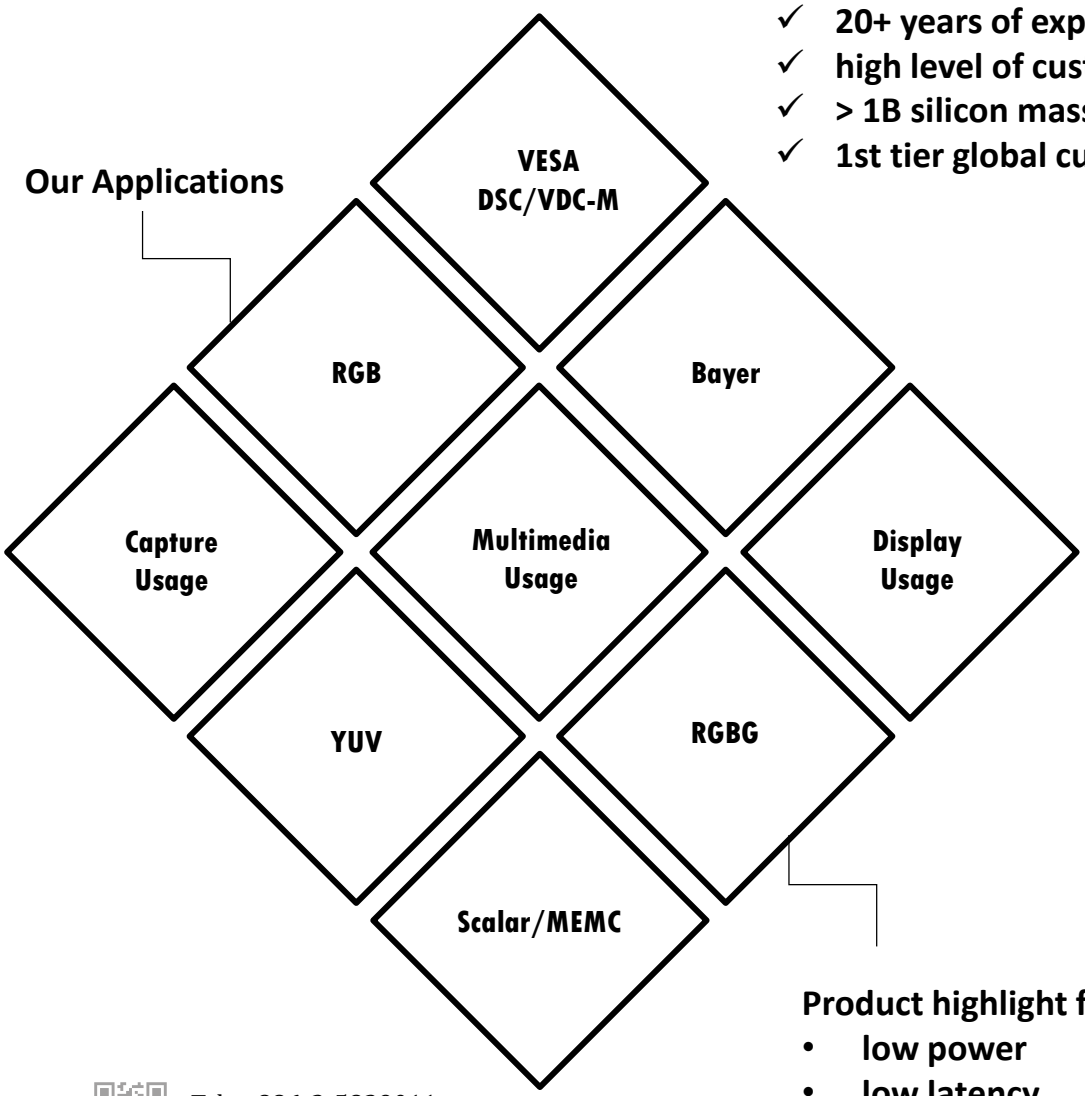
Taiwan Imaging Tek Corp.
TITC 沛錦科技

TITC

Image Compression IP specialist

- ✓ 20+ years of experience
- ✓ high level of customization
- ✓ > 1B silicon mass produced
- ✓ 1st tier global customers

Our Applications



Product highlight features:

- low power
- low latency
- small area

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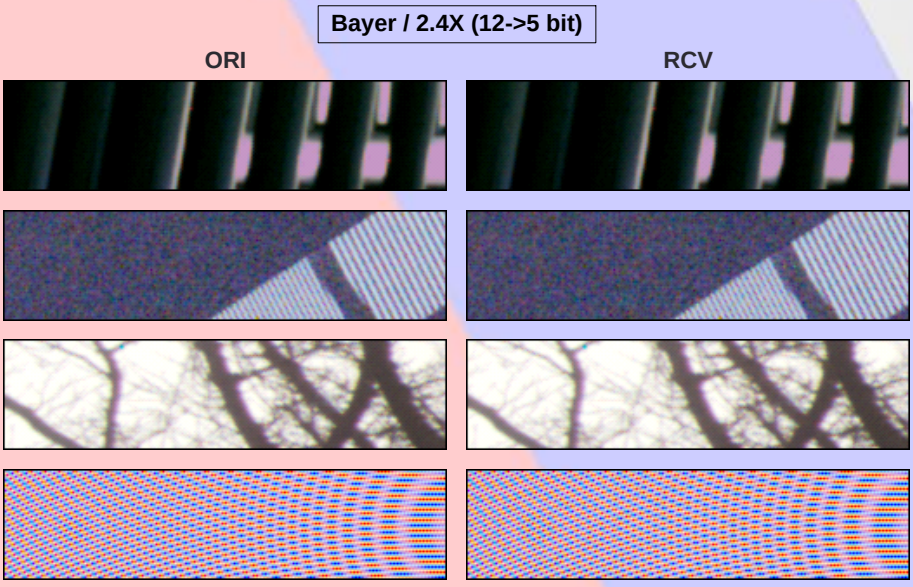
TITC B-Series IP
Bayer for ISP

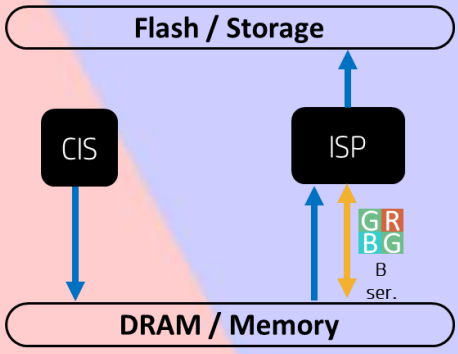
B-series IPs are collection of propietary algorithm which are used for real-time compress/decompress Bayer image data. These IPs/algorithm are designed for front-end of ISP device, which facilitate temporal storage efficiency of Bayer image data. End products like ADAS, surveillance, action/meeting/mobile/professional cam may benefit from B-series IPs.

B-series IPs are featured by customized bitdepth/ratio support, reasonable hardware resources, friendly IP integration, and flexible access/store compressed bitstream. Feature support/algorithm are tailored for picture quality requirement and hardware budget via TITC engineer team.



➢ TITC B-Series IP

Usage / Series		capture / B-series
IP Name		ISP_Bayer v1
Data	Type	Bayer
	Bit-Depth	8~16-bit
Compression	Type	Lossy/Lossless
	Ratio(Lossy)	1.33~2.5X
	Unit	H64V1 / H32V2
Performance	Throughput	4-pix (per T)
Note		* lossy is major trend * compression unit can be customized



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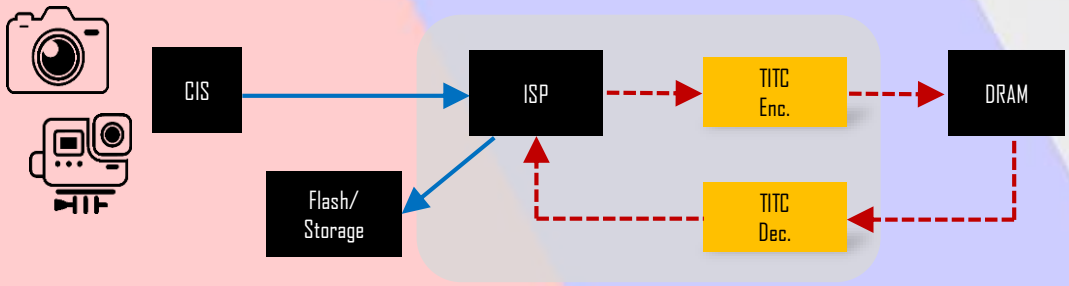
TITC YS-Series IP
YUV for ISP

YS-series IPs are collection of propietary algorithm which are used for real-time compress/decompress YUV subsample data. These IPs/algorithm are designed for back-end of ISP device, which facilitate temporal storage efficiency of YUV subsample data. End products like ADAS, surveillance, action/ meeting/ mobile/ professional cam may benefit from YS-series IPs.

YS-series IPs are featured by customized bitdepth/ratio support, reasonable hardware resources, friendly IP integration, and flexible access/store compressed bitstream. Feature support/algorithm are tailored for picture quality requirement and hardware budget via TITC engineer team.



➢ TITC YS-Series IP

Usage / Series		capture / YS-series	
IP Name		ISP_YUV v1	ISP_YUV v2
Data	Type	YUV422/YUV420	YUV422
	Bit-Depth	8~16-bit	8-bit
Compression	Type	Lossy/Lossless	Lossy/Lossless
	Ratio(Lossy)	1.33~4X	2~4X
	Unit	H32V2	H8V4
Performance	Throughput	2-pix/4-comp (per T)	32-comp (per T)
Note		* focus on 2X * compression unit can be customized	* focus on high ratio, high thoughput

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TITC N-Series IP
Feature-map for AI

N-series IPs are collection of propietary algorithm which are used for real-time compress/decompress featuremap data.These IPs/algorithm are designed for neural network(AI) device, which facilitate temporal storage efficiency of featuremap data.AI edge devices and end products embedded NPU may benefit from N-series IPs.

N-series IPs are featured by lossless/lossy bi-direction support, tiny hardware resources, friendly IP integration, and flexible access/store compressed bitstream.Feature support/algorithm are tailored for neural network architecture via TITC engineer team.

Classification

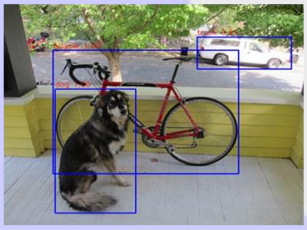
model: mobilenet v2
dataset: ILSVRC2012/50-pics

<lossy compression>
*TITC/1.78X: ave.err=0.251%
<lossless compression>
*TITC: ave.rat=1.90X

Object Detection

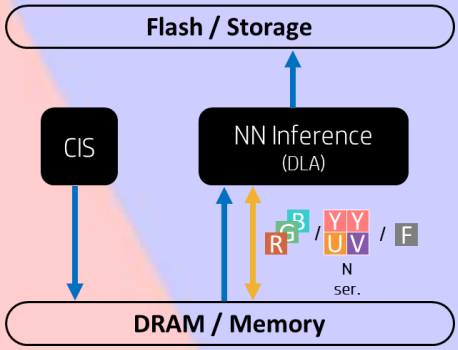
model: tiny-yolo v2
dataset: VOC2007/4952-pics

<lossy compression>
*no compr. : mAP=48.05
*TITC/1.78X: mAP=46.88
<lossless compression>
*TITC: ave.rat=2.36X



➢ TITC AI Inference Device IP

Usage / Series		capture / N-series
IP Name		featuremap v1
Data	Type	featuremap
	Bit-Depth	8-bit
Compression	Type	Lossy/Lossless
	Ratio(Lossy)	1.14~2X
	Unit	H4V4
Performance	Throughput	16-pix (per T)
Note		* lossless is encouraged * compression unit/ratio(lossy) can be customized



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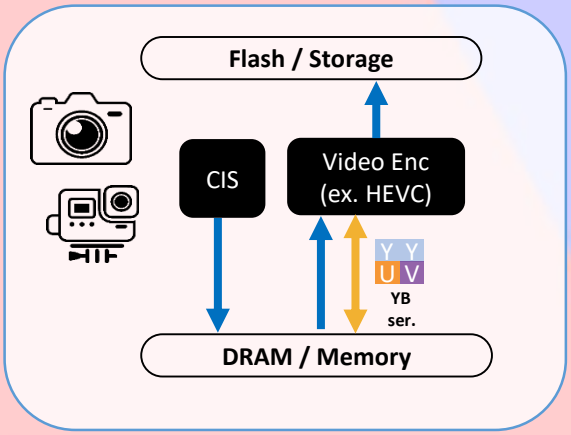
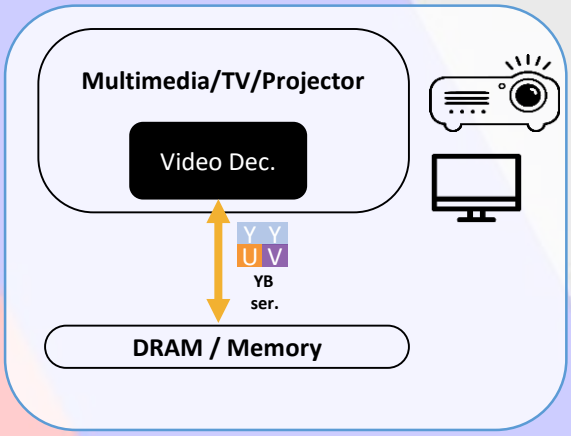
TITC YB-Series IP
YUV for Video Encoder/Decoder

YB-series IPs are collection of propietary algorithm which are used for real-time compress/decompress block-based YUV subsample data. These IPs/algorithm are designed for video encoding/decoding device, which facilitate temporal storage efficiency of ME(motion estimation)/MC(motion compensation) data. End products like cinema camcoder, mobile multimedia system, TV system may benefit from YB-series IPs.

YB-series IPs are featured by customized bitdepth/ratio support, reasonable hardware resources, friendly IP integration, and flexible access/store compressed bitstream. Feature support/algorithm are tailored for picture quality requirement and hardware budget via TITC engineer team.





➢ TITC YB-Series IP

Usage / Series		capture, multimedia / YB-series	
IP Name		YB v1	YB v2
Data	Type	YUV422/YUV420	YUV420/Y-Only
	Bit-Depth	8/10/12-bit	8/10-bit
Compression	Type	Lossy/Lossless	Lossy
	Ratio(Lossy)	1.33~2X	2~4X
	Unit	H4V4/ H8V8/ H8V4	H8V8
Performance	Throughput	2-pix/4-comp (per T)	64-comp (per T)
Note		* compression unit can be customized * lossless+lossy is encouraged	* focus on high ratio, high thoughput

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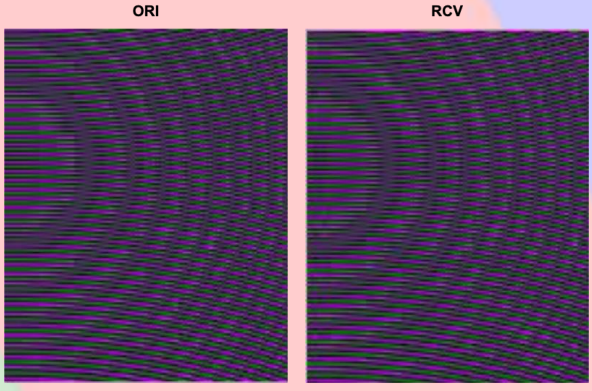
TITC S-Series IP
RGB/YUV for FRC & Scalar

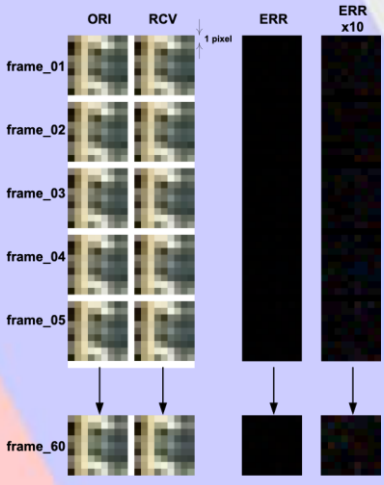
Frame Rate Conversion(FRC) and Scalar have been long developed in multimedia. FRC techniques generate pseudo image frames between at least two consecutive frames, usually by the technique of Motion Estimation and Motion Compensation (MEMC) to get better motion picture qualities. At least one frame picture stored in memory. Scalar techniques as well generate pseud image lines between at least two consecutive lines. Several image lines are required to be in memory. Both techniques need high memory i/o bandwidth when image resolution get higher.

TITC proposed segment-based or block-based, fixed-ratio, visual-lossless compression in RGB/YUV format. This mass production proven technique can ease the pain point of i/o bandwidth hunger. Supporting bit depth up to 12 meets mainstream requirement. Compression unit and bit depth can also be customized.

YUV422 / 3X (20->7 bit)

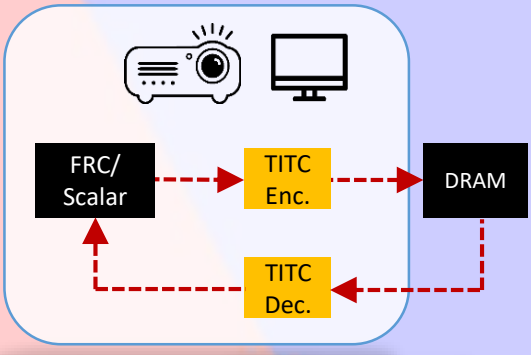


RGB / 3X (30->10 bit)



➢ TITC S-Series IP

Usage / Series		multimedia / S-series
IP Name		FRV v1
Data	Type	RGB/YUV444/YUV422
	Bit-Depth	10/12-bit
Compression	Type	Lossy
	Ratio(Lossy)	2~3X
	Unit	H64V1 / H64V2
Performance	Throughput	2-pix (per T)
Note		* compression unit can be customized



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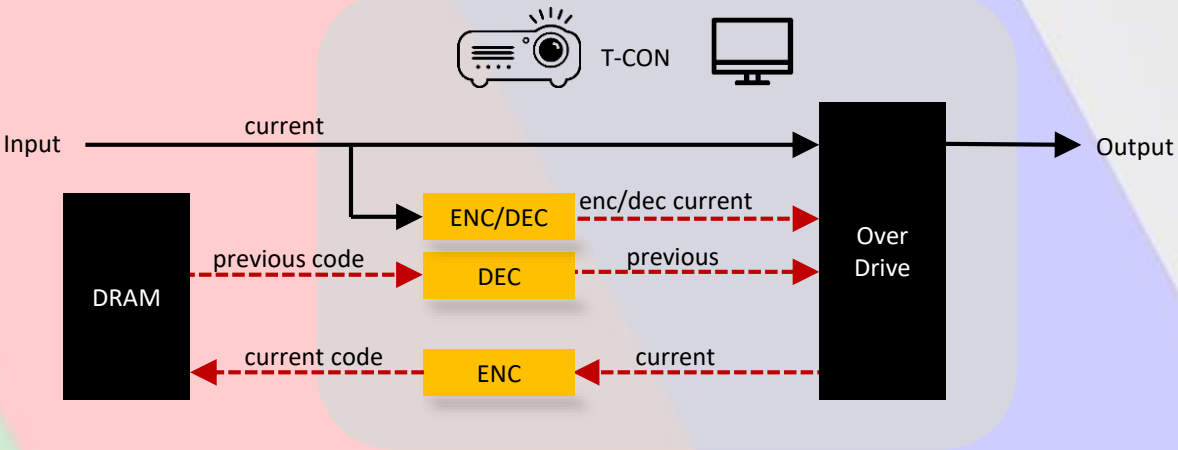
TITC O-Series IP
RGB for Over-Drive

Over-Drive technology is used to compensate the LCD reaction speed, which was not fast enough in high refreshing frame rate. Over drive provides higher level of voltage than the usual when the pixel's bright level gap between current and previous frame is large. Previous frame should be stored in memory to be the reference. Memory cost and bandwidth is considered from system's point of view.

Reference frame data of over drive do not necessarily visual lossless. Higher lossy level may be acceptable. Therefore, FPGA for moving picture quality check is needed when adopting this IP. TITC proposed several types of compression, from small block 2x2 to 4x4 to slice-based, from RGB to Y-only, from compression ratio 2 to 12. Customization is possible.



➢ TITC O-Series IP

Usage / Series		multimedia / O-series	
IP Name		OD v1	OD v2
Data	Type	RGB	Y-only
	Bit-Depth	8-bit	8-bit
Compression	Type	Lossy	Lossy
	Ratio(Lossy)	2.28X	4X
	Unit	H2V2	H4V4
Performance	Throughput	4-pix (per T)	16-pix (per T)
Note		* light resource	* high throughput * for DDI

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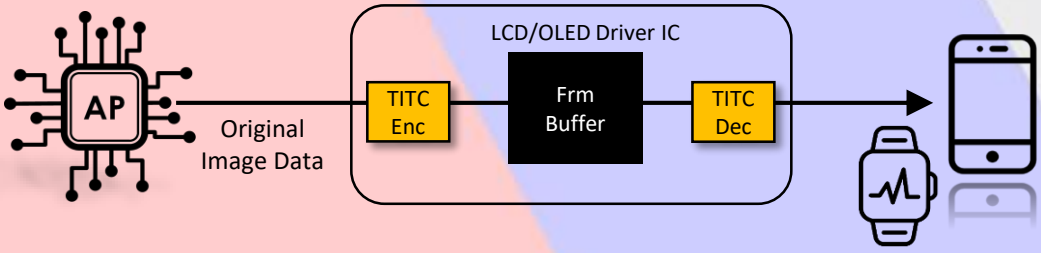
TITC F-Series IP
TITC RGB/RGBG for Frame Buffer

Lower level APs (Application Processor) in smart phones may not support VESA DSC to reduce transmission bandwidth between AP and DDIC (Display Driver IC). DDI sometimes need to support both lower and higher level APs with the same embedded SRAM footprint. Proprietary compression and decompression functions are asked to added in DDIC.

TITC provided huge mass production proven compression and decompression IP to solve this headache. IPs support range from H2V2 2x, H8V2 3x, to H4V4 4x, with the capability of partial update. Special color format like RGBG in AMOLED panel also can be supported by customization. You can rest assured that it is the best solution because of world wide brand name's qualification.



➢ TITC F-Series IP

Usage / Series		display / F-series			
IP Name		FBC-2	FBC-3	FBC-4	FBC-SPR
Data	Type	RGB	RGB	RGB	Pentile
	Bit-Depth	8-bit	8/10-bit	8-bit	8bit
Compression	Type	Lossy	Lossy	Lossy	Lossy
	Ratio(Lossy)	2X	3X(8bit)/3.75X(10bit)	4X	2X
	Unit	H2V2 / H4V1	H8V2	H4V4	H8V1
Performance	Throughput	4-pix (per T)	8-pix (per T)	8-pix (per T)	8-comp. (per T)
Note		* super MP(>300M) * widely adopted by LCD phone/ OLED watch	* super MP(>300M) * widely adopted by OLED phone		* RGB 3X effective

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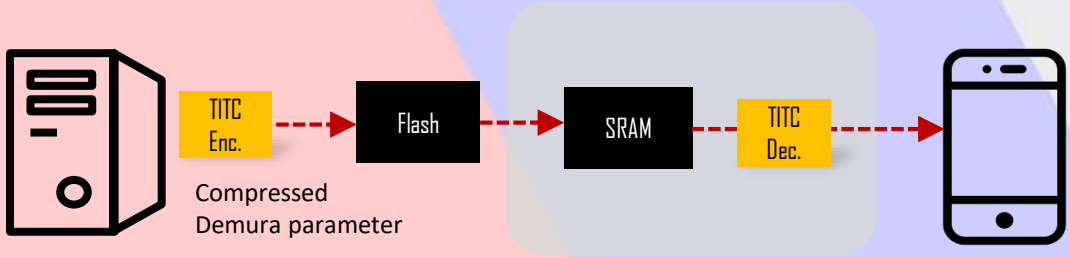
TITC D-Series IP
Demura parameter for Flash

TITC proprietary De-Mura Compression IP is comprised of the Software Encoder and the Hardware Decoder. The compression IP can be configured according to different parameters such as Flash size (e.g. compressed data size is configurable from 16Mbits to 8Mbits), and bin-sizes (i.e. pixel downsample size like 2by2, 4by4, and others).

The software encoder can incorporate customer's De-Mura table format (downsampled or non-downsampled).We provide customized service to stitch customer's De-Mura data, and preprocessing with our data compression IP seemlessly. The hardware decoder can adapt to customer's requirement on throughputs. We provide multi instance architecture to meet high throughput needs. Furthermore, TITC proprietary Compression IP has already been validated by large OLED/LCD panel makers and licensed by IC Fabless customers.



➢ TITC DeMura IP

Usage / Series		display / D-series	
IP Name		Demura v1	Demura v2
Data	Type	RGB/RGBG (Demura paremeter)	RGB/RGBG (Demura paremeter)
	Bit-Depth	8-bit	8/10-bit
Compression	Type	Lossy	Lossy
	Ratio(Lossy)	3~3.8X	compr. as 16 or 8MB
	Unit	frame	frame
Performance	Throughput	4-pix/12-comp (per T)	8-comp (per T)
Note		* enc: software /dec: RTL	* enc: software /dec: RTL

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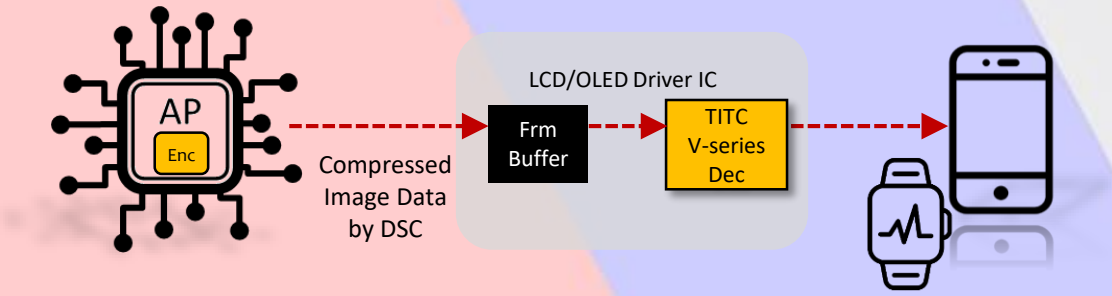
TITC V-Series IP
VESA DSC/VDC-M

VESA DSC (Display Stream Compression) and VDC-M (VESA Display Stream Compression-M) are standard which is used for compressing and decompressing image display streams. It is designed for real-time systems, with real-time compression, transmission, decompression, and display. These standard IP could be used in many applications and save the transmission cost, such as between a mobile application processor and display panel, between a computer graphics and display monitor, and so on.

TITC provides VESA DSC decoder hardware IPs which is compatible to DSC V1.1 and V1.2a, and a VDC-M decoder hardware IP. Specially, TITC provides 6P/T versions DSC decoder, which could be used for 1 slice setting. These IP are configurable in display resolution (Up to 4K, UHD+, and 8K), bits per video component (8 and 10 bits), video output formats(RGB, YCbCr444, YUV422, and YUV420), and multiple slice per line setting (1, 2, or 4). TITC also provides customized service to shrink the IP area when no need to support the whole configuration.



➢ TITC VESA IP

Usage / Series		standard/display / V-series	
IP Name		DSC v1.2a (Dec)	VDCM v1.2 (Dec)
Data	Type	RGB/YUV422/YUV420	RGB/YUV422/YUV420
	Bit-Depth	8/10-bit	8/10-bit
Compression	Type	Lossy	Lossy
	Ratio(Lossy)	up to 4X(8bit) / 5X(10bit)	up to 5X(8bit) / 6X(10bit)
	Unit	multi-slice(1/2/4)	multi-slice(1/2/4)
Performance	Throughput	3/6-pix (per T)	4-pix (per T)
Note		* available customizing for v1.1	* available customizing for v1.1.0

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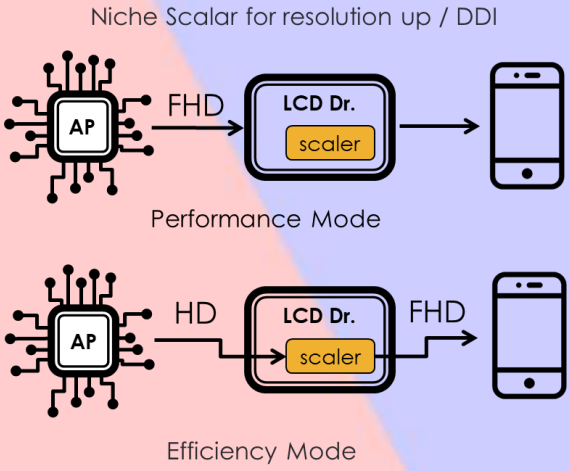
TITC NS-Series IP
Niche Scalar for DDI

Scalar is basic, but essential image signal processing. There are several well known techniques, like nearest neighbor, bilinear, bicubic. For hardware implementation, the algorithm and line buffer cost must be in consideration.

TITC develops a novel method, that the picture quality is close to bicubic with hardware cost effective. Besides, it can also equip with edge enhancement to get higher contrast. One of applications is power saving mode in mobile phone. The AP just transmits low resolution sequences and the sequences will be scaled up to resize the panel resolution in DDI. Therefore, the transition power can be reduced.



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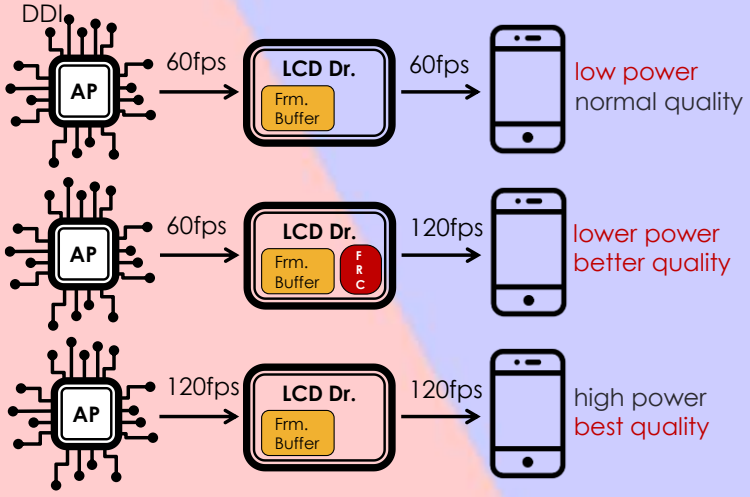
TITC NM-Series IP
Niche MEMC for DDI

The technique "Motion estimation and motion compensation(MEMC)" has been developed for a long time and used widely. In order to get perfect quality, general TV-level MEMC will adopt complex algorithms with high hardware cost.

TITC is proposing a light version MEMC solution for some specific applications. One of applications is frame rate converter in DDI. The AP just transmits low frame rate sequences and the sequences will be pumped up doubly in DDI. Therefore, the transition power can be reduced. Also, the ME kernel is also used in 3D noise reduction to predict the motion vector.

A. Niche MEMC for frame rate-up / DDI



B. Niche MEMC for 3DNR / ISP

Stacking frame under low-light view

without NR with NR

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