VISION SDK LINUX
(v02.07.00)

Data Sheet

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Table of Contents

1 Supported Features

1.1 Use-cases

The Linux + Vision SDK supports the following use-cases as examples

- 1CH VIP capture + SGX DISPLAY(A15)
- 1CH VIP capture + Encode + Decode + SGX DISPLAY(A15)
- 1CH VIP capture + Pedestrian Detect (EVE1 + DSP1) + SGX DISPLAY(A15)
- 4CH LVDS capture + SGX DISPLAY(A15)
- 4CH LVDS capture + 3D SRV (SGX-A15) + DRM DISPLAY(A15)
- 4CH AVB capture + Decode + SGX DISPLAY(A15)

From the list above, two usecases are picked for system-parameter measurements in this document. For others data can be interpreted from BIOS usecases results - please refer Vision SDK BIOS datasheet at $INSTALL_DIR\vision_sdk\docs\VisionSDK_DataSheet.pdf.

1.2 Framework features

- Refer $INSTALL_DIR\vision_sdk\docs\VisionSDK_DataSheet.pdf

1.3 Supported Links on A15 + Linux

Links for the following modules with the features listed below

- SGXDISPLAY
- IPC_IN
- IPC_OUT
- NULL
- SGX 3D Surround View (TDA2xx only)

1.4 Features Not Supported and/or not Tested

- Buffers captured on IPU cannot be accessed / processed by A15 as caching is not taken care in A15. (temporary limitation)
- Alg links on A15 not support, mainly because caching operations on A15 are not tested. (temporary limitation)

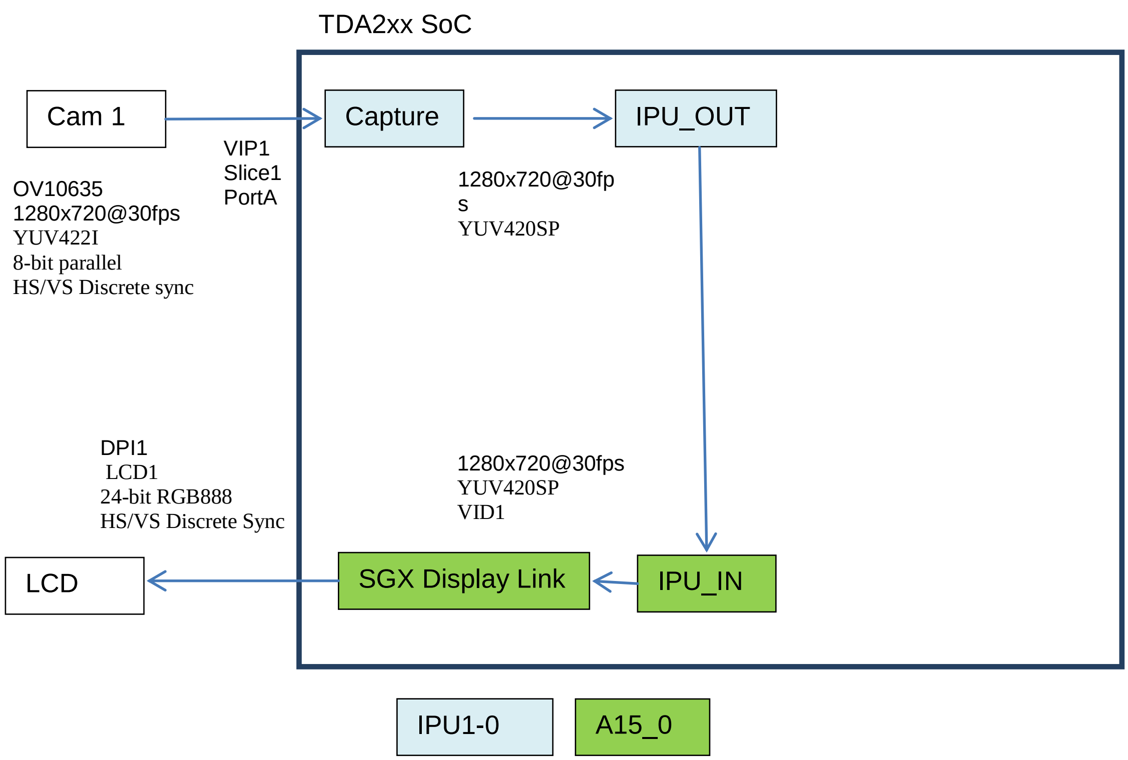
2 1CH VIP capture + SGX DISPLAY (A15) usecase

2.1 Overview

This usecase consists of continuous capture on IPU1_0 and display on A15 with SGX.

Capture can be done at 720p@30fps (OV Sensor) via the VIP1 Slice1 Port A. Display can be on LCD via DPI1 output port or on HDMI display via HDMI output port.

2.2 Dataflow



2.3 System Parameters

Refer Section 13.1 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf

The only difference when Linux is in picture is, A15 runs at 1000MHz instead of 750 MHz.

2.4 CPU loading and Task Info

2.4.1 Total CPU load

CPU	CPU LOAD (%)	
SOC	TDA2xx	TDA2EX
IPU1_0	3.6	1.4
A15	0.8	1

2.4.2 Task Level Information and Task Level CPU load

CPU	TASK NAME	TASK DESCRIPTION	CPU LOAD (%)	
SOC			TDA2xx	TDA2EX
IPU1_0	Capture	Capture frames via VIP port	0.1	0.1
	IPC OUT	To send frame to another processor	0.4	0.4
	SYSTEM_IPU1_127	System thread for generic control command like print heap stats, CPU load etc	0.1	0.3
	Stat Coll	Stat collector	1.8	NA
	App Ctrl	Sensor init and board level contro	0.1	0.1
	Misc	Miscellaneous	0.4	0.3
A15	IPC IN	To receive frames from another processor	NA	NA
	SGXDISPLAY	To submit received buffer to SGX and then display via DRM	NA	NA

2.4.3 Heap Memory Usage

CPU	MEMORY SECTION	MEMORY SIZE RESERVED		MEMORY SIZE USED	
SOC		TDA2xx	TDA2EX	TDA2XX	TDA2EX
IPU1_0	Local heap	256 KB	256 KB	22 KB	22 KB
	HDVPSS Descriptor Mem	2MB	2MB	1 MB	1 MB
Shared Memory	SR0 DDR	10 MB	10 MB	3 MB	0 MB
	SR1 (Frame Buffers)	253 MB	253 MB	9 MB	9 MB
	SR2 (OCMC)	1023 KB	511 KB	0 KB	0 KB
	Remote Log Buffer	1 MB	1 MB	145 KB	145 KB

2.5 System Performance

COMPONENT	PARAMETER	VALUE	
SOC		TDA2xx	TDA2EX
Capture	Out FPS	30	30
SGXDISPLAY	Input FPS	30	30

NOTE: FPS numbers are rounded off to nearest integer

2.6 Processing Latency

		LATENCY	
SOC		TDA2xx	TDA2Ex
Capture to Display Latency	Avg	15.6 ms	15 ms
	Min	7.2 ms	7 ms
	Max	23 ms	25 ms

Note: Latency is from VIP output to the display. Additional capture latency needs to be added for end to end latency

3 Multi-channel 3D Surround view using SGX on Linux Use case TDA2xx

3.1 Overview

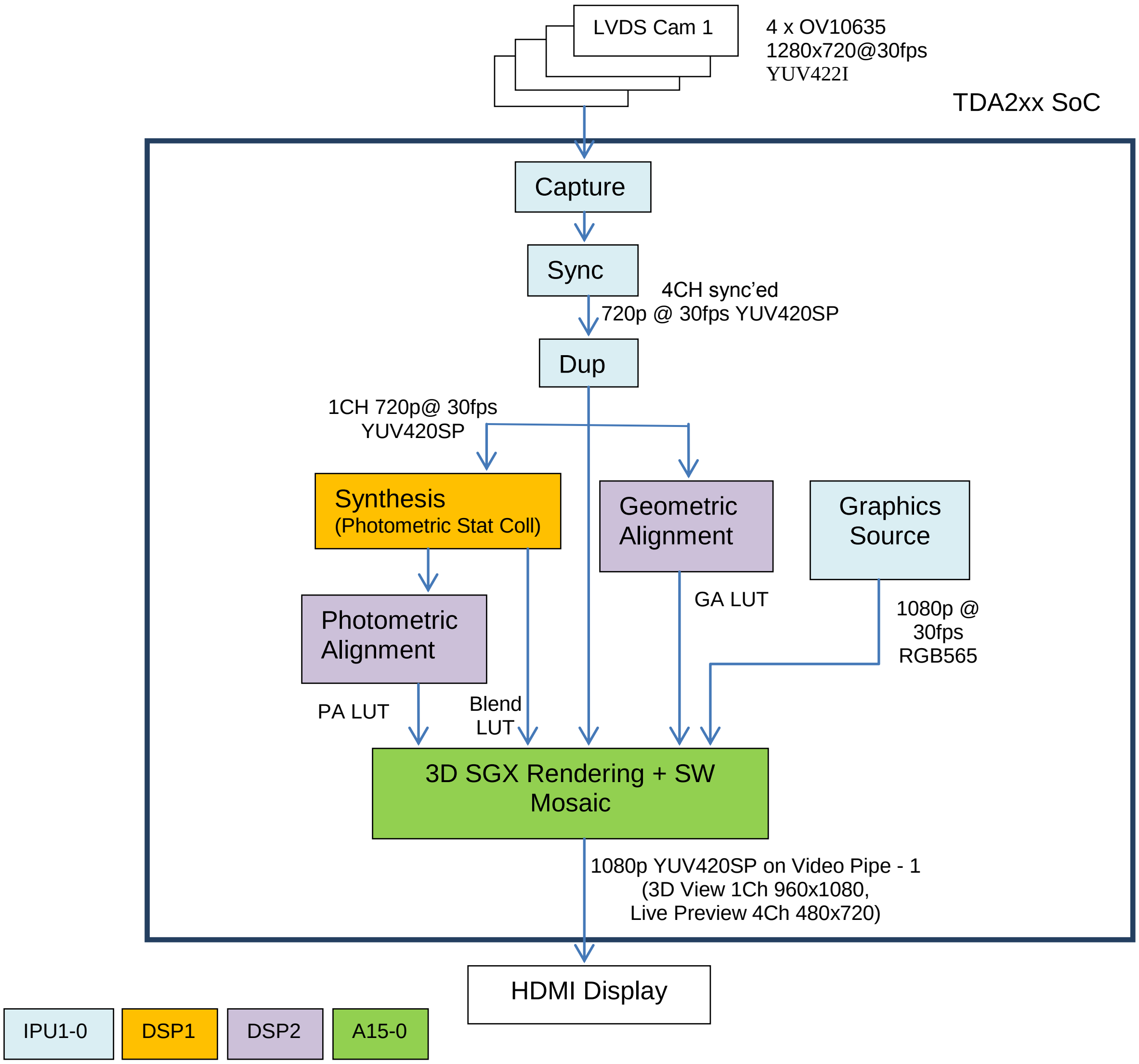
This use case demonstrates 3D surround view using SGX with Linux running on A15.

3.2 Data Flow

3.2.1 4CH LVDS capture, 3D Surround View demonstration

In this configuration we capture 4 Channel video from 4 OV1063x sensors @ 720p 30fps. Captured frames are then passed on to Sync link, where these captured frames are synced based on time stamps. This "group of sync'ed frames" is passed on to algorithm links of Geometric alignment and synthesis link. Geometric Analysis link running on DSP core is invoked once in K frames. This link generates the geometric alignment LUTs to be used during synthesis stage. Photometric Analysis link runs on DSP core. Certain image statistics needed for calculating photometric LUTs are provided by the synthesis stage. Photometric Analysis link generates LUTs for pixel value transformations during Synthesis. Synthesis link on DSP encapsulates the algorithm for generating the photometric statistics & Blend Lookup tables, based on geometric and photometric LUTs. SGX link encapsulates the algorithm for stitching, based on geometric, Blend and photometric LUTs. This Link runs on A15 (Linux) and SGX (3D GRPX Engine) is used to create the 360 degree of the car using Open GL API/Algos. Output of Synthesis link is the stitched frame which is passed onto display link, which shall display the surround view image using display drivers via LCD or HDMI output.

Please note in dataflow diagram below IPC IN/OUT blocks are left-out to improve readability. Please assume these whenever CPU changes in the flow.



**IPC IN/OUT blocks are left-out to improve readability.

3.3 System Parameters

Refer Section 13.1 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf

The only difference when Linux is in picture is, A15 runs at 1000MHz instead of 750 MHz.

3.4 CPU loading and Task Info

3.4.1 Total CPU load

CPU	CPU LOAD (%)
IPU1_0	8.2
A15_0	3.0
DSP1	22.7
DSP2	0.2
SGX	60

3.4.2 Task Level Information and Task Level CPU load

CPU	TASK NAME	TASK DESCRIPTION	CPU LOAD (%)
SOC			**TDA2xx**
IPU1_0	Capture	Capture frames via VIP port	0.5
	IPC OUT	To send frame to another processor	0.9
	SYNC Link	Sync Link to synchronize the frames from different channels	0.8
	Stat Coll	Stat collector	2.3
	GrpxSrc0	Graphic source link	0.8
	App Ctrl	Sensor init and board level contro	0.1
	Misc	Miscellaneous	0.5
A15	IPC IN	To receive frames from another processor	3.0
	SGXDISPLAY	To submit received buffer to SGX and then display via DRM	

3.4.3 Heap Memory Usage

CPU	MEMORY SECTION	MEMORY SIZE RESERVED	MEMORY SIZE USED
IPU1_0	Local heap	256 KB	22 KB
	HDVPSS Descriptor Mem	2MB	2 MB
DSP 1	L2	224 KB	128 KB
	Local Heap	32 KB	14 KB
DSP 2	L2	224 KB	0 KB
	Local Heap	32 KB	14 KB
Shared Memory	SR0	10 MB	3 MB
	SR1 (Frame Buffers)	253 MB	130 MB
	SR2 (OCMC)	1023KB	0KB
	Remote Log Buffer	1 MB	145 KB

3.5 System Performance

COMPONENT	PARAMETER	VALUE
Capture	Out FPS	28fps
ALG Synthesis (DSP1)	Output fps	28fps
ALG – Photometric Align (DSP1)	Output fps	28fps
SGXDISPLAY	Input FPS	28fps

NOTE: FPS numbers are rounded off to nearest integer. The performance bottleneck here is the Linux SGX/DRM driver, the current driver architecture do not allow the SGX to load more than 60%. This will be fixed by Q4-2015.

3.6 Processing Latency

		LATENCY
Capture to Display Latency	Avg	34 ms
	Min	5 ms
	Max	96 ms

NOTE:

- This latency is as measured inside the system by software.

- There will an additional 1/(capture rate) added on top of this from sensor/receiver itself.
- There will an additional 1/(display rate) added on top of this for the frame to actually get displayed on the screen.
- Thus e.g. in a scenario of display at 60fps and capture at 30fps - 16.67ms + 33.33ms needs to be added to latency figures in above table to get true capture to display latency

3.7 DDR BW usage

PARAMETER	BANDWIDTH	
EMIF1 Read + Write	Avg	1179 MB/s
	Peak	1673 MB/s
EMIF2 Read + Write	Avg	1176 MB/s
	Peak	1693 MB/s
Total	Avg	2356 MB/s
	Peak	3367 MB/s

4 Multi-channel LVDS capture and display usecase on Linux for TDA2Ex

4.1 Overview

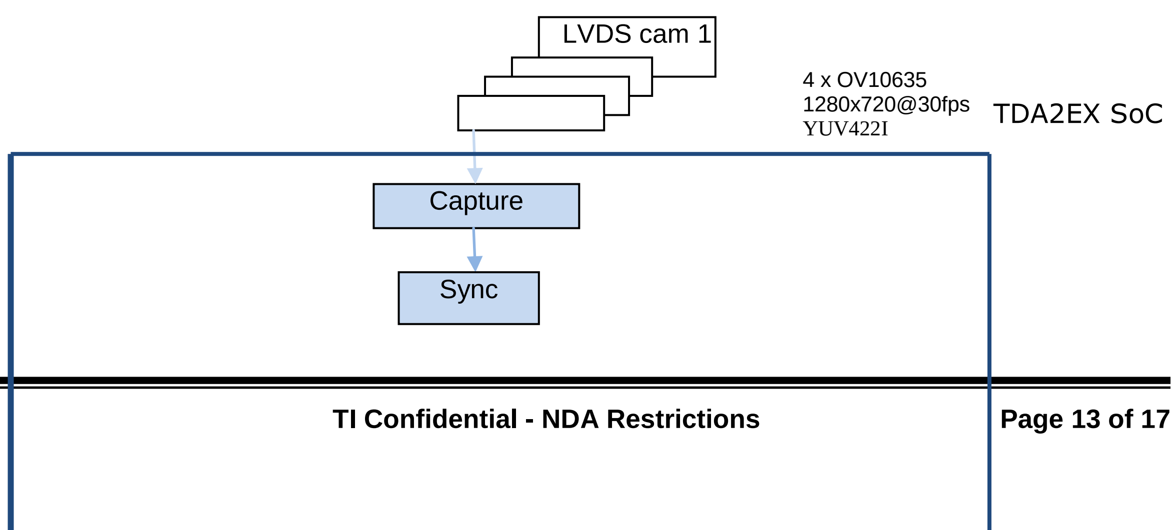
This use case demonstrates 4CH LVDS using SGX with Linux running on A15.

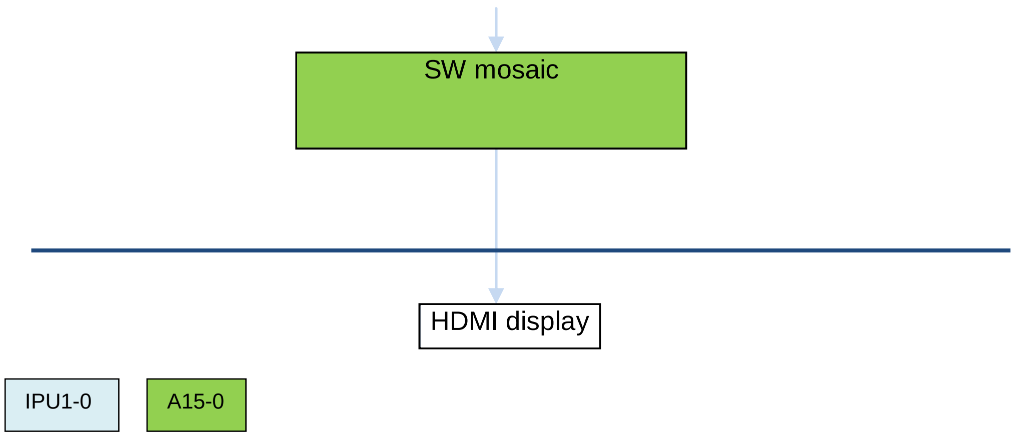
4.2 Data Flow

4.2.1 4CH LVDS capture

In this configuration we capture 4 Channel video from 4 OV1063x sensors @ 720p 30fps. Captured frames are then passed on to Sync link, where these captured frames are synced based on time stamps. Output of Synthesis link is the stitched frame which is passed onto display link, which shall display the images using display drivers via LCD or HDMI output.

Please note in dataflow diagram below IPC IN/OUT blocks are left-out to improve readability. Please assume these whenever CPU changes in the flow.





**IPC IN/OUT blocks are left-out to improve readability.

4.3 System Parameters

Refer Section 13.1 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf

The only difference when Linux is in picture is, A15 runs at 1000MHz instead of 750 MHz.

4.4 CPU loading and Task Info

4.4.1 Total CPU load

CPU	CPU LOAD (%)
IPU1_0	4.3
DSP1	0.2
A15	2.0

4.4.2 Task Level Information and Task Level CPU load

CPU	TASK NAME	TASK DESCRIPTION	CPU LOAD (%)
IPU1_0	Capture	Capture frames via VIP port	0.4
	IPC_OUT	To send frame to another processor	0.4
	SYNC	Sync across frames from multiple channels	0.8

	STAT COLL	DDR BW stats collector	1.3
	MISC	Miscellaneous	0.4

4.4.3 Heap Memory Usage

CPU	MEMORY SECTION	MEMORY SIZE RESERVED	MEMORY SIZE USED
IPU1_0	Local heap	256 KB	22 KB
	HDVPSS Descriptor Mem	2MB	1 MB
DSP 1	L2	224 KB	0 KB
	Local Heap	512 KB	14 KB
Shared Memory	SR0	10 MB	0 MB
	SR1 (Frame Buffers)	253 MB	25 MB
	SR2 (OCMC)	511 KB	0 KB
	Remote Log Buffer	1 MB	145 KB

4.5 System Performance

COMPONENT	PARAMETER	VALUE
Capture	Out FPS	30fps
SGXDISPLAY	Input FPS	30fps

NOTE: FPS numbers are rounded off to nearest integer

4.6 Processing Latency

LATENCY		
Capture to Display Latency	Avg	29.23
	Min	19.85
	Max	37.30

Note: Latency is from VIP output to the display. Additional capture latency needs to be added for end to end latency

4.7 DDR BW usage

PARAMETER	BANDWIDTH	
EMIF Read only	Avg	676 MB/s
	Peak	1436 MB/s

EMIF Write only	Avg	409 MB/s
	Peak	1336 MB/s
Total	Avg	1085 MB/s
	Peak	2772 MB/s

5 System Memory Usage for Tda2xx

5.1 Code / Data Memory Usage

Overall Linux on A15 has full 1.5 GB on the EVM except following two holes in the memory

From 0x85800000 size 0xFC00000 bytes
From 0xA0000000 size 0x4000000 bytes
From 0xA2000000 size 0x2000000 bytes

Refer Section 16.2 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf of code and data memory usage of IPU1_0

6 System Memory Usage for TDA2Ex

6.1 Code / Data Memory Usage

Overall Linux on A15 has full 1.5 GB on the EVM except following one holes in the memory

From 0xA0000000 0x2000000 bytes

Refer Section 16.2 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf of code and data memory usage of IPU1_0

7 IPC latency measurements

This section focuses on IPC latency measurements between Linux (A15) <-> Bios (IPU1_0). A15 <-> DSP IPC latencies are not measured.

For Bios <-> Bios ipc measurements refer Section 12.2 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf

7.1 A15->IPU1_0 IPC latencies

These are average case latencies.

This involves send from A15 + ISR on IPU1_0 and receipt of notification / message on IPU1_0

SOC	IPC One-way Notify Interrupt Latency (usecs)	IPC One-way Buffer Passing Latency (usecs)
TDA2xx	80	105
TDA2EX	Not Tested	Not Tested

7.2 IPU1_0->A15 IPC latencies

These are average case latencies.

This involves time for command msg sent using System_rpmsgSendNotify()/System_rpmsgMsgQSendMsg() on IPU1_0 till it is received on A15.

It means, it is send on IPU1_0 + ISR on A15 + scheduling / context switching overheads on Linux.

SOC	IPC One-way Notify Interrupt Latency (usecs)	IPC One-way Buffer Passing Latency (usecs)
TDA2xx	112	136
TDA2EX	115	137

8 Common System Parameters

Refer Section 13.1 in $INSTALL_DIR/vision_sdk/docs/VisionSDK_DataSheet.pdf

The only difference when Linux is in picture is, A15 runs at 1000MHz instead of 750 MHz.

9 Revision History

Version	Date	Revision History
1.00	25th July 2014	Created for Vision SDK release v2.03
2.00	17th Nov 2014	Updated for Vision SDK release v2.05
3.00	4th Mar 2015	Updated for Vision SDK release v2.06
4.00	7th July 2015	Updated for Vision SDK release v2.07