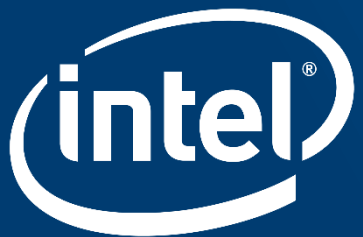


ENHANCE VIDEO PERFORMANCE USING INTEL HARDWARE AND SOFTWARE

Raghavendra Ural
IoT Developer Evangelist
[@ragural](#)

Agenda

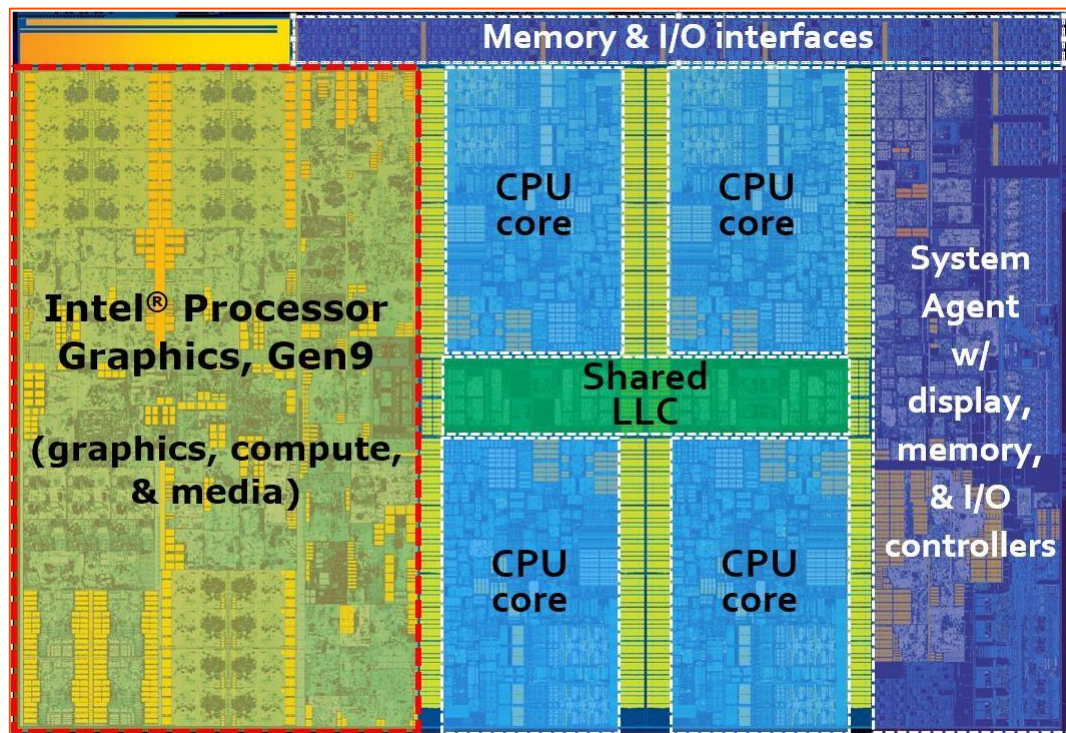
- ✓ Intel® Media SDK Overview
- ✓ Intel® Media Accelerator Reference Software Overview
- ✓ Intel® Components for digital signage and kiosk solutions
- ✓ Lab Overview



INTEL® MEDIA SDK OVERVIEW

CPU vs GPU

Intel Hardware is Heterogeneous



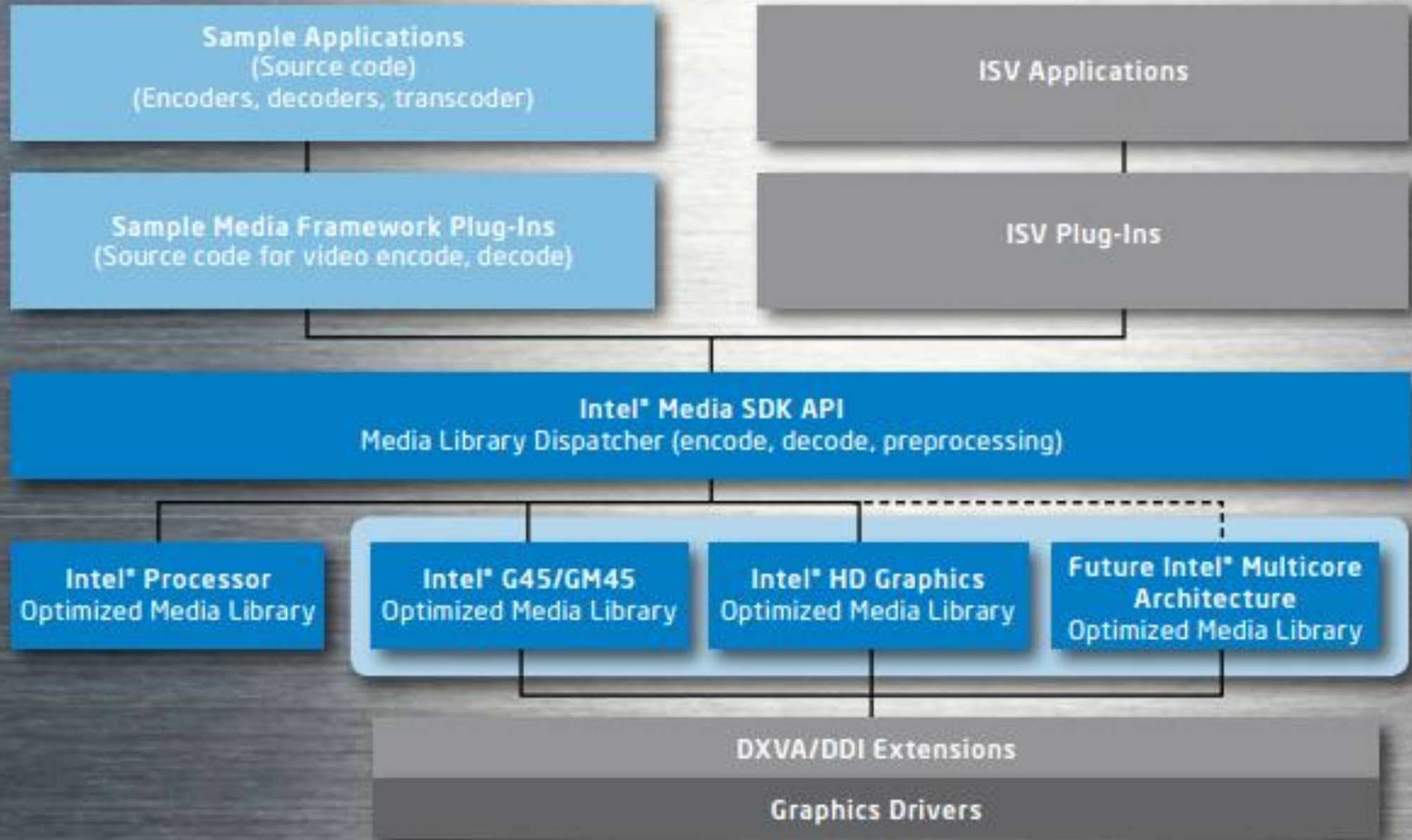
CPU

- Awesome general purpose performance
- Large software ecosystem

Other Programmable Intel Hardware

- GPU (shown here)
- IPU
- FPGA

INTEL® MEDIA SDK HIGH-LEVEL ARCHITECTURE



Intel® Media SDK 2017 Supported Codecs

Standard	Encode	Decode
HEVC (main profile) (High Efficiency Video Coding)	HW	HW
AVC (Advanced Video Coding)	SW/HW/ low power	SW/HW
MPEG-2	SW/HW	SW/HW
MJPEG	SW/ HW	SW/ HW
MVC	SW/HW	SW/HW
VC-1	-	SW/HW

green=new in Intel® Media Server Studio for Gen9

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Intel® Media SDK 2017

Supported Video Processing Features



N:1 Frame Composition

Resizing

Color Conversion

Deinterlacing

Denoising

Frame Rate Conversion

Brightness/Contrast/Saturation

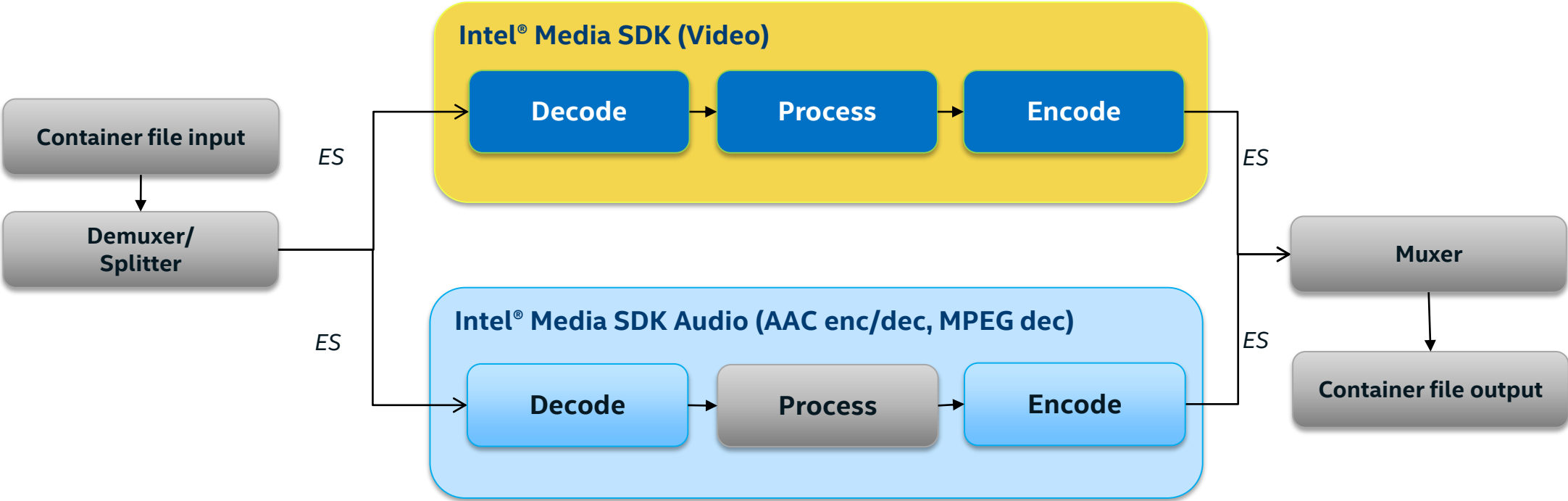
Sharpening

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Media Software Scope Diagram

Transcode pipeline



	Intel Media SDK/Intel® Media Server Studio focus
	Limited support
	Out of scope/external component

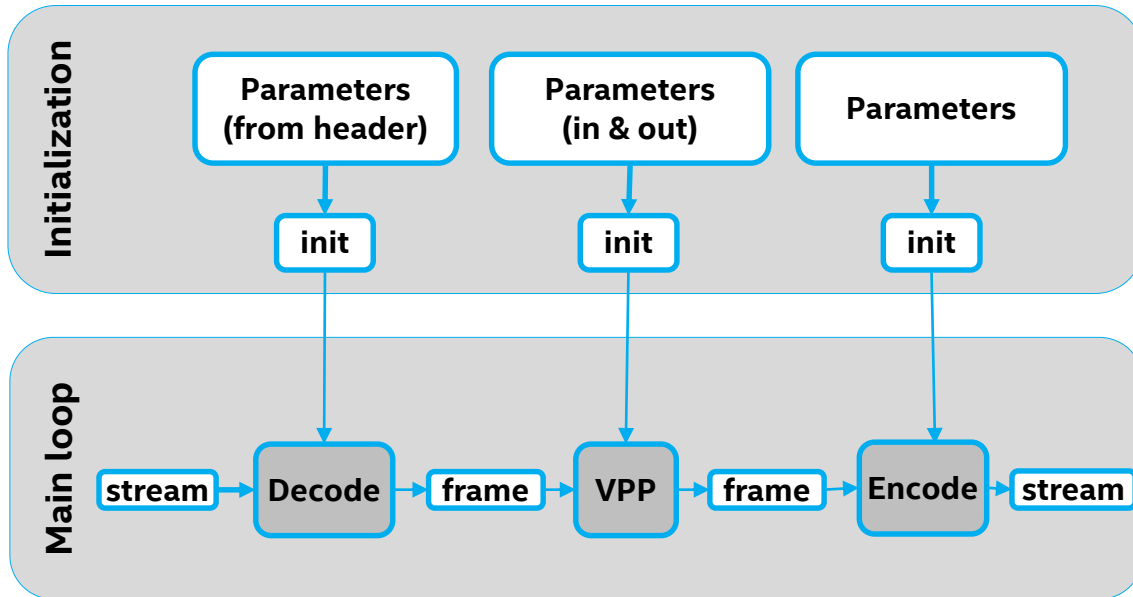
ES = Elementary stream

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Intel® Media SDK / Intel® Media Server Studio



Media accelerator framework
Codec based
High level/parameter interface
3 operations

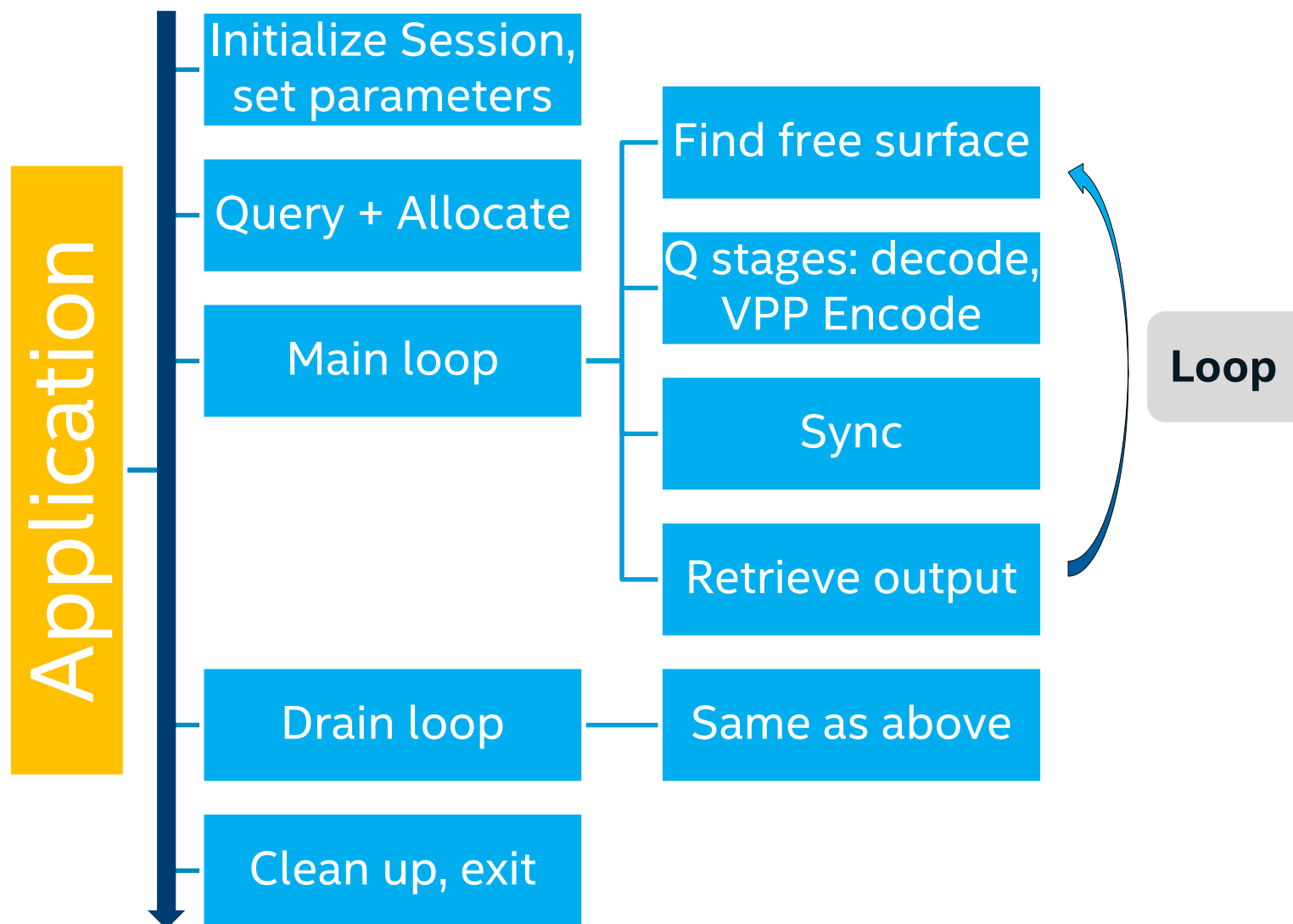
Good option for:

- Accelerated video encode, decode
- (and short list of frame processing)

Links to More Information

- [Media Server Studio](#)
- [Media SDK](#)
- [Intel Media Code Samples](#)

Basic Structure of an Intel® Media SDK-optimized Application



Simple Encoding and Decoding

The following two pseudo-code examples illustrate the simplicity and efficiency of the Intel® Media SDK.

Decoding Procedures

```
Create SDK session
Initialize DECODE
Allocate I/O buffers
While (!EOF || FramesRemaining) do
    If !EOF, read bitstream from file
    Locate available frame buffers
```

```
DECODE::DecoderFrameAsync
CORE::SyncOperation
```

```
    Write output frames to file
Done
De-allocate I/O buffers
Close DECODE
Close SDK session
```

Encoding Procedures

```
Create SDK session
Initialize ENCODE
Allocate I/O buffers
For each frame do
    Locate available frame buffers
    Read raw frames from file
```

```
ENCODE::EncodeFrameAsync
CORE::SyncOperation
```

```
    If output bitstream available, then
        Write bitstream to file
    Endif
Done
De-allocate I/O buffers
Close ENCODE
Close SDK session
```

Decoding sample code









```
MFXVideoDECODE_DecodeHeader(session, bitstream, &init_param);
MFXVideoDECODE_QueryIOSurf(session, &init_param, &request);
allocate_pool_of_frame_surfaces(request.NumFrameSuggested);
MFXVideoDECODE_Init(session, &init_param);
sts=MFX_ERR_MORE_DATA;
for (;;) {
    if (sts==MFX_ERR_MORE_DATA && !end_of_stream())
        append_more_bitstream(bitstream);
    find_unlocked_surface_from_the_pool(&work);
    bits=(end_of_stream())?NULL:bitstream;
    sts=MFXVideoDECODE_DecodeFrameAsync(session,bits,work,&disp,&syncp);
    if (sts==MFX_ERR_MORE_SURFACE) continue;
    if (end_of_bitstream() && sts==MFX_ERR_MORE_DATA) break;
    ... // other error handling
    if (sts==MFX_ERR_NONE) {
        MFXVideoCORE_SyncOperation(session, syncp, INFINITE);
        do_something_with_decoded_frame(disp);
    }
}
MFXVideoDECODE_Close();
free_pool_of_frame_surfaces();
```

```
mfxVersion ver = { {1, 1} }; // minimum API version which supports multiple de
MFXInit(MFX_IMPL_HARDWARE_ANY, &ver, &auxSession);
```

Encode sample code

```
MFXVideoENCODE_QueryIOSurf(session, &init_param, &request);
allocate_pool_of_frame_surfaces(request.NumFrameSuggested);
MFXVideoENCODE_Init(session, &init_param);
sts=MFX_ERR_MORE_DATA;
for (;;) {
    if (sts==MFX_ERR_MORE_DATA && !end_of_stream()) {
        find_unlocked_surface_from_the_pool(&surface);
        fill_content_for_encoding(surface);
    }
    surface2=end_of_stream()?NULL:surface;
    sts=MFXVideoENCODE_EncodeFrameAsync(session, NULL, surface2, bits, &syncp);
    if (end_of_stream() && sts==MFX_ERR_MORE_DATA) break;
    ... // other error handling
    if (sts==MFX_ERR_NONE) {
        MFXVideoCORE_SyncOperation(session, syncp, INFINITE);
        do_something_with_encoded_bits(bits);
    }
}
MFXVideoENCODE_Close();
free_pool_of_frame_surfaces();
```

Program Files (x86) > IntelSWTools > Intel(R)_Media_SDK_2016.0.2 > doc

<input type="checkbox"/>	Name	Date modified
✦	 media-raw-accelerator-man.pdf	6/1/2016 4:15 PM
✦	 mediasdkaudio-man.pdf	6/2/2016 5:20 PM
✦	 mediasdk-distrib.pdf	2/1/2016 4:03 PM
✦	 mediasdkjpeg-man.pdf	6/1/2016 4:15 PM
✦	 mediasdk-man.pdf	6/1/2016 4:15 PM
✦	 mediasdkmvc-man.pdf	6/1/2016 4:15 PM
	 mediasdkscreenap-man.pdf	6/1/2016 4:15 PM
	 mediasdkusr-man.pdf	6/1/2016 4:15 PM

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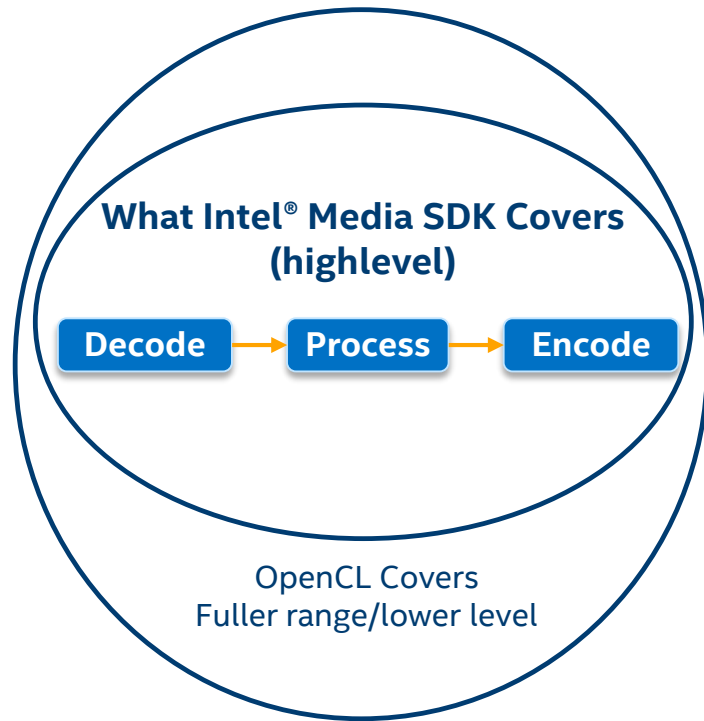
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VPP sample code

```
MFXVideoVPP_QueryIOSurf(session, &init_param, response);
allocate_pool_of_surfaces(in_pool, response[0].NumFrameSuggested);
allocate_pool_of_surfaces(out_pool, response[1].NumFrameSuggested);
MFXVideoVPP_Init(session, &init_param);
in=find_unlocked_surface_and_fill_content(in_pool);
out=find_unlocked_surface_from_the_pool(out_pool);
for (;;) {
    sts=MFXVideoVPP_RunFrameVPPAsync(session,in,out,aux,&syncp);
    if (sts==MFX_ERR_MORE_SURFACE || sts==MFX_ERR_NONE) {
        MFXVideoCore_SyncOperation(session,syncp,INFINITE);
        process_output_frame(out);
        out=find_unlocked_surface_from_the_pool(out_pool);
    }
    if (sts==MFX_ERR_MORE_DATA && in==NULL) break;
    if (sts==MFX_ERR_NONE || sts==MFX_ERR_MORE_DATA) {
        in=find_unlocked_surface(in_pool);
        fill_content_for_video_processing(in);
        if (end_of_input_sequence()) in=NULL;
    }
}
MFXVideoVPP_Close(session);
free_pool_of_surfaces(in_pool);
free_pool_of_surfaces(out_pool);
```


OpenCL + Intel® Media SDK?



Media SDK provides optimized implementations for:

- Codecs
- Frame Processing Operations

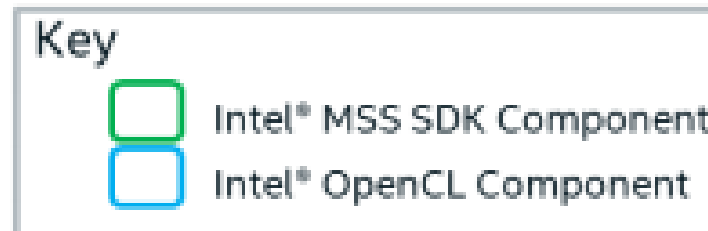
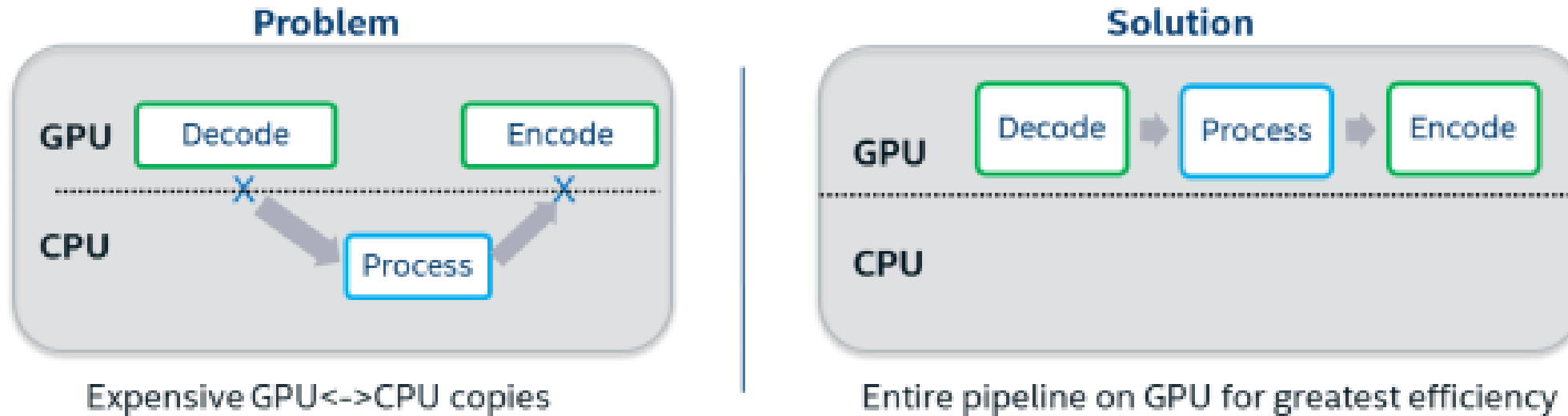
For video processing tasks not in Media SDK's scope, extend with OpenCL

- Make use of growing GPU capabilities
- Keep pipelines on GPU

Example uses: color conversions, custom bit rate control



Why OpenCL + Intel® Media SDK?



Using Media SDK and OpenCL together to keep a video processing pipeline together on the GPU

Media SDK Products

- Media SDK/Media Server Studio—The software API to the hardware codec on GPU.
- Hardware support: 3G Core(GEN 7), 4G Core(GEN 7.5), 5G Core(GEN 8), 6G Core(GEN 9) [see the details](#)
- OS Support: Windows 7/8/10, CentOS, Yocto, Android, Ubuntu.
- Application: Set Top Box, FFMpeg, G-Streamer, Media Server, IVI, Surveillance

How to get the Intel® Media SDK

Intel® Media Server Studio – 3 Editions (includes Free Community)



Platform / Device Targets

- [Select SKUs of Intel® Xeon® & Core™ processor-based platforms](#)
- Applications for media, communications infrastructure, video processing/conferencing, digital surveillance, video cloud & data center
- For HEVC, AVC, MPEG-2, MPEG-Audio

See [Technical Specifications](#) for System Requirements

[Download](#)
software.intel.com/intel-media-server-studio

Intel® Media SDK - FREE

Platform / Device Targets

- Intel® Core™ or Core™ M processors
- Select SKUs of Intel® Celeron™, Pentium™ & Atom™ processors with Intel® HD Graphics supporting Intel® Quick Sync Video
- Client devices – Desktop/mobile applications

See [Technical Specifications](#) for System Requirements

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software.intel.com/media-sdk

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More Resources

Intel® Media SDK

- software.intel.com/media-sdk

Intel® Media Server Studio

- software.intel.com/intel-media-server-studio

**Learn from Samples
& Tutorials**

- github.com/Intel-Media-SDK/samples

**Ask questions
at the forum**

- software.intel.com/forums/intel-media-sdk

Webinar Replays



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INTEL® MEDIA ACCELERATOR REFERENCE SOFTWARE OVERVIEW

What is Intel® Media Accelerator Reference Software?

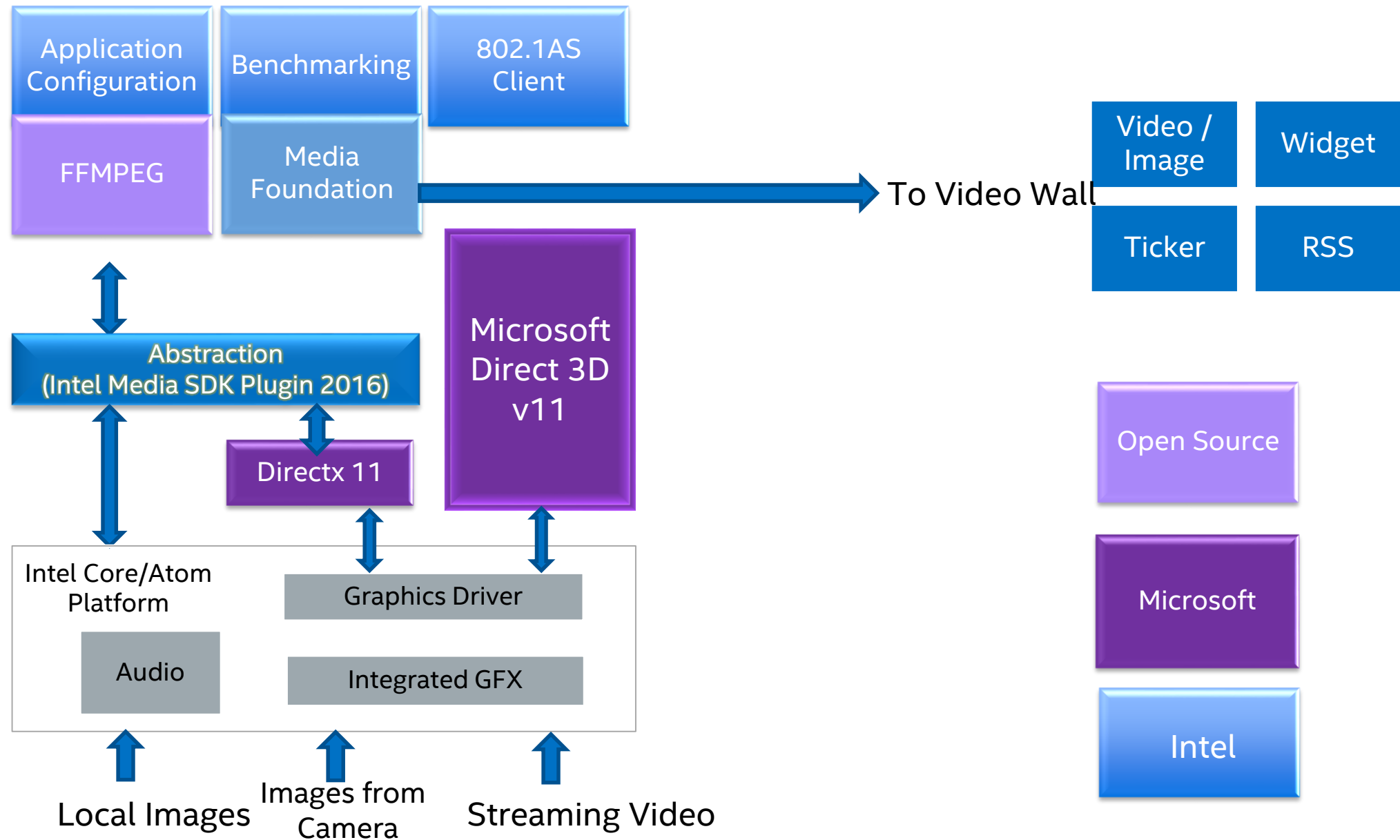
Intel licensed reference code for Digital Signage that uses the best practices for video decode, transcode, playback, compositing, blending, streaming and rendering by using a combination of Intel and other SDKs on Intel platforms

- Target Platforms – Intel Sky Lake/Kaby Lake Core & Braswell, Apollo Lake Atom Platforms
- OS supported – Windows 10
- SDK – FFMPEG, Media Foundation, Media SDK 2016, DirectX 11 (DXVA2.0+)

What is Intel® Media Accelerator Reference Software?

- Efficient Media Foundation Transforms running on Intel GFX for H264/HEVC based 4k/8k HDR media file decode
 - One of the customers, a leading CMS vendor in Asia, reported > 50% efficiency by moving to GFX offload for 4k content by using the filters in the reference codebase
- Creation of overlays and rich media zones by compositing with Direct3D canvas
- Video Sync software feature leveraging Intel Ethernet controllers which support 802.1AS

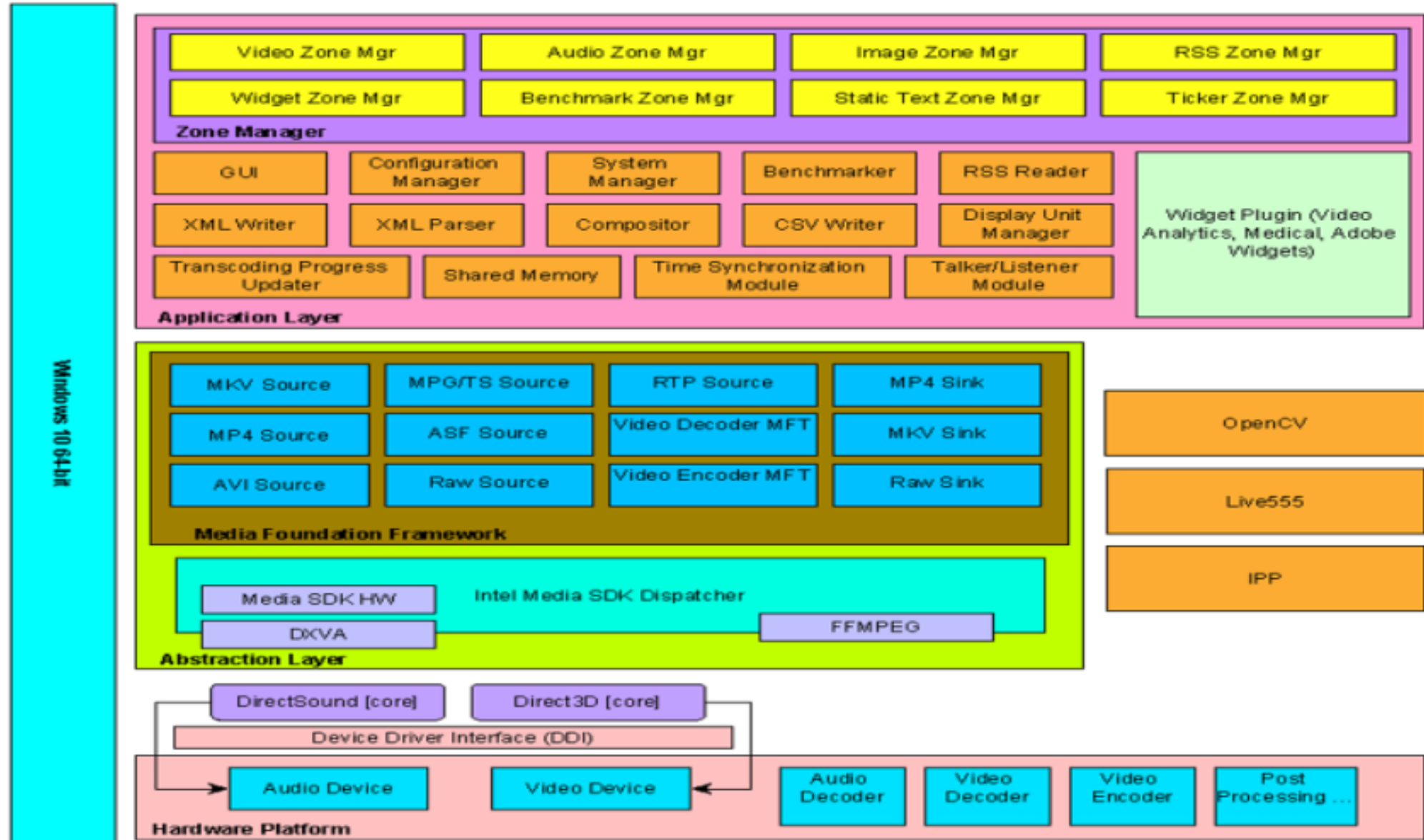
Architecture



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Architecture

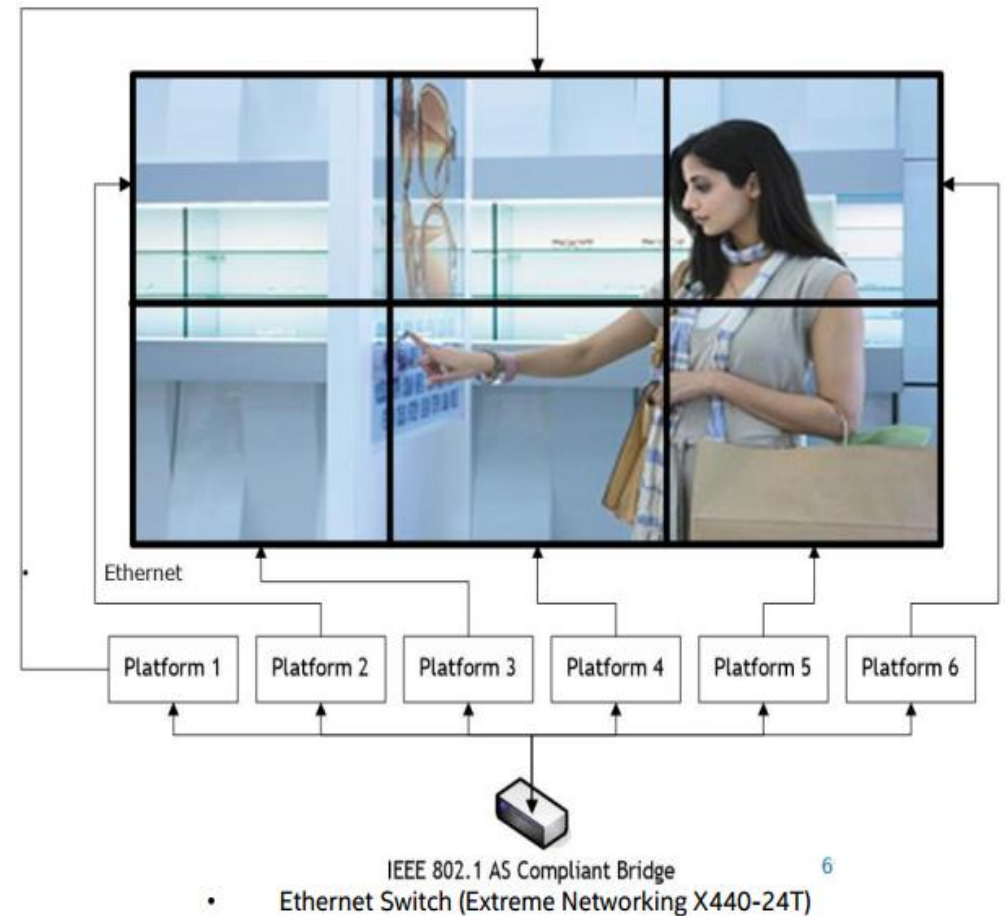


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Video Sync using Integrated GFX









- Media Accelerator Software uses 802.1AS (based on gPTP IEEE 1588) TSN std for implementing sync
- One platform or player is the master which synchronizes the displays on all the other platforms
- Each platform running an 802.1AS service to sync their clocks for video rendering
- Tested with 802.1AS compliant switch (Extreme Networking X440-24t)
- Configuration supports unlimited number of displays/devices





INTEL[®] COMPONENTS FOR DIGITAL SIGNAGE AND KIOSK SOLUTIONS

Intel® Components for digital signage and kiosk solutions

Tier	Solution	Platform	Features
High	<ul style="list-style-type: none"> Multiple players & displays (i.e., video wall) Content: 4K Playback / real time feeds Touchscreens, mobile, gesture Advanced analytics Investment protection 	Embedded Box, OPS, Intel® Core™ i7 processors, Intel® SDM  	<ul style="list-style-type: none"> Gesture Interactivity Collage Display Video Analytics
Mainstream	<ul style="list-style-type: none"> Remote Management via Intel® AMT Single player/multiple screens HD video/real time feeds Touchscreen input/mobile device integration Audience analytics Options to expand 	Embedded Box, OPS, Intel® NUC Intel® Core™ i5 processors, Compute Stick (m5)    	<ul style="list-style-type: none"> Video Analytics AMT Remote management Security Multi Touch/4k Display
Value	<ul style="list-style-type: none"> Plug & play package: Single player/ up to 2 screens Content: still images, video; No in-house tech support 	Embedded, Intel NUC (Intel® Core™ i3 processors, Intel Celeron Intel® Atom™) Intel Compute Stick (Intel Atom) 	<ul style="list-style-type: none"> Dual Display 4K Playback Single Display
Entry		Embedded (Intel Atom) 	<ul style="list-style-type: none"> HD Playback

For updates and additional roadmap information, please go to <https://iotgresources.intel.com> and filter on roadmaps for the most up-to-date RSD roadmap

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LAB OVERVIEW

What are we trying to solve?

Customer Requirement

- Need HD quality digital signage in my Airport for marketing activities
- Need faster service and lower downtime
- Live report on number of people looked at my signage

ISV Business Requirement

- Lower Recurring cost
 - Lower service visit
 - Lower network bandwidth usage
- Lower development time and faster time to market
- Easy maintenance and Centralized control
- Easy system upgrade



Workshop Inventory



Intel® NUC Kit



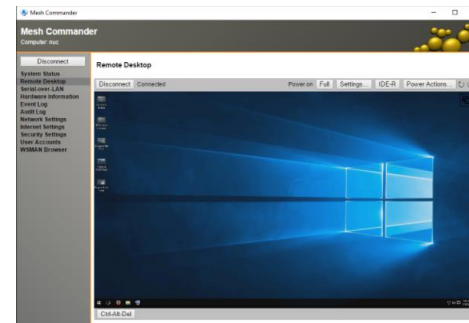
Intel® vPro
Technology



Python-OpenCV
and Camera



Intel® Media SDK



Intel® AMT, Mesh
Commander and
Mesh Central

[1] The edge device, gateway and sensors could change to a new technology or vendor

Developer kit is certified for the US, CAN, and EU and can be purchased under a single SKU. In other regions, components can be purchased separately

Code samples can be downloaded from GitHub

In some countries due to import/exports laws, the attendees may not be able to receive certain/all components of the kit

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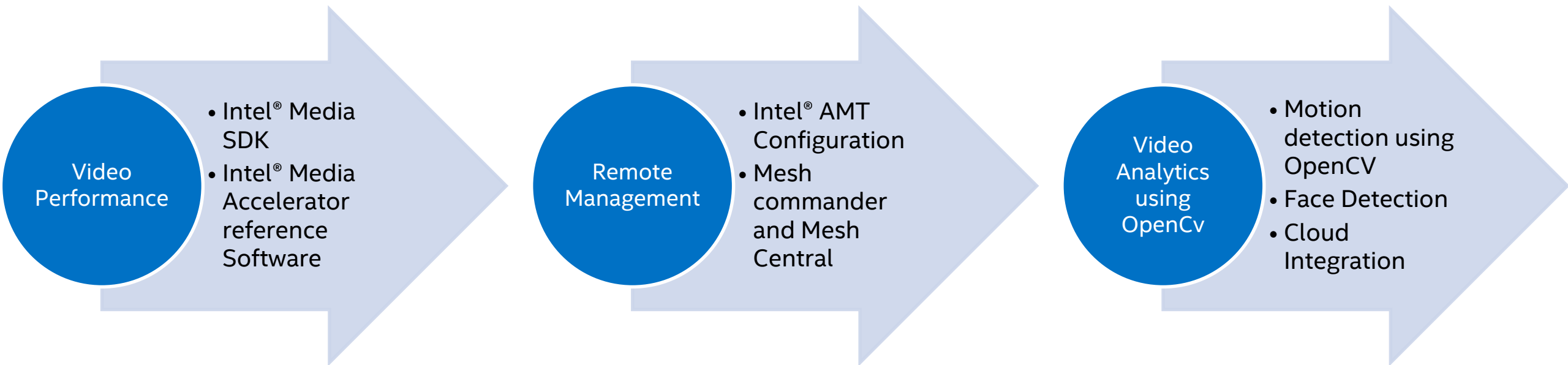
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Workshop Flow



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Workshop Setup

Wifi:

SSID = Intel Retail

Password: intel@123

Documentation and Cloud

Documentation URL: <http://192.168.11.100:9000>

Cloud Server URL: <http://192.168.11.100:9002>

Mesh Central URL: <https://192.168.11.100>

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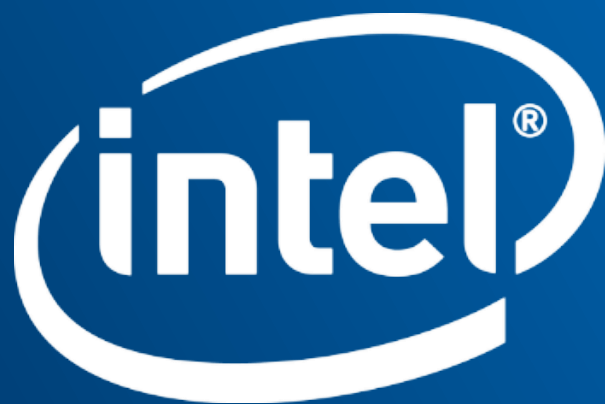
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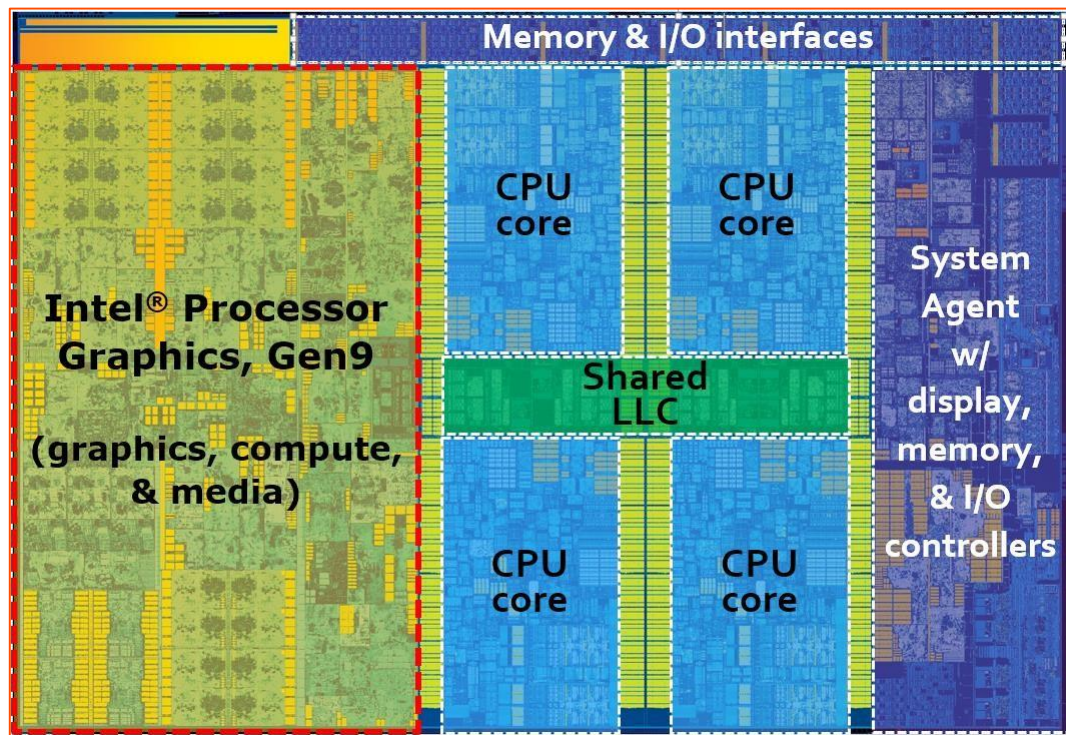




LET'S GET STARTED



Intel Hardware is Heterogeneous



CPU

- Awesome general purpose performance
- Large software ecosystem

Other Programmable Intel Hardware

- GPU (shown here)
- IPU
- FPGA

See [Technical Specifications](#) for System Requirements - [Select SKUs of Intel® Xeon® & Core™ processor-based platforms](#) apply.

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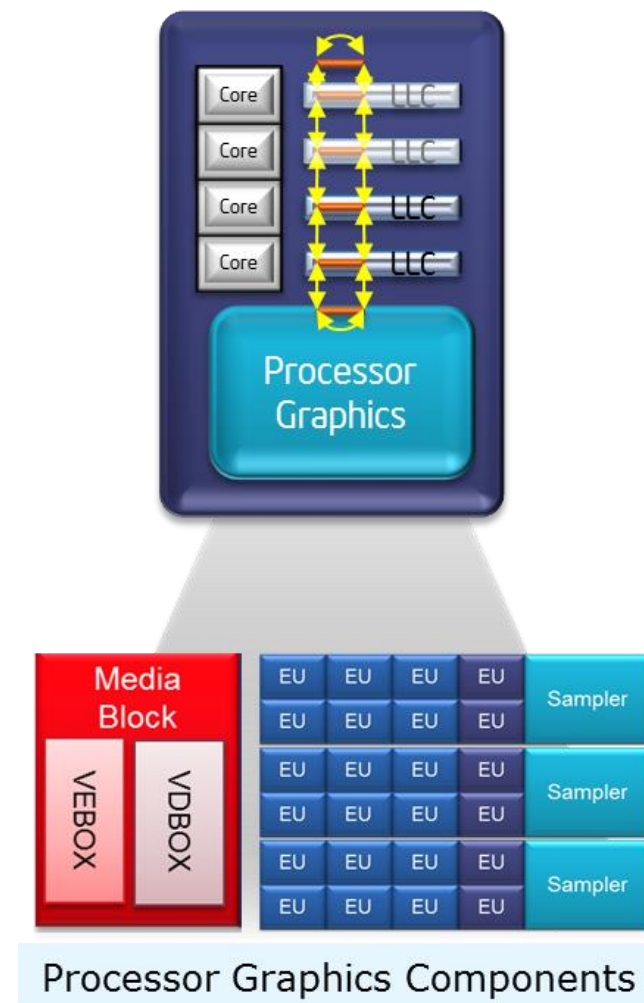
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Media Capabilities

Gen9 Processor Graphics GPU

- 14nm process technology
- Integrated with processor
- Higher Performance
 - GT2 with 24 execution units
 - GT4e* with 72 EUs & 128MB eDRAM
 - CPU+GPU provide over 1 TFLOPS processing power
- Latest API feature support
 - DirectX 3D 2015 version, OGL 4.4, OpenGL ES 3.0, OpenCL 2.1
 - Tightly coupled CPU/GPU programming using Shared Virtual memory + OpenCL
- Expanded hardware acceleration for media features
 - Low power/full fixed function AVC encode
 - HEVC Encode/Decode
 - MJPEG Encode



See [Technical Specifications](#) for System Requirements - [Select SKUs of Intel® Xeon® & Core™ processor-based platforms](#) apply.

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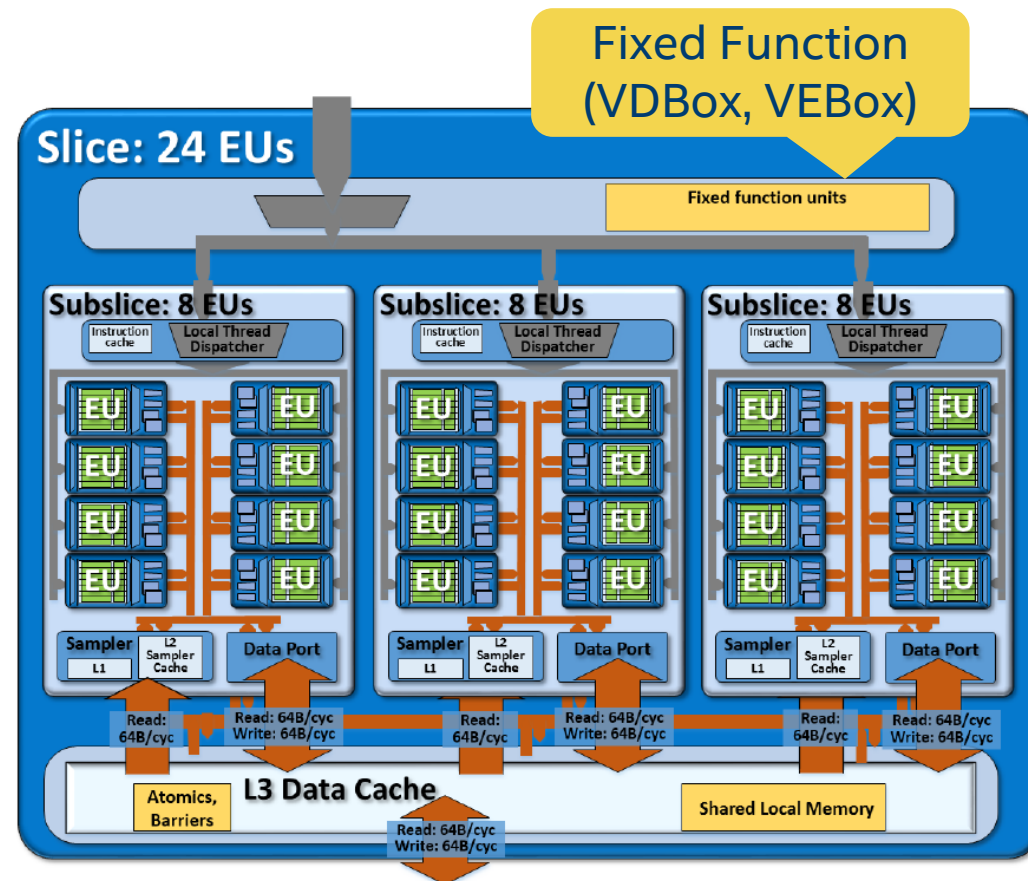
Graphics Technology Highlights

Glossary

- Execution Units (EUs) = general purpose cores
- EUs, samplers, caches, etc. in “slices”
- Fixed function is in “unslice”
- eDRAM adds cache, increases bandwidth

Naming Convention

	adds	Other names	Summary
Intel® HD Graphics		GT2 “4+2”	Good
Intel® Iris™ Graphics	+slices +eDRAM	GT3 “2+3e”	Better
Intel® Iris™ Pro Graphics	+slices +eDRAM	GT3e,GT4e “4+4e”	Best



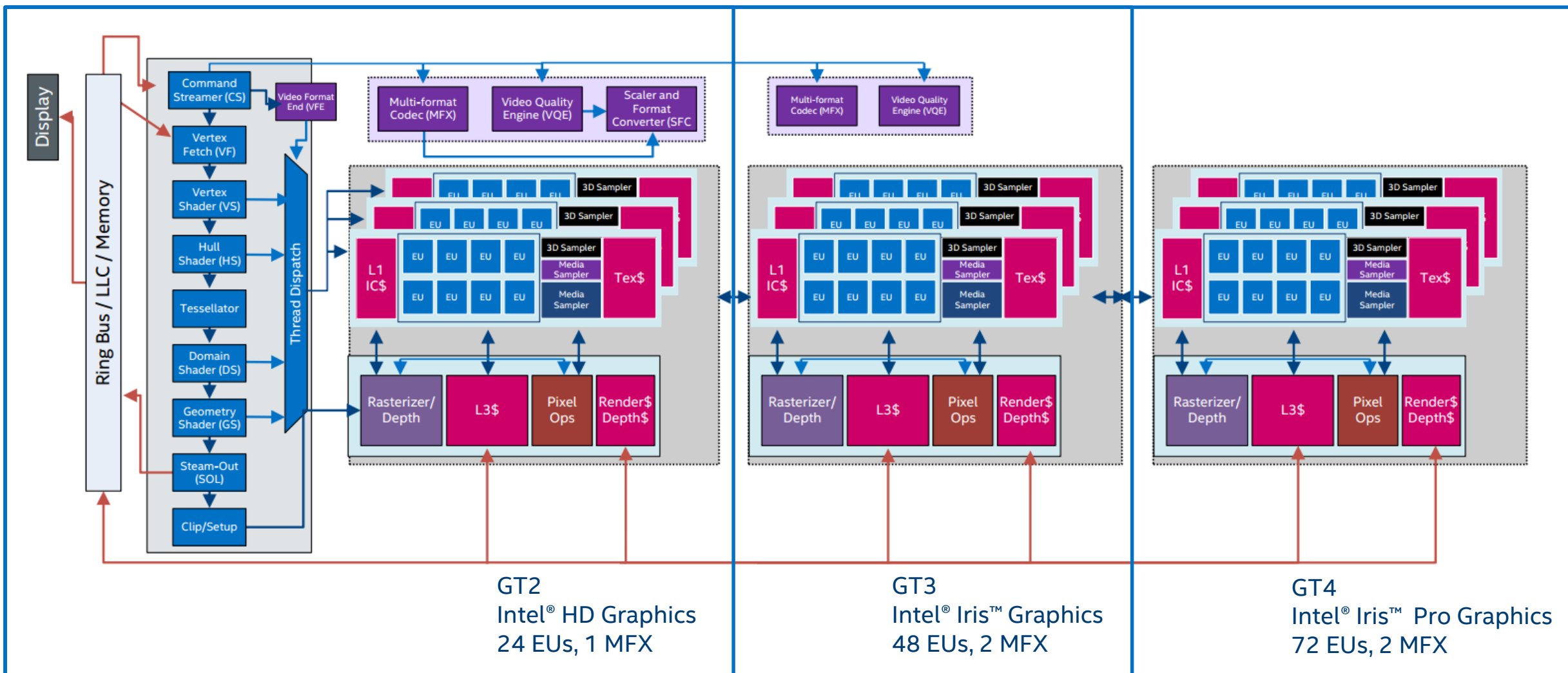
Just look for Intel® QuickSync Video at ark.intel.com

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Intel Processor Graphics/GPU Overview



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Codecs + Frame Processing use Fixed Function + EUs

Video Encoding

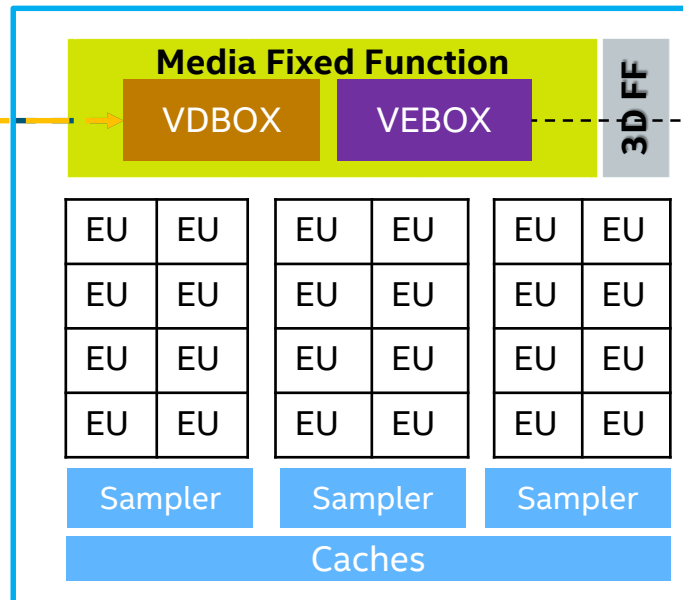
ENC= EU+VDBox VME (MB type, motion vectors, bit budget/BRC)

PAK = VDBox (residue packing & entropy coding)

VDENC = low power encode (6th Generation Core® & forward)

Video Decoding

BSD=VDBox decode



VPP

VPHal

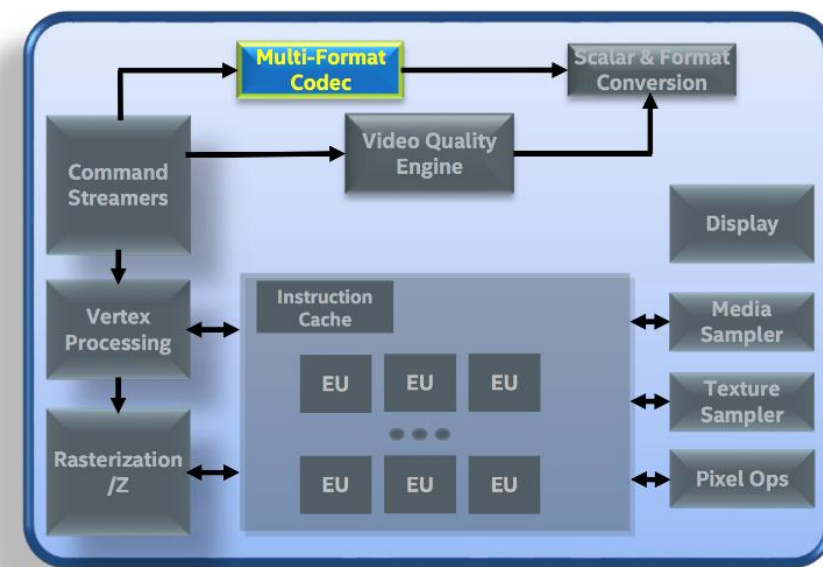
Video Processing Hardware
Acceleration Layer

VEBox

- Deinterlacing
- Denoise (Luma/Chroma)
- Frame Rate Conversion
- Color space conversions
- Composition/alpha blending
- Scaling

Video Transcoding Performance: HEVC

Multistream Performance (1xRT=30fps)		Number of Real-time (30fps) streams	Number of Real-time (60fps) streams
1080p-to-1080p	AVC-to-HEVC	15	7
	HEVC-to-HEVC	8	4
4K-to-4K	AVC-to-HEVC	4	2
	HEVC-to-HEVC	2	1



E3-1500 v5 HEVC is fully accelerated targeting 4K60 capability

NEW! Up to 2 Real-time HEVC streams per Intel® Xeon® processor¹

[Specific hardware technical specifications apply.](#) See [performance benchmarks](#) and [Media Server Studio site](#) for details.

¹15 real-time HD AVC-HEVC or 4 realtime UHD AVC-HEVC transcode, 8 real-time HD HEVC-HEVC or 2 realtime UHD HEVC-HEVC transcode using Intel MediaSDK (Target usage 7), all content 8-bit 4:2:0. - Benchmark platform configuration: Processor: Intel® Xeon® processor E3-1585Lv5 @ 3.0GHz, Ring @ 3.0GHz and GT @1.15GHz; primary BIOS Version: SKLSE2R1.R00.B104.B01.1511110114; driver: 20.19.15.4444. platform: RVP11 halo fab 2; OS: Windows® 8.1x64 Enterprise, 16 GB memory, 2 DIMMS 2133 MHz, one socket, four cores, Intel® Iris™ Pro Graphics P580, Intel® Hyper-threading Technology enabled, Intel® Virtualization technology enabled.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/performance.

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How to get the Intel® Media SDK

Intel® Media Server Studio – 3 Editions (includes Free Community)



Platform / Device Targets

- [Select SKUs of Intel® Xeon® & Core™ processor-based platforms](#)
- Applications for media, communications infrastructure, video processing/conferencing, digital surveillance, video cloud & data center
- For HEVC, AVC, MPEG-2, MPEG-Audio

See [Technical Specifications](#) for System Requirements

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Intel® Media SDK - FREE

Platform / Device Targets

- Intel® Core™ or Core™ M processors
- Select SKUs of Intel® Celeron™, Pentium™ & Atom™ processors with Intel® HD Graphics supporting Intel® Quick Sync Video
- Client devices – Desktop/mobile applications

See [Technical Specifications](#) for System Requirements

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More Resources

Intel® Media SDK

- software.intel.com/media-sdk

Intel® Media Server Studio

- software.intel.com/intel-media-server-studio

**Learn from Samples
& Tutorials**

- github.com/Intel-Media-SDK/samples

**Ask questions
at the forum**

- software.intel.com/forums/intel-media-sdk

Webinar Replays



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