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Linux Interface Specification Device Driver QoS

Application Note

R-Car H3/M3/M3N/E3/D3 Series

Renesas Electronics
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Rev.3.00 Dec. 2021

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(Rev.5.0-1 October 2020)

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How to Use This Manual

- **[Readers]**

  This manual is intended for engineers who develop products which use the R-Car H3/M3/M3N/E3/D3 processor.

- **[Purpose]**

  This manual is intended to give users an understanding of the functions of the R-Car H3/M3/M3N/E3/D3 processor device driver and to serve as a reference for developing hardware and software for systems that use this driver.

- **[How to Read This Manual]**

  It is assumed that the readers of this manual have general knowledge in the fields of electrical
  — Engineering, logic circuits, microcontrollers, and Linux.
    → Read this manual in the order of the CONTENTS.
  — To understand the functions of a multimedia processor for R-Car H3/M3/M3N/E3/D3
    → See the R-Car H3/M3/M3N/E3/D3 User's Manual.
  — To know the electrical specifications of the multimedia processor for R-Car H3/M3/M3N/E3/D3
    → See the R-Car H3/M3/M3N/E3/D3 Data Sheet.

- **[Conventions]**

  The following symbols are used in this manual.
  Data significance: Higher digits on the left and lower digits on the right
  Note: Footnote for item marked with Note in the text
  Caution: Information requiring particular attention
  Remark: Supplementary information
  Numeric representation: Binary ... ××××, 0b××××, or ××××B
  Decimal ... ××××
  Hexadecimal ... 0x×××× or ××××H
  Data type: Double word … 64 bits
  Word … 32 bits
  Half word ... 16 bits
  Byte ... 8 bits

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Table of Contents

1. Overview

1.1 Overview

R-Car H3/M3/M3N/E3/D3 bus system controls bandwidth by QoS values.

This manual explains the interactive QoS values by each use-cases.

1.2 Reference

1.2.1 Related Documents

Error! Reference source not found. shows the document related to this driver.

Table 1-1 Related document (R-Car H3/M3/M3N/E3/D3)

Number	Issue	Title	Edition	Date
-	Renesas Electronics	R-Car Series, 3rd Generation User's Manual: Hardware	Rev.2.20	Jun. 30, 2020
-	Renesas Electronics	R-CarH3-SiP System Evaluation Board Salvator-X Hardware Manual RTP0RC7795SIPB0011S	Rev.1.09	May. 11, 2017
-	Renesas Electronics	R-CarM3-SiP System Evaluation Board Salvator-X Hardware Manual RTP0RC7796SIPB0011S	Rev.0.04	Oct. 3.2016
-	Renesas Electronics	R-CarH3-SiP/M3-SiP/M3N-SiP System Evaluation Board Salvator-XS Hardware Manual	Rev.2.04	Jul. 17, 2018
-	Renesas Electronics	R-CarE3 System Evaluation Board Ebisu Hardware Manual RTP0RC77990SEB0010S	Rev.0.03	Apr. 11, 2018
-	Renesas Electronics	R-CarE3 System Evaluation Board Ebisu-4D (E3 board 4xDRAM) Hardware Manual	Rev.1.01	Jul. 19, 2018
-	Renesas Electronics	R-CarD3 System Evaluation Board Hardware Manual RTP0RC77995SEB0010S	Rev.1.20	Jul. 25, 2017
-	Renesas Electronics	Linux Interface Specification Device Driver QoS User's Manual: Software	Rev.2.50	Apr. 21, 2021

1.3 Notice

This document supports R-Car H3 Ver.3.0/M3 Ver.3.0/M3N Ver.1.x/E3 Ver.1.x/D3 Ver.1.x

1.4 Terminology

The following table shows the terminology related to this module.

Table 1-2 Terminology

Terms	Explanation
QoS	Quality of Service
FIX	Fix bandwidth
BE	Best effort bandwidth

2. Operating Environment

2.1   Hardware Environment

The following table lists the hardware needed to use this module.

Table 2-1 Hardware specification (R-Car H3/M3/M3N/E3/D3)

Name	Version	Manufacture
R-CarH3-SiP System Evaluation Board Salvator-X	-	Renesas Electronics
R-CarM3-SiP System Evaluation Board Salvator-X	-	Renesas Electronics
R-CarH3-SiP/M3-SiP/M3N-SiP System Evaluation Board Salvator-XS	-	Renesas Electronics
R-CarE3 System Evaluation Board Ebisu	-	Renesas Electronics
R-CarE3 System Evaluation Board Ebisu-4D	-	Renesas Electronics
R-CarD3 System Evaluation Board Draak	-	Renesas Electronics

Module Configuration

Figure 2-1 shows the software configuration in which this module is used.
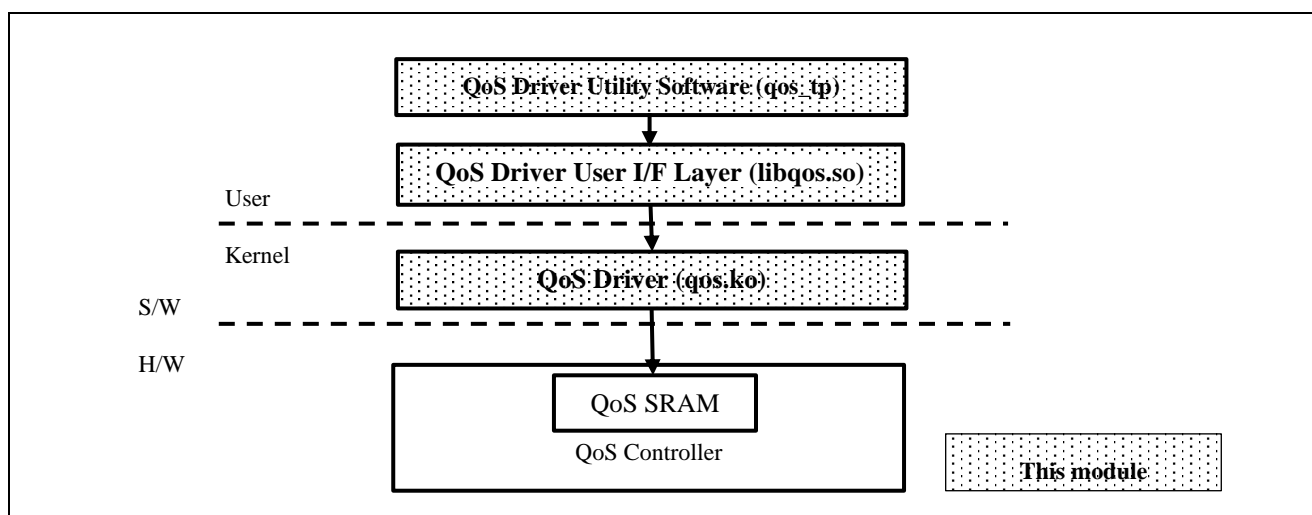
Figure 2-1 Software block diagram

2.2   Software Environment

QoS driver support Yocto recipe package version from v2.9.0

QoS is valid with start-up of kernel.

3. Benefit of R-Car Series, 3rd Generation Bus System

R-Car Series 3rd Generation bus system controls bandwidth usage more effectively by setting QoS parameters along with each use case.
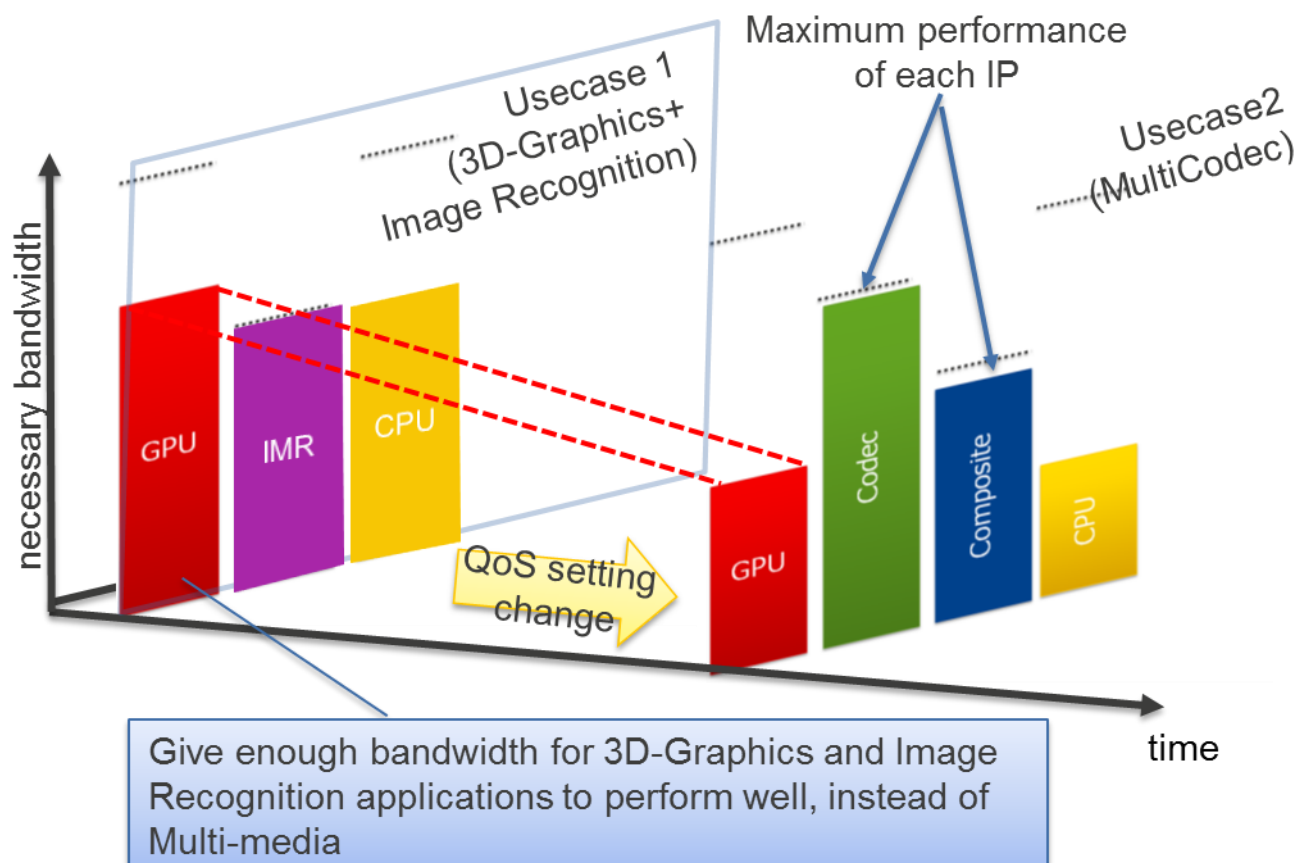
Figure 3-1 Benefit of R-Car Series, 3rd Generation Bus System

To setting QoS arbitration, please select a sample of QoS Parameter.

QoS driver can configure the sample to QoS SRAM at once.

4. QoS parameters

QoS parameters are based on traffic of each Master per a unit of time. R-Car Series, 3rd Generation bus system is Time slot base arbitration system and QoS controller manages all arbitration among several Masters for DRAM access, using QoS parameters. QoS parameters can be set, which provides optimized arbitration for each use case.
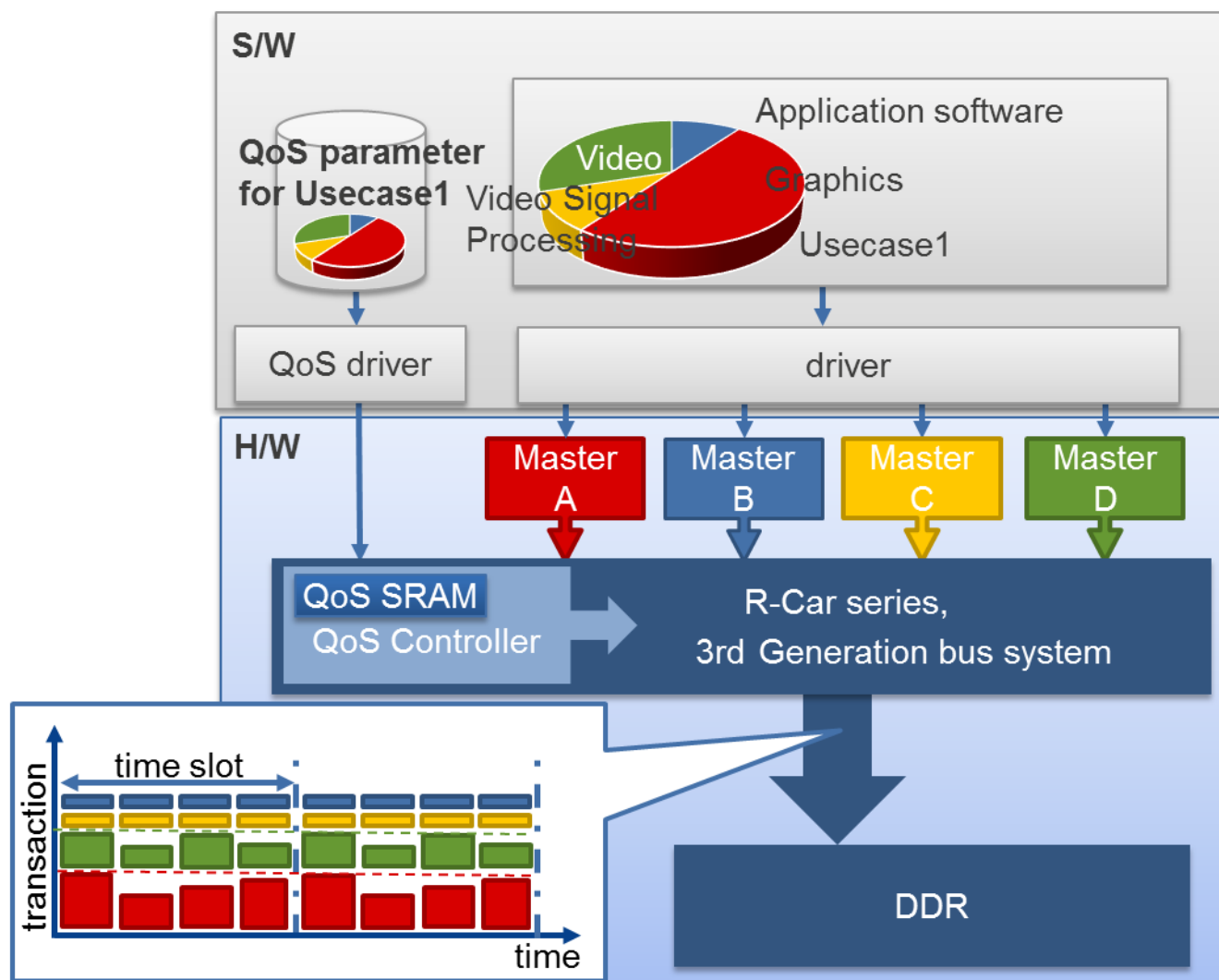
Figure 4-1 System configuration of QoS

As QoS parameters, each Master has one traffic type, which is chosen from FIX or BE.

Table 4-1 Traffic type

Traffic type	Note
FIX (reserved) bandwidth	Reserving bandwidth makes it possible for Masters to perform real-time process consistently. The traffic type of VSPD, VIN, VSPB, VSPI, VCP and Audio etc. are fixed as FIX.
BE (target) bandwidth	User can specify the target bandwidth for each BE Masters, but this BE bandwidth is not reserved. BE bandwidth varies according to the processing of FIX Masters. The traffic type of GPU, CPU and etc. are fixed as BE.

5.Sample of QoS Parameters

5.1 Condition

Table 5-1 Condition (R-Car H3/M3/M3N/E3/D3)

H/W	Condition
H3	Ver. 3.0 LPDDR4, 3200, 32bit x 4channel Split mapping
M3	Ver. 3.0 LPDDR4, 3200, 32bit x 2channel Split mapping
M3N	Ver. 1.0 LPDDR4, 3200, 32bit x 1channel Linear mapping
E3	Ver. 1.0 DDR3L, 1866, 32bit x 1channel Linear mapping
D3	Ver. 1.0 DDR3L, 1866, 16bit x 1channel Linear mapping

5.2 Sample file

QoS sample files in details and display path 1 sample are shown as below.

Table 5-2 Sample file (R-Car H3/M3/M3N/E3)

H/W	Use case	CSV file	Bandwidth of CSV file	Sample display path
M3	Default Setting	m3_Ver30_default_setting_v01_195.csv m3_Ver30_default_setting_v01_390.csv	Table 5-3	---
	Infotainment	m3_Ver30_infotainment_v01_195.csv m3_Ver30_infotainment_v01_390.csv	Table 5-4	Figure 5-1
	Cluster	m3_Ver30_cluster_v01_195.csv m3_Ver30_cluster_v01_390.csv	Table 5-5	Figure 5-2
	Integrated Cockpit	m3_Ver30_integrated_cockpit_v01_195.csv m3_Ver30_integrated_cockpit_v01_390.csv	Table 5-6	Figure 5-3
H3	Default Setting	h3_Ver30_default_setting_v02_195.csv h3_Ver30_default_setting_v02_390.csv	Table 5-7	---
	Infotainment	h3_Ver30_infotainment_v02_195.csv h3_Ver30_infotainment_v02_390.csv	Table 5-8	Figure 5-4
	Cluster	h3_Ver30_cluster_v01_195.csv h3_Ver30_cluster_v01_390.csv	Table 5-9	Figure 5-5
	Integrated Cockpit	h3_Ver30_integrated_cockpit_v02_195.csv h3_Ver30_integrated_cockpit_v02_390.csv	Table 5-10	Figure 5-6
M3N	Default Setting	m3n_Ver1x_default_setting_v04_195.csv m3n_Ver1x_default_setting_v04_390.csv	Table 5-11	---
	Infotainment - Full HD	m3n_Ver1x_infotainment_fhd_v04_195.csv m3n_Ver1x_infotainment_fhd_v04_390.csv	Table 5-12	Figure 5-7
	Infotainment - HD	m3n_Ver1x_infotainment_hd_v04_195.csv m3n_Ver1x_infotainment_hd_v04_390.csv	Table 5-13	Figure 5-8
	Cluster	m3n_Ver1x_cluster_v03_195.csv m3n_Ver1x_cluster_v03_390.csv	Table 5-14	Figure 5-9
E3	Default Setting	e3_Ver1x_default_setting_v03_390.csv e3_Ver1x_default_setting_v03_780.csv	Table 5-15	---
	Meter ,Video and Map	e3_Ver1x_meter_video_and_map_v02_390.csv e3_Ver1x_meter_video_and_map_v02_780.csv	Table 5-16	Figure 5-10
	Meter and HUD	e3_Ver1x_meter_and_hud_v02_390.csv e3_Ver1x_meter_and_hud_v02_780.csv	Table 5-17	Figure 5-11

	Cluster	e3_Ver1x_cluster_v02_390.csv e3_Ver1x_cluster_v02_780.csv	Table 5-18	Figure 5-12
D3	Default Setting	d3_Ver10_default_setting_v01.csv	Table 5-19	---

The specification and number of H/W IPs are different between H3 Ver.1.1 and H3 Ver. 2.0.
Regarding the details, please refer "R-Car Series, 3rd Generation User's Manual: Hardware".
The sample files for H3 Ver. 2.0 are only used for H3 Ver. 2.0 H/W.
If you want to use H3 Ver. 1.1, please use attachment file of RENESAS_RCH3M3_QOS_APP_v0.5.pdf.

The specification of H/W IPs is different between M3 Ver. 1.0 and M3 Ver. 1.1/ Ver. 1.2.
Regarding the details, please refer "R-Car Series, 3rd Generation User's Manual: Hardware".
The sample files for M3 Ver. 1.1 are used for M3 Ver. 1.1 H/W and M3 Ver. 1.2 H/W.
If you want to use M3 Ver.1.0, please use attachment file of RENESAS_RCH3M3_QOS_APP_v0.6.pdf.

The specification of H/W IPs is different between H3 Ver. 2.0 and H3 Ver. 3.0.
Regarding the details, please refer "R-Car Series, 3rd Generation User's Manual: Hardware".
The sample files for H3 Ver. 3.0 are only used for H3 Ver. 3.0 H/W.
If you want to use H3 Ver.2.0, please use attachment file of RENESAS_RCH3M3M3NE3_QOS_APP_v1.03.pdf.

The specification of H/W IPs is different between M3 Ver. 1.1/ Ver. 1.2 and M3 Ver. 3.0.
Regarding the details, please refer "R-Car Series, 3rd Generation User's Manual: Hardware".
The sample files for M3 Ver. 3.0 are only used for M3 Ver. 3.0 H/W.
If you want to use M3 Ver.1.1/Ver.1.2, please use attachment file of
RENESAS_RCH3M3M3NE3_QOS_APP_v2.00.pdf.

You should choice csv file according as your DRAM refresh interval.
You can select DRAM refresh interval by BSP IPL build configuration. Please refer to IPL UM for detail configuration.
BSP IPL supports two kinds of DRAM refresh interval for each chip:

For H3 Ver. 2.0/ Ver. 3.0, M3 Ver. 1.1/ Ver. 1.2/Ver.3.0 and M3N:
Normally in case of 1.95us (default), please use "*_195.csv" file.
Optionally in case of 3.90us, please use "*_390.csv" file.

For E3:
Normally in case of 3.90us (default), please use "*_390.csv" file.
Optionally in case of 7.80us, please use "*_780.csv" file.

5.2.1　M3 Default Setting (for unit test)

"Default-setting" is used as the initial setting value when M3 starts.

　　Sample explain: This sample allocates the each of QoS values to all H/W IPs.

　　This sample can run each H/W IP. Please use for unit test only.

Table 5-3 Bandwidth of M3 Default Setting

No.	Master	R/W Read (MB/s)	Write (MB/s)
1	IMP	3200	3200
2	VSPD0	1782	594
3	VSPD1	1782	594
4	VSPD2	1200	400
5	VSPD3		
6	HDMI	40	40
7	VIN0123		891
8	VIN4567		891
9	VSPB	8000	2000
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	2000	2000
15	VSPI1		
16	VSPI2		
17	FDP	1000	2000
18	IMR	1600	1600
19	iVDP1C	0	0
20	VDPB	3064	370
21	VCPLF	2816	583
22	VCPL4		
23	AP-System Core	9600	9600
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	9600	6400

Video&Display
Audio
etc

5.2.2 M3 Infotainment

Sample explain: The value of this use-case is for executing up to 2 video decodes, 5 video inputs, 3 displays, and 1 graphics application at same time.
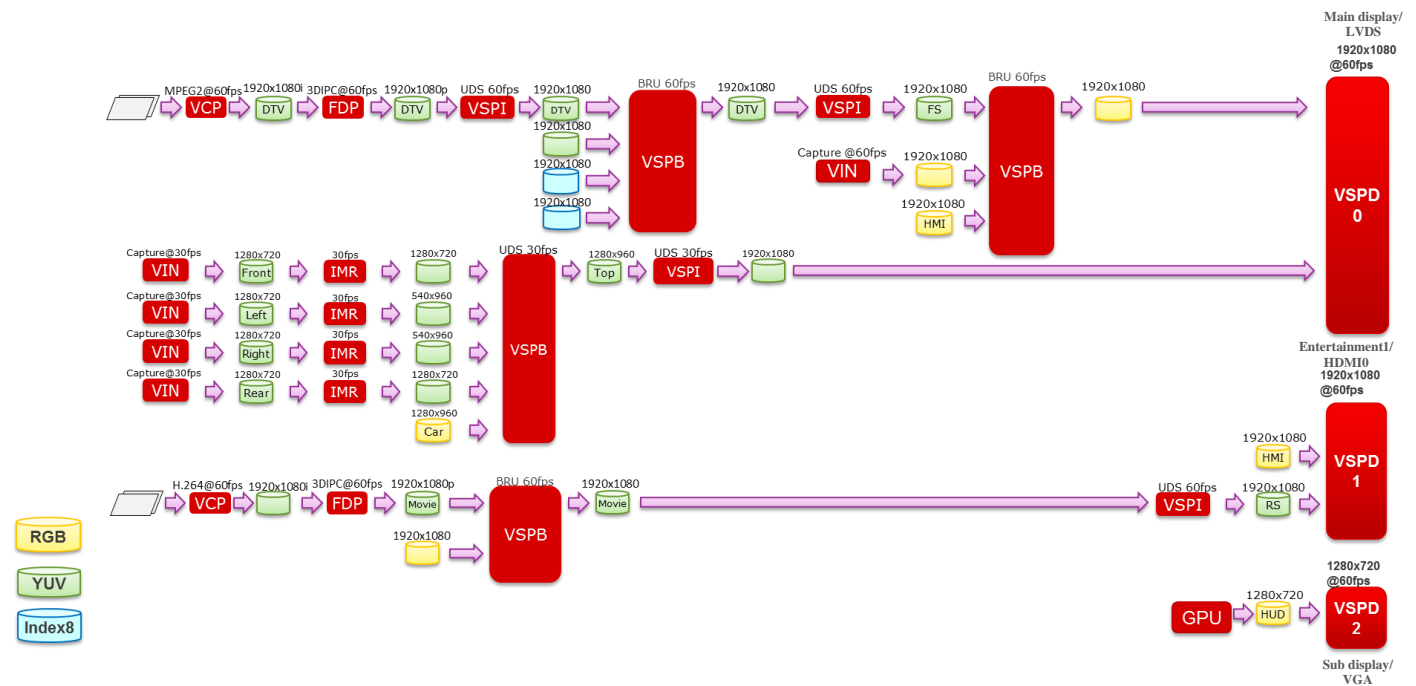
Figure 5-1 M3 Infotainment Use Case Display Path sample

Table 5-4 Bandwidth of M3 Infotainment

No.	Master	R/W Read (MB/s)	R/W Write (MB/s)
1	IMP	3200	3200
2	VSPD0	901	0
3	VSPD1	901	0
4	VSPD2	301	0
5	VSPD3		
6	HDMI	40	40
7	VIN0123		743
8	VIN4567		149
9	VSPB	3678	1151
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	1141	1062
15	VSPI1		
16	VSPI2		
17	FDP	564	533
18	IMR	1000	1000
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	551	209
22	VCPL4		
23	AP-System Core	4800	4800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	6400	4800

Video&Display
Audio
etc

5.2.3   M3 Cluster

Sample explain: The value of this use-case is for executing 1 display and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop LVDS and VGA display.

Display stop setting sample:

setenv bootargs 'video=HDMI-A-1:2880x1080-32@60 video=VGA-1:d video=LVDS-1:d'
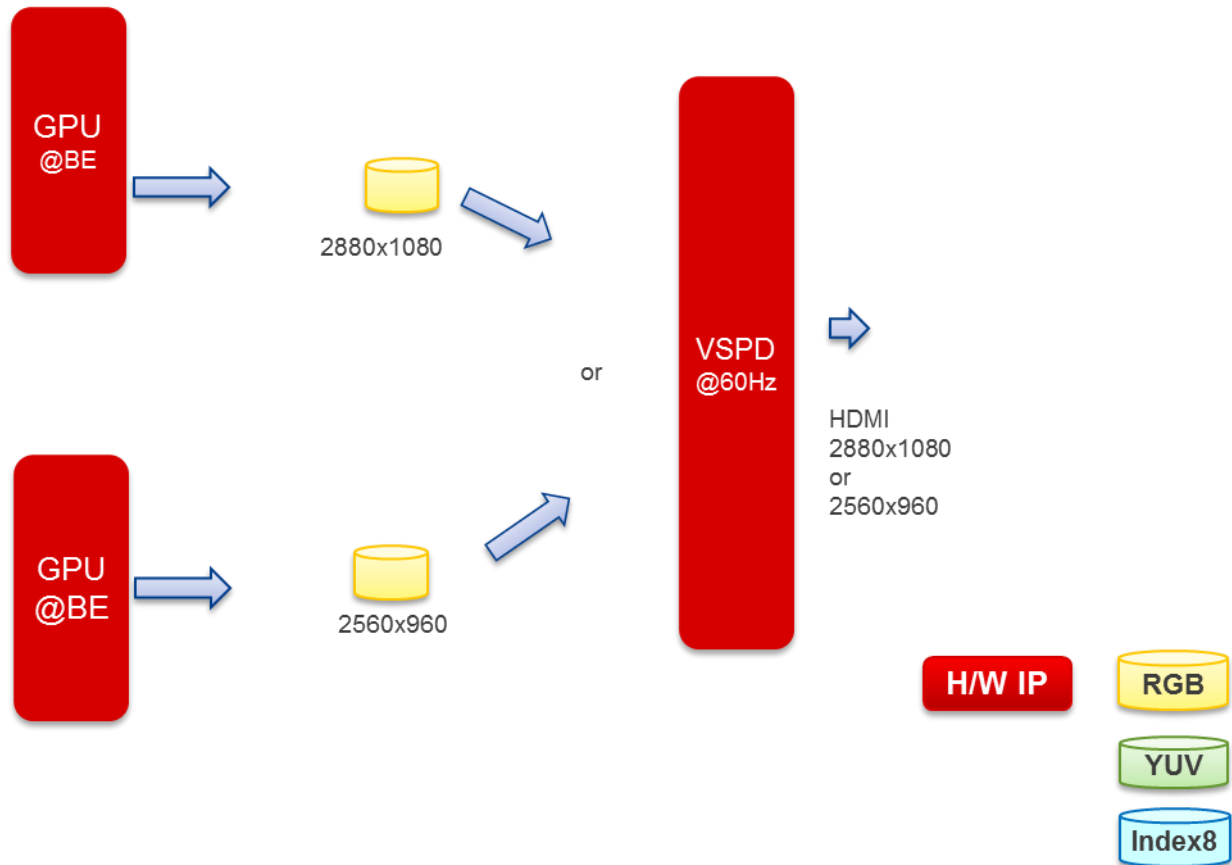
Figure 5-2   M3 Cluster Use Case Display Path sample

Table 5-5 Bandwidth of M3 Cluster

No.	Master	R/W Read (MB/s)	R/W Write (MB/s)
1	IMP	0	0
2	VSPD0	0	0
3	VSPD1	897	0
4	VSPD2	0	0
5	VSPD3		
6	HDMI	40	40
7	VIN0123		0
8	VIN4567		0
9	VSPB	0	0
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	0	0
15	VSPI1		
16	VSPI2		
17	FDP	0	0
18	IMR	0	0
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	4800	4800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	9600	6400

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etc

5.2.4　M3 Integrated Cockpit

　　Sample explain: The value of this use-case is for executing up to 1 video decode, 1 video encode, 3 video inputs and 2 displays, and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop VGA display.

　　Display stop setting sample:

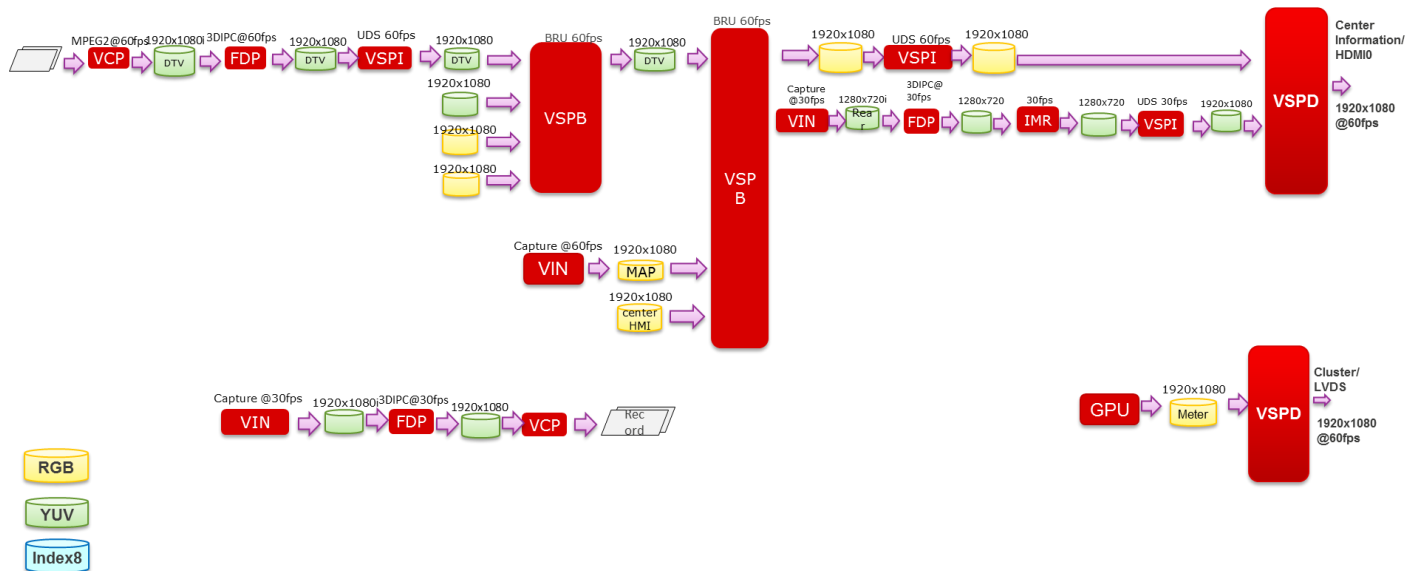　　setenv bootargs 'video=HDMI-A-1:1920x1080-32@60 video=VGA-1:-d'

Figure 5-3 M3 Integrated Cockpit Use Case Display Path sample

Table 5-6 Bandwidth of M3 Integrated Cockpit

No.	Master	R/W	
		Read	Write
		(MB/s)	(MB/s)
1	IMP	3200	3200
2	VSPD0	599	0
3	VSPD1	901	0
4	VSPD2	0	0
5	VSPD3		
6	HDMI	0	0
7	VIN0123		743
8	VIN4567		149
9	VSPB	2767	751
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	1026	1046
15	VSPI1		
16	VSPI2		
17	FDP	741	652
18	IMR	800	800
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	680	202
22	VCPL4		
23	AP-System Core	4800	4800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	6400	4800

| Video&Display |
| Audio |
| etc |

5.2.5 H3 Default Setting (for unit test)

"Default-setting" is used as the initial setting value when H3 starts.

Sample explain: This sample allocates the each of QoS values to all H/W IPs.

This sample can run each H/W IP. Please use for unit test only.

Table 5-7 Bandwidth of H3 Default Setting

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP	9600	9600
2	VSPD0	2386	596
3	VSPD1	2386	1193
4	VSPD2	2386	1193
5	VSPD3		
6	HDMI	80	80
7	VIN0123		1337
8	VIN4567		1337
9	VSPB	8000	2000
10	VSPBD	8000	2000
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	2000	2000
15	VSPI1	2000	2000
16	VSPI2		
17	FDP	2000	4000
18	IMR	3200	3200
19	iVDP1C	4473	1486
20	VDPB	3064	370
21	VCPLF	2816	583
22	VCPL4		
23	AP-System Core	9600	9600
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	500	500
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	19200	19200

| Video&Display |
| Audio |
| etc |

5.2.6　H3 Infotainment

Sample explain:　The value of this use-case is for executing up to 3 video decodes, 5 video inputs and 4 displays, and 1 graphics application at same time.
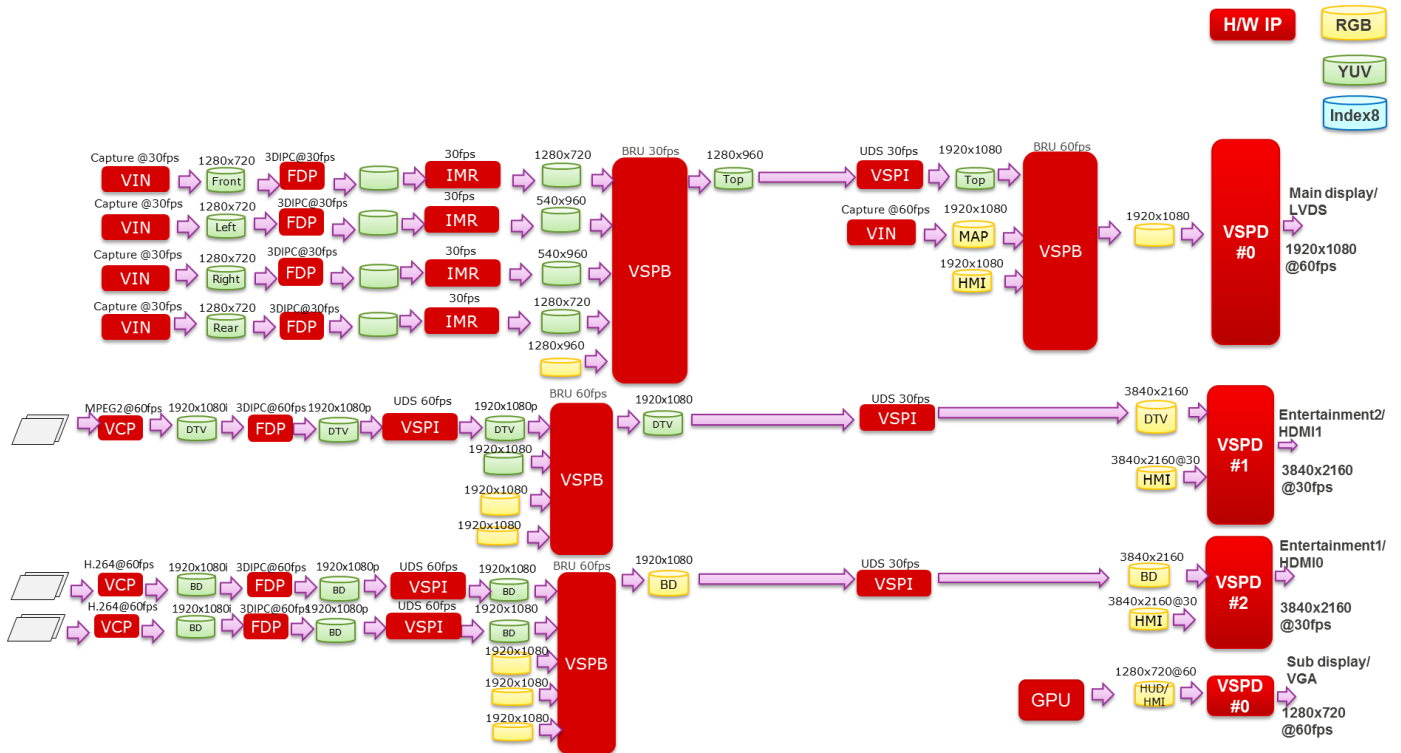

Figure 5-4 H3 Infotainment Use Case Display Path sample

Table 5-8 Bandwidth of H3 Infotainment

No.	Master	FIX R/W	
		Read	Write
		(MB/s)	(MB/s)
1	IMP	1600	1600
2	VSPD0	1004	0
3	VSPD1	2386	0
4	VSPD2	2386	0
5	VSPD3		
6	HDMI	80	80
7	VIN0123		742
8	VIN4567		149
9	VSPB	2915	650
10	VSPBD	2767	751
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	1141	1062
15	VSPI1	498	2053
16	VSPI2		
17	FDP	1215	1038
18	IMR	1000	1000
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	968	355
22	VCPL4		
23	AP-System Core	3200	3200
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	500	500
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	6400	3200

Video&Display
Audio
etc

5.2.7 H3 Cluster

Sample explain: The value of this use-case is for executing 2 display and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop LVDS and VGA display.

Display stop setting sample:

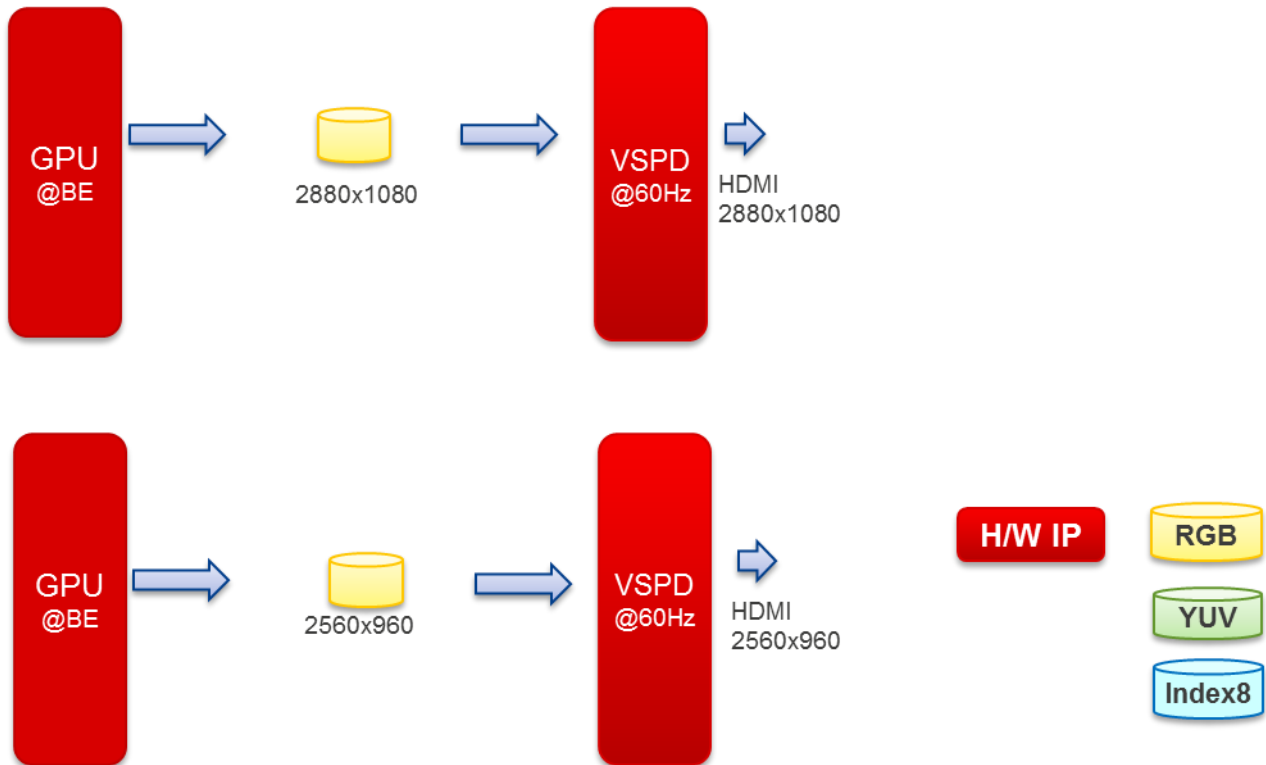setenv bootargs 'video=HDMI-A-1: 2880x1080 -32@60 video=HDMI-A-2:2560x960M-32@60 video=VGA-1:d video=LVDS-1:d'

Figure 5-5 H3 Cluster Use Case Display Path sample

Table 5-9 Bandwidth of H3 Cluster Use Case

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP	0	0
2	VSPD0	0	0
3	VSPD1	897	0
4	VSPD2	897	0
5	VSPD3		
6	HDMI	80	80
7	VIN0123		0
8	VIN4567		0
9	VSPB	0	0
10	VSPBD	0	0
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	0	0
15	VSPI1	0	0
16	VSPI2		
17	FDP	0	0
18	IMR	0	0
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	3200	3200
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	500	500
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	12800	6400

Video&Display
Audio
etc

5.2.8　H3 Integrated Cockpit

　　Sample explain: The value of this use-case is for executing up to 1 video decodes, 3 video inputs and 3 displays, and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop VGA display.

　　Display stop setting sample:

　　setenv bootargs 'video=HDMI-A-1:1920x1080-32@60 video=HDMI-A-2:2880x1080-32@60 video=VGA-1:-d'
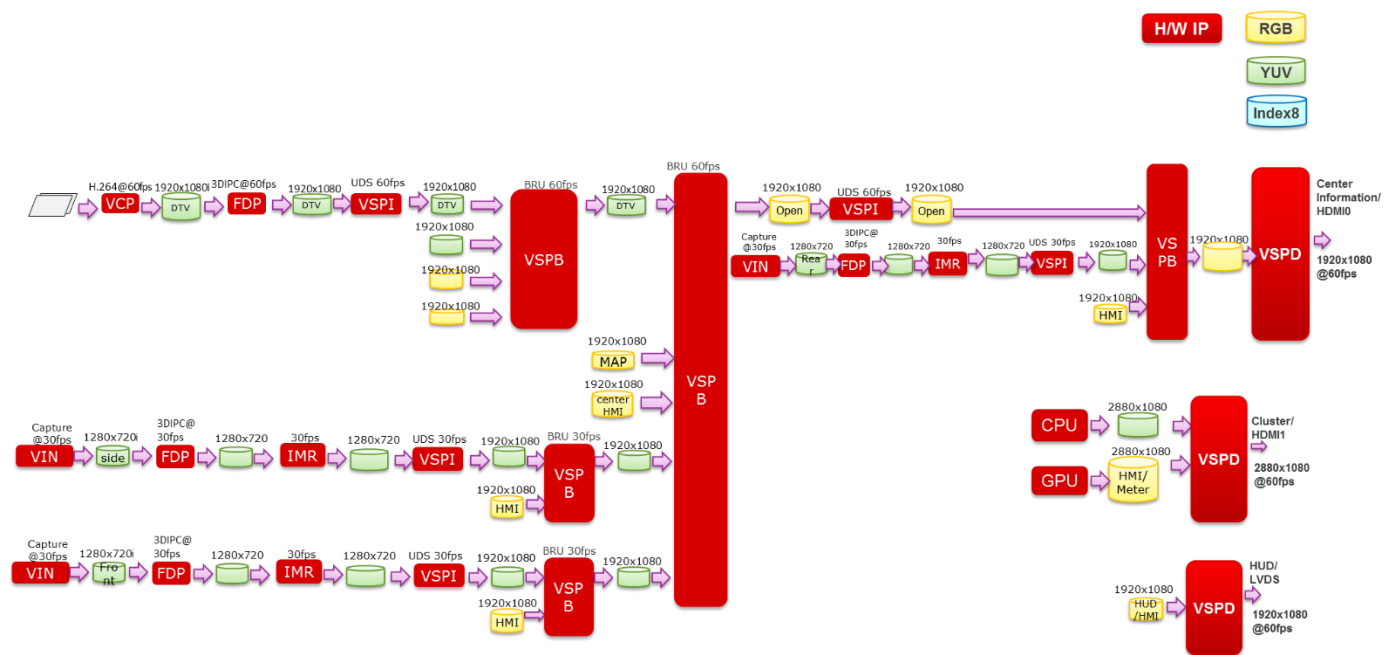

Figure 5-6 H3 Integrated Cockpit Use Case Display Path sample

Table 5-10 Bandwidth of H3 Integrated cockpit

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP	1600	1600
2	VSPD0	599	0
3	VSPD1	599	0
4	VSPD2	1348	0
5	VSPD3		
6	HDMI	80	80
7	VIN0123		446
8	VIN4567		149
9	VSPB	3020	753
10	VSPBD	3020	1000
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	565	515
15	VSPI1	755	1062
16	VSPI2		
17	FDP	749	624
18	IMR	2400	2400
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	417	146
22	VCPL4		
23	AP-System Core	3200	3200
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	500	500
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	40	40
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	9600	6400

Video&Display
Audio
etc

5.2.9 M3N Default Setting (for unit test)

"Default-setting" is used as the initial setting value when M3N starts.

Sample explain: This sample allocates the each of QoS values to all H/W IPs.

This sample can run each H/W IP. Please use for unit test only.

Table 5-11 Bandwidth of M3N Default Setting

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	1782	594
3	VSPD1	1782	594
4	VSPD2		
5	VSPD3		
6	HDMI	40	40
7	VIN0123		1125
8	VIN4567		375
9	VSPB	4584	2016
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	2000	2000
15	VSPI1		
16	VSPI2		
17	FDP	1000	2000
18	IMR	1600	1600
19	iVDP1C	0	0
20	VDPB	3064	370
21	VCPLF	2816	583
22	VCPL4		
23	AP-System Core	4800	4800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	4800	4800
38	DAB	10	10

Video&Display
Audio
etc

5.2.10   M3N Infotainment 1 (Full HD)

Sample explain: The value of this use-case is for executing up to 1 video decode, 1 video encode, 3 video inputs, 3 displays at same time.

Display setting sample:

setenv bootargs 'video=HDMI-A-1:1920x1080-32@60 video=VGA-1: 1280x720-32@60 video=LVDS-1: 1920x1080-32@60
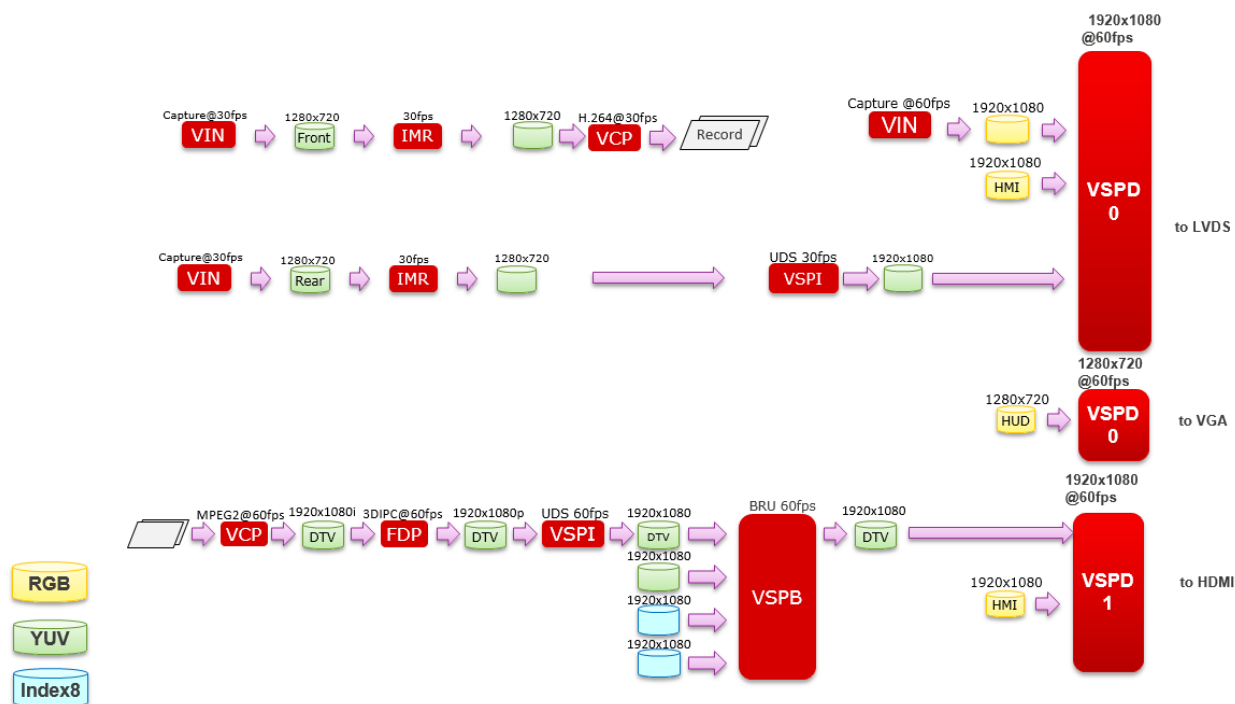

Figure 5-7 M3N Infotainment 1 Use Case Display Path sample

Table 5-12 Bandwidth of M3N Infotainment 1 Use Case

Video&Display
Audio
etc

No.	Master	FIX R/W Read (MB/s)	FIX R/W Write (MB/s)
1	IMP		
2	VSPD0	1811	0
3	VSPD1	906	0
4	VSPD2		
5	VSPD3		
6	HDMI	0	0
7	VIN0123		743
8	VIN4567		149
9	VSPB	776	253
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	553	424
15	VSPI1		
16	VSPI2		
17	FDP	282	208
18	IMR	300	200
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	308	125
22	VCPL4		
23	AP-System Core	1600	1600
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	2400	1600
38	DAB	10	10

5.2.11   M3N Infotainment 2 (HD)

Sample explain: The value of this use-case is for executing up to 1 video decode, 1 video encode, 2 video inputs, 3 displays, and 1 graphics application at same time.

Display setting sample:

setenv bootargs 'video=HDMI-A-1:1280x720-32@60 video=VGA-1: 720x480-32@60 video=LVDS-1: 1280x720-32@60
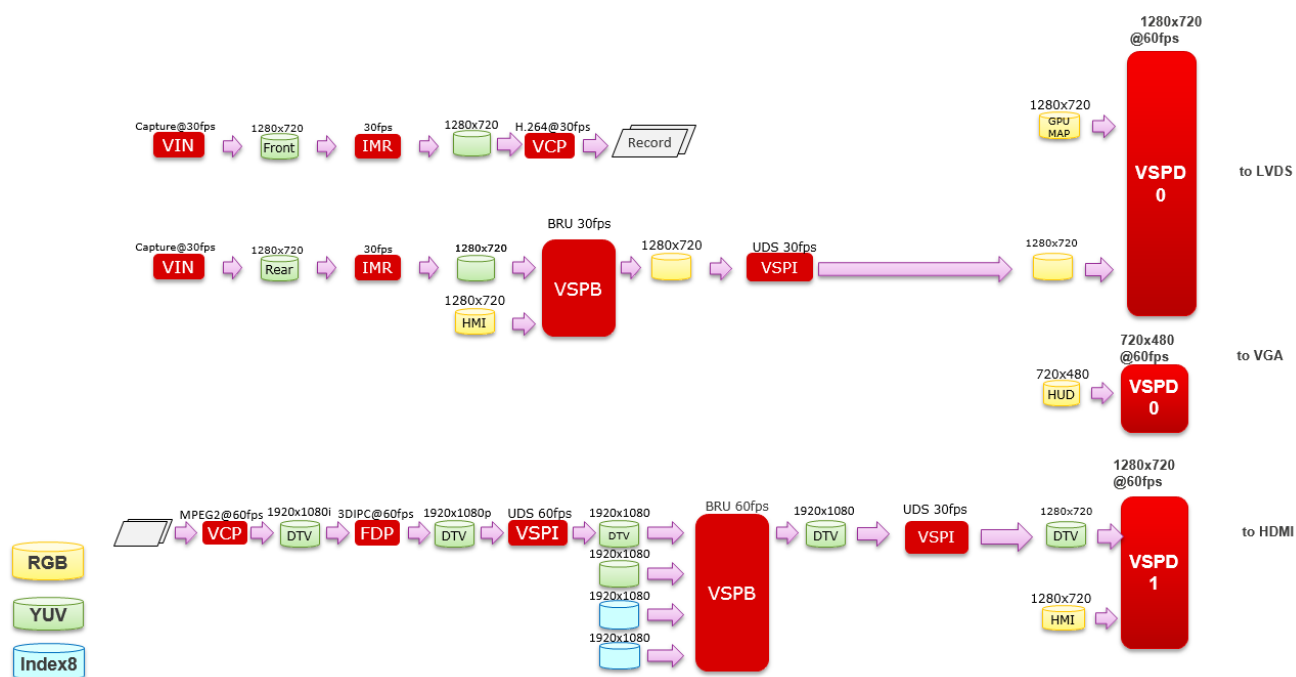

Figure 5-8   M3N Infotainment 2 Use Case Display Path sample

Table 5-13 Bandwidth of M3N Infotainment 2 Use Case

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	734	0
3	VSPD1	457	0
4	VSPD2		
5	VSPD3		
6	HDMI	0	0
7	VIN0123		149
8	VIN4567		149
9	VSPB	1112	476
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	963	553
15	VSPI1		
16	VSPI2		
17	FDP	282	208
18	IMR	300	200
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	308	125
22	VCPL4		
23	AP-System Core	1600	1600
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	4000	2400
38	DAB	10	10

Video&Display
Audio
etc

5.2.12   M3N Cluster

Sample explain: The value of this use-case is for executing 1 display and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop LVDS and VGA display.

Display stop setting sample:

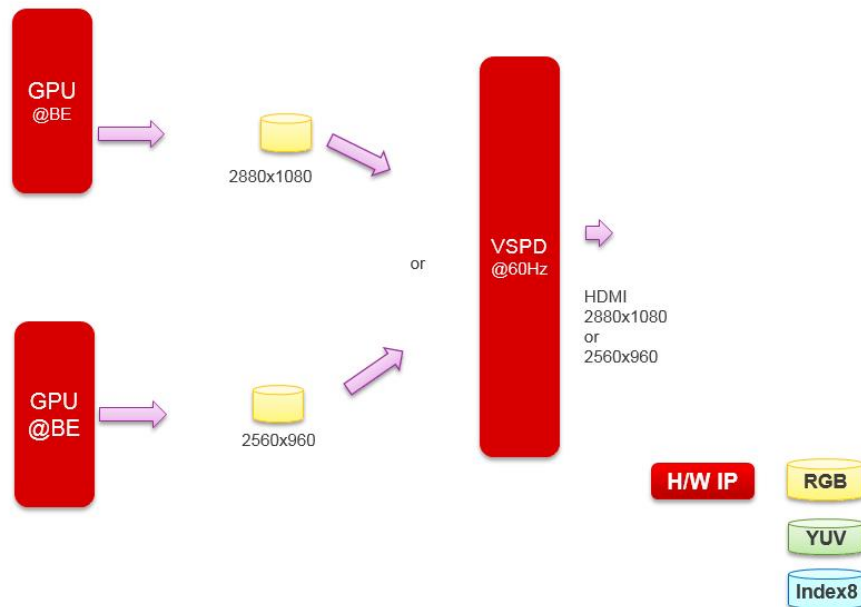setenv bootargs 'video=HDMI-A-1:2880x1080-32@60 video=VGA-1:d video=LVDS-1:d'

Figure 5-9 M3N Cluster Use Case Display Path sample

Table 5-14 Bandwidth of M3N Cluster

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	0	0
3	VSPD1	896	0
4	VSPD2		
5	VSPD3		
6	HDMI	0	0
7	VIN0123		0
8	VIN4567		0
9	VSPB	0	0
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	0	0
15	VSPI1		
16	VSPI2		
17	FDP	0	0
18	IMR	0	0
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	1600	1600
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1	50	50
36	SYS-DMAC Ch16-47	50	50
37	GSX	4800	3200
38	DAB	10	10

Video&Display
Audio
etc

5.2.13 E3 Default Setting (for unit test)

"Default-setting" is used as the initial setting value when E3 starts.

    Sample explain: This sample allocates the each of QoS values to all H/W IPs.

    This sample can run each H/W IP. Please use for unit test only.

Table 5-15 Bandwidth of E3 Default Setting

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	1782	594
3	VSPD1	1782	594
4	VSPD2		
5	VSPD3		
6	HDMI		
7	VIN0123		
8	VIN4567		891
9	VSPB	2000	500
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	500	500
15	VSPI1		
16	VSPI2		
17	FDP	250	500
18	IMR	532	532
19	iVDP1C	0	0
20	VDPB	1532	185
21	VCPLF	1408	292
22	VCPL4		
23	AP-System Core	2400	2400
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1		
36	SYS-DMAC Ch16-47	50	50
37	GSX	2400	2400
38	DAB	10	10

Video&Display
Audio
etc

5.2.14 E3 Meter, Video and Map

Sample explain: The value of this use-case is for executing up to 1 video decode, 2 video inputs, 2 displays at same time.

Display setting sample:

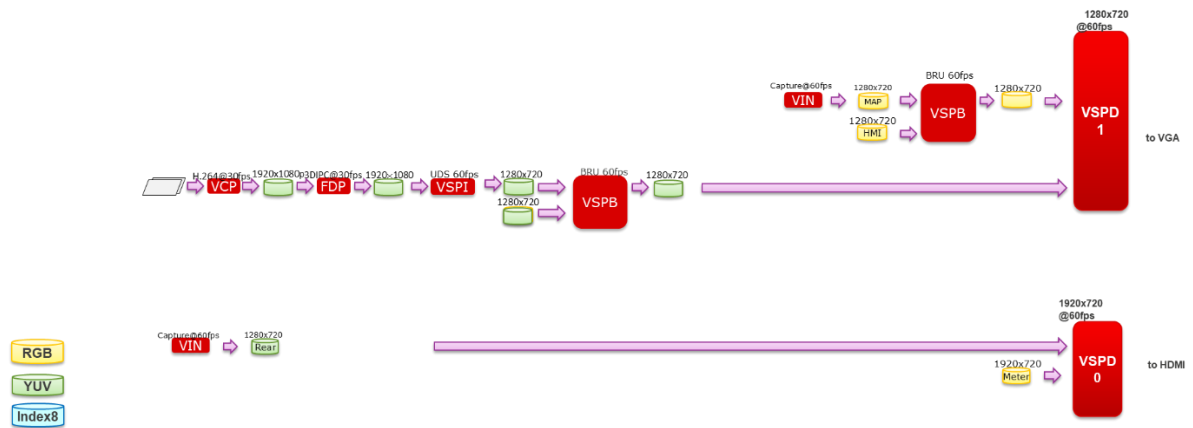setenv bootargs 'video=HDMI-A-1:1920x720-32@60 video=VGA-1: 1280x720-32@60 video=LVDS-1:d'

Figure 5-10 E3 Meter, Video and Map Use Case Display Path sample

Table 5-16 Bandwidth of E3 Meter, Video and Map Use Case

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	610	0
3	VSPD1	457	0
4	VSPD2		
5	VSPD3		
6	HDMI		
7	VIN0123		
8	VIN4567		446
9	VSPB	681	336
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	332	94
15	VSPI1		
16	VSPI2		
17	FDP	113	98
18	IMR	0	0
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	417	146
22	VCPL4		
23	AP-System Core	800	800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1		
36	SYS-DMAC Ch16-47	50	50
37	GSX	1600	800
38	DAB	10	10

Video&Display
Audio
etc

5.2.15 E3 Meter and Hud

Sample explain: The value of this use-case is for executing up to 1 video decode, 1 video inputs, 2 displays at same time.

Display setting sample:

setenv bootargs 'video=HDMI-A-1:1920x720-32@60 video=VGA-1: 720x480-32@60 video=LVDS-1: d'
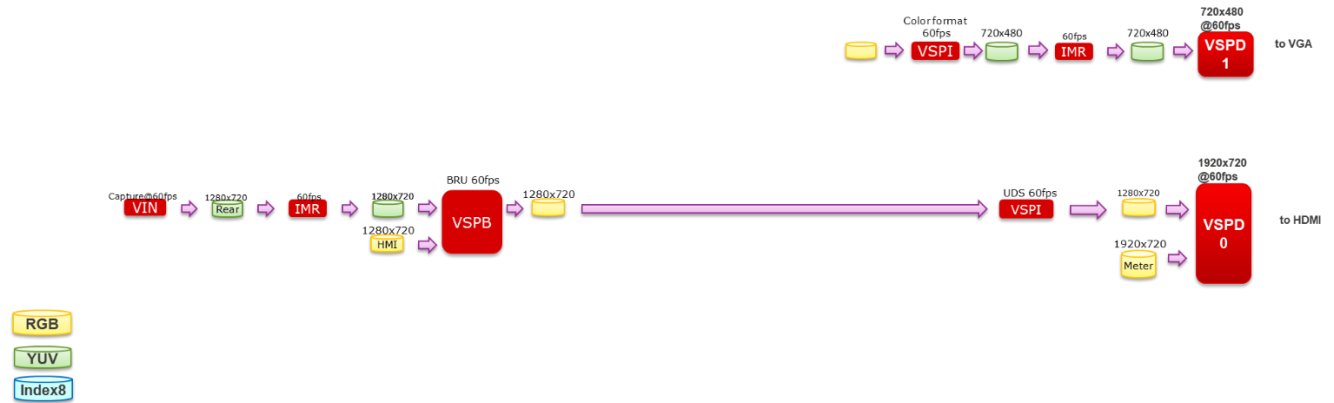
Figure 5-11 E3 Meter and Hud Use Case Display Path sample

Table 5-17 Bandwidth of Meter and Hud Use Case

No.	Master	FIX R/W Read (MB/s)	FIX R/W Write (MB/s)
1	IMP		
2	VSPD0	807	0
3	VSPD1	63	0
4	VSPD2		
5	VSPD3		
6	HDMI		
7	VIN0123		
8	VIN4567		149
9	VSPB	341	223
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	343	265
15	VSPI1		
16	VSPI2		
17	FDP	0	0
18	IMR	400	400
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	800	800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1		
36	SYS-DMAC Ch16-47	50	50
37	GSX	2000	1200
38	DAB	10	10

Legend
Video&Display
Audio
etc

5.2.16 E3 Cluster

Sample explain: The value of this use-case is for executing 1 display and 1 graphics application at same time.

[Note] If this QoS sample setting uses, please stop LVDS and VGA display.

Display stop setting sample:

setenv bootargs 'video=HDMI-A-1:1920x720-32@60 video=VGA-1:d video=LVDS-1:d'
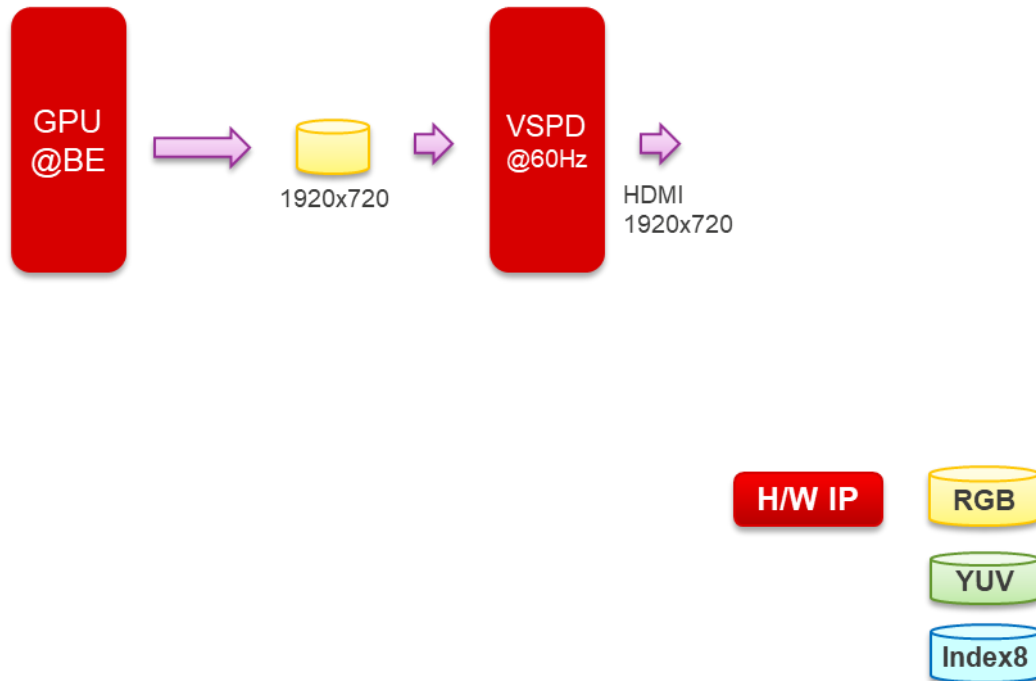
Figure 5-12 E3 Cluster Use Case Display Path sample

Table 5-18 Bandwidth of E3 Cluster

No.	Master	FIX R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	404	0
3	VSPD1	0	0
4	VSPD2		
5	VSPD3		
6	HDMI		
7	VIN0123		
8	VIN4567		0
9	VSPB	0	0
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	340	340
12	SYS-DMAC Ch0-15	100	100
13	EtherAVB	125	125
14	VSPI0	0	0
15	VSPI1		
16	VSPI2		
17	FDP	0	0
18	IMR	0	0
19	iVDP1C	0	0
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	800	800
24	Realtime Core	25	25
25	RT-DMAC RT-DMAC Descriptor	25	25
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0	600	600
29	PCIe/SATA	750	750
30	ADSP	100	250
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	50	50
35	SSP1		
36	SYS-DMAC Ch16-47	50	50
37	GSX	2400	2400
38	DAB	10	10

Video&Display
Audio
etc

5.2.17 D3 Default Setting (for unit test)

"Default-setting" is used as the initial setting value when D3 starts.

>**Sample explain:** This sample allocates the each of QoS values to all H/W IPs except for VDPB and VCPLF.

>This sample can run each H/W IP. Please use for unit test only.

Table 5-19 Bandwidth of D3 Default Setting

No.	Master	R/W Read (MB/s)	Write (MB/s)
1	IMP		
2	VSPD0	1590	318
3	VSPD1	592	119
4	VSPD2		
5	VSPD3		
6	HDMI		
7	VIN0123		0
8	VIN4567		600
9	VSPB	1000	500
10	VSPBD		
11	SYS-DMAC Ch0-15 Descriptor	170	170
12	SYS-DMAC Ch0-15	50	50
13	EtherAVB	100	100
14	VSPI0		
15	VSPI1		
16	VSPI2		
17	FDP		
18	IMR	532	532
19	iVDP1C		
20	VDPB	0	0
21	VCPLF	0	0
22	VCPL4		
23	AP-System Core	800	800
24	Realtime Core		
25	RT-DMAC RT-DMAC Descriptor	13	13
26	Secure Engine	50	10
27	USB2.0	240	240
28	USB3.0		
29	PCIe/SATA		
30	ADSP		
31	MLP Audio-DMAC Descriptor	20	20
32	Audio-DMAC	10	10
33	DCU	10	10
34	SDHI0123 SYS-DMAC Ch16-47 Descriptor	25	25
35	SSP1		
36	SYS-DMAC Ch16-47	25	25
37	GSX	800	800
38	DAB	10	10

Video&Display
Audio
etc

5.3   Set QoS Parameters

Please refer Linux Interface Specification Device Driver QoS User's Manual.

6.Integration

6.1 Directory Configuration

This application note's directory configuration is shown below.

```
rch3m3m3ne3d3_linux_qos_v250

├──Document
│       RENESAS_RCH3M3M3NE3D3_QOS_APP_v2.50.pdf
│
└──Reference
     m3_Ver30_default_setting_v01_195.csv
     m3_Ver30_default_setting_v01_390.csv
     m3_Ver30_infotainment_v01_195.csv
     m3_Ver30_infotainment_v01_390.csv
     m3_Ver30_cluster_v01_195.csv
     m3_Ver30_cluster_v01_390.csv
     m3_Ver30_integrated_cockpit_v01_195.csv
     m3_Ver30_integrated_cockpit_v01_390.csv
     m3n_Ver1x_default_setting_v04_195.csv
     m3n_Ver1x_default_setting_v04_390.csv
     m3n_Ver1x_infotainment_fhd_v04_195.csv
     m3n_Ver1x_infotainment_fhd_v04_390.csv
     m3n_Ver1x_infotainment_hd_v04_195.csv
     m3n_Ver1x_infotainment_hd_v04_390.csv
     m3n_Ver1x_cluster_v03_195.csv
     m3n_Ver1x_cluster_v03_390.csv
     h3_Ver30_default_setting_v02_195.csv
     h3_Ver30_default_setting_v02_390.csv
     h3_Ver30_infotainment_v02_195.csv
     h3_Ver30_infotainment_v02_390.csv
     h3_Ver30_cluster_v01_195.csv
     h3_Ver30_cluster_v01_390.csv
     h3_Ver30_integrated_cockpit_v02_195.csv
     h3_Ver30_integrated_cockpit_v02_390.csv
     e3_Ver1x_default_setting_v03_390.csv
     e3_Ver1x_default_setting_v03_780.csv
     e3_Ver1x_meter_video_and_map_v02_390.csv
     e3_Ver1x_meter_video_and_map_v02_780.csv
     e3_Ver1x_meter_and_hud_v02_390.csv
     e3_Ver1x_meter_and_hud_v02_780.csv
     e3_Ver1x_cluster_v02_390.csv
     e3_Ver1x_cluster_v02_780.csv
     d3_ Ver10_default_setting_v01.csv
```

Figure 6-1 Directory configuration (R-Car H3/M3/M3N/E3/D3)

REVISION HISTORY		Linux Interface Specification Device Driver QoS Application Note	
Rev.	**Date**	**Description**	
		Page	**Summary**
0.1	May 13, 2016	—	New version
0.2	Jun 16, 2016	—	Default setting add
0.3	Jul 20, 2016	—	Setting sample name change and Use case dataflow sample add
0.4	Aug 24, 2016	1 5 6 --	1.3 Notice comment add Table4-1 FIX/BE IP change Table5-2 CSV file name change Table5-3,5-4,5-5,5-6,5-7,5-8 setting format change
0.5	Jan 11, 2017	6 7 12 17-18 --	Table5-2 csv file name change, h3_integrated_cockpit add 5.2.1 Sample purpose add 5.2.4 Sample purpose add 5.2.7 H3 Integrated Cockpit QoS sample add Table5-3,5-4,5-5,5-6,5-7,5-8,5-9 setting value change
0.6	Mar 15, 2017	--	H3 Ver.2.0 setting add
0.7	Apr 14, 2017	--	H3 Ver.2.0 cluster setting add M3 Ver.1.1, M3 Ver.1.2 setting add
1.00	Aug 01, 2017	1 3 6 8 18 23	1.1 Overview change and 1.3 Notice comment add 2.2 Software Environment add 5.2 CSV file name change 5.2.2 Table5-1 Sample purpose change 5.2.7 Information change 6.1 CSV file name change
1.01	Oct 12, 2017	1 3 5 20 21 23 25	1.1 Overview add M3N information 2.1 Hardware Environment add M3N information 5.1 Table 5-2 m3n csv file name add 5.2.9 M3N Default Setting (for unit test) add 5.2.10 M3N Infotainment 1 (Full HD) add 5.2.11 M3N Infotainment 2 (HD) add 5.2.12 M3N Cluster add
1.02	Dec 14, 2017	5 7 28	5.2 Table 5-2 Sample file change 5.2.2 Table 5-4 Bandwidth of M3 Infotainment change 6.1 Figure 6-1 Directory configuration change
1.03	Mar 23, 2018	1 3 5 28 29 31 33 37	1.1 Overview add E3 information 2.1 Hardware Environment add E3 information 5.1 Table 5-2 e3 csv file name add 5.2.13 E3 Default Setting (for unit test) add 5.2.14 E3 Meter, Video and Map add 5.2.15 E3 Meter and Hud add 5.2.16 E3 Cluster add 6.1 Figure 6-1 Directory configuration change
1.04	Apr 02, 2018	1 5 5 6 14-25 37	1.2 Notice add H3 Ver.3.0 information 5.1 Condition add H3 Ver.3.0 information 5.2 Table 5-2 H3 Ver.3.0 csv file name add and M3N.1.x csv file name change 5.2 Explain detail "refresh interval" Table 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, 5-13 change 6.1 Figure 6-1 Directory configuration change
1.05	Apr 24, 2018	1 5 5 6 14 28-34 37	1.3 Notice add M3 Ver.1.2 information 5.1 Condition add M3 Ver.1.2 information 5.2 Table 5-12 H3 Ver.3.0 csv file name change 5.2 Explain detail "M3 Ver.1.2" Table 5-7 change Table 5-15, 5-16, 5-17, 5-18 change 6.1 Figure 6-1 Directory configuration change
2.00	Nov 05, 2018	5 7-13	Table5-2 csv file name change Table 5-3, 5-4, 5-5, 5-6 change

		14-20	Table 5-7, 5-8, 5-9, 5-10 change
		21-27	Table 5-11, 5-12, 5-13, 5-14 change
		28-34	Table 5-15, 5-16, 5-17, 5-18 change
		37	6.1 Figure 6-1 Directory configuration change
2.02	June 24, 2019	1, 5, 6 7-13	Table 5-3, 5-4, 5-5, 5-6 change (update for M3 Ver.3.0) Article 5-2 (update for M3 Ver.3.0)
2.50	Apr 21, 2021	-	Add R-Car D3 support Add Kernel v5.10 support
3.00	Dec. 10, 2021	-	Add Kernel v5.10.41 support

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Application Note

Publication Date: Rev.3.00   Dec. 10, 2021

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