H.264 MAIN PROFILE DECODER (v1.10) on C64x+

FEATURES

- **eXpressDSP™ Algorithm Interface Standard (XDAIS)compliant**
- **eXpressDSP Digital Media (XDM) Interface compliant**
- **Validated on the DM6446 EVM**
- **Up to level 3.0 features of the main profile (MP)supported**
- **Progressive, interlaced, Picture Adaptive Frame Field (PicAFF), and Macroblock Adaptive Frame Field (MBAFF) type picture decoding supported**
- **Multiple slices and multiple reference frames supported**
- **CAVLC and CABAC decoding supported**
- **All intra-prediction and inter-prediction modes supported**
- **Up to 16 MV per MB supported**
- **Frame based decoding supported**
- **Frame size being non-multiples of 16 through frame cropping supported**
- **Frame width of the range of 32 to 720 pixels supported**
- **Byte-stream syntax for the input bit stream supported**
- **Parsing of Supplemental Enhancement Information (SEI) and Video Usability Information (VUI)supported**
- **Long term reference frame and adaptive reference picture marking supported**
- **Reference picture list reordering supported**
- **Gaps in the frame number supported**
- **Decoding of streams with IPCM coded macroblocks supported**
- **Skipping of non reference pictures supported**
- **Configurable delay for display of frames supported**
- **Basic error concealment features supported**
- **Outputs are available in YUV 420 planar and 422 interleaved little endian formats**
- **Tested for compliance with JM version 11.0 reference decoder**
- **Dynamic change in the frame size (ability to decode different frame sizes present in the very same stream) supported**
- **Allegro test suites (non HD streams) fully compliant**

DESCRIPTION

H.264 (from ITU-T, also called as H.264/AVC) is a popular video coding algorithm enabling high quality multimedia services on a limited bandwidth network. H.264 standard defines several profiles and levels that specify restrictions on the bit stream and hence limits the capabilities needed to decode the bit streams. Each profile specifies a subset of algorithmic features and limits that all decoders conforming to that profile may support. Each level specifies a set of limits on the values that may be taken by the syntax elements in that profile.

PRODUCT PREVIEW

Performance Summary

This section describes the performance of the H.264 main profile decoder.

Table 1. Configuration Table

CONFIGURATION	ID
Level 3.0 Main Profile	H264MP_DEC_001

Table 2. Cycles Information – Profiled on DM6446 EVM with Code Generation Tools Version 6.0.7 and H264MP_DEC_001 configuration

MODE	PERFORMANCE STATISTICS(1) (IN MEGA CYCLES PER SECOND)(2)		
	TEST DESCRIPTION	AVERAGE(3)	PEAK(4)
Progressive	D1p25_parkrun_420p_IBBP_CABAC_16mv_Progr_2Mbps.264	370.17	392.64
	D1p25_parkrun_420p_IBBP_CABAC_4mv_Progr_2Mbps.264	358.31	380.36
	D1p25_parkrun_420p_IBBP_CAVLC_4mv_Progr_2Mbps.264	292.29	301.09
	D1p25_parkrun_420p_IPP_CABAC_4mv_Progr_2Mbps.264	337.47	361.45
	D1p25_parkrun_420p_IPP_CAVLC_4mv_Progr_2Mbps.264	261.55	272.2
Interlaced	football_p704x480_IBBP_CABAC_16mv_Intlcd_2Mbps.264	370.06	457.66
	football_p704x480_IBBP_CABAC_4mv_Intlcd_2Mbps.264	369.02	456.14
	football_p704x480_IBBP_CAVLC_4mv_Intlcd_2Mbps.264	287.64	339.49
	football_p704x480_IPP_CABAC_16mv_Intlcd_2Mbps.264	377.68	402.09
	football_p704x480_IPP_CABAC_4mv_Intlcd_2Mbps.264	373.6	399.57
	football_p704x480_IPP_CAVLC_4mv_Intlcd_2Mbps.264	284.65	298.94
Mbaff	football_p704x480_IBBP_CABAC_16mv_mbaff_2Mbps.264	448	477.1
	football_p704x480_IBBP_CABAC_4mv_mbaff_2Mbps.264	444.87	468.59
	football_p704x480_IBBP_CAVLC_4mv_mbaff_2Mbps.264	371.23	388.89
	football_p704x480_IPP_CABAC_16mv_mbaff_2Mbps.264	455.64	481.15
	football_p704x480_IPP_CABAC_4mv_mbaff_2Mbps.264	447.82	469.05
	football_p704x480_IPP_CAVLC_4mv_mbaff_2Mbps.264	361.31	378.07
Progressive	D1p25_parkrun_420p_IBBP_CABAC_16mv_Progr_3Mbps.264	415.37	431.3
	D1p25_parkrun_420p_IBBP_CABAC_4mv_Progr_3Mbps.264	395.72	412.25
	D1p25_parkrun_420p_IBBP_CAVLC_4mv_Progr_3Mbps.264	309.46	319.98
	D1p25_parkrun_420p_IPP_CABAC_4mv_Progr_3Mbps.264	386.08	395.96
	D1p25_parkrun_420p_IPP_CAVLC_4mv_Progr_3Mbps.264	286.17	291.27
Interlaced	football_p704x480_IBBP_CABAC_16mv_Intlcd_3Mbps.264	411.44	603.42
	football_p704x480_IBBP_CABAC_4mv_Intlcd_3Mbps.264	409.91	598.72
	football_p704x480_IBBP_CAVLC_4mv_Intlcd_3Mbps.264	307.13	378.97
	football_p704x480_IPP_CABAC_16mv_Intlcd_3Mbps.264	421.09	460.29
	football_p704x480_IPP_CABAC_4mv_Intlcd_3Mbps.264	414.68	456.39
	football_p704x480_IPP_CAVLC_4mv_Intlcd_3Mbps.264	299.93	329.68
Mbaff	football_p704x480_IBBP_CABAC_4mv_mbaff_3Mbps.264	530.16	572.36
	football_p704x480_IBBP_CAVLC_4mv_mbaff_3Mbps.264	397.96	432.72
	football_p704x480_IPP_CABAC_4mv_mbaff_3Mbps.264	471.88	497.31
	football_p704x480_IPP_CAVLC_4mv_mbaff_3Mbps.264	372.11	386.54

(1) There could be a variation of 1-2% in the values
(2) Measured with program memory, stack, and I/O buffers in external memory and with cache configuration: 32K-bytes L1P cache, 64K-bytes L1D data memory, 16K-bytes L1D cache, 64K-bytes L2 cache and use of 69K-bytes of VICP memory, DDR speed at 162 MHz, CPU speed at 486 MHz
(3) Based on average number of cycles per frame @ 30 frames per second (fps)
(4) Based on worst-case cycles averaged over 6 frames @ 30 fps

Table 2. Cycles Information – Profiled on DM6446 EVM with Code Generation Tools Version 6.0.7 and H264MP_DEC_001 configuration (continued)

MODE	PERFORMANCE STATISTICS(1) (IN MEGA CYCLES PER SECOND)(2)		
	TEST DESCRIPTION	AVERAGE(3)	PEAK(4)
Progressive	D1p25_parkrun_420p_IBBP_CABAC_16mv_Progr_4Mbps.264	457.26	491.01
	D1p25_parkrun_420p_IBBP_CABAC_1mv_Progr_4Mbps.264	401.77	423.32
	D1p25_parkrun_420p_IBBP_CAVLC_1mv_Progr_4Mbps.264	308.73	319.34
	D1p25_parkrun_420p_IPP_CABAC_1mv_Progr_4Mbps.264	400.31	406.79
	D1p25_parkrun_420p_IPP_CAVLC_1mv_Progr_4Mbps.264	291.26	295.25
Interlaced	football_p704x480_IBBP_CABAC_1mv_Intlcd_4Mbps.264	417.39	607.08
	football_p704x480_IBBP_CAVLC_1mv_Intlcd_4Mbps.264	302.16	384.11
	football_p704x480_IPP_CABAC_1mv_Intlcd_4Mbps.264	441.24	493.01
	football_p704x480_IPP_CAVLC_1mv_Intlcd_4Mbps.264	317.59	337.32
Mbaff	football_p704x480_IBBP_CABAC_4mv_mbaff_4Mbps.264	509.61	537.68
	football_p704x480_IBBP_CAVLC_4mv_mbaff_4Mbps.264	417.8	449.08
	football_p704x480_IPP_CABAC_4mv_mbaff_4Mbps.264	500.26	545.7
	football_p704x480_IPP_CAVLC_4mv_mbaff_4Mbps.264	395.65	413.72

Table 3. Memory Statistics - Generated With Code Generation Tools Version 6.0.7

CONFIGURATION ID	MEMORY STASTICS(1)				TOTAL
	PROGRAM MEMORY	DATA MEMORY			
		INTERNAL	EXTERNAL	STACK	
H264MP_DEC_001	492	62	7600	24	8100

(1) All memory requirements are expressed in kilobytes (1K-byte = 1024 bytes) and there could be a variation of approximately 1-2% in values

Table 4. Internal Data Memory Split-up

CONFIGURATION ID	DATA MEMORY - INTERNAL(1)		
	SHARED		INSTANCE(2)
	CONSTANTS	SCRATCH	
H264MP_DEC_001	0	62 (L1D)	0

(1) Internal memory refers to L1D RAM. All memory requirements are expressed in kilobytes and there could be a variation of approximately 1-2% in values.
(2) I/O buffers not included. Some of the instance memory buffers could be scratch.

Notes

- Evaluation version performance values may be higher than the values specified in the performance table.
- Display buffer for YUV422 interleaved format is 810K-bytes for 625SD format (720 x 576)
- Input buffer to algorithm is assumed to have at least one encoded frame data. Maximum input buffer size for input bitstream allowed is 640K-bytes.
- Memory configuration
  - L1P : 32K-bytes program cache
  - L1D : 64K-bytes data memory and 16K-bytes data cache
  - L2 : 64K-bytes cache
  - VICP: 69K-bytes (2 sections of program memory)
- Algorithm requests L1D data memory as 'DARAM0'.
- The performance values obtained in Table 2 are sensitive to algorithm code placement. Refer the sample linker file provided in the test application setup for algorithm code placement. This is used for profiling in Table 2. Some of the code is placed in VICP memory, as specified in linker file.
- The algorithm uses 4 QDMA channels. One channel uses 24 linked transfers and all other channels use up to a maximum of 8 linked transfers. The algorithm uses DMAN3 interface for logical allocation of these channels.
- The algorithm uses the same amount of internal and external memory for all picture resolutions.
- Total data memory for N non pre-emptive instances = Constants + Runtime Tables + Scratch + N*(Instance + I/O buffers + Stack)
- Total data memory for N pre-emptive Instances = Constants + Runtime Tables + N*(Instance + I/O buffers + Stack + Scratch)

References

- ISO/IEC 14496-10:2005 (E) Rec. - Information technology - Coding of audio-visual objects - H.264 (E) ITU-T Recommendation.
- *H.264 Main Profile Decoder User Guide* (literature number SPRUEB0A)

Glossary

Term	Description
Constants	Elements that go into .const memory section
Scratch	Memory space that can be reused across different instances of the algorithm or across different algorithms
Shared	Sum of Constants and Scratch
Instance	Memory that contains persistent information - allocated for each instance of the algorithm

Acronyms

Acronym/Abbreviation	Description
625SD	Level 3.0 maximum resolution format size 720 x 576
CIF	Common intermediate format
CPB	Coded picture buffer
DMA	Direct memory access
DMAN3	DMA manager
EVM	Evaluation module
QCIF	Quarter common intermediate format
QDMA	Quick direct memory access
SDTV	Standard definition television
VGA	Video graphics array (640 x 480 resolution)
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media

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