Ace Thought
High Quality Video Anytime, Anywhere
HEVC Software Solutions
HEVC - Introduction

• High Efficiency Video Coding (HEVC) or H.265 is a next generation video coding standard developed by ITU-T (VCEG) and ISO/IEC (MPEG).

• HEVC / H.265 reduces bit-rate requirement by 50% compared to H.264/AVC High Profile with same picture quality.

• HEVC / H.265 standard increases the computational complexity of HEVC decoder by 1.6x and HEVC Encoder by 4.5x compared to the H.264 standard.
HEVC comparison with H.264

<table>
<thead>
<tr>
<th>Tools</th>
<th>HEVC</th>
<th>H.264</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macro-blocks</strong></td>
<td>Variable size block structure upto 64x64 size (Coding Units, CU)</td>
<td>Traditional fixed size 16x16 macro-block</td>
</tr>
<tr>
<td><strong>Intra Prediction Modes</strong></td>
<td>35 Modes for better prediction accuracy</td>
<td>9 modes</td>
</tr>
<tr>
<td><strong>Transform Size</strong></td>
<td>Large Size Transform – 4x4, 8x8, 16x16 and 32x32</td>
<td>4x4 and 8x8</td>
</tr>
<tr>
<td><strong>Inter Prediction Block Sizes</strong></td>
<td>Symmetric Mode – 2Nx2N, NxN, 2NxN, Nx2N</td>
<td>16x16, 16x8, 8x16, 8x8, 8x4, 4x8 and 4x4</td>
</tr>
<tr>
<td></td>
<td>Asymmetric Mode – 2NxnU, 2NxnD, nLx2N, nRx2N</td>
<td></td>
</tr>
<tr>
<td><strong>Inter Prediction Filters</strong></td>
<td>Luminance : 8-tap and 7 tap</td>
<td>Luminance : 6-tap + Bilinear Chrominance : 4 tap</td>
</tr>
<tr>
<td></td>
<td>Chrominance : 4 tap</td>
<td></td>
</tr>
<tr>
<td><strong>Deblocking</strong></td>
<td>Filtering upto 8x8 block edges</td>
<td>Filtering upto 4x4 block edges</td>
</tr>
<tr>
<td><strong>New Tools</strong></td>
<td>Sample Adaptive Offset (SAO) and Tiles &amp; Wavefront Parallel processing</td>
<td></td>
</tr>
</tbody>
</table>
HEVC Decoder - Product

- HEVC Decoder / H.265 Decoder target devices:
  - Smart-phones & Tablets
  - Desktop & Laptops
  - TV & Set-up boxes

- HEVC Decoder / H.265 Decoder target platforms:
  - ARM Cortex-A processors.
  - Intel Atom and Core-i3/i5/i7 processors
  - Android, iOS, Windows 8, Windows 7, Mac OS, Linux
HEVC Decoder - Performance

HEVC Main Profile Decoder performance on ARM

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Bit-Rate</th>
<th>Frame-Rate</th>
<th>CPU Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>720x480</td>
<td>1Mbps</td>
<td>24fps</td>
<td>11%</td>
</tr>
<tr>
<td>1280x720</td>
<td>2Mbps</td>
<td>24fps</td>
<td>25%</td>
</tr>
<tr>
<td>1280x720</td>
<td>3Mbps</td>
<td>24fps</td>
<td>30%</td>
</tr>
<tr>
<td>1920x1080</td>
<td>3Mbps</td>
<td>24fps</td>
<td>55%</td>
</tr>
<tr>
<td>1920x1080</td>
<td>4Mbps</td>
<td>24fps</td>
<td>60%</td>
</tr>
</tbody>
</table>

*1.6 GHz Quad Core ARM Cortex-A15 processor with NEON running under Android OS 4.3*
HEVC Decoder - Performance

HEVC Main Profile Decoder performance on INTEL

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Bit-Rate</th>
<th>Frame-Rate</th>
<th>CPU Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1280x720 2Mbps</td>
<td></td>
<td>24fps</td>
<td>11 %</td>
</tr>
<tr>
<td>1280x720 3Mbps</td>
<td></td>
<td>24fps</td>
<td>14 %</td>
</tr>
<tr>
<td>1920x1080 3Mbps</td>
<td></td>
<td>24fps</td>
<td>21 %</td>
</tr>
<tr>
<td>1920x1080 4Mbps</td>
<td></td>
<td>24fps</td>
<td>25 %</td>
</tr>
<tr>
<td>1920x1080 6Mbps</td>
<td></td>
<td>24fps</td>
<td>27 %</td>
</tr>
<tr>
<td>1920x1080 10Mbps</td>
<td></td>
<td>24fps</td>
<td>33 %</td>
</tr>
</tbody>
</table>
Products – Software Video Codecs

Video Decoders
- H.265 (HEVC) Main & Main 10
- H.264 (AVC) BP, MP & HP
- VC-1 (WMV9) SP, MP & AP
- MPEG-4 SP & ASP
- H.263 P0 & Sorenson Spark
- MPEG-2

Video Encoders
- H.265 (HEVC) Main *
- H.264 (AVC) BP
- MPEG-4 SP
- H.263 P0 & Sorenson Spark

*Under development
### Processors

- **ARM Cortex-A** with NEON & MPCore – Cortex-A8, A9, A15
- ARM9, ARM9E, ARM11
- **Intel Atom** (MMX, SSE1/2/3)
- Intel Core i Processors (MMX, SSE1/2/3/4, AVX1/2)

### Operating Systems

- Android
- iOS
- Windows Phone 8 (WP8)
- Windows 8, 7, XP
- Linux
- Mac OSX
Software Video Codecs – Key Features

Video Codec Benefits

- Video decoders support all profiles (including Main, High/Advance) thereby enabling wider use-cases.
- Optimized for single, dual and quad core processors with ARM NEON™ Advanced SIMD & Intel x86 SIMD (SSS3, AVX)
- Re-entrant library
- Implemented in ANSI C thereby enabling portability.
- Both C and C++ interfaces are available for easy integration.
- Proprietary fast Motion Estimation, Sub-Pixel Refinement, Rate-Control and Optimization algorithms.

Note: Please refer to respective Codec product specification document for more details.
Products – ATT Media Player

Enabling Multi-screen Content Delivery and Playback

SDK for OTT Multi-Screen Applications

- No worries for **device fragmentation**! ATT Media Player API supports player development across multiple devices and operating systems.
- Intelligent Adaptive Bit Rate algorithms for **HLS & MPEG – DASH** to ensure best video experience.
- Customizable API to support industry standard **DRM** solutions – Playready, Verimatrix, Widevine.
- Customizable API to support **Ad insertion** and CDN integration
- Support for **Speed Control** Playback for education (0.5 – 2.0x)
- Support for **Closed Caption** and subtitles
### Supported OS
- Android (v2.3 – v4.4)
- iOS
- Windows 7/8
- Mac OS X

### Supported File Formats
- MP4
- AVI
- MKV
- MPEG2-TS

### Streaming Protocols
- **MPEG-DASH**
- HTTP Live Streaming (HLS)
- RTSP
- HTTP Progressive download

### Video Formats
- HEVC (H.265) MP/MP10
- H.264 BP/MP/HP
- MPEG4 – SP/ASP
- H.263
- VP8
- VP9

### Audio Formats
- MP3
- HE-AAC
- AMR NB/WB
Ace Thought
High Quality Video Anytime, Anywhere
Engineering Services
Outline

- High Performance Computing
  - CPU
  - GPU
  - FPGA

- Audio & Video Compression
  - Video & Audio Codecs
  - Image/Video Pre/Post processing

- Multimedia Middleware
  - File Formats, Streaming Protocols, Multimedia Frameworks
  - Media Player, IP Video Streaming, Mobile TV
High Performance Computing

CPU

Code Optimization – Our Expertise

Porting applications to mobile or desktop architectures and operating systems written in C, C++, Java, Objective-C or .NET

Algorithmic Optimization of signal processing, imaging, medical analysis algorithms

Refactoring of application to exploit architecture like Cache, Memory & CPU instructions
Our Vectorization services accelerate CPU intensive modules using SIMD instructions on mobile, desktop and embedded platforms.
Parallel Computing – Our Expertise

Parallelization of Sequential Applications by:

- Domain Decomposition (Data Parallelism)
- Task Decomposition (Task Parallelism)
- Pipelining (Division of Task into various stages)

Technologies & Platforms

- POSIX, OpenMP
- Windows x86, Mac OSX, Linux, Android, Apple iOS, Embedded Linux

Copyright Ace Thought Technologies Pvt Ltd 2014
High Performance Computing

GPU

OpenCL/ CUDA – Our Expertise

Development of OpenCL/CUDA kernels to utilize GPGPU

Optimization of C/C++ application by accelerating modules using OpenCL on Windows, Mac OSX, Android, Apple iOS, Linux
FPGA Optimization Service offerings:

• Development of OpenCL programs
• Porting of C/C++ signal processing modules to FPGA using OpenCL

* OpenCL Support for Altera ([link here](#))
* OpenCL Support for Xilinx ([link here](#))
Ace Thought
High Quality Video Anytime, Anywhere
Audio & Video Compression Services
Audio & Video Compression (A/V)

Our Expertise

- Development of Codecs (Decoder & Encoder) in C/C++/ASM
- Optimization of Codecs for Desktop, Mobile & Embedded platforms/processors
- Productization of Open Source Codecs – ffmpeg, x264, Android, etc
- Development & Optimization of pre/post processing modules for image, video, audio & speech.
- Camera sensor tuning, Vision Algorithms, Video Analytics

A/V

CODECS

Pre/Post Processing
Audio & Video Compression CODECS

Development – Our Expertise

Video Codecs (Encoder & Decoder)

- HEVC (H.265), H.264 (AVC), VP8, VP9, VC-1 (WMV9), MPEG-4 & MPEG-2
- SVC (Scalable Video Codec) & MVC (Multi View Codec) – H.264, HEVC

Audio Codecs (Encoder & Decoder)

- MPEG-4 & MPEG-2 AAC, Dolby AC3, AMR NB/WB, MP3, MP2, MP1, & Ogg Vorbis
Our Codec Optimization Services accelerate Codecs using SIMD, OpenCL, memory, cache & multi-threaded optimization.
Audio & Video Compression
CODECS

OpenSource – Our Expertise

Codecs

- ffmpeg, x264, Android, x265, Open SVC, H.264 JM/JCT-VC, HEVC HM

Frameworks

- Gstreamer, Android Stagefright, Android OpenCore, Microsoft Directshow, Khronos OpenMax
Pre/Post Processing Expertise:

- **OpenGL** post processing acceleration on Android & iOS
- Resolution Scaling
- Color Space Conversion
- Noise filtering
- Deblocking & De-ringing
- Video Stabilization
- Camera sensor tuning
- Video Analytics
- Vision Algorithms
- Image sharpening
Ace Thought
High Quality Video Anytime, Anywhere
Multimedia Middleware Services
Expertise in design and development of robust and efficient multimedia middleware, applications and components for various embedded architectures/platforms.
Multimedia Middleware
Our Expertise

Applications

• Media Player, Media Recorder & Media Editor
• IP based Streaming & Surveillance
• Multimedia applications.

Media Containers/File Formats

• MP4, 3GPP, ASF (WMV), AVI, MKV

Streaming Protocols

• MPEG-DASH, HTTP Live Streaming (HLS), RTP, RTSP, RTMP
Multimedia Middleware
Our Expertise

**Multimedia Frameworks**
- Gstreamer
- Android Stagefright & OpenCore
- Microsoft DirectShow & DirectX Media Objects (DMOs)
- Khronos OpenMax

**Industry Segments**
- Digital Signage Middleware
- Car DVR Middleware
- Network streaming CAR/In-Flight infotainment system
- Mobile TV
- Video Conferencing
- IP Camera (Video Surveillance)
HEADQUARTERS
Ace Thought Technologies Pvt. Ltd.
IT-C7, KMG Towers, 2nd Floor, IT Park,
Sector 67, Mohali – 160062
INDIA

sales@acethought.com
+ 91 – 9845236149
+ 91 – 9478019015
www.acethought.com