H.264, MPEG2 and  
MPEG 4 for  
HSDPA-Style Wireless Video  
Telephony and DVB**

# Glossary

<b>16CIF</b>	Sixteen Common Intermediate Format Frames are sixteen times as big as CIF frames and contain 1408 pixels vertically and 1152 pixels horizontally
<b>2G</b>	Second generation
<b>3G</b>	Third generation
<b>3GPP</b>	Third Generation Partnership Project
<b>4CIF</b>	Four Common Intermediate Format Frames are four times as big as CIF frames and contain 704 pixels vertically and 576 pixels horizontally
<b>AB</b>	Access burst
<b>ACCH</b>	Associated control channel
<b>ACELP</b>	Algebraic Code Excited Linear Predictive (ACELP) Speech Codec
<b>ACF</b>	autocorrelation function
<b>ACL</b>	Autocorrelation
<b>ACO</b>	Augmented Channel Occupancy matrix, which contains the channel occupancy for the local and surrounding base stations. Often used by locally distributed DCA algorithms to aid allocation decisions.
<b>ACTS</b>	Advanced Communications Technologies and Services. The fourth framework for European research (1994–98). A series of consortia consisting of universities and industrialists considering future communications systems.
<b>ADC</b>	Analog-to-Digital Converter
<b>ADPCM</b>	Adaptive Differential Pulse Coded Modulation
<b>AGCH</b>	Access grant control channel
<b>AI</b>	Acquisition Indicator
<b>AICH</b>	Acquisition Indicator CHannel
<b>ANSI</b>	American National Standards Institute
<b>ARIB</b>	Association of Radio Industries and Businesses
<b>ARQ</b>	Automatic Repeat Request, Automatic request for retransmission of corrupted data
<b>ATDMA</b>	Advanced Time Division Multiple Access
<b>ATM</b>	Asynchronous Transfer Mode

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<b>AUC</b>	Authentication center
<b>AV.26M</b>	A draft recommendation for transmitting compressed video over error-prone channels, based on the H.263 [258] video codec
<b>AWGN</b>	Additive White Gaussian Noise
<b>B-ISDN</b>	Broadband ISDN
<b>BbB</b>	Burst-by-Burst
<b>BCCH</b>	Broadcast control channel
<b>BCH</b>	Bose-Chaudhuri-Hocquenghem, a class of forward error correcting codes (FEC)
<b>BCH Codes</b>	Bose-Chaudhuri-Hocquenghem (BCH) Codes
<b>BER</b>	Bit error rate, the fraction of the bits received incorrectly
<b>BN</b>	Bit number
<b>BPSK</b>	Binary Phase Shift Keying
<b>BS</b>	A common abbreviation for base station
<b>BSIC</b>	Base station identifier code
<b>BTC</b>	Block Truncation Coding
<b>CBER</b>	Channel bit error rate, the bit error rate before FEC correction
<b>CBP</b>	Coded block pattern, a H.261 video codec symbol that indicates which of the blocks in the macroblock are active
<b>CBPB</b>	A fixed-length codeword used by the H.263 video codec to convey the coded block pattern for bidirectionally predicted (B) blocks
<b>CBPY</b>	A variable-length codeword used by the H.263 video codec to indicate the coded block pattern for luminance blocks
<b>CC</b>	Convolutional Code
<b>CCCH</b>	Common control channel
<b>CCITT</b>	Now ITU, standardization group
<b>CCL</b>	Cross-correlation
<b>CD</b>	Code Division, a multiplexing technique whereby signals are coded and then combined in such a way that they can be separated using the assigned user signature codes at a later stage
<b>CDF</b>	Cumulative density function, the integral of the probability density function (PDF)
<b>CDMA</b>	Code Division Multiple Access
<b>CELL_BAR_ACCESS</b>	Boolean flag to indicate whether the MS is permitted
<b>CIF</b>	Common Intermediate Format Frames containing 352 pixels vertically and 288 pixels horizontally
<b>CIR</b>	Carrier to Interference Ratio, same as SIR
<b>COD</b>	A one-bit codeword used by the H.263 video codec that indicates whether the current macroblock is empty or nonempty
<b>CPICH</b>	Common Pilot Channel
<b>CT2</b>	British Second Generation Cordless Phone Standard
<b>CWTS</b>	China Wireless Telecommunication Standard
<b>DAB</b>	Digital Audio Broadcasting
<b>DAC</b>	Digital-to-Analog Converter

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<b>DAMPS</b>	Pan-American Digital Advanced Phone System, IS-54
<b>DB</b>	Dummy burst
<b>DC</b>	Direct Current, normally used in electronic circuits to describe a power source that has a constant voltage, as opposed to AC power in which the voltage is a sine wave. It is also used to describe things that are constant, and hence have no frequency component.
<b>DCA</b>	Dynamic Channel Allocation
<b>DCH</b>	Dedicated transport CHannel
<b>DCS1800</b>	A digital mobile radio system standard, based on GSM but operating at 1.8 GHz at a lower power
<b>DCT</b>	A discrete cosine transform that transforms data into the frequency domain. Commonly used for video compression by removing high-frequency components of the video frames
<b>DECT</b>	A Pan-European digital cordless telephone standard
<b>DL</b>	Down-link
<b>DPCCCH</b>	Dedicated Physical Control CHannel
<b>DPCH</b>	Dedicated Physical CHannel
<b>DPCM</b>	Differential Pulse Coded Modulation
<b>DPDCH</b>	Dedicated Physical Data CHannel
<b>DQUANT</b>	A fixed-length coding parameter used to differential change the current quantizer used by the H.263 video codec
<b>DS-CDMA</b>	Direct Sequence Code Division Multiple Access
<b>DSMA-CD</b>	Digital Sense Multiple Access-Collision Detection
<b>DTTB</b>	Digital Terrestrial Television Broadcast
<b>DVB-T</b>	Terrestrial Pan-European Digital Video Broadcast Standard
<b>EIR</b>	Equipment identity register
<b>EMC</b>	Electromagnetic Compatibility
<b>EOB</b>	An end-of-block variable-length symbol used to indicate the end of the current block in the H.261 video codec
<b>EREC</b>	Error-Resilient Entropy Coding. A coding technique that improves the robustness of variable-length coding by allowing easier resynchronization after errors
<b>ERPC</b>	Error-Resilient Position Coding, a relative of the coding scheme known as Error-Resilient Entropy Coding (EREC)
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EU</b>	European Union
<b>FA</b>	First Available, a simple centralized DCA scheme that allocates the first channel found that is not reused within a given preset reuse distance
<b>FACCH</b>	Fast associated control channel
<b>FACH</b>	Forward Access CHannel
<b>FAW</b>	Frame Alignment Word
<b>FBER</b>	Feedback error ratio, the ratio of feedback acknowledgment messages that are received in error
<b>FCA</b>	Fixed Channel Allocation

---

<b>FCB</b>	Frequency correction burst
<b>FCCH</b>	Frequency Correction Channel
<b>FD</b>	Frequency Division, a multiplexing technique whereby different frequencies are used for each communications link
<b>FDD</b>	Frequency-Division Duplex, a multiplexing technique whereby the forward and reverse links use a different carrier frequency
<b>FDM</b>	Frequency Division Multiplexing
<b>FDMA</b>	Frequency Division multiple access, a multiple access technique whereby frequency division (FD) is used to provide a set of access channels
<b>FEC</b>	Forward Error Correction
<b>FEF</b>	Frame Error Flag
<b>FER</b>	Frame error rate
<b>FH</b>	Frequency hopping
<b>FIFO</b>	First-In First-Out, a queuing strategy in which elements that have been in the queue longest are served first
<b>FN</b>	TDMA frame number
<b>FPLMTS</b>	Future Public Land Mobile Telecommunication System
<b>fps</b>	Frames per second
<b>FRAMES</b>	Future Radio Wideband Multiple Access System
<b>GBSC</b>	Group of blocks (GOB) start code, used by the H.261 and H.263 video codecs to regain synchronization, playing a similar role to PSC
<b>GEI</b>	Functions similar to PEI but in the GOB layer of the H.261 video codec
<b>GFID</b>	A fixed-length codeword used by H.263 video codec to aid correct resynchronization after an error
<b>GMSK</b>	Gaussian Mean Shift Keying, a modulation scheme used by the Pan-European GSM standard by virtue of its spectral compactness
<b>GN</b>	Group of blocks number, an index number for a GOB used by the H.261 and H.263 video codecs
<b>GOB</b>	Group of blocks, a term used by the H.261 and H.263 video codecs, consisting of a number of macroblocks
<b>GOS</b>	Grade of Service, a performance metric to describe the quality of a mobile radio network
<b>GP</b>	Guard Period
<b>GPS</b>	Global Positioning System
<b>GQUANT</b>	Group of blocks quantizer, a symbol used by the H.261 and H.263 video codecs to modify the quantizer used for the GOB
<b>GSM</b>	A Pan-European digital mobile radio standard, operating at 900MHz
<b>GSPARE</b>	Functions similar to PSPARE but in the GOB layer of the H.261 video codec
<b>H.261</b>	A video coding standard [257], published by the ITU in 1990
<b>H.263</b>	A video coding standard [258], published by the ITU in 1996
<b>HC</b>	Huffman Coding
<b>HCA</b>	Hybrid Channel Allocation, a hybrid of FCA and DCA
<b>HCS</b>	Hierarchical Cell Structure

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<b>HDTV</b>	High-Definition Television
<b>HLR</b>	Home location register
<b>HO</b>	Handover
<b>HTA</b>	Highest interference below Threshold Algorithm, a distributed DCA algorithm also known as MTA. The algorithm allocates the most interfered channel, whose interference is below the maximum tolerable interference threshold.
<b>IF</b>	Intermediate Frequency
<b>IMSI</b>	International mobile subscriber identity
<b>IMT-2000</b>	International Mobile Telecommunications-2000
<b>IMT2000</b>	Intelligent Mobile Telecommunications in the Year 2000, Japanese Initiative for 3rd Generation Cellular Systems
<b>IS-54</b>	Pan-American Digital Advanced Phone System, IS-54
<b>IS-95</b>	North American mobile radio standard, that uses CDMA technology
<b>ISDN</b>	Integrated Services Digital Network, digital replacement of the analogue telephone network
<b>ISI</b>	Intersymbol Interference, Inter-Subcarrier Interference
<b>ITU</b>	International Telecommunications Union, formerly the CCITT, standardization group
<b>ITU-R</b>	International Mobile Telecommunication Union – Radiocommunication Sector
<b>JDC</b>	Japanese Digital Cellular Standard
<b>JPEG</b>	“Lossy” DCT-based Still Picture Coding Standard
<b>LFA</b>	Lowest Frequency below threshold Algorithm, a distributed DCA algorithm that is a derivative of the LTA algorithm, the difference being that the algorithm attempts to reduce the number of carrier frequencies being used concurrently
<b>LIA</b>	Least Interference Algorithm, a distributed DCA algorithm that assigns the channel with the lowest measured interference that is available.
<b>LODA</b>	Locally Optimized Dynamic Assignment, a centralized DCA scheme, which bases its allocation decisions on the future blocking probability in the vicinity of the cell
<b>LOLIA</b>	Locally Optimized Least Interference Algorithm, a locally distributed DCA algorithm that allocates channels using a hybrid of the LIA and an ACO matrix
<b>LOMIA</b>	Locally Optimized Most Interference Algorithm, a locally distributed DCA algorithm that allocates channels using a hybrid of the MTA and an ACO matrix
<b>LP filtering</b>	Low-pass filtering
<b>LP-DDCA</b>	Local Packing Dynamic Distributed Channel Assignment, a locally distributed DCA algorithm that assigns the first channel available that is not used by the surrounding base stations, whose information is contained in an ACO matrix
<b>LPF</b>	Low-pass filter
<b>LSB</b>	Least significant bit
<b>LSR</b>	Linear Shift Register
<b>LTA</b>	Least interference below Threshold Algorithm, a distributed DCA algorithm that allocates the least interfered channel, whose interference is below a preset maximum tolerable interference level
<b>LTI</b>	Linear Time-invariant

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<b>MA</b>	Abbreviation for Miss America, a commonly used head and shoulders video sequence referred to as Miss America
<b>Macroblock</b>	A grouping of 8 by 8 pixel blocks used by the H.261 and H.263 video codecs. Consists of four luminance blocks and two chrominance blocks
<b>MAI</b>	Multiple Access Interference
<b>MAP</b>	Maximum–A–Posteriori
<b>MB</b>	Macroblock
<b>MBA</b>	Macroblock address symbol used by the H.261 video codec, indicating the position of the macroblock in the current GOB
<b>MBS</b>	Mobile Broadband System
<b>MC</b>	Motion Compensation
<b>MCBPC</b>	A variable-length codeword used by the H.263 video codec to convey the macroblock type and the coded block pattern for the chrominance blocks
<b>MCER</b>	Motion Compensated Error Residual
<b>MDM</b>	Modulation Division Multiplexing
<b>MF-PRMA</b>	Multi-Frame Packet Reservation Multiple Access
<b>MFlop</b>	Mega Flop, 1 million floating point operations per second
<b>MODB</b>	A variable-length coding parameter used by the H.263 video codec to indicate the macroblock mode for bidirectionally predicted (B) blocks
<b>MPEG</b>	Motion Picture Expert Group, also a video coding standard designed by this group that is widely used
<b>MPG</b>	Multiple Processing Gain
<b>MQANT</b>	A H.261 video codec symbol that changes the quantizer used by current and future macroblocks in the current GOB
<b>MS</b>	A common abbreviation for Mobile Station
<b>MSC</b>	Mobile switching center
<b>MSE</b>	Mean Square Error
<b>MSQ</b>	Mean Square centralized DCA algorithm that attempts to minimize the mean square distance between cells using the same channel
<b>MTA</b>	Most interference below Threshold Algorithm, a distributed DCA algorithm also known as HTA. The algorithm allocates the most interfered channel, whose interference is below the maximum tolerable interference level.
<b>MTYPE</b>	H.261 video codec symbol that contains information about the macroblock, such as coding mode, and flags to indicate whether optional modes are used, like motion vectors, and loop filtering
<b>MV</b>	Motion vector, a vector to estimate the motion in a frame
<b>MVD</b>	Motion vector data symbol used by H.261 and H.263 video codecs
<b>MVDB</b>	A variable-length codeword used by the H.263 video codec to convey the motion vector data for bidirectionally predicted (B) blocks
<b>NB</b>	Normal burst
<b>NCC</b>	Normalized Channel Capacity
<b>NLF</b>	Nonlinear filtering
<b>NMC</b>	Network management center

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<b>NN</b>	Nearest-Neighbor centralized DCA algorithm; allocates a channel used by the nearest cell, which is at least the reuse distance away
<b>NN+1</b>	Nearest-Neighbor-plus-one centralized DCA algorithm; allocates a channel used by the nearest cell, which is at least the reuse distance plus one cell radius away
<b>OFDM</b>	Orthogonal Frequency Division Multiplexing
<b>OMC</b>	Operation and maintenance center
<b>OVSF</b>	Orthogonal Variable Spreading Factor
<b>P-CCPCH</b>	Primary Common Control Physical CHannel
<b>PCH</b>	Paging CHannel
<b>PCM</b>	Pulse code modulation
<b>PCN</b>	Personal Communications Network
<b>PCPCH</b>	Physical Common Packet CHannel
<b>PCS</b>	Personal Communications System, a term used to describe third-generation mobile radio systems in North America
<b>PDF</b>	Probability Density Function
<b>PDSCH</b>	Physical Down-link Shared CHannel
<b>PEI</b>	Picture layer extra insertion bit, used by the H.261 video codec, indicating that extra information is to be expected
<b>PFU</b>	Partial Forced Update
<b>PGZ</b>	Peterson-Gorenstein-Zierler (PGZ) Decoder
<b>PHP</b>	Japanese Personal Handyphone Phone System
<b>PI</b>	Page Indicator
<b>PICH</b>	Page Indicator CHannel
<b>PLMN</b>	Public land mobile network
<b>PLMN_PERMITTED</b>	Boolean flag to indicate, whether the MS is permitted
<b>PLMR</b>	Public Land Mobile Radio
<b>PLR</b>	Packet-Loss Ratio
<b>PP</b>	Partnership Project
<b>PQUANT</b>	A fixed-length codeword used by the H.263 video codec to indicate the quantizer to use for the next frame
<b>PRACH</b>	Physical Random Access CHannel
<b>PRMA</b>	Packet Reservation Multiple Access, a statistical multiplexing arrangement contrived to improve the efficiency of conventional TDMA systems, by detecting inactive speech segments using a voice activity detector, surrendering them and allocating them to subscribers contending to transmit an active speech packet
<b>PRMA++</b>	PRMA System allowing contention only in the so-called contention slots, which protect the information slots from contention and collisions
<b>PSAM</b>	Pilot symbol-assisted modulation, a technique whereby known symbols (pilots) are transmitted regularly. The effect of channel fading on all symbols can then be estimated by interpolating between the pilots.
<b>PSC</b>	Picture start code, a preset sequence used by the H.261 and H.263 video codecs, that can be searched for to regain synchronization after an error
<b>PSD</b>	Power Spectral Density



<b>PSNR</b>	Peak Signal to Noise Ratio, noise energy compared to the maximum possible signal energy. Commonly used to measure video image quality
<b>PSPARE</b>	Picture layer extra information bits, indicated by a PEI symbol in H.261 video codec
<b>PSTN</b>	Public switched telephone network
<b>PTYPE</b>	Picture layer information, used by H.261 and H.263 video codecs to transmit information about the picture, e.g. Resolution, etc.
<b>QAM</b>	Quadrature Amplitude Modulation
<b>QCIF</b>	Quarter Common Intermediate Format Frames containing 176 pixels vertically and 144 pixels horizontally
<b>QMF</b>	Quadrature Mirror Filtering
<b>QN</b>	Quater bit number
<b>QoS</b>	Quality of Service
<b>QT</b>	Quad-Tree
<b>RACE</b>	Research in Advanced Communications Equipment Programme in Europe, from June 1987 to December 1995
<b>RACH</b>	Random Access CHannel
<b>RC filtering</b>	Raised-cosine filtering
<b>RF</b>	Radio frequency
<b>RFCH</b>	Radio frequency channel
<b>RFN</b>	Reduced TDMA frame number in GSM
<b>RING</b>	A centralized DCA algorithm that attempts to allocate channels in one of the cells, which is at least the reuse distance away that forms a "ring" of cells
<b>RLC</b>	Run-Length Coding
<b>RPE</b>	Regular pulse excited
<b>RS Codes</b>	Reed-Solomon (RS) codes
<b>RSSI</b>	Received Signal Strength Indicator, commonly used as an indicator of channel quality in a mobile radio network
<b>RTT</b>	Radio Transmission Technology
<b>RXLEV</b>	Received signal level: parameter used in handovers
<b>RXQUAL</b>	Received signal quality: parameter used in handovers
<b>S-CCPCH</b>	Secondary Common Control Physical CHannel
<b>SAC</b>	Syntax-based arithmetic coding, an alternative to variable-length coding, and a variant of arithmetic coding
<b>SACCH</b>	Slow associated control channel
<b>SB</b>	Synchronization burst
<b>SCH</b>	Synchronization CHannel
<b>SCS</b>	Sequential Channel Search distributed DCA algorithm that searches the available channels in a predetermined order, picking the first channel found, which meets the interference constraints
<b>SDCCH</b>	Stand-alone dedicated control channel
<b>SF</b>	Spreading Factor

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<b>SINR</b>	Signal-to-Interference plus Noise ratio, same as signal-to-noise ratio (SNR) when there is no interference.
<b>SIR</b>	Signal-to-Interference ratio
<b>SNR</b>	Signal-to-Noise Ratio, noise energy compared to the signal energy
<b>SPAMA</b>	Statistical Packet Assignment Multiple Access
<b>SQCIF</b>	Sub-Quarter Common Intermediate Format Frames containing 128 pixels vertically and 96 pixels horizontally
<b>SSC</b>	Secondary Synchronization Codes
<b>TA</b>	Timing advance
<b>TB</b>	Tailing bits
<b>TC</b>	Trellis Coded
<b>TCH</b>	Traffic channel
<b>TCH/F</b>	Full-rate traffic channel
<b>TCH/F2.4</b>	Full-rate 2.4 kbps data traffic channel
<b>TCH/F4.8</b>	Full-rate 4.8 kbps data traffic channel
<b>TCH/F9.6</b>	Full-rate 9.6 kbps data traffic channel
<b>TCH/FS</b>	Full-rate speech traffic channel
<b>TCH/H</b>	Half-rate traffic channel
<b>TCH/H2.4</b>	Half-rate 2.4 kbps data traffic channel
<b>TCH/H4.8</b>	Half-rate 4.8 kbps data traffic channel
<b>TCM</b>	Trellis code modulation
<b>TCOEFF</b>	An H.261 and H.263 video codec symbol that contains the transform coefficients for the current block
<b>TD</b>	Time Division, a multiplexing technique whereby several communications links are multiplexed onto a single carrier by dividing the channel into time periods, and assigning a time period to each communications link
<b>TDD</b>	Time-Division Duplex, a technique whereby the forward and reverse links are multiplexed in time.
<b>TDMA</b>	Time Division Multiple Access
<b>TFCI</b>	Transport-Format Combination Indicator
<b>TIA</b>	Telecommunications Industry Association
<b>TN</b>	Time slot number
<b>TPC</b>	Transmit Power Control
<b>TR</b>	Temporal reference, a symbol used by H.261 and H.263 video codecs to indicate the real-time difference between transmitted frames
<b>TS</b>	Technical Specifications
<b>TTA</b>	Telecommunications Technology Association
<b>TTC</b>	Telecommunication Technology Committee
<b>TTIB</b>	Transparent tone in band
<b>UHF</b>	Ultra high frequency
<b>UL</b>	Up-link

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<b>UMTS</b>	Universal Mobile Telecommunications System, a future Pan-European third-generation mobile radio standard
<b>UTRA</b>	Universal Mobile Telecommunications System Terrestrial Radio Access
<b>VA</b>	Viterbi Algorithm
<b>VAD</b>	Voice activity detection
<b>VAF</b>	Voice activity factor, the fraction of time the voice activity detector of a speech codec is active
<b>VE</b>	Viterbi equalizer
<b>VL</b>	Variable length
<b>VLC</b>	Variable-length coding/codes
<b>VLR</b>	Visiting location register
<b>VQ</b>	Vector Quantization
<b>W-CDMA</b>	Wideband Code Division Multiple Access
<b>WARC</b>	World Administrative Radio Conference
<b>WATM</b>	Wireless Asynchronous Transfer Mode (ATM)
<b>WLAN</b>	Wireless Local Area Network
<b>WN</b>	White noise
<b>WWW</b>	World Wide Web, the name given to computers that can be accessed via the Internet using the HTTP protocol. These computers can provide information in a easy-to-digest multimedia format using hyperlinks.

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