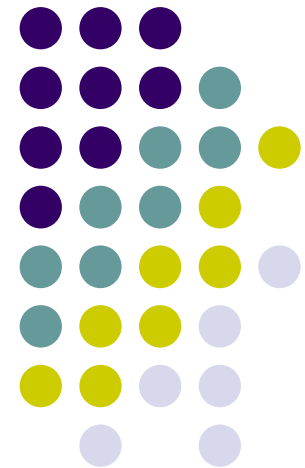


RAiO Technology Inc.

RA8876 Application Note

04/12/2013

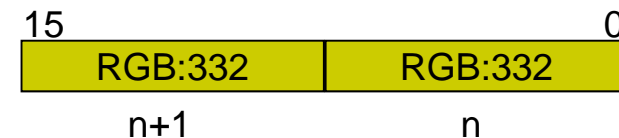


Memory data

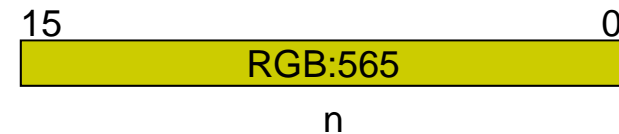


- SDRAM only use for frame buffer.
- Type 1: 1-bit/pixel data (monochrome)
 - only used in BitBLT engine

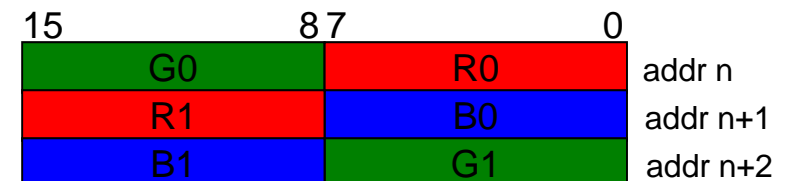
- Type 2: 8-bits/pixel (RGB:332)



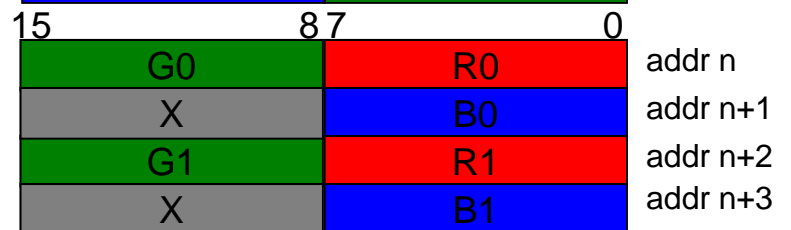
- Type 3: 16-bits/pixel (RGB:565)



- Type 4: 24-bits/pixel (RGB:888)



- Type 5: 24-bits/pixel (RGB:888)



Frame number in 16Mb(1Mb x 16) memory



resolution		Color depth			
H	V	8-bits	16-bits	24-bits(1)	24-bits(2)
320	240	27	13	9	6
480	272	16	8	5	4
480	640	6	3	2	1
800	480	5	2	1	1
800	600	4	2	1	1
1024	600	3	1	1	0
1024	768	2	1	0	0
1280	768	2	1	0	0
1280	800	2	1	0	0
1366	768	1	0	0	0

Note: 1. two pixels stored with 3 16-bytes. Compact.
2. one pixels stored with 2 16-bytes. Waist one byte.

Frame number in 64Mb(4Mb x 16) memory



resolution		Color depth			
H	V	8-bits	16-bits	24-bits(1)	24-bits(2)
320	240	109	54	36	27
480	272	64	32	21	16
480	640	27	13	9	6
800	480	21	10	7	5
800	600	17	8	5	4
1024	600	13	6	4	3
1024	768	10	5	3	2
1280	768	8	4	2	2
1280	800	8	4	2	2
1366	768	7	3	2	1

Note: 1. two pixels stored with 3 16-bytes. Compact.
2. one pixels stored with 2 16-bytes. Waist one byte.

Frame number in 128Mb(8Mbx16) memory

RA8876/77 Support Max.512Mb



resolution		Color depth			
H	V	8-bits	16-bits	24-bits(1)	24-bits(2)
320	240	218	109	72	54
480	272	128	64	42	32
480	640	54	27	18	13
800	480	43	21	14	10
800	600	34	17	11	8
1024	600	27	13	9	6
1024	768	21	10	7	5
1280	768	17	8	5	4
1280	800	16	8	5	4
1366	768	15	7	5	3

Note: 1. two pixels stored with 3 16-bytes. Compact.
2. one pixels stored with 2 16-bytes. Waist one byte.

App1: Still image display

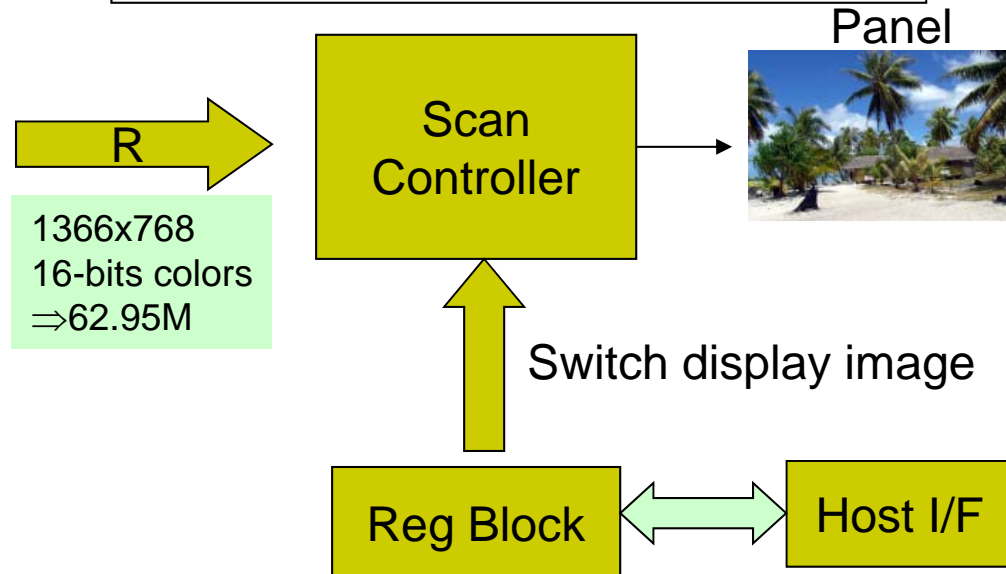


1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**
4. **Image size equal to panel size**

Scan consume bandwidth limitation:

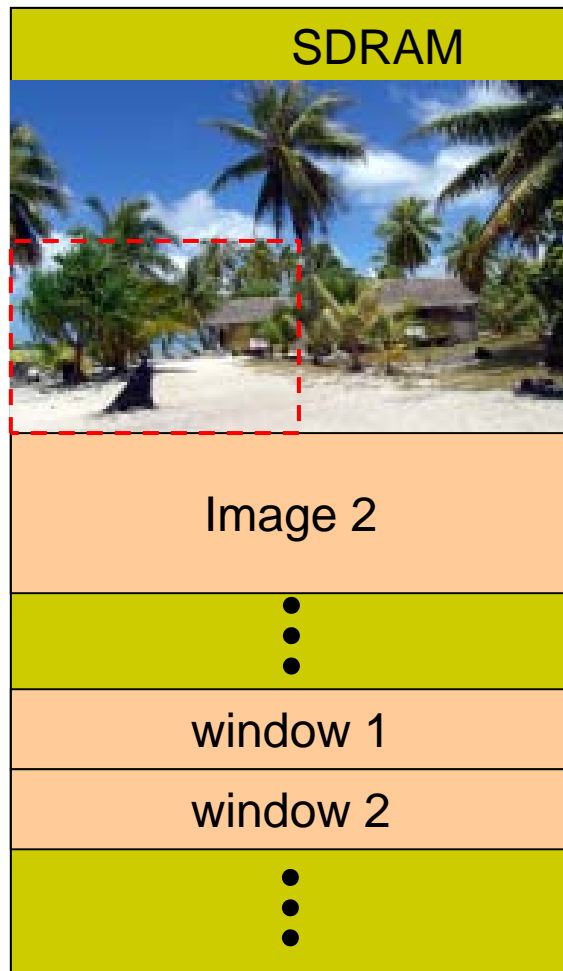
$H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$

Not recommend over 60.



App2:

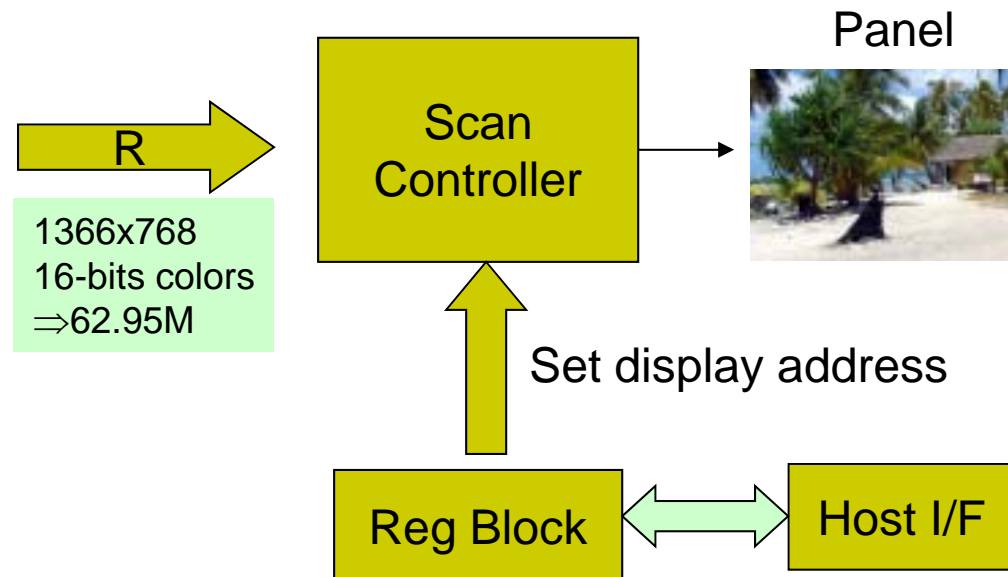
Partial image display



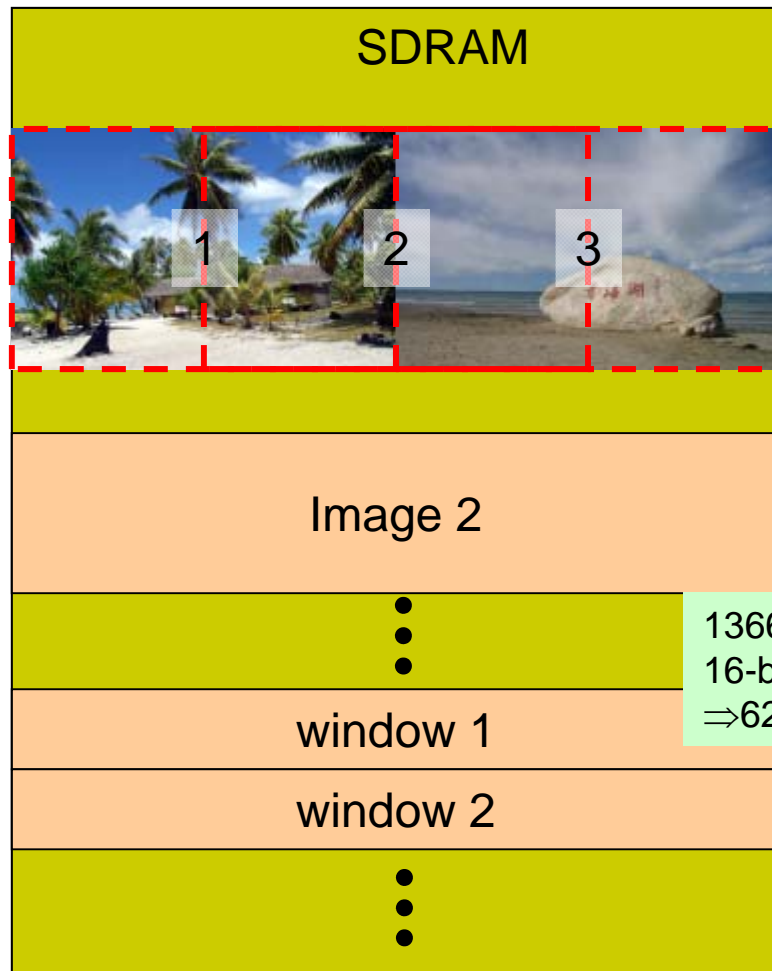
1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**
4. **Image size large than panel size.**

Scan consume bandwidth:

$$\text{H-res} * \text{V-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$$



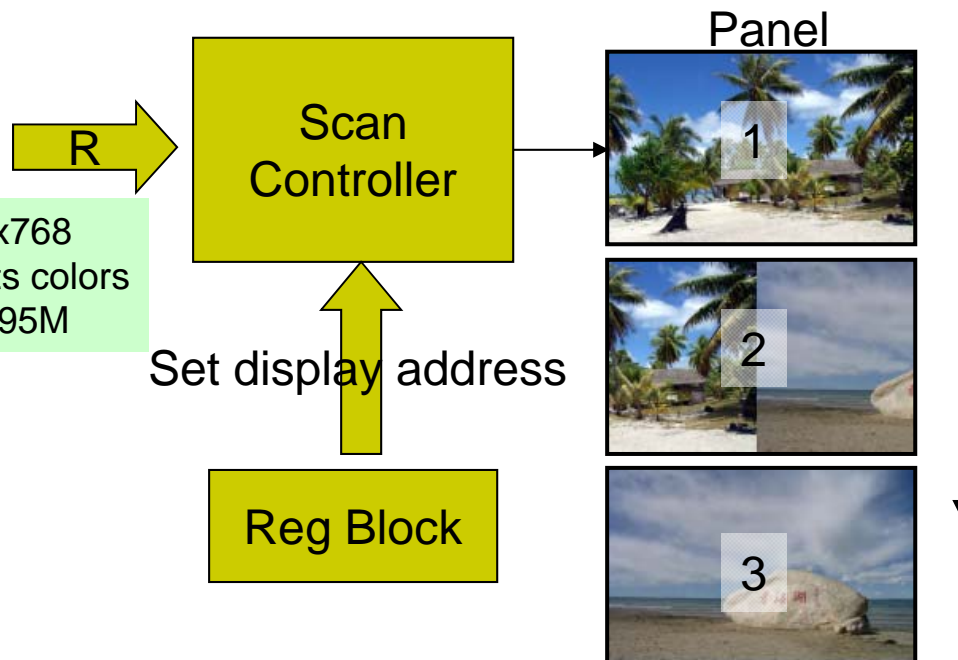
App3: Image Shift-in & Shift-out



1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**
4. **Two images combine as a large image.**

Scan consume bandwidth:

$$\text{H-res} * \text{V-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$$



1366x768
16-bits colors
⇒62.95M

App4: Horizontal Flip

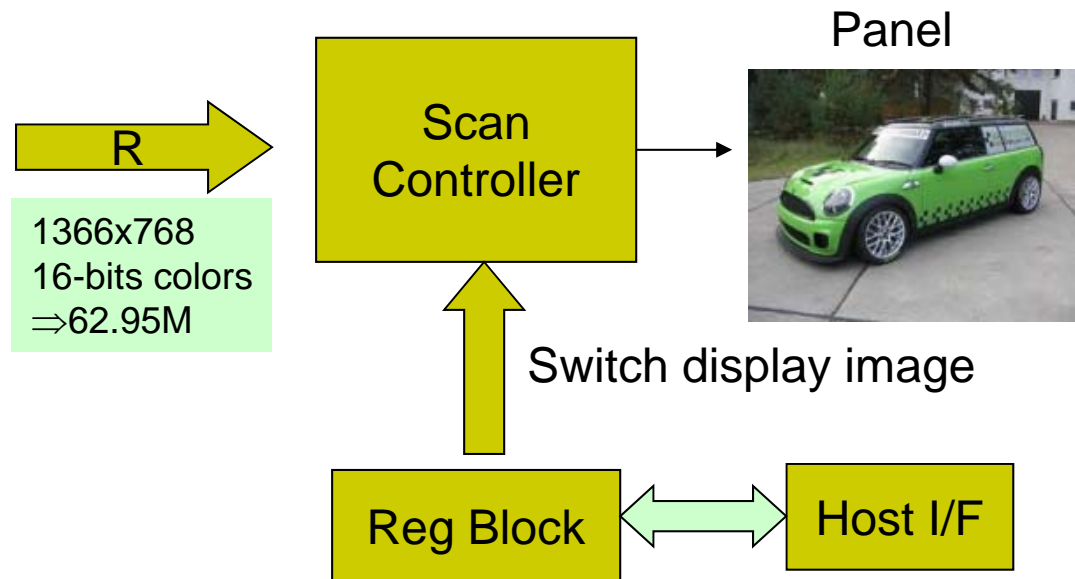


1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**

Scan consume bandwidth limitation:

$H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$

Not recommend over 60.



App5: Vertical Flip

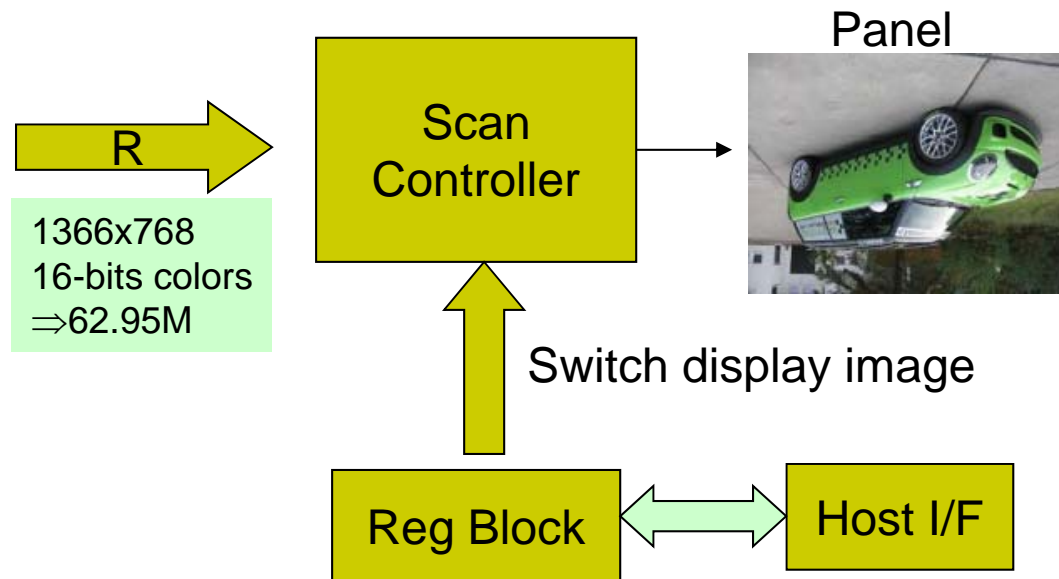


1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**

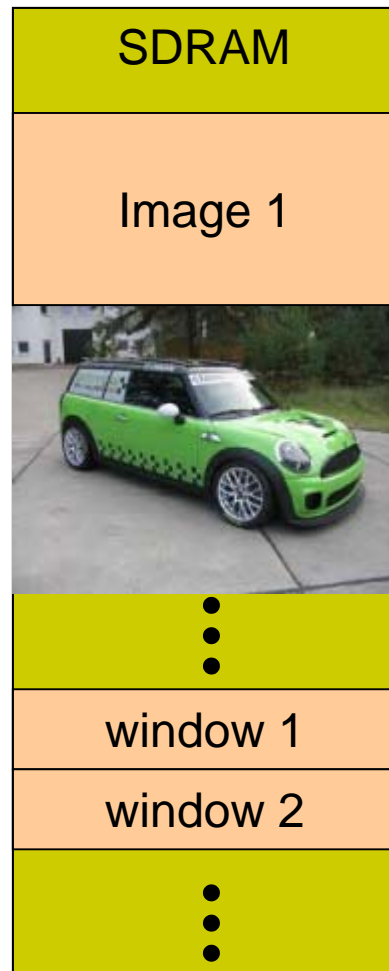
Scan consume bandwidth limitation:

$H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$

Not recommend over 60.



App6: Horizontal Flip + Vertical Flip

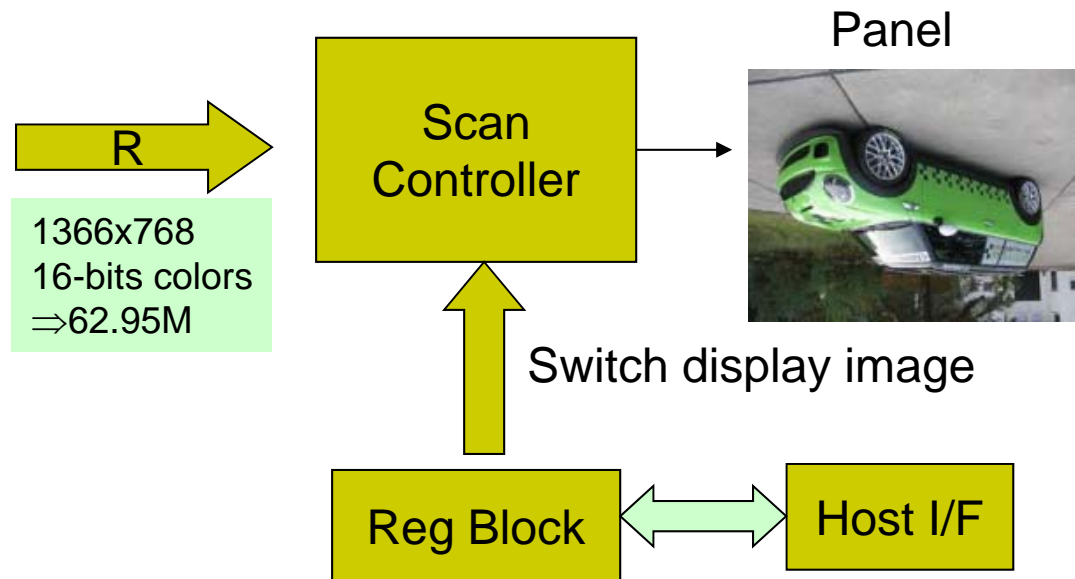


1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**

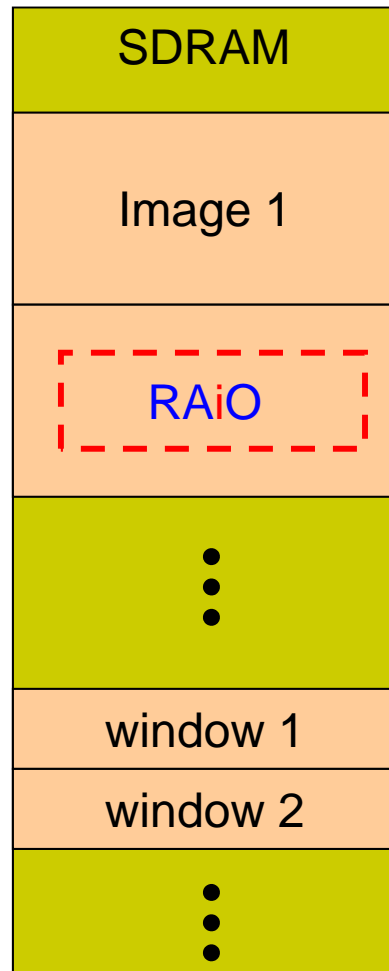
Scan consume bandwidth limitation:

$H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$

Not recommend over 60.

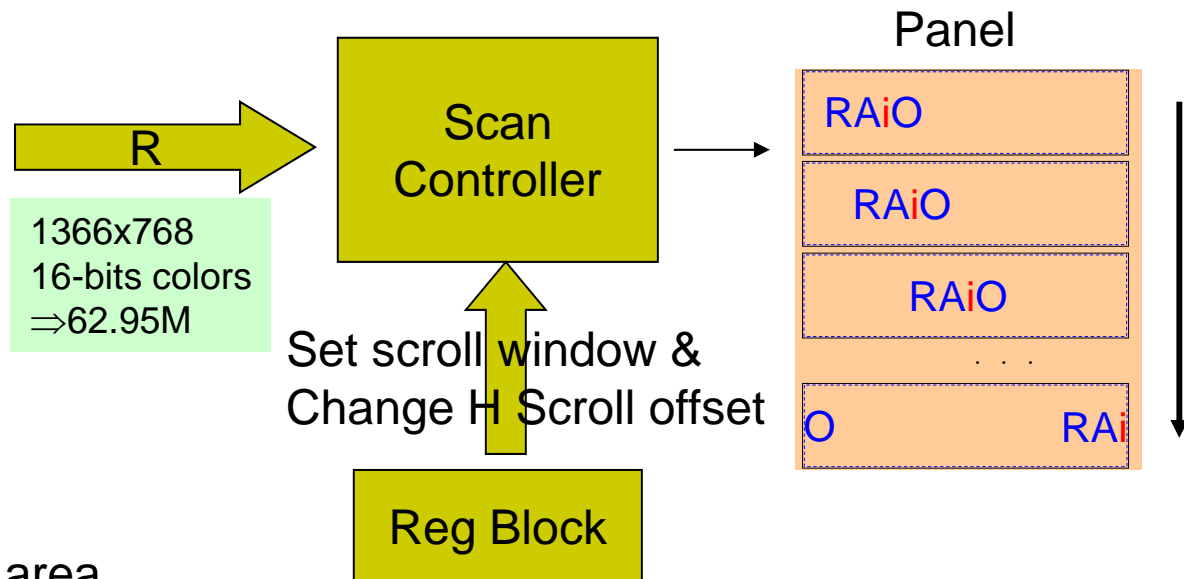


App7: Horizontal Scroll



1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**

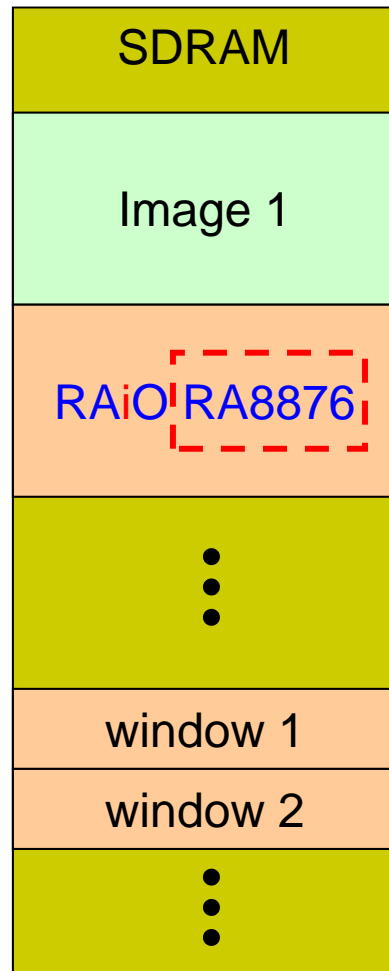
Scan consume bandwidth limitation:
 $H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$
Not recommend over 60.



Scroll area \leq display area

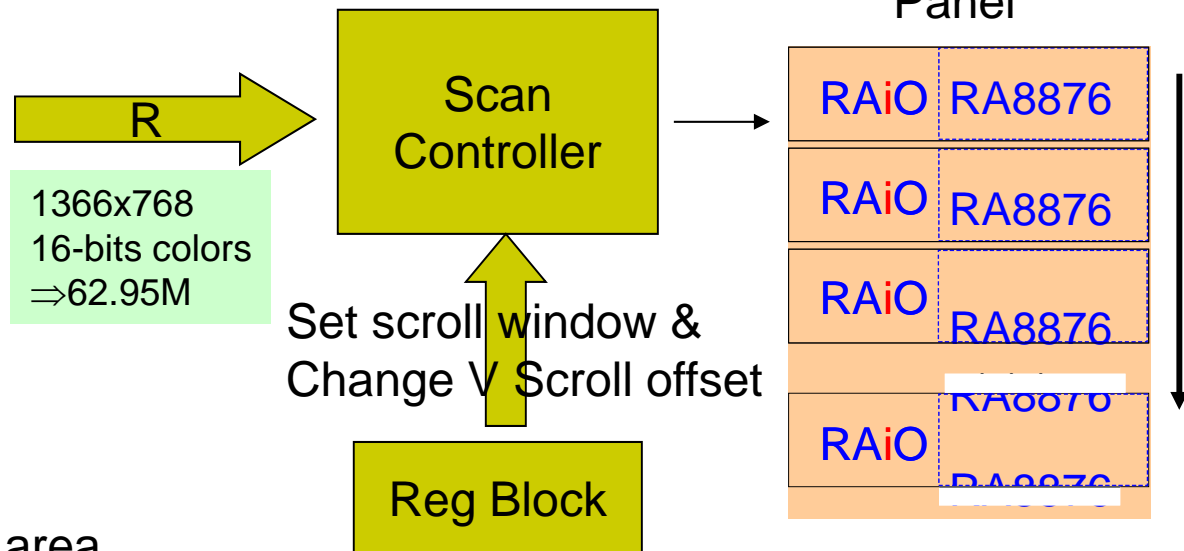
Horizontal/ Vertical Scroll can mix operation

App8: Vertical Scroll



1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. **Image already download to memory.**

Scan consume bandwidth limitation:
 $H\text{-res} * V\text{-res} * 60\text{Hz} * \text{depth}(1|2|3|4) / 2$
 Not recommend over 60.



Scroll area \leq display area

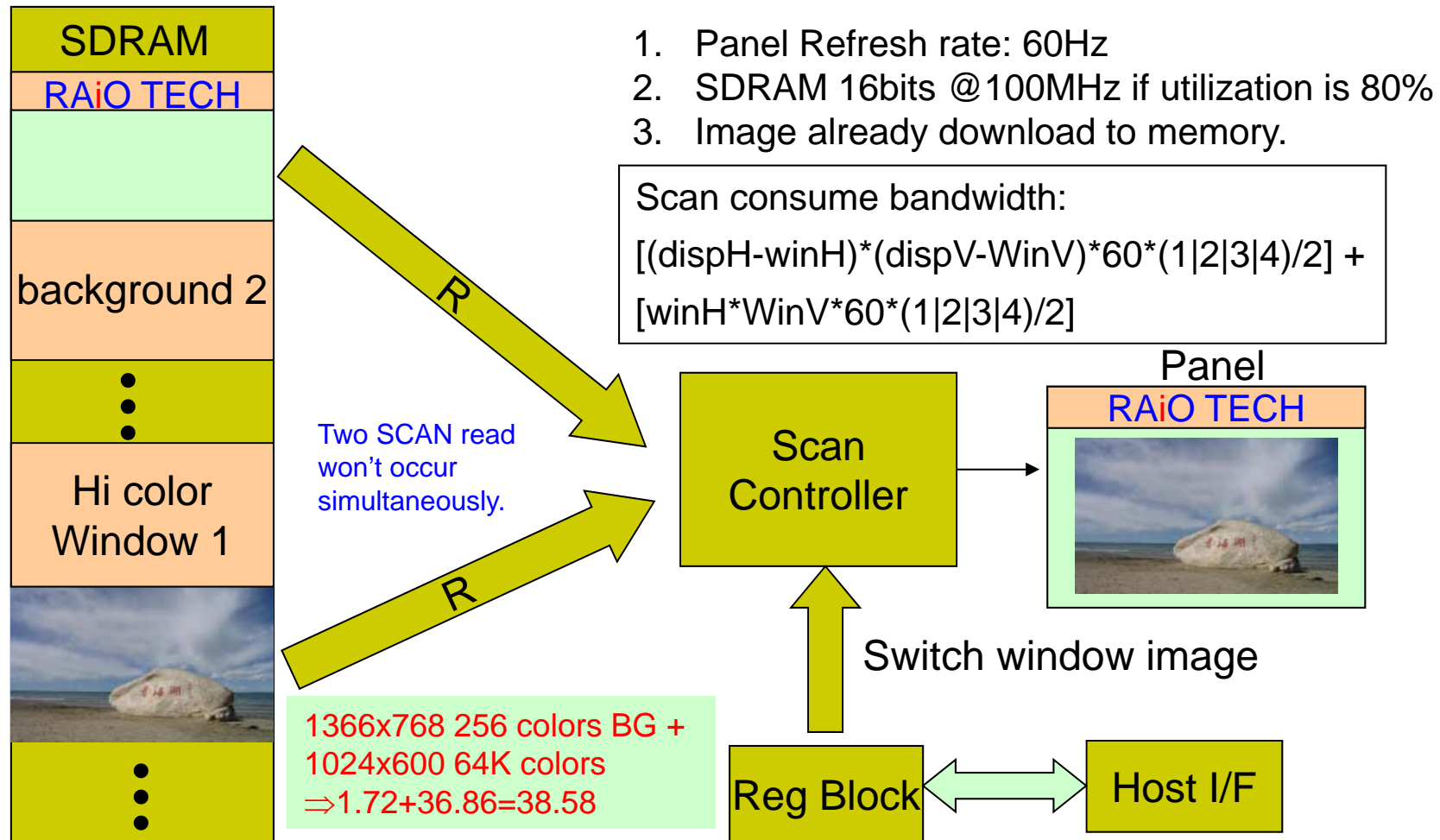
Horizontal/ Vertical Scroll can mix operation

App1 ~ 8 consume bandwidth

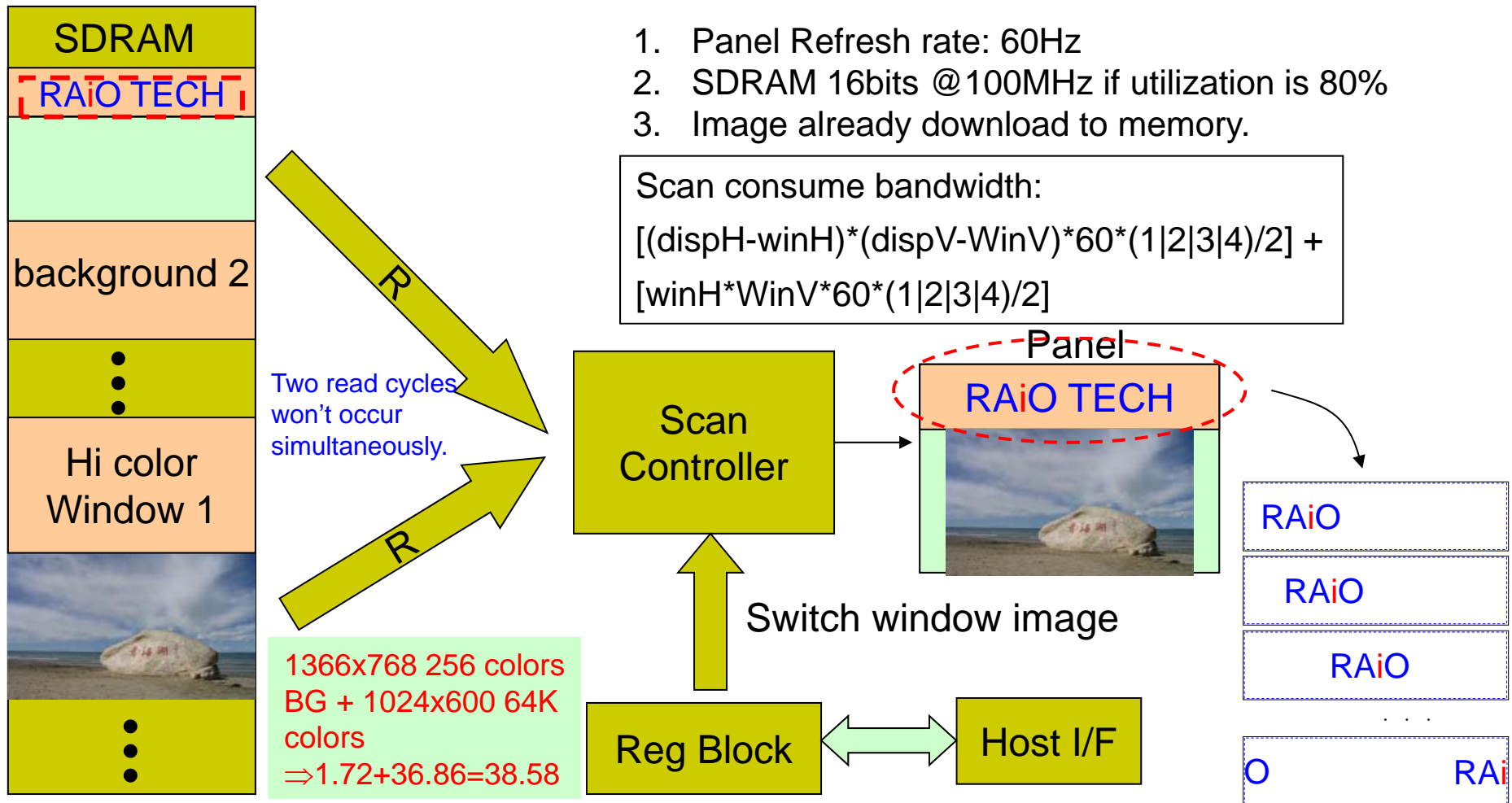


resolution		Scan BW (1R)			
H	V	8-bits	16-bits	24-bits(1)	24-bits(2)
320	240	2.3	4.61	6.91	9.22
480	272	3.92	7.83	11.75	15.67
480	640	9.22	18.43	27.65	36.86
800	480	11.52	23.04	34.56	46.08
800	600	14.4	28.8	43.2	57.6
1024	600	18.43	36.86	55.3	73.73
1024	768	23.59	47.19	70.78	94.37
1280	768	29.49	58.98	88.47	117.96
1280	800	30.72	61.44	92.16	122.88
1366	768	31.47	62.95	94.42	125.89

App9: Background + window on top

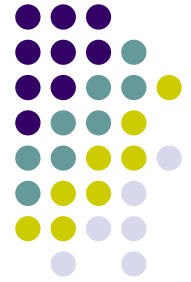


App10: Window mix with Scroll



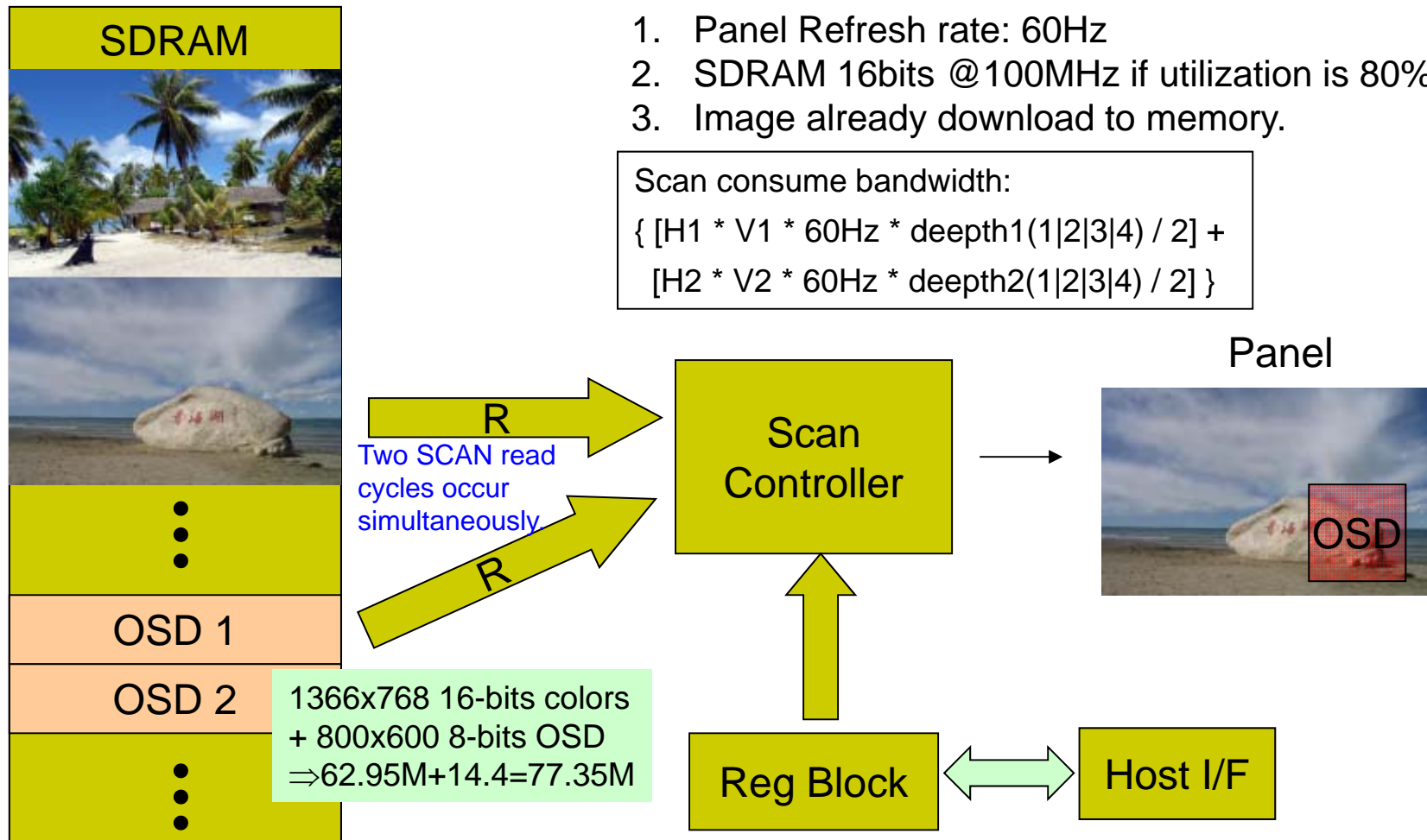
Summary

Single layer Scan function

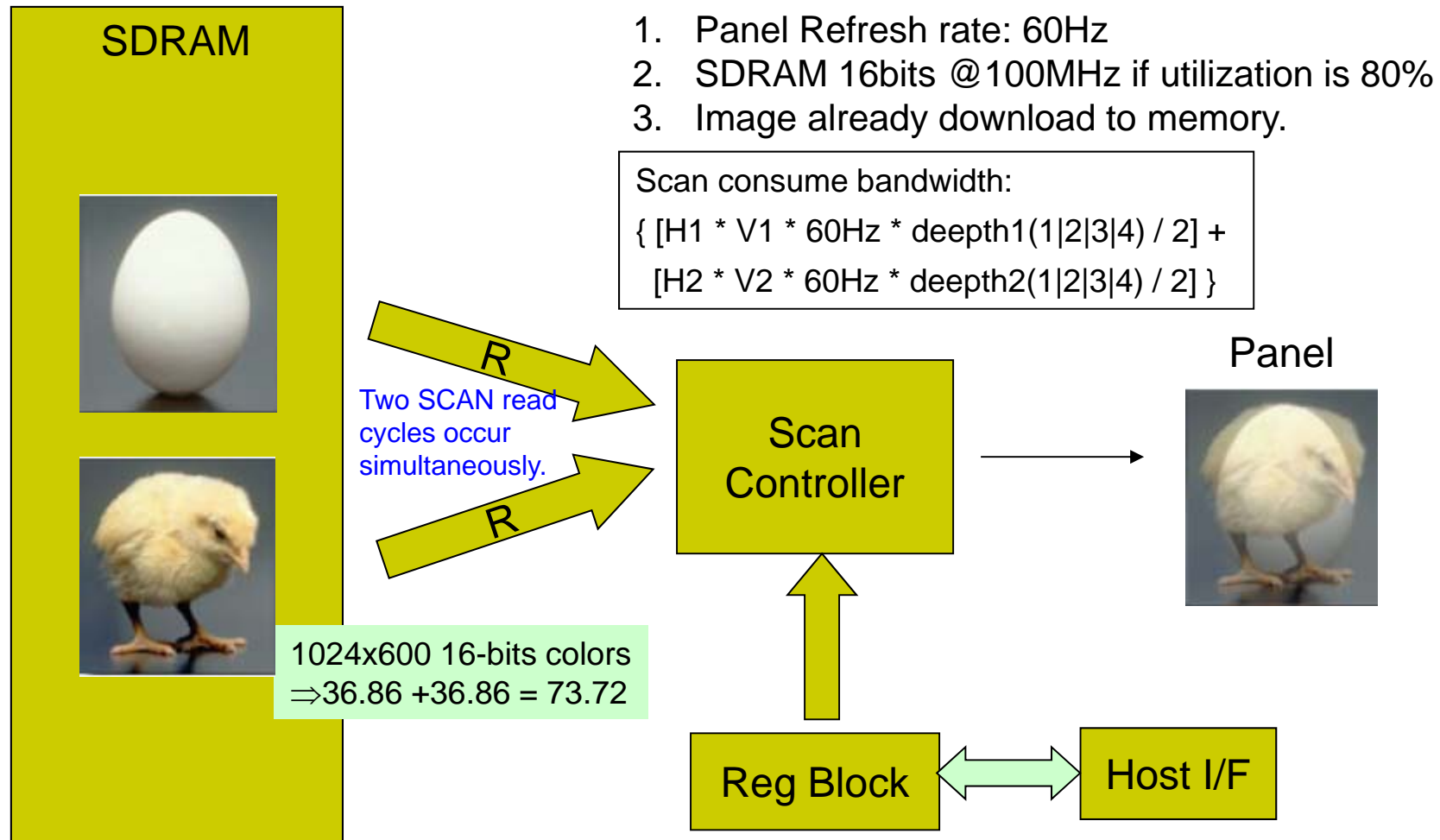


- Still image display
- Partial image display
- Image shift-in & shift-out
- Horizontal / Vertical Flip
- Horizontal / Vertical Scroll
- Background + window on top
- Background + window on top with scroll

App11: Alpha-blending – OSD application

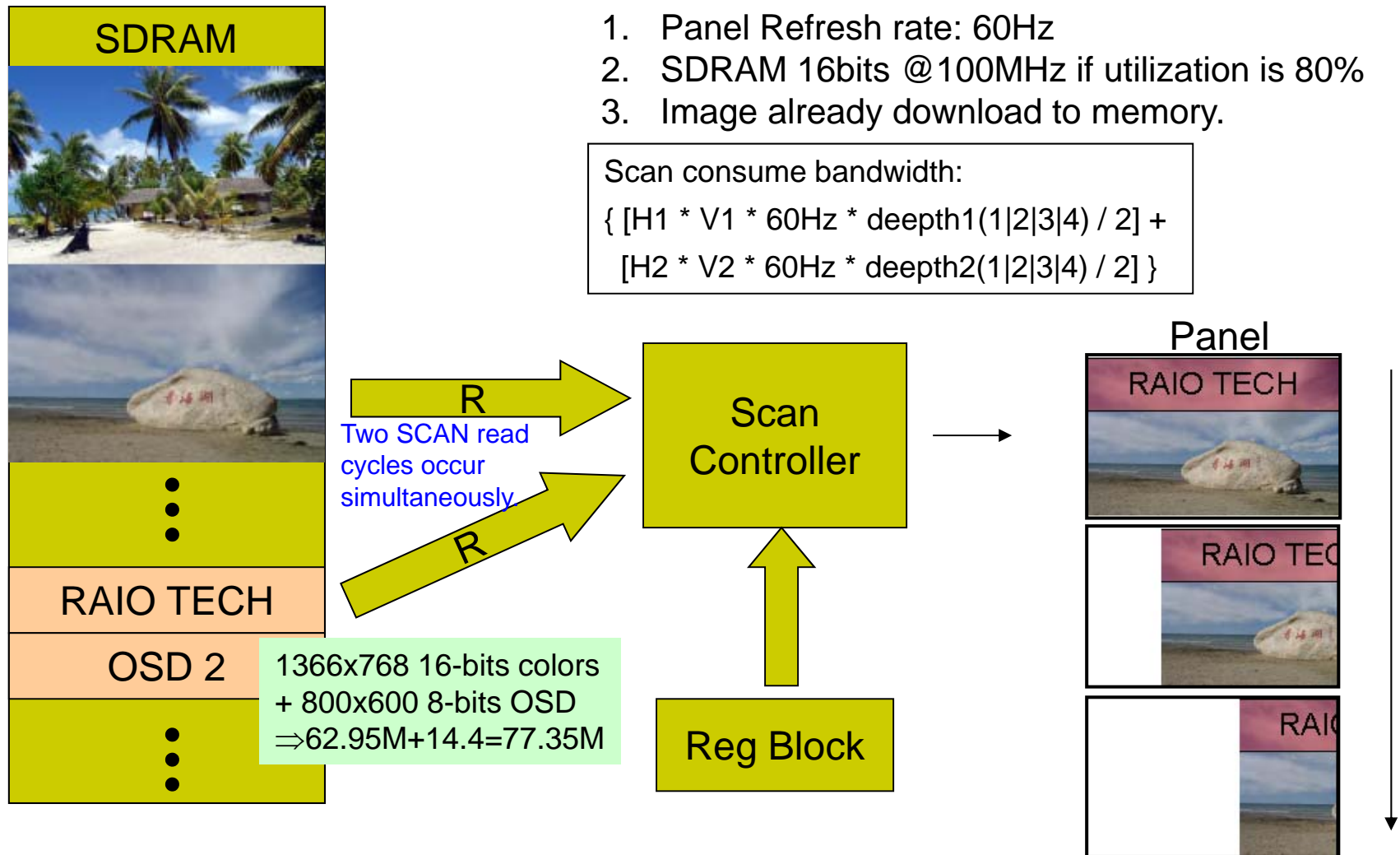


App12: Alpha-blending – fade-in / fade-out



App13:

Layer 1 & 2 Scroll Simultaneously



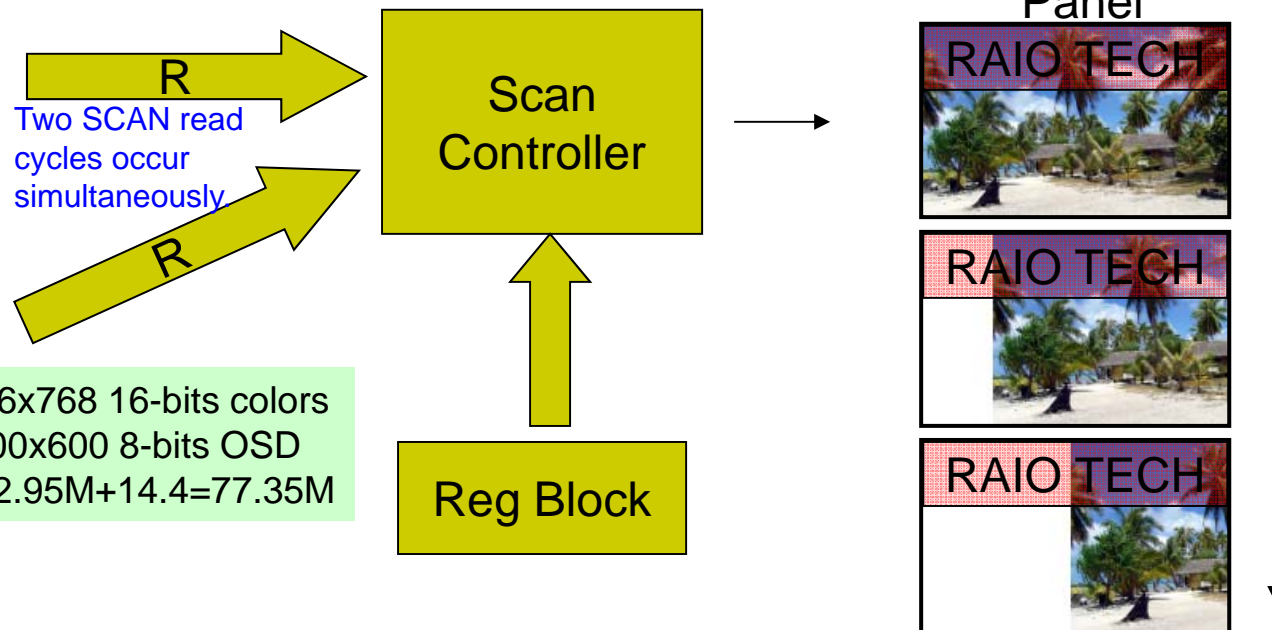
App14: Only Layer 1 Scroll



1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. Image already download to memory.

Scan consume bandwidth:

$$\{ [H1 * V1 * 60Hz * depth1(1|2|3|4) / 2] + [H2 * V2 * 60Hz * depth2(1|2|3|4) / 2] \}$$



App15: Only Layer 2 Scroll

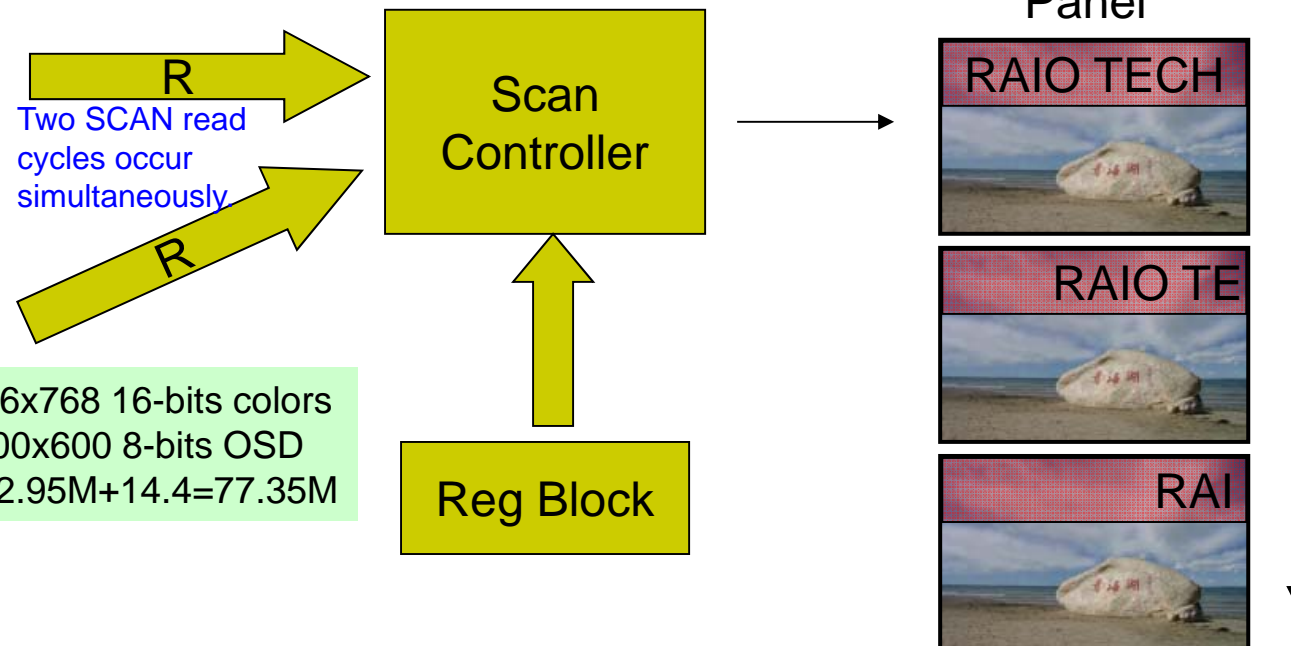


1366x768 16-bits colors
+ 800x600 8-bits OSD
⇒ 62.95M + 14.4 = 77.35M

1. Panel Refresh rate: 60Hz
2. SDRAM 16bits @100MHz if utilization is 80%
3. Image already download to memory.

Scan consume bandwidth:

$$\{ [H1 * V1 * 60\text{Hz} * \text{depth1}(1|2|3|4) / 2] + [H2 * V2 * 60\text{Hz} * \text{depth2}(1|2|3|4) / 2] \} < 80$$



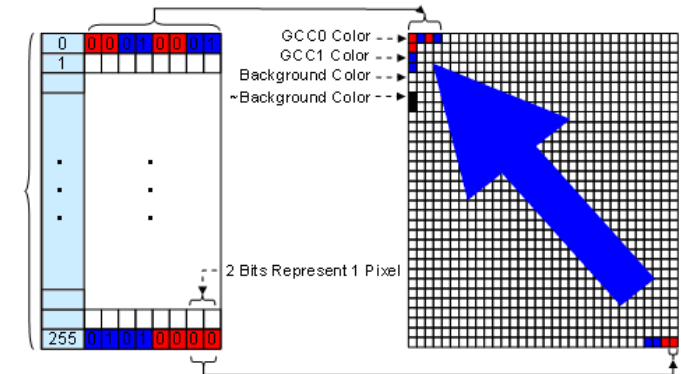
Summary

Two layer Scan function

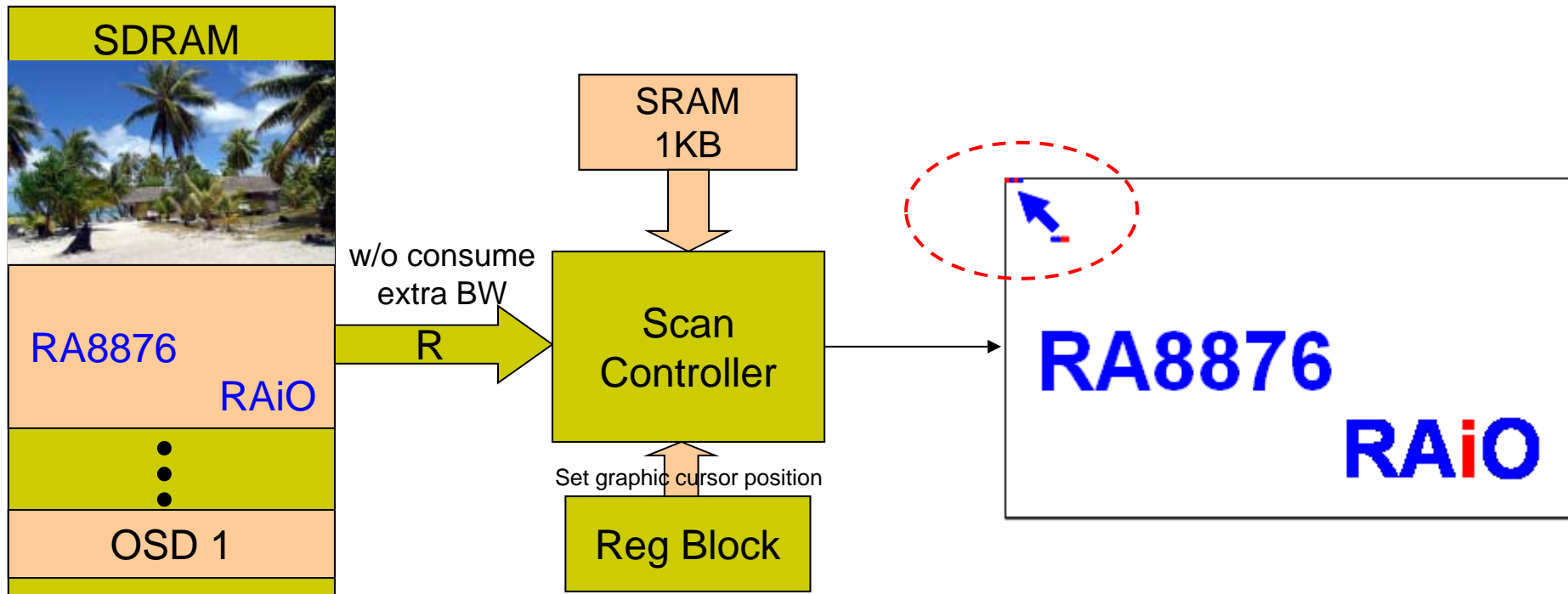
- Alpha-blending – OSD application
- Alpha-blending – fade-in / fade-out
- Layer 1 and/or 2 Scroll



App16: Graphic cursor



- The size of graphic cursor is 32x32 pixels, each pixel is composed by 2-bit, which indicates 4 colors setting (color 0, color 1, background color, the inversion of background color).
- Embedded 1KB SRAM, offer 4 groups of graphic cursor for selection. Each graphic cursor take 256Bytes ($32 \times 32 \times 2/8$).

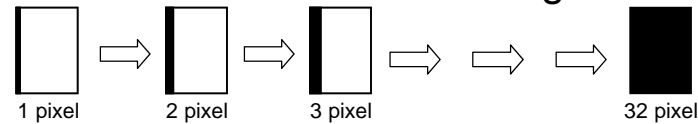


App17: Text cursor

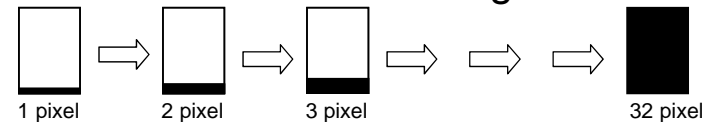


- When Draw input set as text mode, a text cursor will visible according to user's register programming.

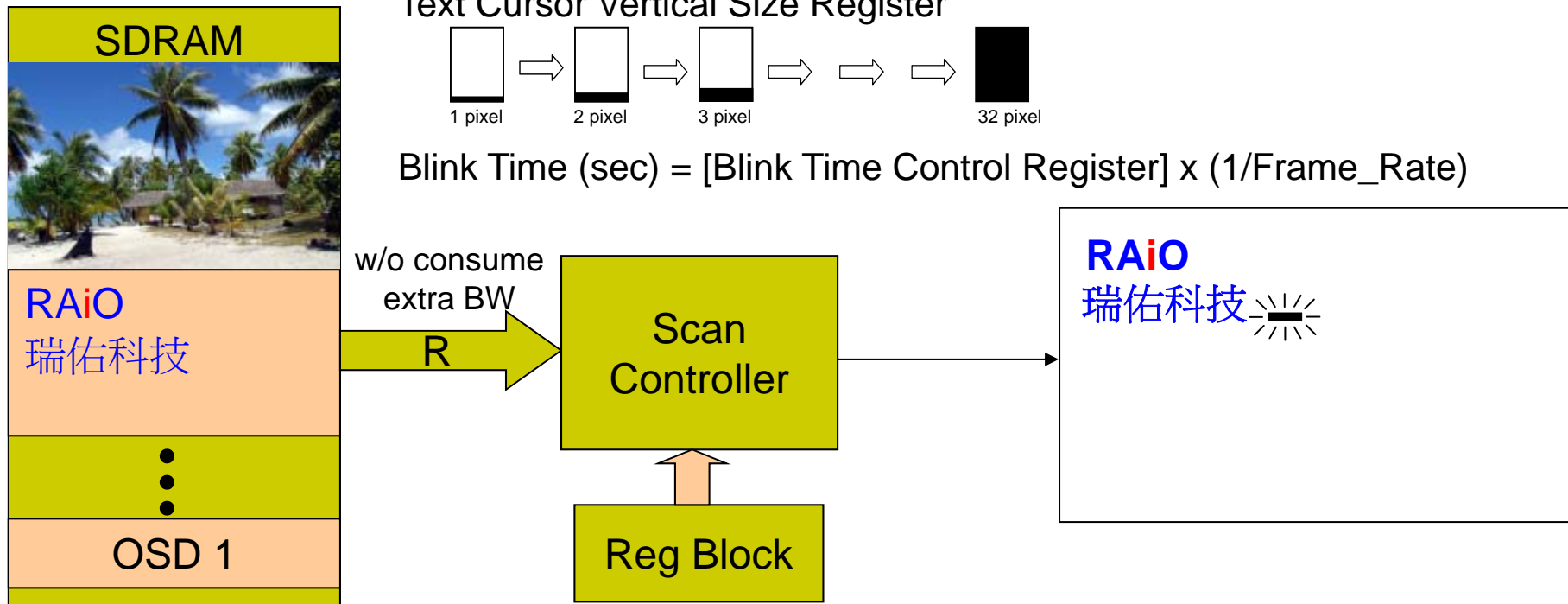
Text Cursor Horizontal Size Register



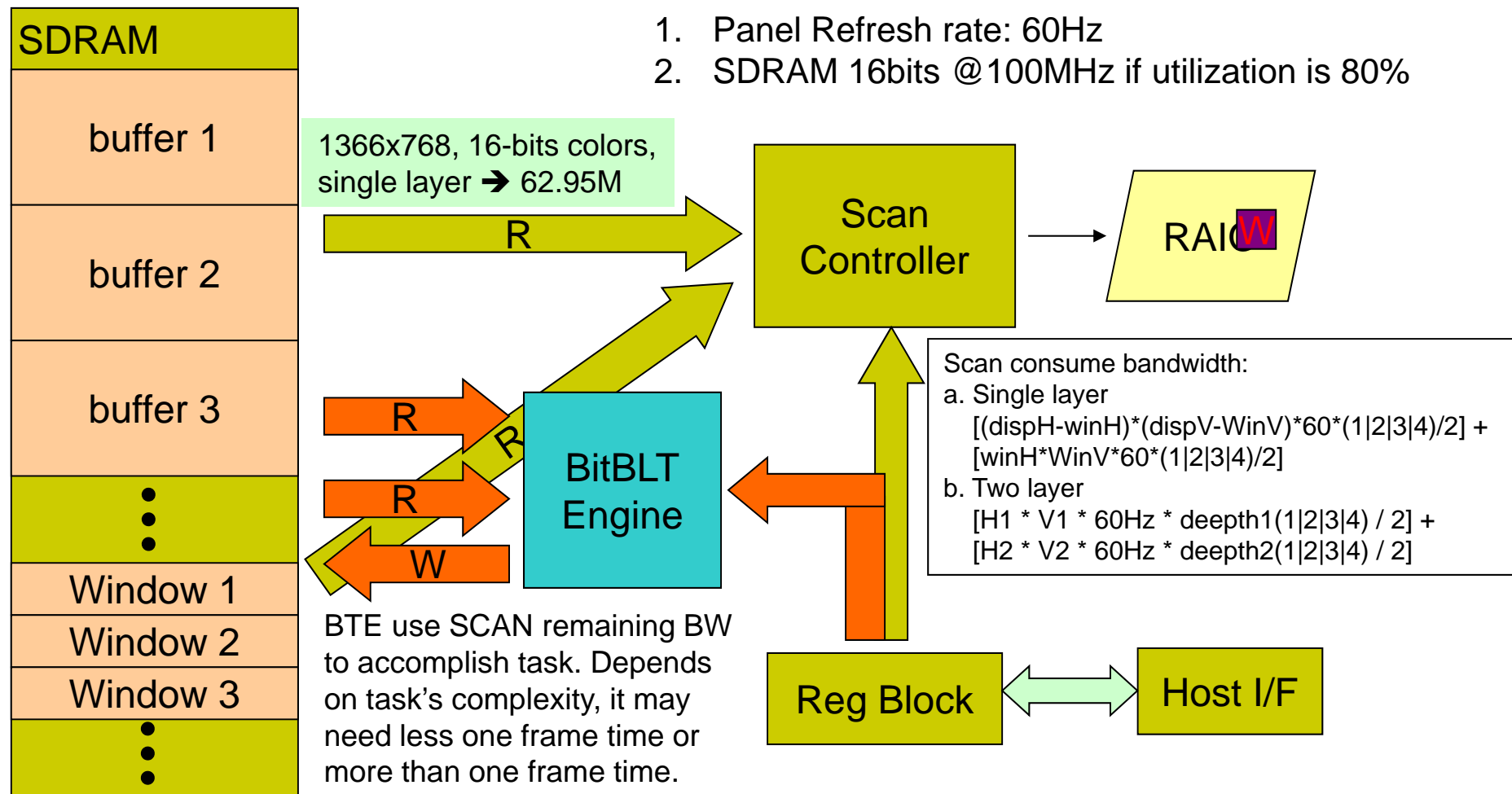
Text Cursor Vertical Size Register



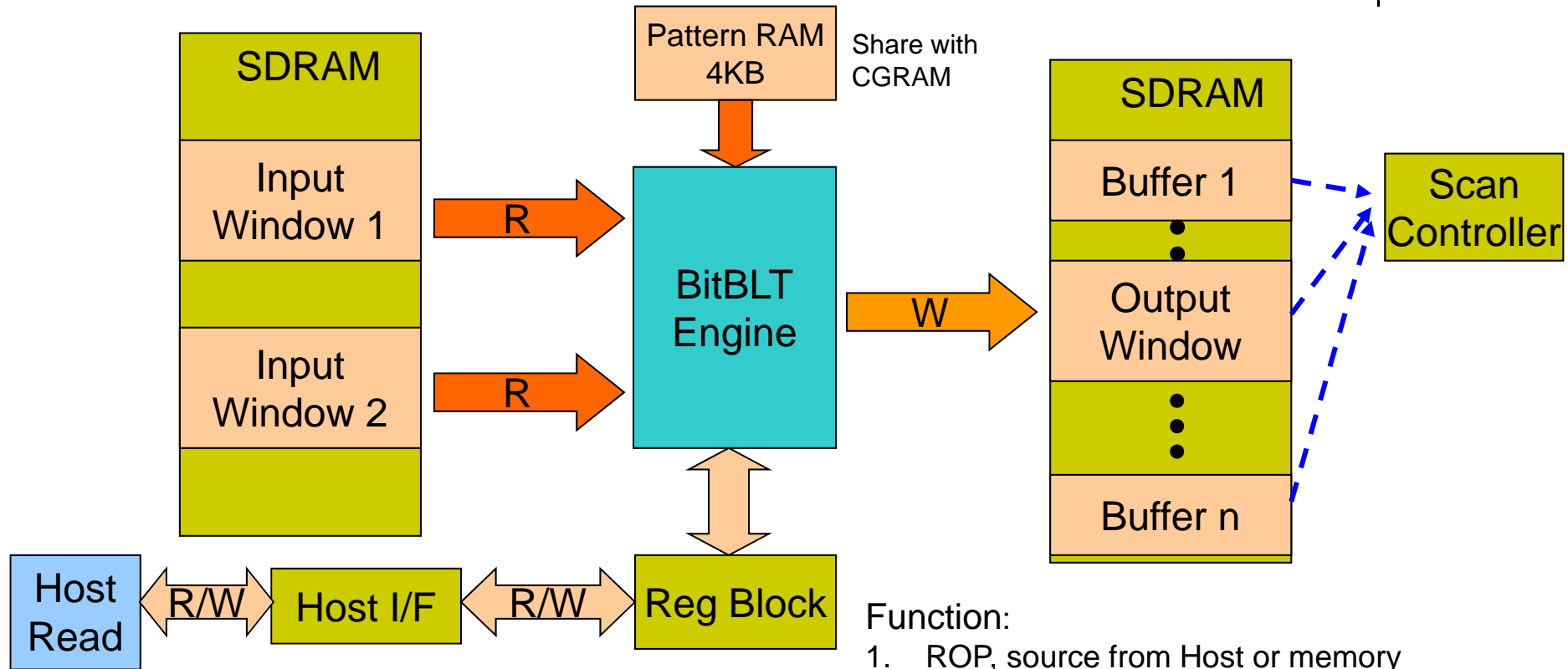
$$\text{Blink Time (sec)} = [\text{Blink Time Control Register}] \times (1/\text{Frame_Rate})$$



App18: BitBLT active



BitBLT operation

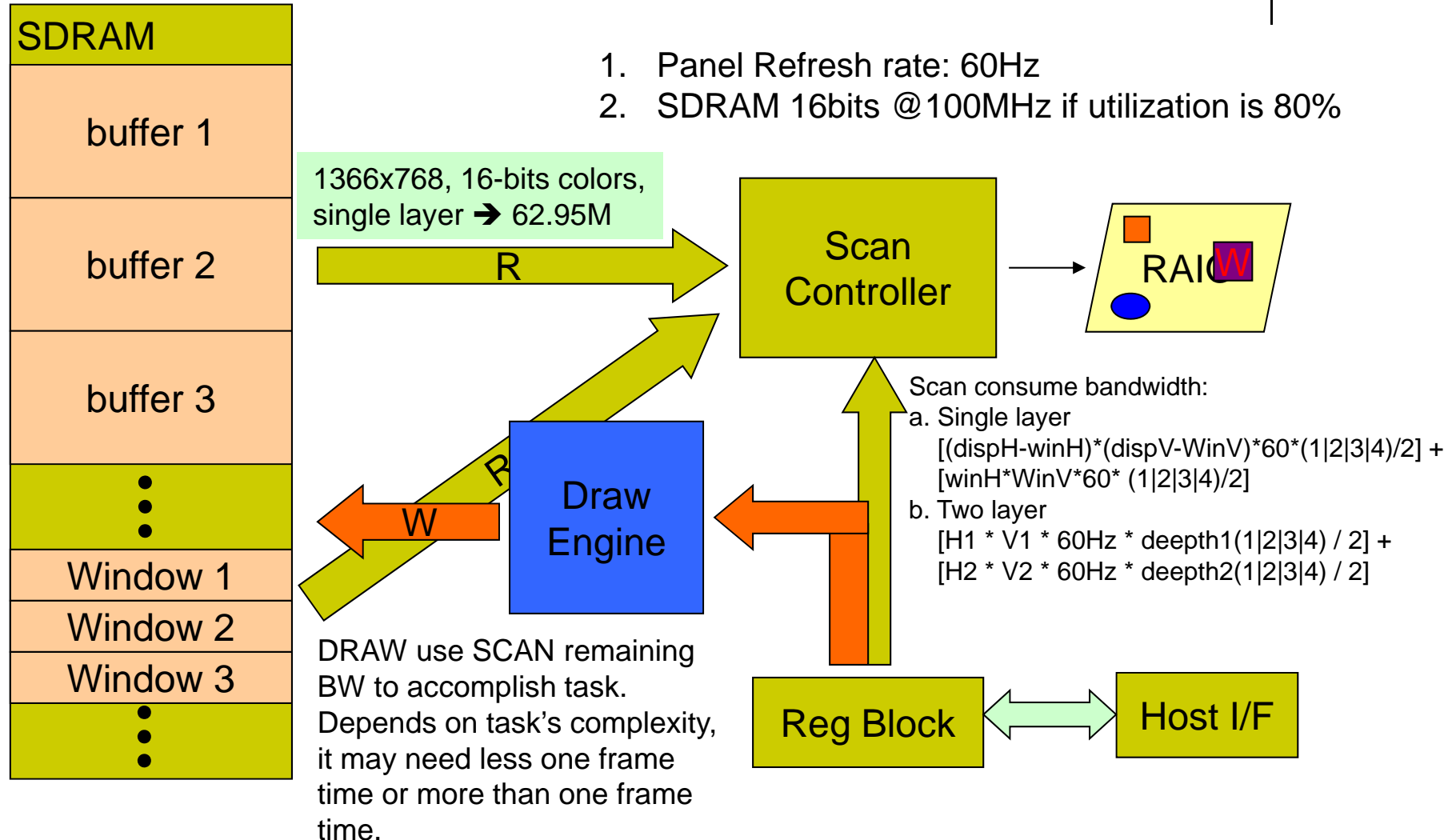


Input Window 1, 2 and output window may have different color depth.

Function:

1. ROP, source from Host or memory
2. Alpha-blending
3. Pattern fill
4. Solid fill
5. Color depth convert
6. Convert monochrome data to color

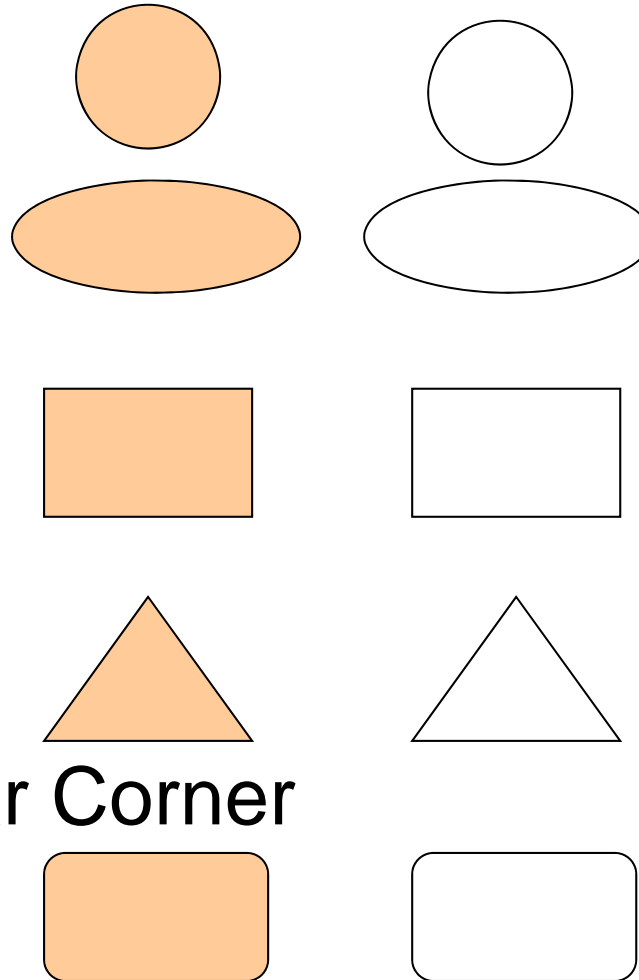
App19: Draw Geometric Pattern





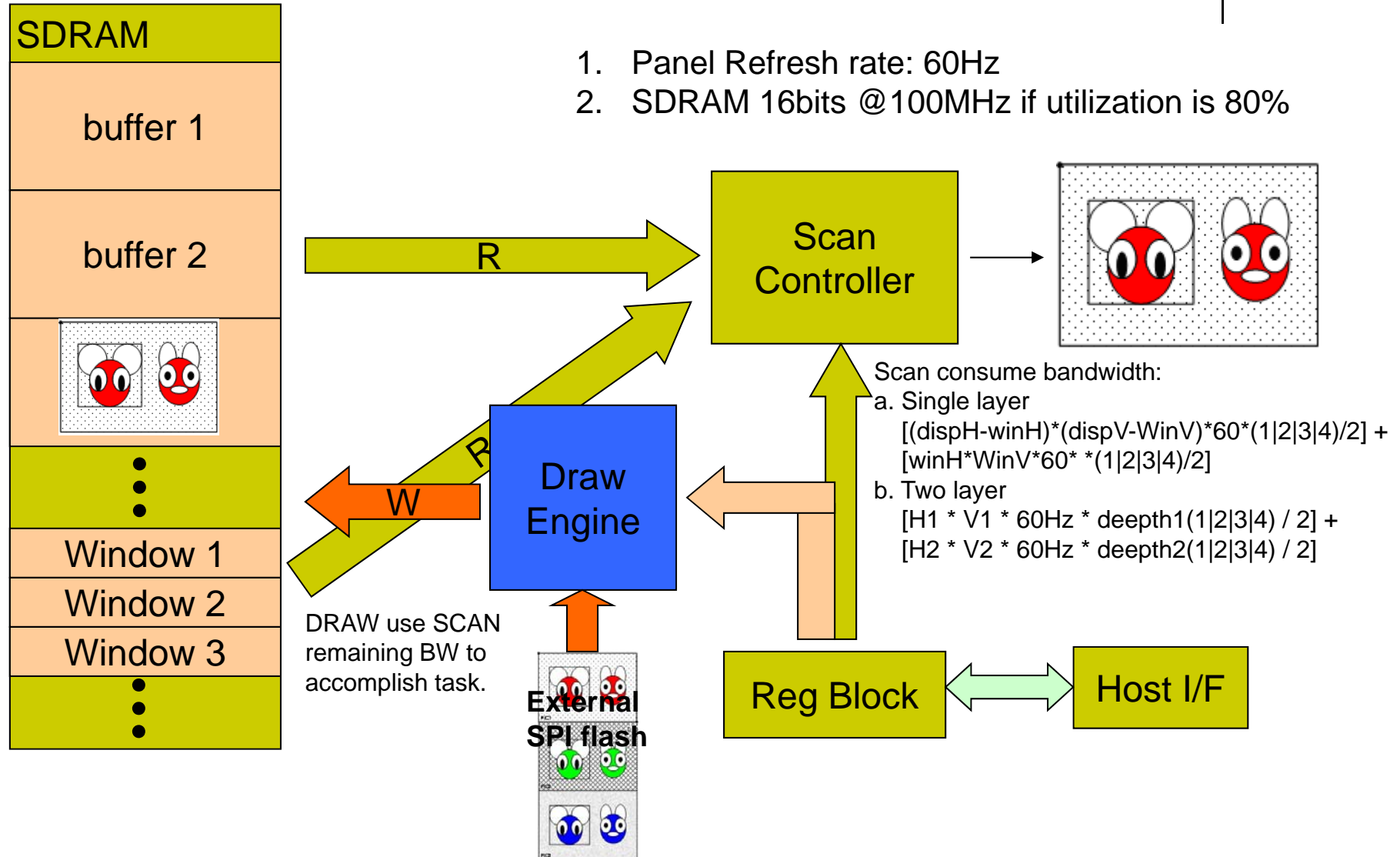
Geometric Pattern

- Circle
- Ellipse
- Curve
- Square
- Line
- Triangle
- Square Of Circular Corner

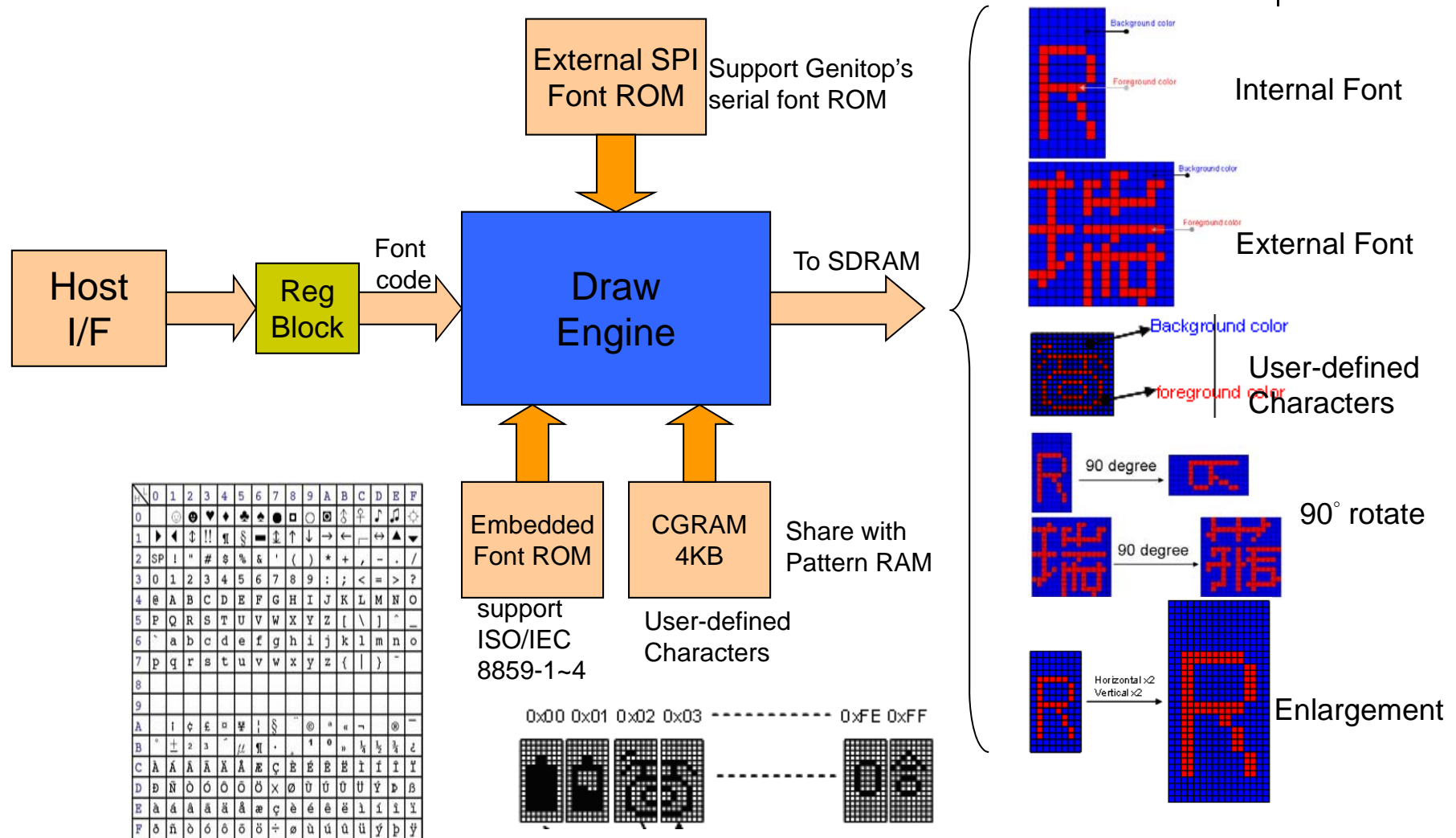




App21: Load image from serial flash



App22: Text input



Appendix – Panel specification reference



resolution		Code	ratio	Size	I/F	PCLK MHz	color	Model
H	V							
320	240	QVGA	4:3	5.7"	P	6.4	18b	G057QN01 V0
480	272	WQVGA	16:9	4.3"	P	9	24b	LQ043T3DX02
480	640	VGA	4:3	3.7"	P	25.2	18b	LS037V7DW01
800	480	WVGA	16:9	8.5"	P	33.26	24b	LQ085Y3DW01
800	600	SVGA	4:3	8.4"	L	40	24b	LQ084S3LG01
1024	600	WSVGA	15.4:9	4.8"	L	54	18b	LMS480JC01
1024	768	XGA	4:3	12.1"	L	65	18b	LQ121X3LG02
1280	768	WXGA	5:3	8.9"	L	68.25	18b	N089A1 - L01
1280	800	WXGA	16:10	12.1"	L	83.5	24b	LQ121K1LG52LCD
1366	768	WXGA	16:9	15.6"	L	76	24b	M156B1-L02



Application vs. Function

- App1 ~ App17 : Scan Function
- App18 : BitBLT Function
- App19 ~ App22 : Draw Function

[illegible]

[illegible]

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