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DM816x – Hybrid DVR Product
Specification
Document Version 1.0

PRODUCT

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Revision History

Version	Date	Revision History
0.1	Mar 2010	DM816x Hybrid DVR RDK Product Spec Initial Draft
0.2	18 Mar 2010	Modified after internal review
0.3	5 Apr 2010	Modified based on Danny's review comments
0.4	2 Jun 2010	Modified based on the final HW alignment. Updated Sec 2.1 Updated Software Features – Streaming, Video Overlay, Playback search.
0.5	2 July 2010	Added Appendix mentioning details of Alpha Version software on Alpha version hardware
0.6	14 Aug 2010	Added Sec 2.3 for the display specifications
1.0	02 Jan 2012	Specification of DVRRDK based on McFW

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1   Introduction

DVR Reference Design Kit (DVR RDK) based on Texas Instruments next generation single chip technology – DM816x provides a high performance solution for hybrid digital video recorders for up to 16 analog CCTV inputs and 4 network streams from IP cameras. The DVR RDK is highly scalable to stack more such solutions and scale the number of input channels to much higher number.

DVR RDK comes with all the required I/O interfaces like USB mouse, keyboard, touch screen, IR remote control, multiple HDMI outputs, spot display etc. which makes the design very easy-to-use. The dual HDMI outputs can be exclusive and can display different input channels.

DVRRDK has comprehensive functions of Live View, Playback controls like Play, Pause, Resume, Trick Play, Skip Play etc.

An extensive GUI with adds to an all together different, look-and-feel for the users.

2   Features

2.1   Key Hardware Features

- Supports up to 16 Channel Analog input cameras
- Supports IP Network camera input port
- Based on TI Davinci DM816x SoC with ARM Cortex A8 as the general purpose processor, C67x floating point DSP, multiple coprocessors for multi-channel capture and display, coprocessors for H.264/MPEG4/JPEG Encode and Decode operations
- 4 TI TVP5158 multi-channel video decoders for up to 16CH D1 analog camera video/audio input via dual video/audio port
- 16 video input port, supports NTSC/PAL.
- 16 audio input port. Mono audio capture using TVP5158
- 1 analog video loopback output port for installation. This can be connected to any of the 16 input ports and can be controlled using some rotor switch.
- 2 channel audio output port, one over HDMI and the other through AICxxx. Both are stereo audio outputs.
- 2 HMDI transmit-only port (one on-chip and one using an external HDMI TX chip)
- 1 Spot Display – Standard Definition NTSC/PAL for individual channel
- VGA Output up to 1600x1200 @ 60fps, through DVO output port of DM816x
- 2 x 1GB of DDR3 DRAM
- 1GB/256MB NAND Flash
- 1 RS-232 port and 1 RS-485 port (full-duplex)
- 16 sensor input port, 4 alarm output port
- Keys input on front panel
- USB 2.0 3-port (USB Mouse, USB keyboard, USB Backup drive)
- 4 internal SATA Interface (1-to-4 SATA port multiplier for On-chip SATA)
- One eSATA interface (On-chip SATA)
- 2 Gigabit Ethernet ports
- Optional Features
    - o   DVD Backup using external DVD drive on eSATA port
    - o   IR remote controller

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2.1.1 Hardware Block Diagram
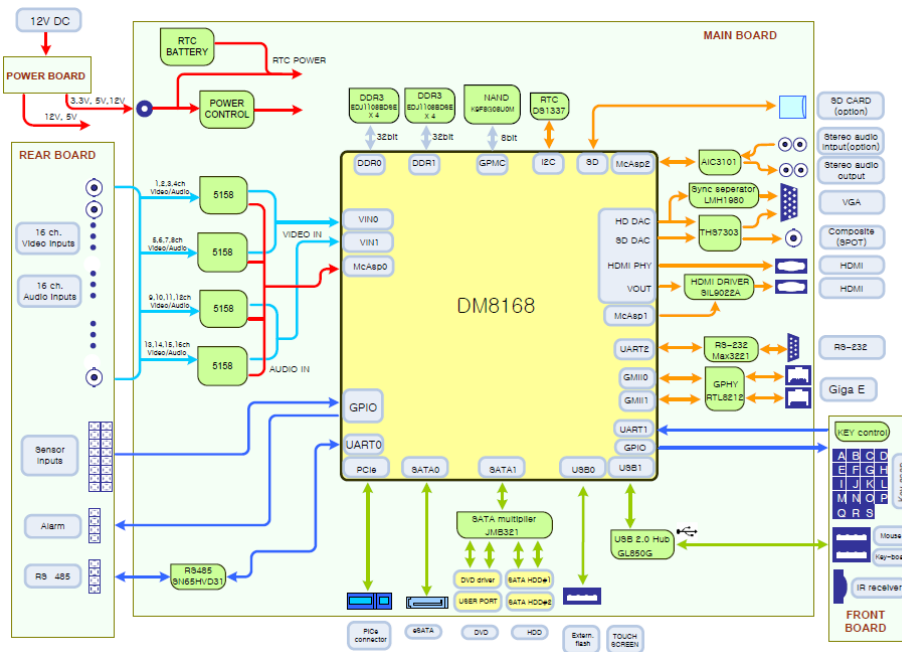
2.2   Software Features

- Supports up to 16 Channel Analog input cameras and input network streams from IP Cameras equivalent to 480fps D1 (including the playback of recorded content). Example : 16 Analog Camera + 8 IP Cameras (D1) + 8 Playback D1, 16 Analog Camera + 16 IP Cameras (D1) + 0 Playback D1

- In Network Video Recorder configuration (no analog CCTV input), supports up to 32 D1 IP camera playback or 12 720P IP camera playback or 6 1080P playback

Video Combinations				
Number of Input Channels (16 Analog Camera + IPNC)	Channel Property	Recording Stream 1	Recording stream 2	Recording stream 3 (Phase 2)
16 Analog cameras	Resolution	D1 (720x480 NTSC) (720x576 PAL)	CIF (360x240 NTSC) (360x288 PAL)	D1 (720x480 NTSC) (720x576 PAL)
	FPS	480 (NTSC) 400 (PAL)	240 (NTSC) 200 (PAL)	80 (NTSC) 64 (PAL)
	Per Channel Bitrate	512Kbps, 1/2/4/6Mbps	64/128/256/512Kbs /1Mbps	1/2/4Mbps
	Codec	H264	H264	MJPEG
IPNC / Playback	Resolution	Up to 1080P	Up to D1	Up to 1080P
	FPS	480 fps @ D1 (NTSC)		
	Codec	H264/MPEG4	H264/MPEG4	MJPEG
NVR Configuration	Channel Property	Recording Stream 1	Recording stream 2	Recording stream 3 (Phase 2)
IPNC / Playback	Resolution	Up to 1080P	Up to D1	Up to 1080P
	FPS	960 fps @ D1 or 360 fps 720P or 180 fps 1080P		
	Codec	H264/MPEG4	H264/MPEG4	MJPEG
System Software Components				
OS	• Linux on ARM Cortex A8			
Camera Input				
Camera Type	• Analog Camera input (via TVP5158 decoder)			

	o TVP5158 decoder controlled from the user-space drivers running on A8 • IP Network Camera (IPNC) input
Video system	• NTSC • PAL

Video Resolutions for Encode	• CIF (352x240 NTSC, 352x288 PAL)
	• D1 (704x480 NTSC, 704x576 PAL)
	• Dynamic resolution change for each stream is possible
	  o D1, CIF for primary stream (H.264)
	  o CIF, QCIF for secondary stream (H.264)
	  o Tertiary stream resolution same as primary stream (MJPEG)
	  o No specific constraint in the framework for the resolutions of primary and secondary stream

Video frame rate	• Up to 30fps for NTSC and up to 25fps for PAL depending on video capture combination • User adjustable fps for each channel at initialization time or even when DVR is operational
PTZ Control	• Analog camera PTZ control • PSIA/ONVIF specification PTZ control for IP Cameras

Video Adjustments	• Following adjustments available for the video capture from analog cameras
	  o Brightness
	  o Contrast
	  o Saturation
	  o Hue
	  o Sharpness
	  o Noise Filter

Audio input	• Up to 16 Audio inputs (from Analog camera), one for each CH of video • Mono capture from all channels
Audio sampling rate	• 8Khz • 16Khz
Audio Adjustments	• 0 (mute) – 10 (max) levels • Can be controlled for each channel independently • TVP5158 Audio ADC will be controlled for volume control. No software volume control
Audio Processing	
Audio Compression format	• G.711 on A8 • AAC

Video Processing	

Video Overlay	• QT Development Kit based implementation. Easy to develop on PC/workstation and use it on DVR RDK
	• Text Overlay
	   o 16 Character camera name overlay
	   o Date overlay
	   o Time overlay
	   o Date formats
	     - MM – DD – YYYY
	     - DD – MM – YYYY
	     - YYYY – DD – MM
	• Transparency support
	• Intelligent color selection overlay – white font on dark background and vice-versa

Video Compression	• H264 BP/MP/HP, MJPEG
Video Decode	• Universal H.264, MPEG4 and MJPEG decode
Video bit-rate	• User adjustable from 128Kbps to 8Mbps
Video Analytics Detection	• Support Tamper Detection at 5fps for each channel
Video Motion Detection	• Motion detection based on the preview channels (Live Motion Detect) • Not using motion vectors from the H.264 compression • DSP based algorithm to detect motion based on the minimum block granularity of 32x10 • Independent of the frame rate change on the encoded channel • User selectable areas of interest per channel • Up to 7 motion Detect sensitivity levels per channel
Video de-interlacing	• 16 channel De-interlacing on analog input • 4-field de-interlacing always enabled
Video Signal Detection	• Auto detection of analog video input – NTSC/PAL
Video Digital PTZ	• Support for digital zoom upto 4x for any 2 channels simultaneously • Available on the preview path and not on the encode path
Other features	• Video loss detection • Privacy Mask (Rectangular shaped masks)
Video Display and Audio output	
Display	• HDMI 0

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Configuration	- o Driven from on-chip HDMI transmitter on DM816x - o Dynamic resolution and timing change for 1080P60, 1080i60, 720P60, XGA60, SXGA60 - HDMI1 - o Driven from DVO2 port on DM816x - o External HDMI transmitter Sil9022A used on the board - o Dynamic resolution and timing change for 1080P60, 1080i60, 720P60, XGA60 and SXGA60 - o Tied to VGA output – means the content, resolution and timing of HDMI1 and VGA are always same - VGA - o Driven from on-chip HDDAC on DM816x - o Dynamic resolution and timing change for 1080P60, 1080i60, 720P60, XGA60 and SXGA60 - o Tied to HDMI1 (DVO2) output – means the content, resolution and timing of HDMI1 and VGA are always same - Spot TV (CVBS) - o Driven from on-chip SD VENC on DM816x - o Dynamic resolution and timing change for NTSC or PAL displays - All the displays can be controlled using the "sysfs" interface on linux also - The tie-up of displays is also configurable in the framework as per user requirements
Display Layouts	- Classic layouts: 1x1, 2x2, 4x4… (Refer to later sections for detailed display layouts) ~~3D layouts: CamFlow, TimeFlow and EventFlow~~ - Spot Dispay from a user selectable input source channel - o Only single channel display on spot TV - o No mosaic layouts on spot TV
Display Layout Configuration	Preview resolution and encode resolution can be different
Audio Output	1 channel audio output to speaker (Stereo) - o By default mono output is used as the captured audio is mono 1 channel audio output through HDMI - User can select the channel (input or playback) whose audio output can be enabled - Audio sampling rate - 8Khz / 16Khz - Audio volume controls 0 (mute) – 10 (max) levels

AV Sync	• AV Sync when audio is enabled (<= 33ms drift between Audio and Video)
Streaming	
Streaming	• User selectable stream resolution and framerate. One stream per input channel. ○ Default resolution for network streaming in CIF • All input compressed channels are streamed using RTSP protocol • Playback channel can also be streamed via RTSP protocol • Audio and video and streamed together • ~~Streaming format is compliant to PSIA IP Media Device Spec and ONVIF~~ • Upto 10 clients connection • Multicast support • ~~Scalable Video Coding support for streaming data based on SDP transactions~~
Networking	
	• ~~Support Web-server interface using HTTP over TCP/IP~~ • ~~Support SMTP, NTP, FTP support~~ • DHCP and Static IP Support • ~~Automatic search for all UPnP supported IP cameras~~
Storage	
Storage Medium	• Internal & external Hard Disk Drive (HDD) up to 1TB • ~~RAID support~~ • USB Storage Drive
Audio Video Storage Format	• Optimize DVR-friendly system that supports fast multi-channel recording and playback. • Custom file format (NO standard file format like AVI, MOV) • Audio, Video, AV Index Info files stored as separate files • ~~SVC support for file storage system~~
Directory Structure	• Custom Directory structure

Recording mode	Recording to HDD based on
	   • Manual mode
	   • User specified schedule
	   • External Sensor Event input , Motion Detection Event and Video Loss Event
	   • Video analytic event
	   • Combination of above mentioned events

Other options	• Disk format

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	• Disk checking and recovery
	• Disk de-fragmentation support
	• Option to flush compressed data memory cache when external trigger is received.
NAND Storage	• Filesystem on NAND as root filesystem. Also used for storing Boot code, Linux OS, application firmware, system parameters
Data Backup	
Backup	• Copy files from HDD drive based to external SATA HDD, USB Flash Memory Drive and DVD
	• Copy VA events or system configuration to USB Flash Memory Drive
	• Possible to backup files while multi-channel record is in progress
	• Option of backup for individual channels that can be played back on PC players like Media Player, VLC etc. Saved files are in AVI format
Backup mode	• User selected files marked for backup
	• Auto-backup of data based on date-time, event, camera input
Playback	
Playback	• Playback of files present in HDD and display on display device
	• Playback while multi-channel record is in progress
	• Up to 16 channel simultaneous playback
Playback Search	• Playback search based on camera input, event, date-time
	• Event/Record list display for specific time interval. Filter on events in the list .
Playback options	• 1x, 2x, 4x, 8x FF/REW, jump to specific time, slow rewind, slow forward
	• Pause / resume
	• Audio volume control - 0 (mute) to 10 (max) levels
	• AV Sync when audio is enabled
	• Page Up/Down the channels with instant playback option
	• Each channel auto delete setup
Alarm	
Alarm Output	• Trigger Alarm based on VA event, external sensor event
	• Alarm can be setup for each channel independently by user
	• WAV file playback for Alarm output
	• Event Detection Pop-up, Email notification based on setting with the MJPEG snapshot at the event
	• HDD Failure Alert
User Interface	

UART Debug Interface	• Debugging shell via the UART interface
	• The Linux shell is visible over here
VMS	• PC based VMS GUI application for viewing of streaming data from DVR
Front Panel Key Pad	• For all basic functions of live and playback control
IR Remote Control	•
Other Auxiliary Features	
Boot-up time	• Power-ON to live display for all channels < 10 seconds
	• Power-ON to all channel encoding/recording start and display MUST be < 30 seconds
Hardware Diagnostic	• Detailed hardware diagnostic interface to test and validate each peripheral connection
Others	• Support for multi-user access control
	• Root User can control all the features and display layouts
	• Individual user can only view the displays configured by root user
Scalability	• Scalable over PCIe interface to connect multiple DVR systems
Language Support	• Supports English Language, with documentation to implement other language support

	Display Resolution	Encode Resolution
NTSC	720x480	704x480
PAL	720x576	704x576

2.3   Display Specifications

DM816x DVR RDK supports multiple display devices namely – 2 HDMI port supporting upto 1080P60, 1 VGA port supporting upto 1080P60 and a spot display of NTSC/PAL for each input channel.
Default display configuration is as below

- HDMI0 → Independent display timing, resolution and framerate
- HDMI1 & VGA → Tied together. Both displays can work simultaneously but the timing, content and resolution is same across the two displays. Independent from HDMI0
- SDTV (Spot) → Independent display. Allows one channel live preview, based on channel selection

The display specifications for DVR Reference Design are mentioned below:

For ease of understanding, we would call the three possible displays from DVR as **Display 1**, **Display 2** and **Display 3.**

Display 1 – This is the primary display for the DVR system. It can be either a VGA monitor display @ 1280x1024 60fps or it can be HDMI display @ 1080i60. It is configurable by the user.
When **Display 2** is switched off, **Display 1** on HDMI port can scale to 1080P60. User has the control to select the display resolutions.

Display 2 – This is the secondary display for the DVR system. It is HDMI display @ 1080i60. User can select this display to be 720P60 also. No upscaling done when all 16 input channels are displayed.
When **Display 1** is switched off, **Display 2** can scale to 1080P60. User has the control to select the display resolutions.

Display 3 – This is the spot display. It is useful for viewing individual channels, generally for installation. It is a composite analog signal with NTSC or PAL timing.

All GUI controls are on the primary display (**Display 1**). Even the layout controls for **Display 2** and **Display 3** are also on the GUI shown on **Display 1**. Only the grid borders and status details are shown on **Display 2** and **Display 3**.

The following table lists down the possible combinations of the channels visible on the different display outputs from DM816x DVR RDK. The table shows combinations w.r.t. DVR and Hybrid DVR mode.

Table 1   Display Combinations for DM816x DVR RDK

Display Port	Possible Combinations
Display 1 (1280x1024@60fps OR 1080i60) OR (1080P60 if **Display 2** is off)	• Primary Display • Only Playback Channels • Live Channels + 1 Channel Quick Playback o In this mode, one of the live channels can quickly be moved to playback mode without change in the layout for other channels • Multi-channel Live + Playback
Display 2 (1080i60) OR (1080P60 if **Display 2** is off)	• Secondary Display • Only Live channels are supported
Display 3 (NTSC or PAL analog)	• Spot display for individual live channels • Can support full screen (D1) or 2x2 grid

2.4   Display Layout Features

The combinations of supported layouts are listed below:

2.4.1   4x3 Layout on HDTV

• Each channel display resolution is 480x320

• Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)

• Page Up/Down allows the next set of channels to be viewed

CH1	CH2	CH3	CH4
CH5	CH6	CH7	CH8
CH9	CH10	CH11	CH12

Figure 1.   HDTV - 4x3 Layout

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2.4.2 4x4 Layout on HDTV

- Each channel display resolution is 384x256
- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)
- Page Up/Down allows the next set of channels to be viewed

CH1	CH2	CH3	CH4
CH5	CH6	CH7	CH8
CH9	CH10	CH11	CH12
CH13	CH14	CH15	CH16

Figure 2. HDTV 2 - 4x4 Layout

2.4.3 2x2 Layout on HDTV – 8 Channel layout

- 2x2 for displaying full captured resolution (D1)
- 4 other channels displayed in CIF resolution
- Page Up/Down allows the next set of channels to be viewed
- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)
- Each channel display resolution is 720x480 in 2x2 layout. Each smaller channel display resolution is 360x240

CH1	CH2	CH5
		CH6
CH3	CH4	CH7
		CH8

Figure 3. HDTV - 2x2 Layout

2.4.4   12 Channel Layout on HDTV

- Allows one channel to be seen on bigger resolution as compared to the other channels
- Page Up/Down allows the next set of channels to be viewed
- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)
- Each channel display resolution is 384x256. Bigger channel resolution is 1152x768

		CH1	CH2	CH3
			CH4	CH5
			CH6	CH7
CH12	CH11	CH10	CH8	CH9

Figure 4.   HDTV - 12 Channel Layout

2.4.5   14 Channel Layout on HDTV

- Allows two channels to be seen on bigger resolution (almost original resolution D1) as compared to the other channels
- Page Up/Down allows the next set of channels to be viewed
- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)
- Each channel display resolution is 384x256. Bigger channel resolution is 768x512

		CH1		CH2	CH11
					CH12
CH3	CH4	CH5	CH6		CH13
CH7	CH8	CH9	CH10		CH14

Figure 5.   HDTV - 14 Channel Layout

![Texas Instruments]

Following layouts are shown w.r.t. 1280x1024 resolution for VGA monitor. The sizes would vary to support 1600x1200 resolution on the monitor.

2.4.6   4x4 Layout on VGA Monitor (1280x1024)

- Each channel display resolution is 320x224

- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)

- Page Up/Down allows the next set of channels to be viewed

CH1	CH2	CH3	CH4
CH5	CH6	CH7	CH8
CH9	CH10	CH11	CH12
CH13	CH14	CH15	CH16

Figure 6.   VGA - 4x4 Layout

2.4.7   2x2 Layout on VGA Monitor (1280x1024)

- 2x2 for displaying almost full resolution input (D1)

- Page Up/Down allows the next set of channels to be viewed

- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)

- Each channel display resolution is 640x416 in 2x2 layout.

CH1	CH2
CH3	CH4

Figure 7.   VGA - 2x2 Layout

2.4.8   Full Screen Layout on VGA Monitor (1280x1024)

- Full ccreen display of each channel

- Page Up/Down allows the next channel to be viewed

- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)

- Each channel display resolution is 1280x1024 in this layout.

```
CH1
```

Figure 8.   VGA – Full screen Layout

2.4.9   8 Channel Layout on VGA Monitor (1280x1024)

- Allows one channel to be seen on bigger resolution as compared to the other channels

- Page Up/Down allows the next set of channels to be viewed

- Each channel window in the layout can display any input analog camera source, IP Camera or Playback output (based on the combinations listed in Table 1)

- Each channel display resolution is 320x224. Bigger channel resolution is 960x672
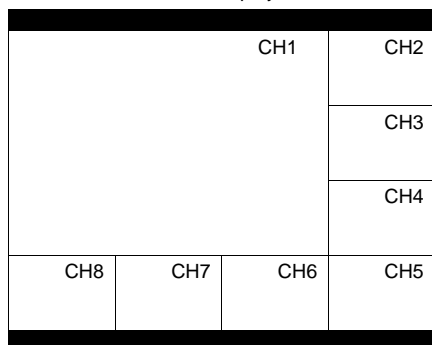
```
                        CH1    CH2

                               CH3

                               CH4

 CH8    CH7    CH6    CH5
```

Figure 9.   VGA - 8 Channel Layout

Following layouts are shown w.r.t. **Display 3**. This is the spot display to show live channels only.

2.4.10 Full Screen Layout on Standard Definition TV (720x480)

- Full screen for displaying one channel at-a-time, each at D1 resolution.
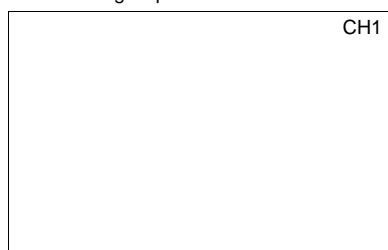- Page Up/Down allows the next channel to be viewed

Figure 10. NTSC/PAL – Full Screen Layout

2.4.11 2x2 Layout on Standard Definition TV (720x480)

- 2x2 for displaying four channels, each at CIF (360x240) resolution.
- Page Up/Down allows the next set of channels to be viewed
- Each channel window in the layout can display any input analog camera source.
- The resolution for each window changes w.r.t. PAL resolution.
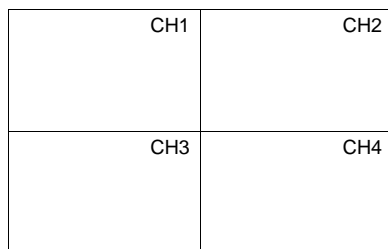

Figure 11. NTSC/PAL - 2x2 Layout

2.5   3D Graphics Layouts
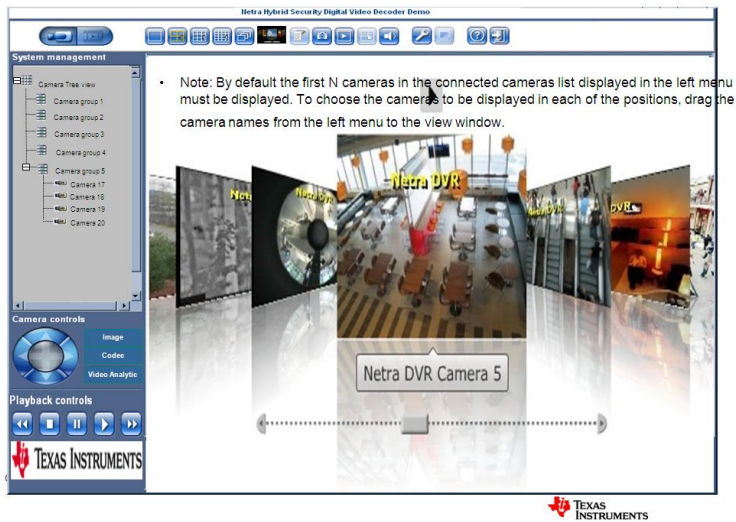
The layouts based on 3D graphics are listed below:

Figure 12.   DVR CamFlow

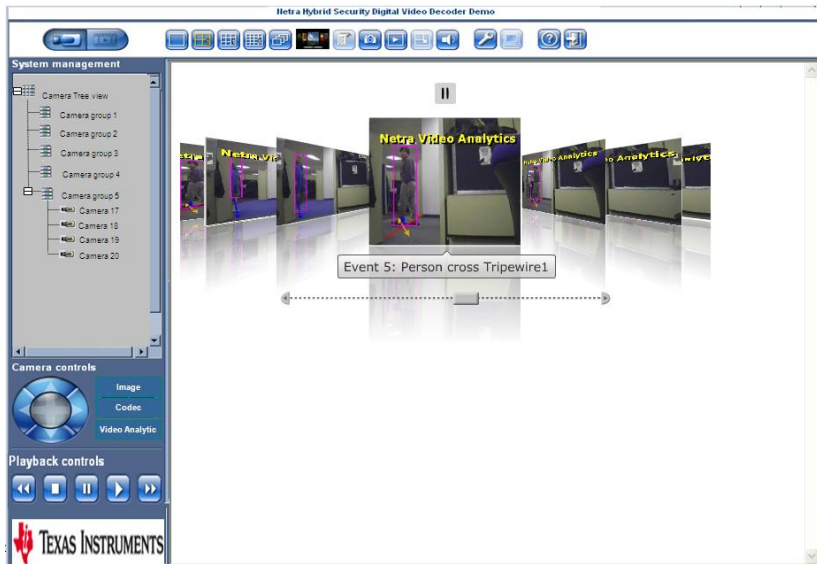**Figure 13.**   DVR TimeFlow

Figure 14.   DVR EventFlow

3 DM816x DVR Performance and ARM Load

DVR performance nos. are measured at core frequency that is listed in Table-1. Performance nos. of difference configurations (Table-2) are measured at these frequencies. Table-3 list observed performance nos. in different configurations

Table 1. Core Frequency

Core	Frequency (In MHz)
M3-VPSS	280
M3-Video	280
DSP	280
A8	1000
DDR	800

Table 2. Configuration Table

Configuration	Configuration ID
Progressive Demo, 16Ch-D1, NTSC input, OSD-ON, SCD-ON	DVR_CONFIG_1
Progressive Demo, 16Ch-D1, NTSC input, OSD-ON, SCD-OFF	DVR_CONFIG_2
Progressive Demo, 16Ch-D1, PAL input, OSD-ON, SCD-ON	DVR_CONFIG_3
Progressive Demo, 16Ch-D1, PAL input, OSD-ON, SCD-OFF	DVR_CONFIG_4

Table 3. DVR Performance no.

Configuration ID	FPS	CPU Load (in %)			
		M3- VPSS	M3-Video	DSP	A8 (Avg/Max)
DVR_CONFIG_1	30	87	77	64	10 / 17
DVR_CONFIG_2	30	83	79	12	12 / 18
DVR_CONFIG_3	25	78	67	60	9 / 16
DVR_CONFIG_4	25	73	71	10	11 / 21

Appendix A– Scope of Features for Alpha Version (ver 0.5) of DM816x DVR RDK

A.1 Hardware Modifications

Alpha version of DM816x DVR RDK hardware is a reduced version w.r.t. the hardware features listed in Sec 2.1Key Hardware Features. The specific changes are listed below:

1. 2 x 1GB of DDR2-800 DRAM operating at 400MHz, instead of ~~2 x 1GB of DDR3 DRAM~~

2.

A.2 Software Usecases

- Supports up to 16 Channel Analog input cameras and input network streams from IP Cameras equivalent to 120 ~~240~~ fps D1 (including the playback of recorded content).
    - Noise Filter and De-interlacer would **not** be used in this usecase.
- Supports up to 8 ~~16~~ Channel Analog input cameras and input network streams from IP Cameras equivalent to 120 ~~240~~ fps D1 (including the playback of recorded content).
    - Noise Filter and De-interlacer on the input channels would be used in this usecase.
    - This use case is exactly same as original DM816x DVR RDK specification, but with half the performance due to half DRAM bandwidth.
- In Network Video Recorder configuration (no analog CCTV input), supports up to 12 ~~24~~ D1 IP camera playback or 5 ~~9~~ 720P30 IP camera playback or 3 ~~4~~ 1080P30 playback
    - This use case is exactly same as original DM816x DVR RDK specification, but with half the performance due to half DRAM bandwidth.
- Audio capture/encode/record/streaming supported. Audio decode/playback supported. Audio sync targeted as stretch goal
- Primary Display (*Display 1*) supporting 1280x1024 @ 60fps or HDMI 1080i60. Combinations for display are listed in Table 1.

Video Combinations			
Number of Input Channels (16 Analog Camera + IPNC)	Channel Property	Recording Stream 1	Recording stream 2
8CH D1 Enc/Rec + 8 CH CIF Enc/Stream + 4 CH D1 Dec Use Case (With NF and DEI)			
8 Analog cameras	Resolution	D1 (720x480 NTSC) ~~(720x576 PAL)~~	CIF (360x240 NTSC) ~~(360x288 PAL)~~

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	FPS	240 (NTSC) ~~200 (PAL)~~	120 (NTSC) ~~100 (PAL)~~
	Per Channel Bitrate	512Kbps, 1/2/4/6Mbps	64/128/256/512Kbs /1Mbps
	Codec	H264	H264/MPEG4
IPNC / Playback	Resolution	Up to 1080P	Up to D1
	FPS	120 fps @ D1	
	Codec	H264/MPEG4	H264/MPEG4
Display Layouts	Only one display to be used at a time. Layouts defined in following sections: ▪ 4x3 Layout on HDTV ▪ 4x4 Layout on HDTV ▪ 2x2 Layout on HDTV – 8 Channel layout ▪ 2x2 Layout on VGA Monitor (1280x1024)		

16 CH D1 Enc/Rec/Stream + 4 CH D1 Dec Use Case (Without NF and DEI)

> Comment [AS1]: Need to check if streaming would be possible realtime

16 Analog cameras	Resolution	D1 (720x480 NTSC) ~~(720x576 PAL)~~	
	FPS	480 (NTSC) ~~400 (PAL)~~	
	Per Channel Bitrate	512Kbps, 1/2/4/6Mbps	
	Codec	H264	
IPNC / Playback	Resolution	Up to 1080P	
	FPS	120 fps @ D1	
	Codec	H264/MPEG4	
Display Layouts	Only one display to be used at a time. Layouts defined in following sections: ▪ 4x3 Layout on HDTV ▪ 4x4 Layout on HDTV ▪ 2x2 Layout on HDTV – 8 Channel layout ▪ 2x2 Layout on VGA Monitor (1280x1024)		
NVR Configuration	**Channel Property**	**Recording Stream 1**	**Recording stream 2**
IPNC / Playback	Resolution	Up to 1080P	Up to D1

FPS	360 ~~720~~ fps @ D1 or 120 ~~270~~ fps 720P or 60 ~~120~~ fps 1080P	
Codec	H264/MPEG4	H264/MPEG4

A.3 Key Features Not in Scope

- Alarm Output

- Sensor Input

- VMS integration (RTSP Streaming to VLC is supported)

- Backup Features

- 3D Graphics GUI

- Event Based Recording

- Motion Detection

- Video Overlay

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