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Embedded Solutions

1.1 H.264 Video Decoder Development

Project Highlights:

- Fully Compliant with Baseline profile of MPEG-4 Part 10/H.264(14496- Sub Part 10) video decoder.
- Passed all the conformance test cases provided by the JVT group for Baseline profile.
- Ready to port to DSP's/GPP's with faster time to market.

Project Details:

Duration of the Project	5 Months
Project Size	15 person Months
Team Size	3
Language	MFC, ANSI C Reference Implementation
Tools Used	MFC, Visual Studio C++, In-house batch Files

Business Challenges/Needs:

This solution is the in-house development on the video compression area to create the necessary components for the embedded group's vision and also creating a skilled work force to meet the future technical expertise requirement to serve the customer with quality work. The next step in the organizations goal in the video coding technology is in the Scalable Video Coding part of the H.264 standard for the next generation solutions and Main profile codec development for the high end consumer solutions.

Solution:

H.264 video standard is previously known as H.26L, was initially started by ITU-T VCEG in 1998. In 2001, VCEG and ISO MPEG established the Joint Video Team (JVT) to take the responsibility of developing it into a standard. The standard is now finished and called officially Advanced Video Coding (AVC), also known as ITU-T H.264 and ISO MPEG-4 part 10. The main objective of the H.264 was to improve coding performance and efficiency with a simple syntax specification. The basic video coding approach used in H.264 is very similar to that adopted in previous standards, such as H.263. However, new features and enhanced prediction methods make it able to provide low bit rate, low coding delay and high complexity video coding. H.264 can be applied in a variety of video applications: internet video streaming, mobile video, high definition TV, video storage on DVD and so on. The standardization is going on for the scalable profile of the H.264 . In TECLVER, the decoder development for this codec is visualized and underdevelopment.

The following are the key features of the solution on the H.264 video decoding

- Fully Compliant with Baseline profile of MPEG-4 Part 10/H.264(14496- Sub Part 10) video decoder.
- Passed all the conformance test cases provided by the JVT group for Baseline profile.
- Supports all the error resilience tools Flexible Macroblock Ordering(FMO), Arbitrary Slice Ordering(ASO) and Redundant Slices(RS)
- Reference C implementation fully compliant with ANSI C standard
- Supports Multiple reference frame decoding
- Supports Variable block size inter prediction
- Efficient implementation of De-blocking filter.
- Optimized for both speed and memory.
- Ready to port to DSP's/GPP's with faster time to market.
- Fully re-entrant to support multi channel operations.

1.2 MPEG-4 AAC Audio Decoder Development

Project Highlights:

- Fully Compliant with MPEG-4 Part 3 Advanced Audio Coding standard compliance Decoder.
- Passed all the conformance test cases provided by the standardization group.
- Ready to port to DSP's/GPP's with faster time to market [Fixed point version of the codec are available].

Project Details:

Duration of the Project	6 Months
Project Size	20 person Months
Team Size	3
Language	MFC
Tools Used	MFC, Visual Studio C++, In-house batch Files

Business Challenges/Needs:

This solution is the in-house development on the multimedia- audio codec technology to create the necessary components for the embedded group's vision and also creating a skilled work force to meet the future technical expertise requirement to serve the customer with quality work. The continuation of this project is HE-AAC and the development and it is currently in progress.

Solution:

MPEG-4 Part 3 standard is called Advanced Audio Coding (AAC) audio. The conformance bit streams are specified in MPEG-4 Part 5. A notable addition in this version of the standard compare to the MPEG-2 AAC is Perceptual Noise Substitution (PNS). HE-AACv1 (AAC with SBR) was first standardized in ISO/IEC 14496-3:2001/Amd.1. HE-AAC v2 (AAC with Parametric Stereo)

was first specified in ISO/IEC 14496-3:2001/Amd.4. AacPlus v2 is also standardized by ETSI (European Telecommunications Standards Institute) as TS 102005.[2]

The following are the features of the AAC codec compare to the previously vilely available MP3 codec

- More sample frequencies (from 8 kHz to 96 kHz) than MP3 (16 kHz to 48 kHz)
- Up to 48 channels (MP3 supports up to two channels in MPEG-1 mode and up to 5.1 channels in MPEG-2 mode)
- Arbitrary bitrates and variable frame length. Standardized constant bit rate with bit reservoir.
- Higher efficiency and simpler filter bank (hybrid → pure MDCT)
- Higher coding efficiency for stationary signals (block size: 576 → 1024 samples)
- Higher coding efficiency for transient signals (block size: 192 → 128 samples)
- Can use Kaiser-Bessel derived window function to eliminate spectral leakage at the expense of widening the main lobe
- Much better handling of audio frequencies above 16 kHz
- More flexible joint stereo (separate for every scale band)
- Adds additional modules (tools) to increase compression efficiency: TNS, Backwards Prediction, PNS etc.

The following are the key features of the solution on the audio decoding

- MPEG-4 AAC audio decoder 'C' Reference Development
- Development from Scratch – to enable Modular and Optimized solution in terms of Memory and performance
- Fully Re-entrant design to have multi channel application
- Extending the development to SBR and parametric audio decoder.
- Porting to chosen DSP to address the market ready solution

1.3 WiMax Physical and MAC layer development

Project Highlights:

The following are the some of the key features of the Mobile WiMax CPE solution.

- First version of the case study is targeted for 5 Mbps downlink and 2Mbps uplink data rates with 5MHZ channel bandwidth.

- PUSC and AMC permutation modes will be supported in the first release.
- Advanced multiple input multiple output antenna techniques for better carrier-to noise ratio and high data throughput. (Beam forming and Diversity techniques).

Project Details:

The following are the proposed WiMax CPE requirements planned for the first release. Most of the optional and advanced features are not included in this release. These features will be updated after the first release.

Sl.No	System Requirement	Downlink	Uplink	Remarks
1	Data Rate	5Mbps	2Mbps	
2	Permutation mode	AMC,PUSC	AMC,PUSC	
3	Modulation and Encoding Types			
	Modulation	QPSK QAM16 QAM64	QPSK QAM16 QAM64	
	Encoding	CC,CTC	CC,CTC	
	Rate	½,2/3,3/4	½,2/3,3/4	
	Constraint length (K)	7	7	
4	Frame Period	5ms		
5	Fast feedback demodulation	CINR reporting, CQICH, No ARQ and No HARQ		Planned for Release 2
6	Power Control	Closed loop	Active and passive open and closed loop	Planned for Release 2
7	OFDMA Frame Formation			
	Sampling Frequency(Fs)	5.6 MHz		
	Channel Bandwidth(BW)	5 MHz		
	FFT length(N_{FFT})	512		
	Subcarrier spacing (BW/N_{FFT})	10.9375 KHz		
	Cyclic prefix(G)	1/8		
	Useful Symbol Time (T_u)	91.42857 µsec		
	Cyclic prefix time ($T_g = G * T_u$)	11.42857 µsec		
	Total Symbol Duration ($T_s = T_g + T_u$)	102.85714µsec		
	Physical Slot (PS) PS = 4/Fs	0.7142857µsec		
	No.of PS in One Symbol (T_s/PS)	144		
	No.of PS in 5msec frame (0.005/PS)	7000		
	Total No.of Symbols in a TDD frame	47		

		(6768 PS)		
	RTG in PS	100		
	TTG in PS	132		
	TDD (Symbols)	24 32 36	23 15 11	
8	Diversity	Not supported	Not supported	
9	STC	Not supported	Not supported	
10	Handoff	Not supported	Not supported	
11	Ranging capabilities			Complete MAC layer Network entry process supported
	Initial Ranging			
	Periodic Ranging			
	No. of CDMA code supported	256		
12	IP connectivity			MAC layer protocols required to establish IP connectivity

Business Challenges/Needs:

The Communication team is currently working on the WiMax Physical and MAC layer development case study to build the team on fast growing broadband wireless technology to offer services to customers. Now company has developed the necessary understanding and expertise on the standard requirements and WiMax technology so as to add value to our customers with our domain specific knowledge on key emerging technology to reduce their time-to-market

Solution:

WiMAX (Worldwide Interoperability for Microwave Access) brings all the benefits of broadband landline connections to the wireless world. Broadband wireless equipment based on the IEEE 802.16 intended for wireless metropolitan area networks (MANs) is broadly referred to as "WiMAX." Like WiFi, WiMAX enables users to take advantage of high speed wireless data transfer. But unlike WiFi, WiMAX offers true broadband wireless access over longer distances with guaranteed quality of service

Fixed WiMAX is based on an older version of IEEE 802.16 standard, (802.16-2004 previously known as Revision D, or 802.16d), ratified in July 2004. IEEE standards only specify the Physical

(PHY) and Media Access Control (MAC) layers. Optimized for dynamic mobile radio channels, mobile WiMAX is based on the IEEE 802.16e amendment and provides support for handoffs and roaming. It uses Scalable Orthogonal Frequency Division Multiplexing Access (SOFDMA), a multi-carrier modulation technique that uses sub-channelization scheme for bandwidth allocation to the users.

The following are some of the key features of the Mobile WiMax CPE solution.

- First version of the case study is targeted for 5 Mbps downlink and 2Mbps uplink data rates with 5MHZ channel bandwidth.
- PUSC and AMC permutation modes will be supported in the first release.
- First release support convolution encoding and second release will support Convolution Turbo encoding (CTC).
- Advanced multiple input-multiple output antenna techniques for better carrier-to noise ratio and high data throughput. (Beam forming and Diversity techniques). This will be supported in the second release.
- Second release will support Mobility and Handover techniques.