Designing with the Newest IP Network Camera Reference Design

Texas Instruments

Agenda

- Video Security Market Overview
- What kinds of cameras are there?
- DM365 IP Network Camera Reference Designs
- Adding Differentiation with Analytics

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Security is Everywhere in Today's Life

Public Safety

City Centers

Government
Homeland Security

Police
Law Enforcement

Industrial & Commercial

Critical Facilities

Banking

Gaming

Retail

Transportation

Mobile Solutions

Train / Underground

Airports

Residential & Consumer

Residential

Do It Yourself
Costco, Best Buy, Fry's

Access Control

Biometric Solutions

- Fingerprint
- Facial Recognition

Intrusion Alarms

- Glass Breakage
- Passive IR detector
- V/I detectors
- Smart Occupancy
- Control Panel

Intrusion Alarms

- Video Door Bell
- Cards/Readers
- Flow Control

Video Surveillance

DVR

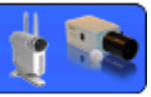
- Embedded DVR
- Networked DVR
- PC-based cards

DVS

- Stand-alone device
- PC-based cards

CCTV Camera

IP Camera



- Low/Mid-end
- Premium

Fire & Life Safety

Fire & Smoke

- Thermal
- Optical
- Ionic

Smart Sensor

Acronyms

Video Sizes

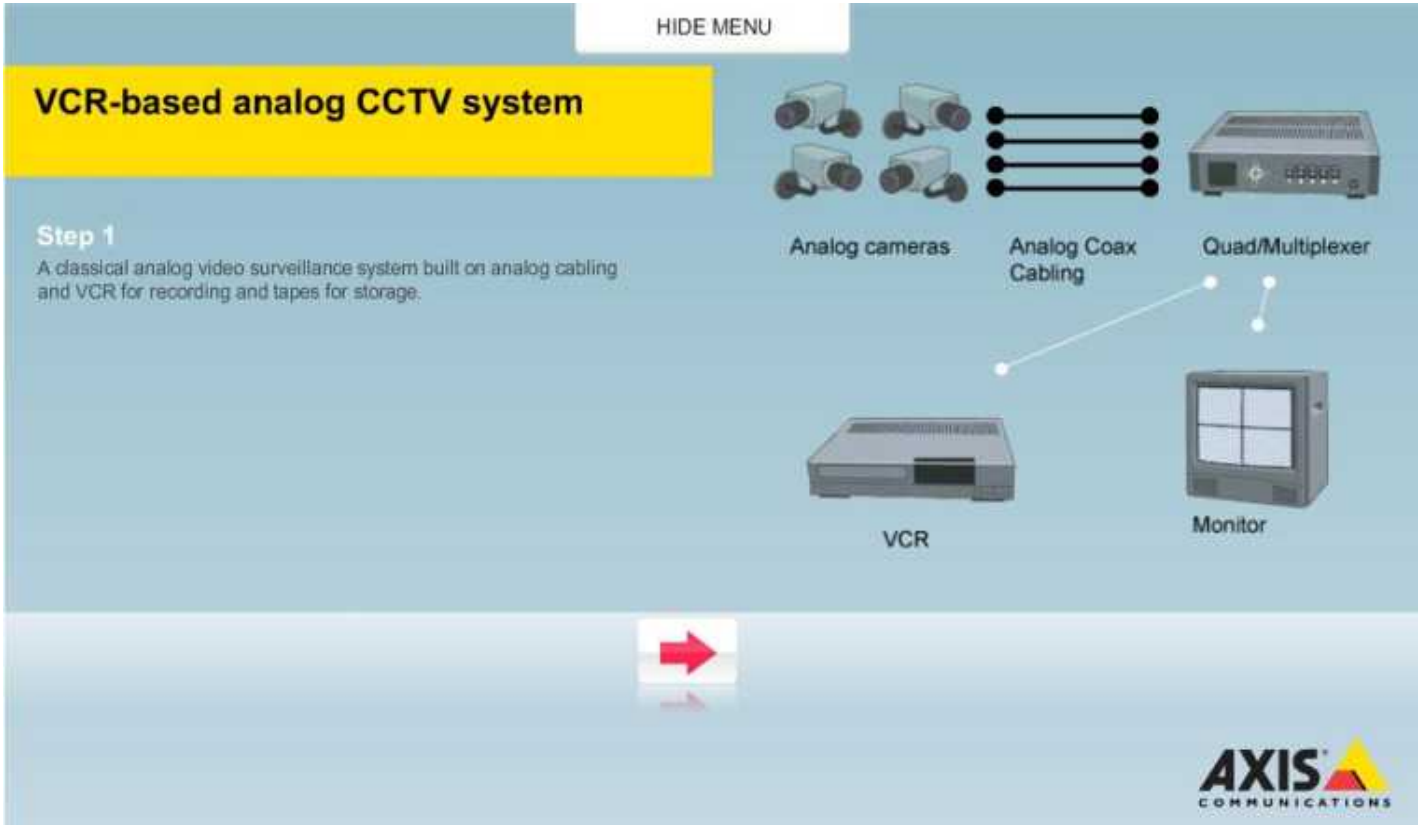
QCIF	**176x144**	**progressive**
CIF	**352x288**	**interlaced**
4CIF	**704x576**	
D1 NTSC	***720x480 (30fps, 60 fields/s)***	
D1 PAL	***720x576 (25fps, 50 fields/s)***	
720p(30)	**1080x720(30fps)**	
1080i60	***1920x1080(60 fields/s)***	
1080p30	**1920x1080(30 fps)**	

Acronyms

Video Encoders

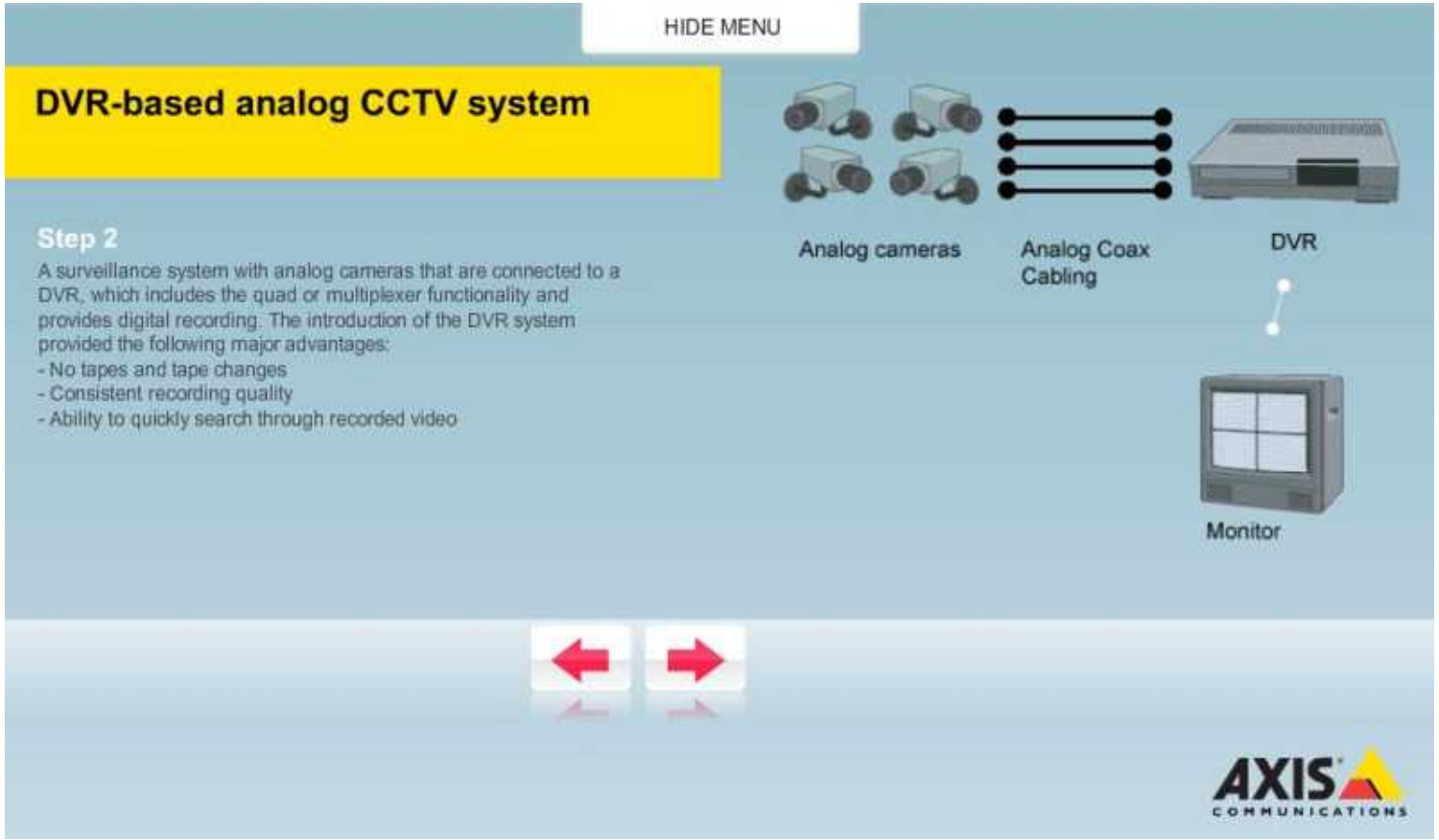
JPEG	- still image standard (Digital Camera)
MJPEG	- Sequence of JPEG images for Video
MPEG2	- Video Compression used in DVD
MPEG4	- Enhancement of MPEG2
H264	- Video Compression used in BluRay

System Architecture - Analogue



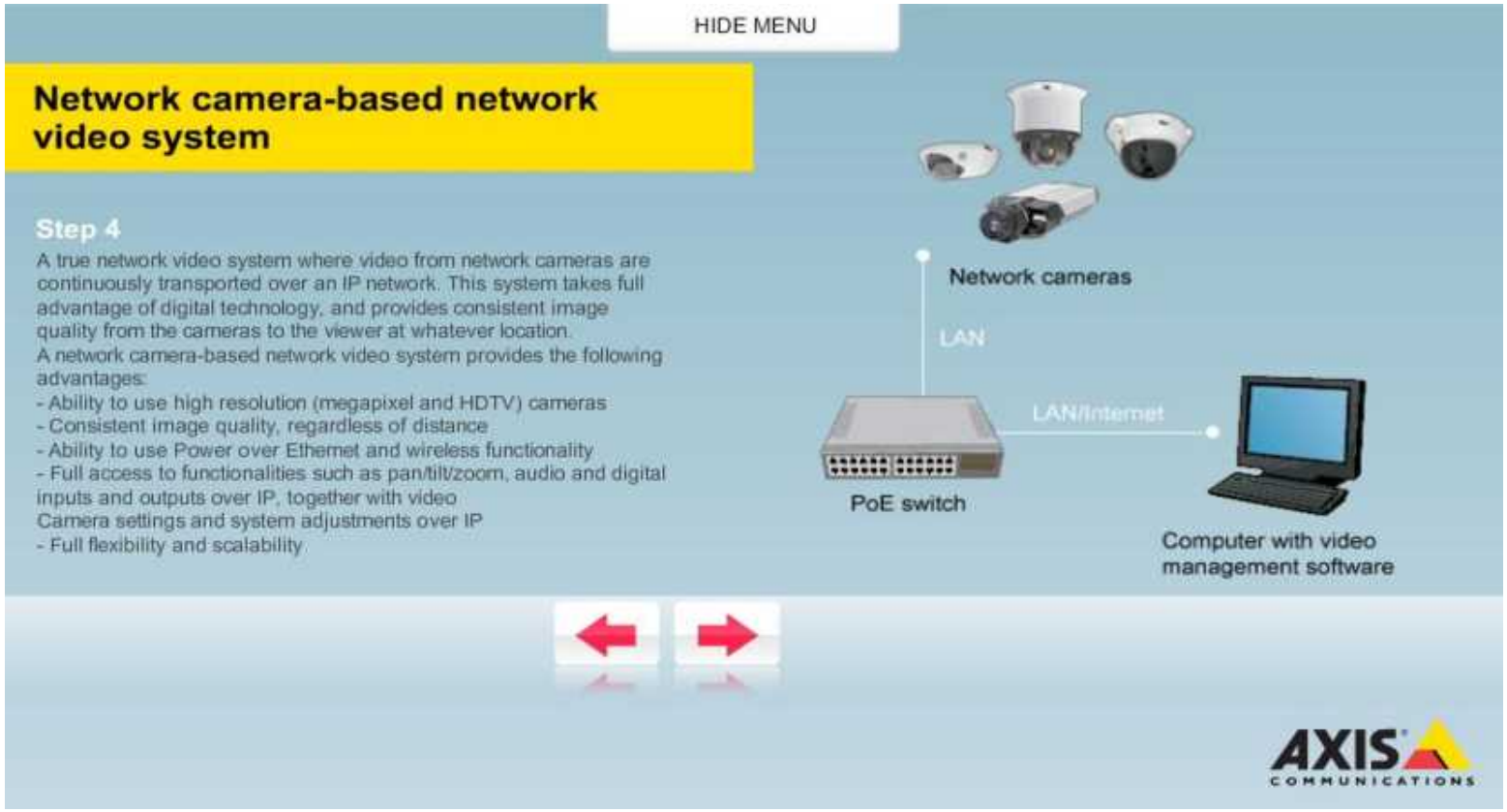
VCR records 4 channels at reduced CIF size (352x288).
Tapes need changed, difficult to search.
Major cost in installing cameras and cables.

System Architecture - Hybrid



Reuse existing cabling infrastructure
Replace VCR with Digital Video Recorder, record at D1/4CIF (704x576).

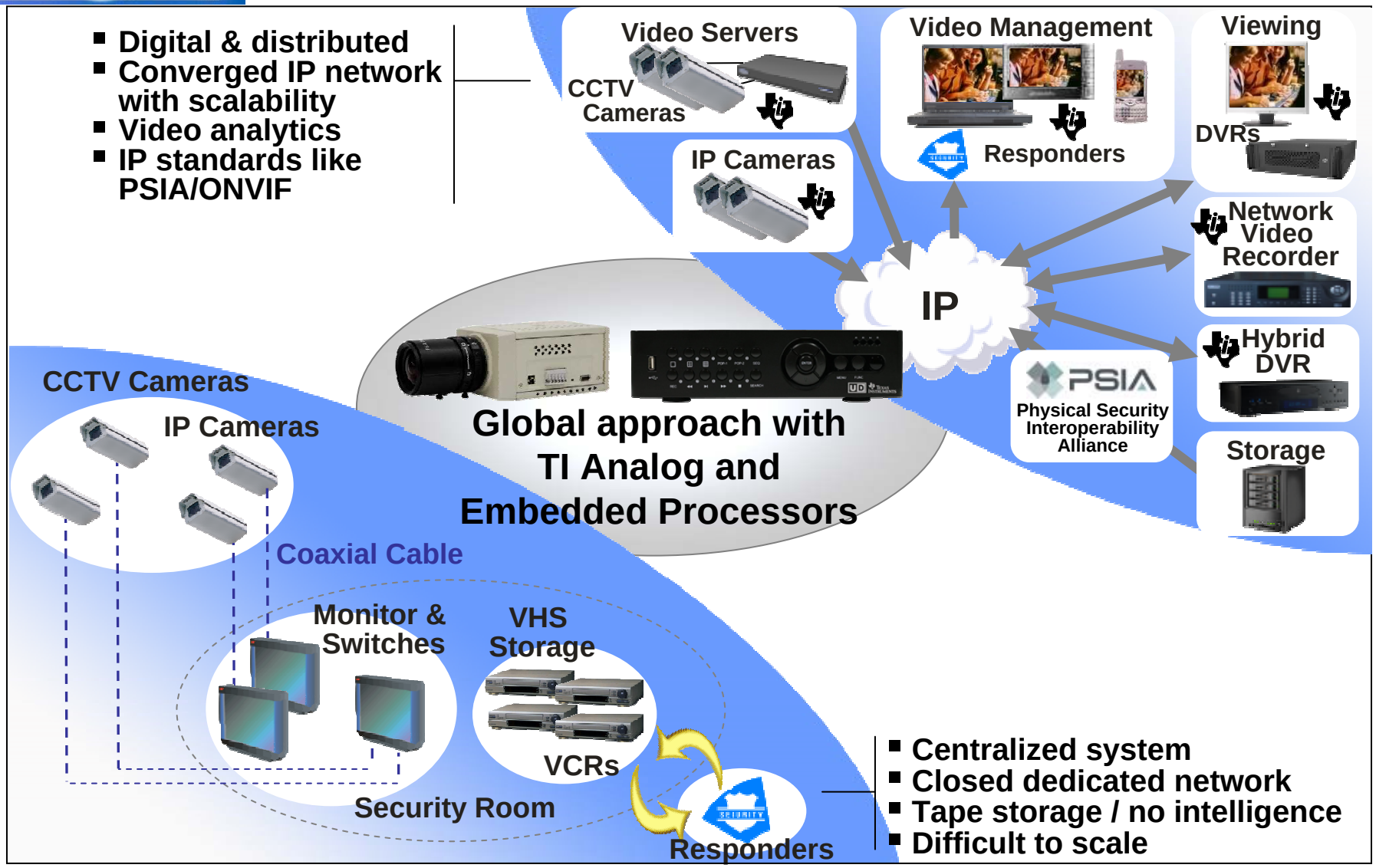
System Architecture – All Digital



Use more than D1 cameras
Installation easier with Power over Ethernet.
Video Management system allows greater flexibility for archiving/searching.
New installation with converged IP network for security and communications.

Analog to IP networks: New technology needed, economy requires customers do more with less

- Digital & distributed
- Converged IP network with scalability
- Video analytics
- IP standards like PSIA/ONVIF



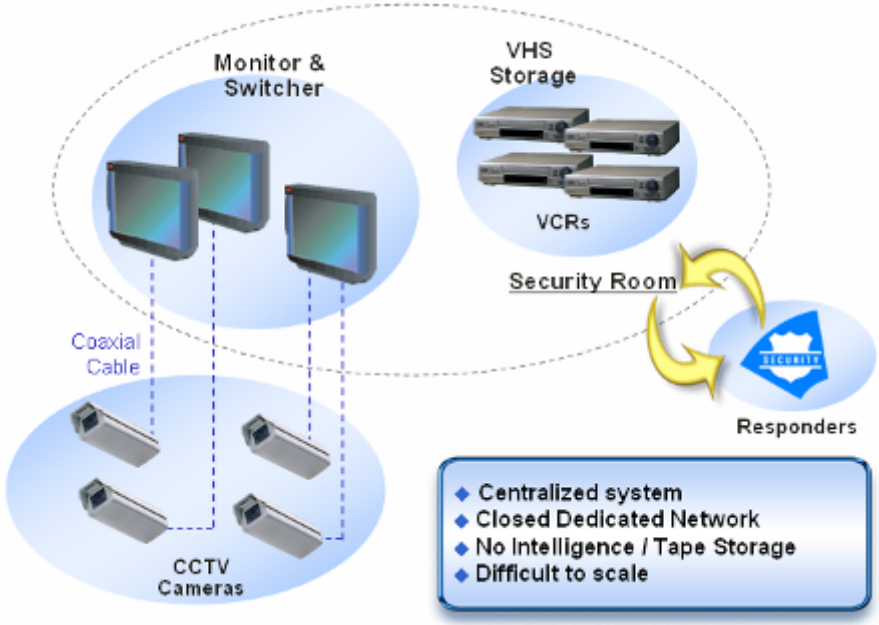
- Centralized system
- Closed dedicated network
- Tape storage / no intelligence
- Difficult to scale

Video Surveillance Market Evolution

Legacy Video Security Systems

Deployed Today

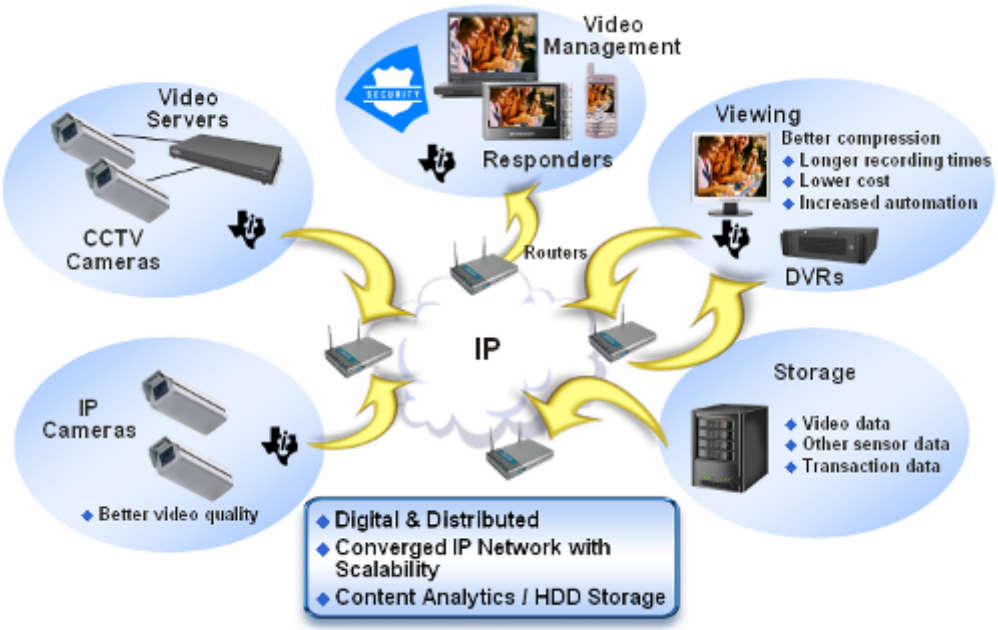
Video Security 1.0



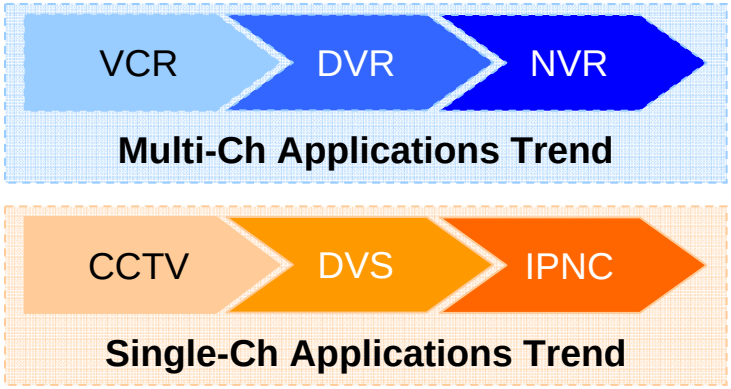
Converged IP Video Security

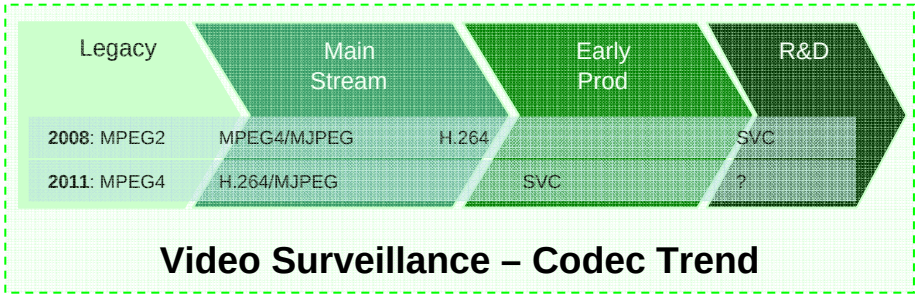
Transitioning Now

Video Security 2.0



Video Surveillance Market Evolution





Multi-channel applications trends

- 1st H.264 CIF shipping now, most of customers working on D1 solution, legacy MPEG4/MJPEG
- Increasing average channel count for DVR
- Migration of PC-based to Embedded DVR
- DVR to Hybrid DVR/NVR
- NVR is linked to IPNC adoption
- HD display

- Historical CCTV camera manufacturers are adding DVR product lines and IP Camera

- Legacy installation with very long replacement cycles
  - Conversion of VCR to DVR nearly completed
  - CCTV conversion to IP Netcam has just started

Camera applications trends

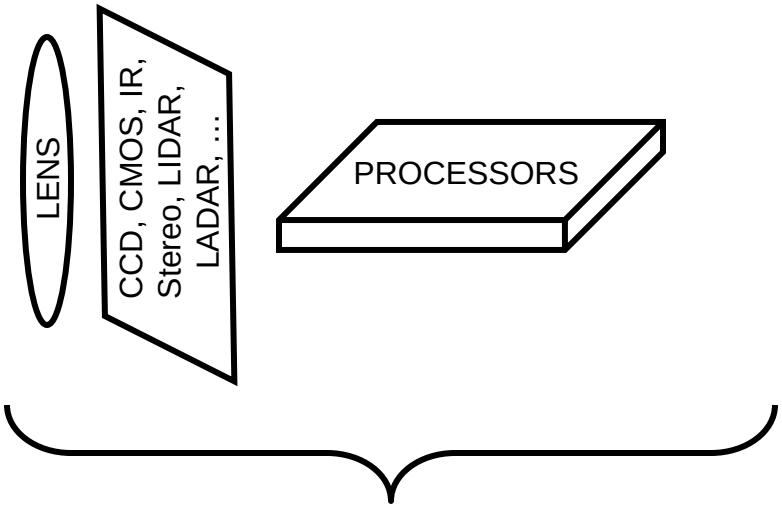
- H.264 D1 shipping now, most of customers working on megapixel solution
- HD but optimized for quality/bit rate
- H.264 mainstream, MJPEG at low fps
- Low cost 1080p CMOS sensors, Megapixel CCD sensors
- Dual / Triple streaming

- VideoAnalytics is moving from early adopter to mainstream
  - Basic VA embedded in SoC (Face Detection, Video Noise Filtering, Video Stabilization)
  - Advanced analytics in add in DSP or servers

Video Analytics

Image In, Information Out

CAMERAS



INFORMATION

- Size
- Shape
- 3-D position
- Orientation
- Motion
- Surface properties
- Object class; identity
- Events
- Illumination, weather, …

VISION FUNCTIONS

- Color analysis
- Range estimation
- Camera calibration
- Shape from shading, motion, texture, …
- Object detection
- Object tracking
- Object mensuration
- Object classification
- Event detection …

APPLICATIONS

- Automotive safety
- Video surveillance
- Industrial inspection
- Robotics
- Gaming
- Smart TVs…

Video Analytic algorithms produce information about objects

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Residential

Do It Yourself
Costco, Best Buy, Fry's

Tickets gates
Cheat detection
Vending machines

Access Control

Glass break
Light on/off …

Loss prevention
Risk management
Business intelligence

Video Surveillance

Fire & Life Safety

Biometric Solutions
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- Facial Recognition

Intrusion Alarms
- Glass Breakage
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Intrusion Alarms
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- Flow Control

People counting
Trip wire / Wrong way

DVR
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- Networked DVR
- PC-based cards

DVS
- Stand-alone device
- PC-based cards

CCTV Camera

IP Camera
- Low/Mid-end
- Premium

Intelligent motion detection
Tamper/Focus detection
Auto tracking
PTZ focus

Fire & Smoke
- Thermal
- Optical
- Ionic

Smart Sensor

IPNC + Smoke + Fire
Pool alert system …

Texas Instruments

Video Analytics

Analytics add value to the end user of the surveillance system.
Can automate processes or supplement human monitoring.

- Instrusion Detection
- Vehicle Monitoring
- Abandoned Object Detection
- Loitering Detection
- Camera Tampering and Failure Detection
- Object Removal
- People Counting

Video Analytics

Analytics identifies objects in the background.

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Cameras – What Types are there?

- Fixed
- Dome
- Pan Tilt Zoom (PTZ)
- Pan Tilt Zoom Dome
- MegaPixel/High Definition
- High Dynamic Range/IR

Cameras – Fixed & Dome

Fixed Camera
- D1 Resolution
- Fixed at installation
- Indoor or outdoor in protective casing
- Uses standard lens mount

Dome Camera
- Protects camera
- Hides direction of camera
- More discrete design
- Not possible to swap lens

Pan Tilt Zoom/ PTZ Dome

- Motorised camera
- Usually operator controlled to focus on region of interest.
- With Digital PTZ commands are over IP not separate RS485
- Can be programmed to follow an automatic scan pattern or be driven by analytics to follow movement.
- Provides optical zoom to x30 and 360 degree coverage.

Generally a system will have fixed cameras to cover entire area plus some PTZs to focus on region of interest.
May have additional features such as stabilisation, privacy masking and analytics embedded.

Electronic PTZ

No moving parts leading to higher reliability and more discrete design.
Based on use of megapixel sensor and a wide angle lens to cover larger field of view which is down-sampled for viewing (left hand image).

The zoom will window a VGA or D1 pixel area from sensor and provide a clean image with 1:1 pixel mapping to the sensor (right hand image).
This avoids any loss of detail or sharpness that could be found with an optical zoom.

Wide Dynamic Range/Day and Night

CCD sensor provides ~60dB

So with an iris it can handle indoor or outdoor scenes.
With indoor setting bright outdoors is all saturated.

WDR sensor provides ~90dB

So it can handle indoor and outdoor scenes with neither the indoor being too dark nor outdoor saturating

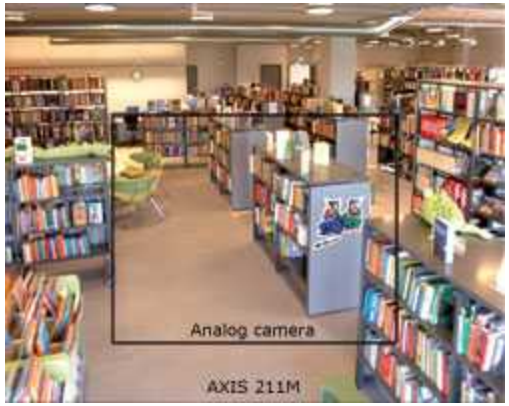
CCD Image WDR CMOS

Day and night cameras have Infra-Red filters to cut out IR during day and IR light source

High Definition/Megapixel Cameras

Benefits
- A single camera can cover 4x area with same level detail.
  Rule of thumb 1 pixel per cm

- A single camera can provide much more detail for face/item recognition
  Rule of thumb 5 pixels per cm



Drawbacks
-Higher network bandwidth/storage requirements.

Only available with digital systems as analogue are limited to D1.

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Low power IP camera reference design up to H.264 main profile 1080p at 30 fps

Industry-leading compression in a full HD 1080p30 solution with complete camera utilizing only 3 Watts

H.264 MP 1080p at 30 fps or 720p at 60 fps
MPEG-4 up to 720p at 60 fps
MJPEG at 5Megapixels at 15 fps

30 percent more host processing performance over the previous generation

30% more ARM host processing performance offering more headroom for differentiation

5th generation ISP for video stabilization, face detection, noise filtering, auto white balance, auto exposure + new Linux application software package

ISP Tuning Tool 1.0
PSIA 1.0 support
Hardware-accelerated AES encryption
Global dynamic range enhancement

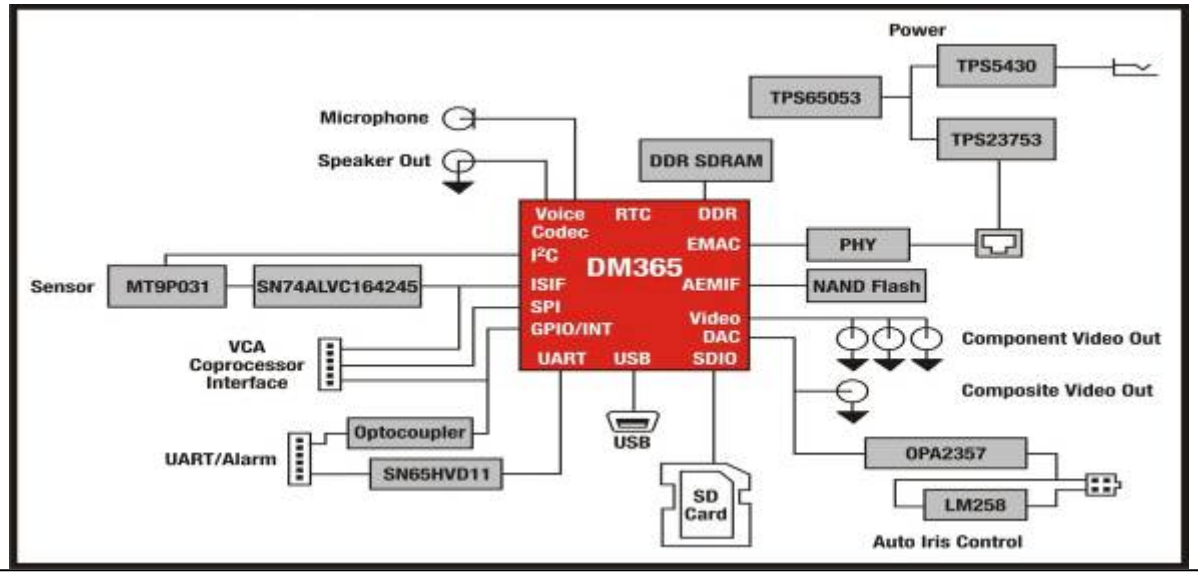
DM368IPNC-MT5 – IP Camera Ref. Design

Hardware features

- TI TMS320DM36x digital media processor based on DaVinci™ technology includes ARM926 & H.264 HW video coprocessor, EMAC, RTC & integrated voice codec for BOM savings
- Aptina 5 MP sensor CMOS imager optimized for low-light performance
- Board size 65 x 50mm, low-power (3W)
- Power over Ethernet, Audio, SD storage

Software features

- Complete Linux-based IP camera application including free source code
- Encode up to H.264 HD 1080p at 30fps, MPEG-4 1080p at 25fps or 720p60
- Triple stream per channel (H.264, MPEG-4, MJPEG)
- Integrated auto white balance & auto exposure
- Royalty-free, production-ready codecs included
- Software framework includes input/output and media APIs, codec engine
- Ability to add video analytics with DaVinci TMS320DM643x DSP



DaVinci™ IP Camera Ref. Design Roadmap

SW Compatibility

Features

Reference Design

- Production
- Sampling
- Development

Advanced VA SW from 3rd parties (OV, Aimetis, Cernium, in-house etc.) on C64x+ from 300 to 700 MHz

VA Advanced

Centaurus Integrated C674x

Visit www.ti.com/ipcamera

Object Video Analytics
+
MPEG4 720p
Dual Stream
NOW

DM365 IPNC-VCA2

H.264 720p30
Dual stream +
Object Video Analytics
4Q09

DM355 IPNC-VCA1

IPNC at analog CCTV BOM

- HD, D1, CIF support
- H.264/MPEG4/JPEG
- Dual/Triple stream
- WDR & 5MP
- TTM
- Comprehensive SW

DM365 IPNC-IMX035

H.264 720p30
Sony WDR sensor
4Q09

DM368 IPNC-MT5

H.264 1080p30
Multi Stream
4Q09

DM365 IPNC-MT5

H.264 720p30
Multi Stream
NOW

DM355 IPNC-MT5

MPEG4 720p30
Dual Stream
NOW

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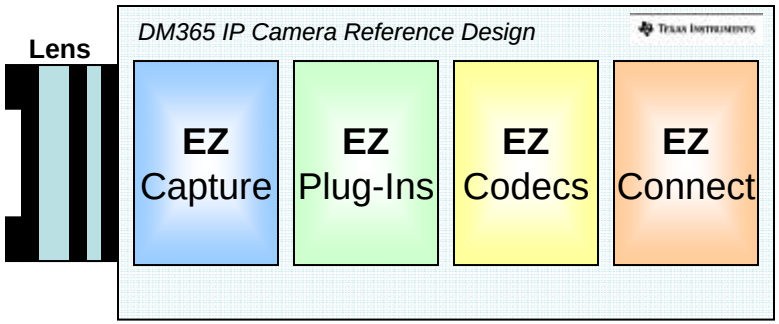
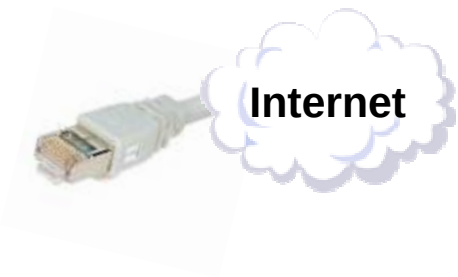
TI Makes Security Application Easy
With DM36x Davinci Processor Based Solutions





EZ Capture

IP Camera SW package offers **easy** access to best in class Image quality leveraging TI ISP

- **LDC**: Lens Distortion Correction
- **De-interlacing**: Motion compensated algorithm
- **ISP Tuning Tool**: Image tuning in only few clicks

EZ Plug-Ins

IP Camera SW package provides video processing algorithms for **easy** differentiation

- **Video Stabilization**
- **Face Detection**
- **Face Recognition**
- **VNF**: 2D/3D Video Noise Filters
- **2A**: Auto Exposure & Auto white balance
- **GDRE**: Global Dynamic Range Enhancement

EZ Codecs

IP Camera SW package has **easy** configurable built-in combos & patented codec technology

- **Codec Combo**: H.264, MPEG4, MJPEG with single, dual, triple stream
- **Parameter**: adapt frame/bit-rate, rate-control
- **Patented Smart Codec** Technology

EZ Connect

IP Camera SW package has **easy** to use connectivity solutions and built-in encryption

- **AES** Coprocessor for encryption and decryption
- **PSIA standard** compliancy
- **SD card** for local storage

EZ Display

IP Camera SW package includes advanced software for **easy** display features

- **On Screen Display**: SW OSD for logo, text, date & time insertion
- **Privacy Masking** on detected faces

Best in Class Image Quality With EZ Capture

EZ Capture on DM36x Platform

Lens Distortion Correction

- Barrel and Pincushion distortion correction
- Chromatic aberration correction

Before

After

Motion compensated de-interlacing algorithm

- User selectable threshold value
- YUV422 interleaved & YUV420 Semi-planar support

Before

After

ISP Tuning Tool

- Real time ISP parameter update through Ethernet
- Semi-automatic tuning support
- Graphic user interface for parameter tuning
- Command-line tuning for all ISP registers & customized parameters

Differentiate Your Application With EZ Plug-Ins

DM36x Platform

Auto Exposure & Auto White Balance

Global Dynamic Range Enhancement

Face Detection Tracking & Recognition

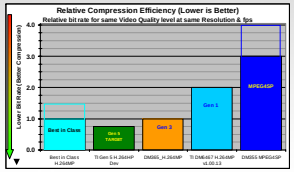
Video Noise Filters

Advanced Video Stabilization

Video Noise Filters

TI ISP Technology

Best in Class Compression



TI Smart Codec Technology

Video Stabilization

Problem

Camera shakes due to weather, traffic or vehicle shaking degrades video quality

DM36x

Texas Instruments

Solution

TI has developed advanced video stabilization that

- ➔ Reduces Jitter
- ➔ Improve visual quality
- ➔ Improve video bit rate

Face Detection & Recognition

Problem

Detecting and recognizing face for identification, access control, privacy mask …

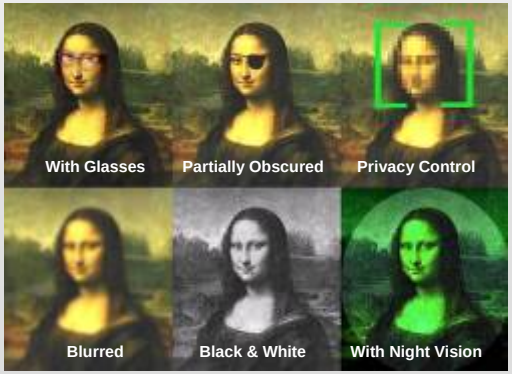
DM36x

Texas Instruments

Solution

TI Technology detect and recognize the world's most famous face in an instant !

➔ Track multiple face (>30) with detection in <20ms



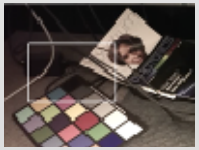
Video Noise Filters

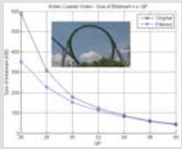
Problem

Image noise degrades low light image quality:

➔ Increasing sensor gain increases noise

➔ Using larger sensor increases cost and size





Solution

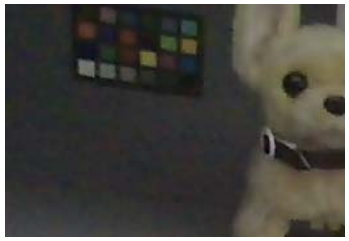
TI developed advanced Video Noise Filter with both spatial and temporal noise filtering capabilities

➔ Enhances visual quality, without removing detail

➔ Enables low light imaging

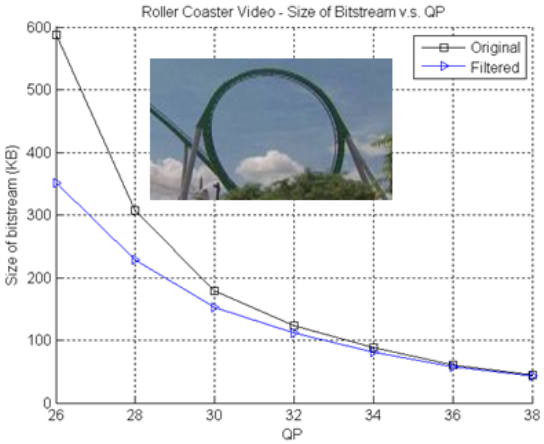
➔ Increases video coding efficiency

TI Video Noise Filter Technology

	Cut The Noise	Save the Details	Enable Low Light Imaging (1)
Without TI Video NF			
With TI Video NF			

(1): MPEG-4 710Kbps CVBR VGA 30fps

Increase Video Coding Efficiency



Video file Size is Reduced

➔ Compression quality can be improved for same bit-rate improving total end to end video quality

Global Dynamic Range Enhancement & Auto White Balance

Problem

Provide clear picture in high dynamic range scenes with both shaded and bright areas

➔ Need always more dynamic range in security application

➔ Low cost CMOS sensor have less dynamic range, need to compensate in ISP for low cost systems

Solution

TI developed GDRE and AWB Technology optimized on DM365 ISP

➔ Bring more details in the shadows w/o washing out the highlights

➔ Compensate for lower dynamic range in low cost sensors

➔ Excellent color accuracy under all lighting condition, easy to tune and Stable real time white balance correction

EZ Plug-Ins – Business Model

Evaluation Model

- **Included into IP Camera Reference Design SW v1.0 release (GA) and above**
- **Work only for 10 min at a time & can be restarted**
- **Watermark demo video with OSD**
- **For demos and evaluation only: cannot be used in practical customer applications**

Working Mode

- **Click-wrap production license agreement with TI to receive complete production library**
- **4 pre defined packages with royalty/unit**
- **Available on 300MHz part** only

Plug-in	Part #	Royalty/Unit
	TMS320DM365ZCES	**$1.50**
	TMS320DM365ZCEF	**$1.50**
	TMS320DM365ZCEA	**$1.00**
All 3 above	**TMS320DM365ZCEFSA**	**$2.50**

EZ Codecs
Video Quality & Compression Efficiency

How do we evaluate video quality

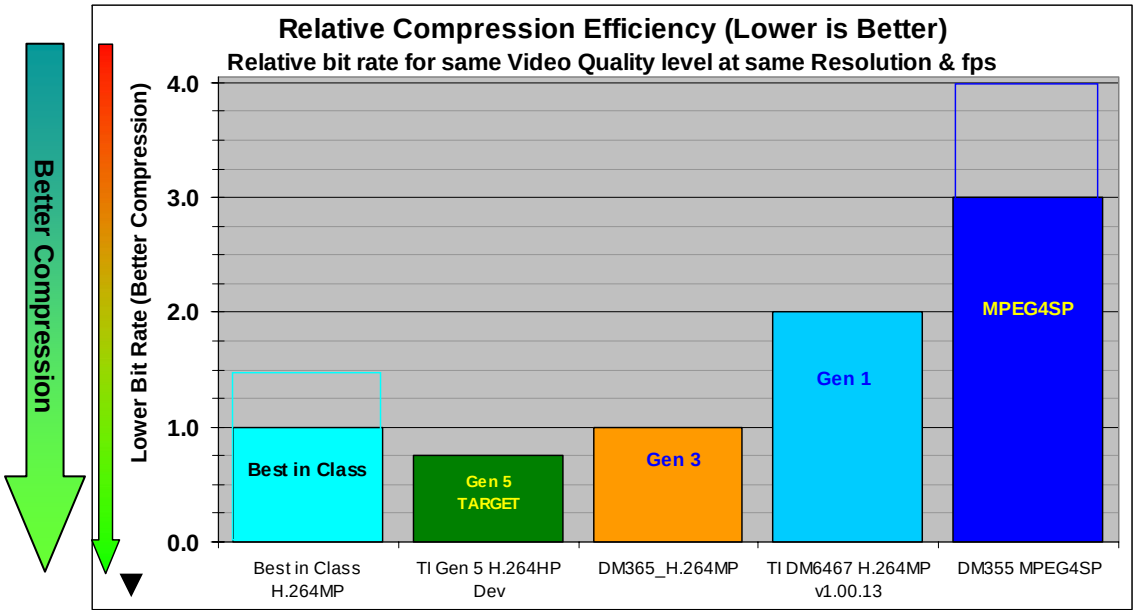
- **Evaluate video like real people do**
  - **Moved from Peak Signal-to-Noise Ratio (PSNR) to Perceptual Video Evaluation**
  - **Use of Differential Mean Opinion Score (DMOS) + Tektronix PQA500**
- **Detailed analysis of video streams vs. "Average" analysis**
- **More real life use cases based on customer feedback**
- **End to end integrated solutions including effects of Noise Filtering, ISP etc…**
- **Look for total system synergy**

Video compression efficiency

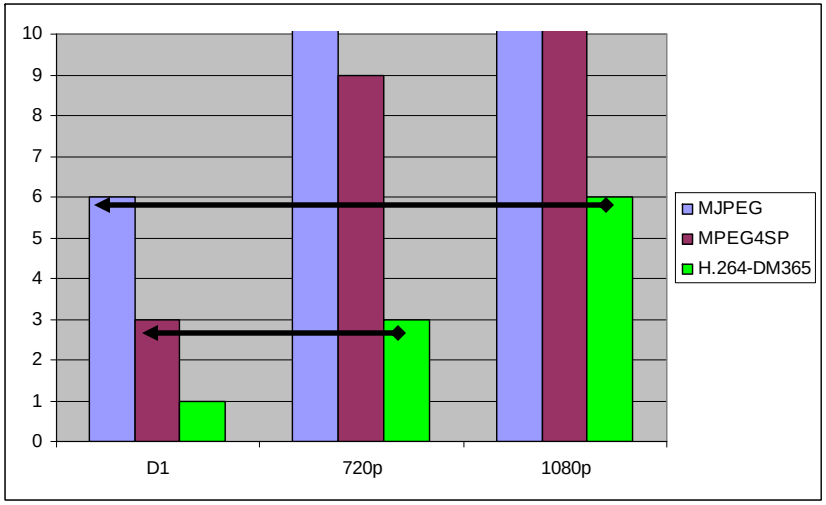
- **Video encode quality tied to bit rate**
  - **You can achieve any level of video encode quality by adjusting bit rate**
- **Compression efficiency**
  - **Measure of how efficiently a video encoder achieves a fixed video quality level**
  - **Provides a direct objective measure of encoder effectiveness that is easily translated to money value**
- **Best compression efficiency =**

  Solution A encodes same level of quality at half the bit rate as Solution B
  - ➔ **Save money by storing same amount of video in half the size hard drive, or**
  - ➔ **Advertise double the video capacity, or**
  - ➔ **2x more video streams can be sent over same network capacity**
- **Best Compression = WIN in maket**

DM365 H.264 – Best in Class Compression



- **DM365 has BEST in class H.264 compression efficiency**
  - ➔ **For same video quality, TI DM365 H.264 HP can compress video up to 4x more than DM355 MPEG4-SP**



- **TI H.264 technology gives HD video at SD bit rates**
  - ➔ **720p video at same bit rates as D1 MPEG4**
  - ➔ **1080p video at same bit rates as D1 MJPEG**

TI DM365 H264 Codec Technology

- TI High Performance Codec **ties in all TI technologies & image processing blocks into one complete system**
  - **All components communicate & work together**
  - **Allows the codec to adjust quickly to specific situations and scene changes, further improving encode efficiency beyond that of basic codecs**

- Availability
  - **Phase1: best in Class H.264**
    - **GA July 2009**
  - **Phase2: High Performance H264 Codec**
    - **GA Mar 10**

- Region of Interest (ROI) coding
  - **Mask ROI and assign more bits to ROI specified outside encoder by:**
    - **Manually**
    - **Face detection**
    - **Video analytics**
    - **Scene classification**
  - **ROI can also be used as privacy mask or selective pre-filtering**
- Use scene information available from camera to improve encode by changing rate ctrl or other parameters
  - **Exposure change, scene color change (info from 2A)**
  - **Sound change (info from audio)**
  - **Face detection: (info from HW CoP)**
  - **PTZ feedback (info from PTZ cmd)**
- Multi-pass encode

DM36x – Video Performance Matrix

H264 HP Codecs	GA	Comment
720p encode + decode	now	In Production
720p low latency encode	Jan -10	Slice based encode/decode
720p low latency decode	Jan -10	Universal Decode on DM36x-400
1080p30 encode + decode	Mar-10	High Performance codec

		H.264 HP (1) with DM36x @			MPEG-4 (2) with DM36x @			MJPEG with DM36x @		
Resolution	Megapixel	400MHz	300MHz	270MHz	400MHz	300MHz	270MHz	400MHz	300MHz	270MHz
2584 x 1936	5.0	-	-	-	-	-	-	17fps	13fps	11fps
2312 x 1736	4.0	-	-	-	-	-	-	21fps	15fps	14fps
2000 x 1504	3.0	20fps	13fps	11fps	-	-	-	28fps	21fps	19fps
1920 x 1080	2.1	30fps	19fps	17fps	25fps	20fps	19fps	40fps	30fps	29fps
1632 x 1224	2.0	30fps	19fps	17fps	25fps	20fps	19fps	40fps	30fps	29fps
1280 x 960	1.2	50fps	30fps	28fps	40fps	30fps	25fps	50fps	50fps	45fps
1152 x 864	1.0	60fps	39fps	35fps	50fps	40fps	30fps	>60fps	60fps	55fps
1280 x 720	0.9	60fps	39fps	39fps	60fps	45fps	40fps	>60fps	>60fps	>60fps
640 x 480	0.3	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps
320 x 240	0.08	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps
176 x 144	0.03	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps	>60fps

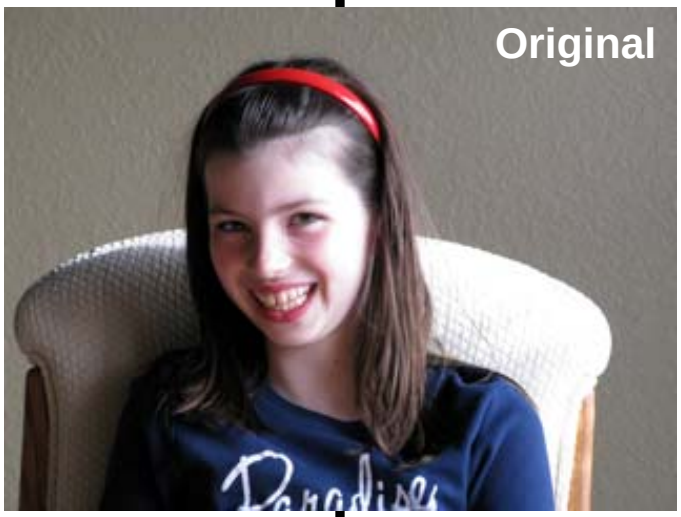
Notes

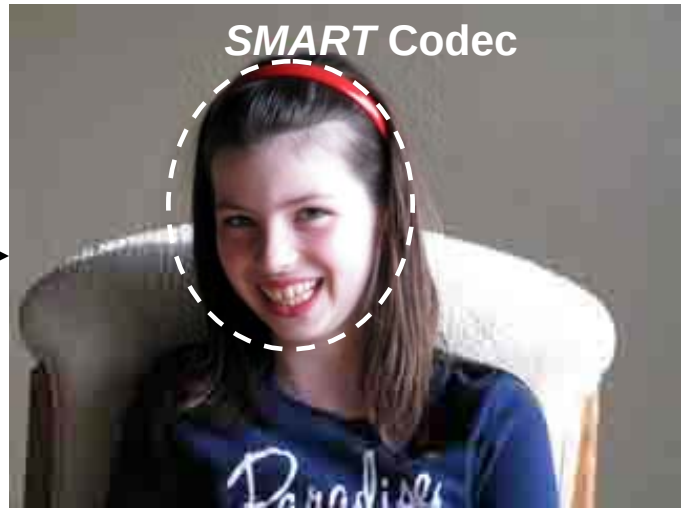
(1): H.264 maximum resolution 2048x2048
Perf. based on high performance codec

(2): MPEG4 maximum resolution 1920x1920

TI Codec – ROI Coding Example

Compressed
Low Bitrate video
Standard Codec





Compressed Low
Bitrate video
TI Codec
ROI tied to face detect

DM365-300MHz

Multi-Stream Codec Combinations

- **IP Camera cases**
  - **H264 720p @30fps, (1-6Mbps) + H264 CIF @15-30 fps (64-512kbps) + Motion Detection + G.711 speech codec**
  - **H.264 720p @30fps, (1-6Mbps) + MJPEG VGA @15fps + Motion Detection + G.711 speech codec**
  - **H.264 720p @30fps, (1-6Mbps) + H264 CIF @15fps (64-512kbps) + MJPEG VGA @5fps + G.711 speech codec**
- **Multichannel cases**
  - **2x D1 H.264 channels @30fps, bitrate range per stream: 384Kbps–2Mbps**
  - **4 x D1 MPEG4 channels @30fps, bitrate range per stream: 512kbps – 4Mbps**

How to Access TI EZ Modules

Included into IP Camera SW package v1.0 and above

- At no cost**: EZ Capture, EZ Codecs, EZ Connect and EZ Display**
- For demo and evaluation only**: EZ Plug-Ins (production license needed)**

Version 1.0 – Available now

- Video Stabilization on all resolutions up to 720p30 with no latency
- 2D/3D Noise Filter, Spatial Noise Filter and Temporal Noise Filter
- Face detection on all resolution up to 720p30
- Privacy Mask on detected faces on all resolution up to 720p30
- Lens Distortion Correction on all resolutions up to 720p30
- Motion detection algorithm
- Software On Screen Display

Version 1.5 – November 09

- SD card storage based on schedule and alarm
- TI Auto Exposure and Auto White Balance
- Global Dynamic Range Enhancement
- Smart Codec
- Face Recognition
- PSIA Compliance
- Tuning Tool V1.0

Version 2.0 – March 2010

- AES Encryption, sRTP & https

DM36x – ISP deep dive

Sensor Interface

- Raw, YUV and ITU-R BT.656/1120, 16bit Parallel, Up to 120MP/sec

Features

- **Fundamental processing**
  - 2D Black clamping, White Balance, Advanced CFA de-mosaic
  - 3D Color reproduction (including memory color enhancement)
  - Channel independent adjustable Gamma
  - Two cascaded Noise filters
  - Edge enhancement with Halo suppression, Color artifact reduction
  - Resizing (2 resizers for 2 different size output simultaneously (range:x8~x1/16) / Flipping
- **Lens/Sensor Artifact Correction**
  - [Lens] 2D Matrix Lens shading correction
  - [Lens] Barrel & Pincushion Lens distortion correction (Chromatic aberration correction)
  - [Sensor] Defect pixel correction (Look-up table based and On-the-fly)
  - [Sensor] Crosstalk reduction, Linearization
  - [Sensor] Fixed pattern noise removal (Dark frame subtract)
- **Statistics collection for 3A, fine ISP tuning and advanced features**
  - H3A statistics collection (AE/AWB: 56x128 regions, AF: 36x128 regions)
  - Histogram, Global motion detection, Boxcar (small image for quick analysis)

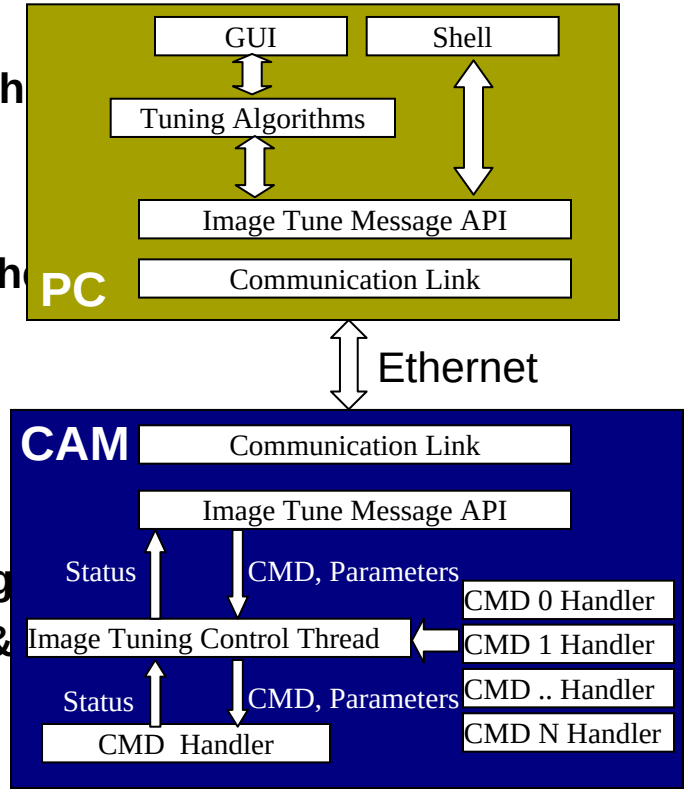
Advanced Features

- Face detect (First latch time: Avg.10msec, up to 35 faces)
- 3D Noise filter (Temporal filter and Wavelet based Spatial filter)
- Video Stabilization
- Global Brightness and Contrast Enhancement

DM365 ISP Tuning Tool

- **Camera S/W**
  - **Real time ISP parameter update through Eth**
  - **Updated ISP parameter storage in NAND**
  - **Raw, YUV capture**
  - **Customized parameters tuning through Eth**

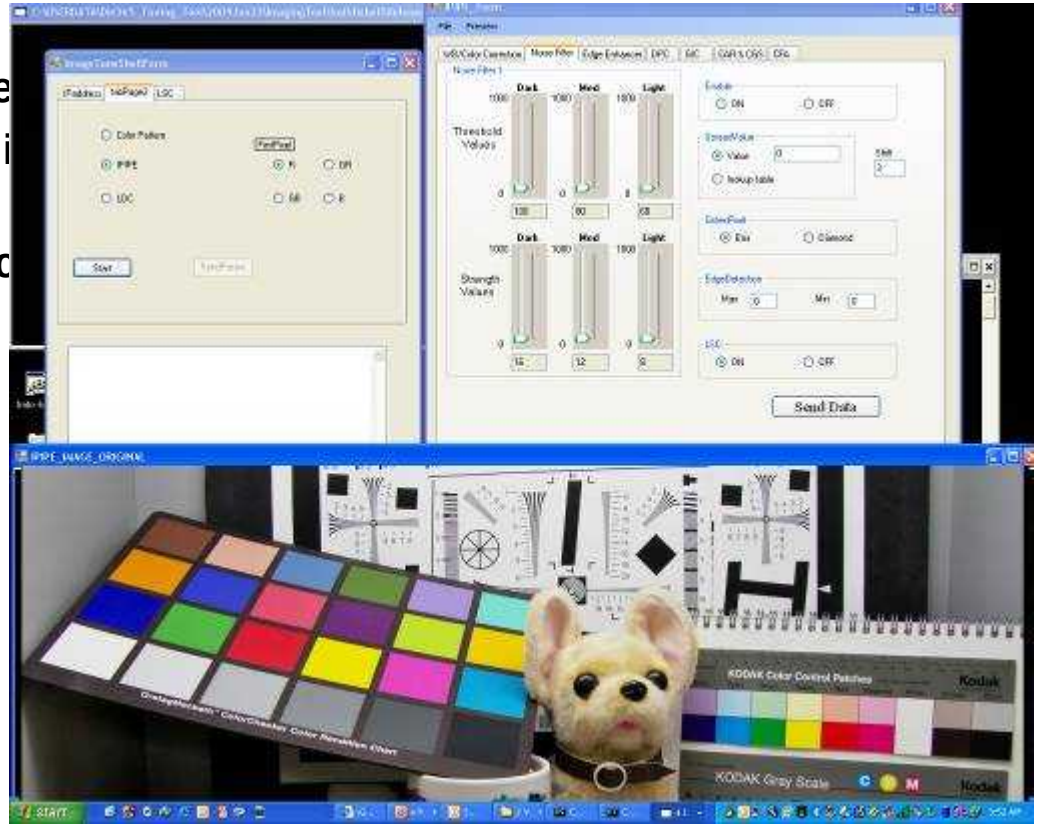
- **PC S/W**
  - **Semi-automatic tuning support [Noise Filter, Color Correction, LDC]**
  - **Graphic user interface for parameter tuning**
  - **Command-line tuning for all ISP registers & customized parameters**



Schedules
SW Package 1.5, Nov 09

ISP Semi-automatic tuning

- **Semi-automatic tuning tool helps to find decent parameters through simple mouse clicking**
  - **Capturing Raw image of the chart scene recommended (e.g. Macbeth color chart)**
  - **Downloading Raw image to PC through Ethernet (Mass storage**
  - **Following Simple procedures gi in guide.**
  - **Real-time parameter update in c by clicking Send button**



Beta release includes Semi-automatic tuning for
Noise Filter
Color correction matrix
Lens distortion correction

DM368IPNC-MT5 Business Model example

- **Purchase DM368IPNC-MT5 reference design from Appro for $995 plus shipping and handling.**

- **Sign production license agreement at no cost with TI/Aptina to receive complete Hardware and Software package including**
  - **LSP, schematics, gerbers, etc…**
  - **Source code for Linux Camera application**
  - **TI's H.264, MPEG4, MJPEG and G.711 codecs**

- **Reference Design includes 8 hours phone or email support from Appro**
  - **Optional - Appro design service available**
    - **US$100 Per man-hour**
    - **US$3K Per man-week**
    - **US$7k Per man-month**

Get started today with production-ready, DM365-based reference designs

DM368IPNC-MT5: $995

With production agreement:

- **Schematic & Gerber files**
- **Royalty-free Linux based IP camera application**
- **Source code included**

www.ti.com/ipcamera

Order entry open now

Major Milestones

1. First demo at Public Safety and Security (CPSE) / Security China tradeshow, Shenzhen, China, November 1-4
2. Order entry Nov 1st with 8 weeks Lead-time
3. $995 plus shipping and handling
4. General availability of TI H.264 1080p30 IP Camera Reference Design in March 2010

TI & Appro DM365IPNC-MT5

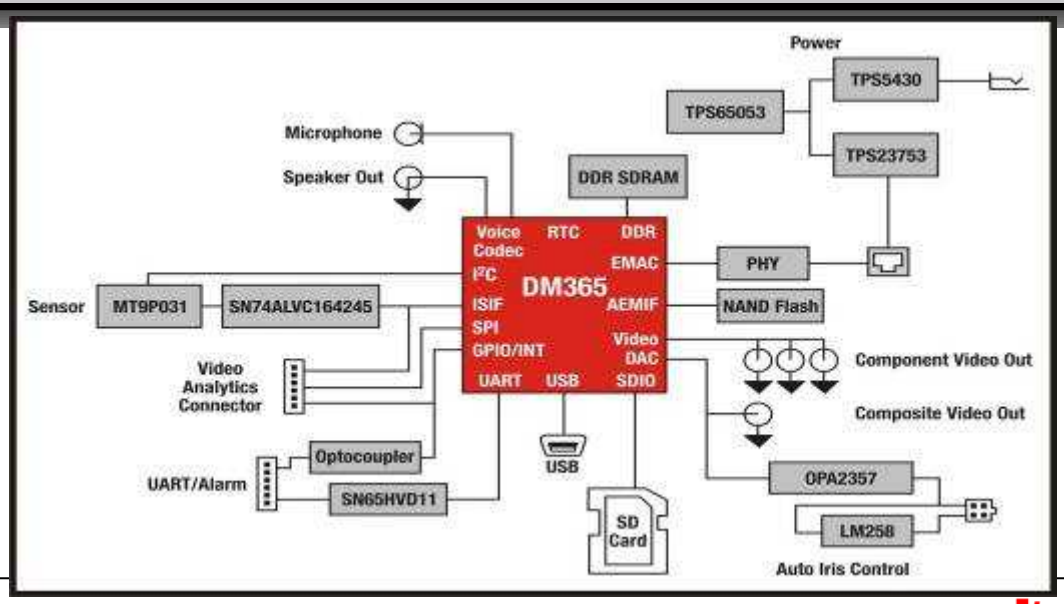
IP camera reference design

Hardware features

- TI TMS320DM365 digital media processor ba on DaVinci™ technology includes ARM926 & H.264 HW video coprocessor, EMAC, RTC & integrated voice codec for BOM savings
- Aptina 5 MP sensor CMOS imager optimized for low-light performance
- Board size 65 x 50mm, low-power (<3W)
- Integrated video analytics HW connector
- Power over Ethernet, Audio, SD storage

Software features

- Complete Linux-based IP camera application including free source code
- Encode up to H.264 /MPEG-4 HD 1080p at reduced frame rate or 720p full frame rate
- Triple stream per channel (H.264, MPEG-4, MJPEG)
- Integrated auto white balance & auto exposure
- Royalty-free, production-ready codecs included
- Software framework includes input/output and media APIs, codec engine
- Ability to add video analytics with DaVinci TMS320DM643x DSP
- PSIA standard support



Texas Instruments

H.264 HD 720p30 IP camera at < $40 eBOM*

Function	Component	Manufacturer	Device	Cost ($)
Processor Board	Davinci DMSoC 270 MHz	TI	TMS320DM365ZCE	12.95
	1 Gb DDR SDRAM	SAMSUNG	K4T1G164QQ-ZCD5	1.10
	256 Mb NAND FLASH	SAMSUNG	K9F5608D0C	1.50
	RTC			0.00
	Ethernet PHY	DAVICOM	DM9161B	0.72
	Miscellaneous			3.46
Sensor Board	1/2.5" 5 Mpixel CMOS Sensor	APTINA	MT9P031	8.00
	Dual-Supply Voltage Translator	TI	SN74ALVC164245DGG	0.40
	Miscellaneous			0.93
Power Board	Step Down Converter	TI	TPS5430DDA	0.64
	5 Channel Power Mgmt IC	TI	TPS65053RGE	1.06
	Miscellaneous			2.82
PoE	Transformer	COILCRAFT	POE13P-12L	0.76
	PoE Controller	TI	TPS23753PWP	1.15
	Optocoupler	FAIRCHILD	FOD2742B	0.39
	Miscellaneous			1.54
Audio	Audio Codec			0.00
	Microphone	FEI SHENG	MIC	0.21
	Miscellaneous			0.20
UART/Alarm	RS-485 Transceiver	TI	SN65HVD11D	0.82
	Miscellaneous			0.45
Memory Card	Miscellaneous			0.38
USB	Miscellaneous			0.20
Auto-Iris	Low Power DC/DC Boost	TI	TPS73001DBVR	0.15
	Dual CMOS Op-Amp	TI	OPA2357AIDGS	0.69
	Low Power Dual Op-Amp	TI	LM258DGK	0.11
	Miscellaneous			0.34
Video Anal. Interface	VA connector	KING MATE	18X2_SMT_1.27MM	0.65
	Miscellaneous			0.02
RTC Battery Backup	LDO	TI	TPS73001DBVR	0.15
	Backup Capacitor	ELNA	DSK-3R3H224-H	0.21
	Miscellaneous			0.02
Component Video	High Speed OP Amp (x2)	TI	OPA2357AIDGS	1.38
	Miscellaneous			0.87

Assumed 50Ku pricing and connectors included

- Hardware configurability enables multiple camera designs from a low cost basic camera to full featured product

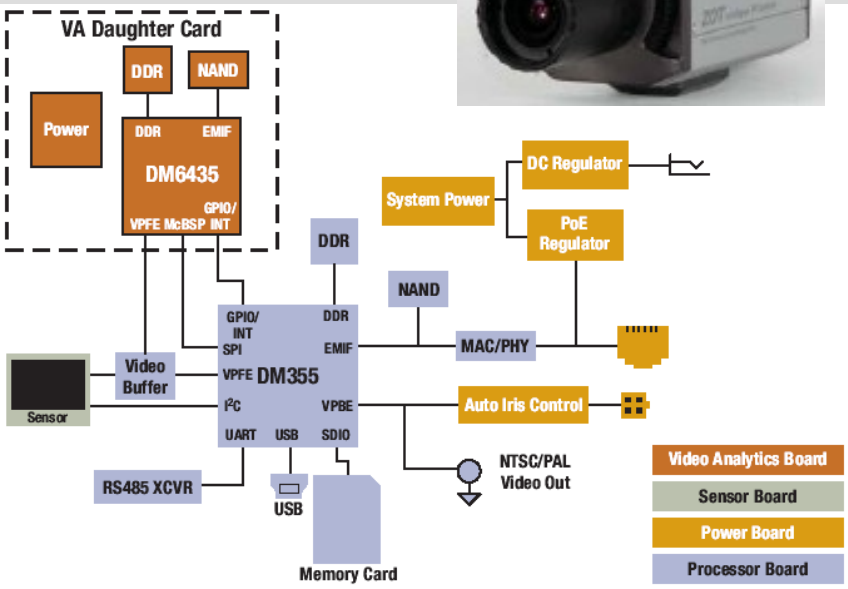
Base Camera	33.59
Base Camera + PoE	37.43
Base + PoE + Audio	37.84
Base + PoE + Auto Iris	38.72
Full Featured Camera	42.03
Analog HD camera	44.29

TI/OV/ZOT DM355IPNC-VCA1 reference design

Low Cost, High Definition & Best in Class Low Light Performance

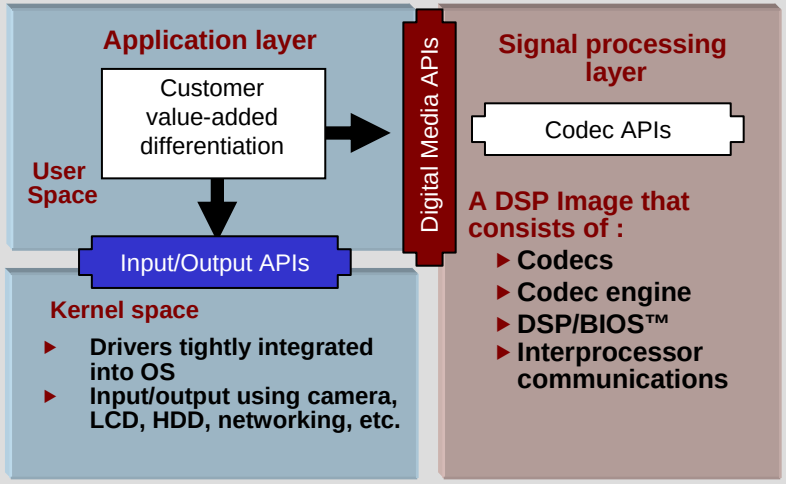
Hardware features

- TI DaVinci™ TMS320DM355 SoC, ARM926 & hardware video coprocessor
- TI DaVinci™ TMS320DM6435, C64x+ DSP core
- Aptina 5 MP sensor (2x2 binning ~ 1.3 MP) CMOS imager optimized for low light performance
- IPNC Board size 65 x 50mm
- VCA Daughter card board size 41x40mm
- Low-power (<3W)
- PoE, Audio, SD storage



Software features

- Complete Linux based IP net camera application including free source code
- Dual stream capabilities
  - MPEG4 HD 720P + MPEG4 CIF + G.711
  - MPEG4 HD 720P + MJPEG CIF + G.711
- Integrated auto white balance & auto exposure
- Field proven, robust, royalty-free MPEG4 & MJPEG
- Motion detection with multiple regions of interest
- Davinci IPNC software framework including IO APIs, media APIs, and DaVinci codec engine
- VA daughter card with DaVinci TMS320DM6435 DSP running Object Video analytics SW



OV analytics - IPNC tech specs

- **Behaviors in package:**
  - ***Tripwire***
    - **Detects when the specified object moving in a specified direction crosses over a line (tripwire) drawn within the camera's field of view.**
  - ***Multiple tripwire***
    - **Enables building rules with association between two virtual tripwires with respect to crossing one before the other and relative time between crossing both.**
  - ***Inside area detection***
    - **Detects when the specified object moves inside of a designated Area of Interest within the camera's field of view.**
  - ***Scene change***
    - **Detects any event that significantly changes the field of view of the camera.**

- **Sample usages:**
  - ***Tripwire***
    - **Outdoor perimeter protection; vehicles moving in wrong direction; secure area monitoring.**
  - ***Multiple tripwire***
    - **Relative speed monitoring; illegal turns; unauthorized people or vehicle flow.**
  - ***Inside area detection***
    - **Person enters secure area; sudden movement within area of interest; objects appear within area**
  - ***Scene change:***
    - **Camera tampering; sudden camera movement; camera disabled or masked; lights on or off**

IP Camera Ref. Design Business Models

DM365IPNC-MT5	DM355IPNC-MT5		DM355IPNC-VCA1
Purchase Reference Design at www.ti.com/ipcamera from			
Appro for $795 **+ shipping & handling**	**Appro for** $795 **+ shipping & handling**		**ZOT (including HW VA module) for** $995 **+ shipping & handling**
Sign Production License Agreement at no cost **with**			
TI/Aptina **to receive complete HW & SW package**			TI/Aptina **to receive complete HW & SW package**
LSP, schematics, gerbers, etc …			**+ VA connector definition in schematic**
Source code **for Linux Camera application**			**+** ARM to DSP SPI driver **& VA GUI**
All TI codecs + H.264	**TI's MPEG4, MJPEG and G.711** codecs		
Reference design kit purchase includes **8 hours phone/email support from**			
Appro with additional design services available for US$100 per man-hour, US$3K per man-week, US$7k per man-month			**ZOT directly with ODM services available**
Option **- Sign production** 2A **(Auto White Balance and Auto Exposure) SLA with Appro for** $0.75 royalty per camera			**+** purchase VA HW module(2) from ZOT**: min order quantity 500 pieces/lot, 5000 pieces/year**

(1): total $1.5 with
- $0.75 for 2A

(2): total of 3 OV analytics packages
- US$110 for "Object Classification + AOI Inside"
- US$150 for "Object Classification + Trip Wire"
- US$175 for "Object Classification + Multi-lines Trip Wire"
- For Custom packages, please contact ObjectVideo

Agenda

- Video Security Market Overview
- What kinds of cameras are there?
- DM365 IP Network Camera Reference Designs
- Adding Differentiation with Analytics

TI's Video Analytics Strategy

Basics

DM3xx

Texas Instruments

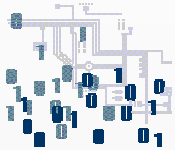
Megapixel Support - Now

Advanced features available on DM3xx Platform- Now

- ➔ Video Stabilization
- ➔ Face Detection
- ➔ Video Noise Filter

Video & Vision

Advanced



VLIB speeds video analytics development & increases performance - Now

- ➔ In House Development

ZOT card running Object Video boost time to market and flexibility - Now

- ➔ License ODM Products

License Analytics technology from TI partners – Now

- ➔ License Application SW

Differentiate with Basics Analytics

TI Advanced SW Features

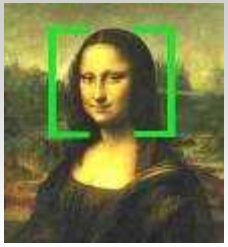
TI Advanced SW Features – DM3xx Platform –

VNF cut the Noise and Preserve the Details

VNF Improves Image quality

Advanced Video Stabilization

VNF Enables better Low Light Imaging



Face Detection

VNF Increases video coding efficiency up to 2X

Face Tracking & Recognition

Differentiate with Advanced Analytics

1.) What is VLIB for C64x ?

VLIB is not:

A complete end application like:

Software providers

ObjectVideo, AGENT, VCA TECHNOLOGY

Analytics product providers

NICE, cernium, ioi ioimage intelligent video appliances™

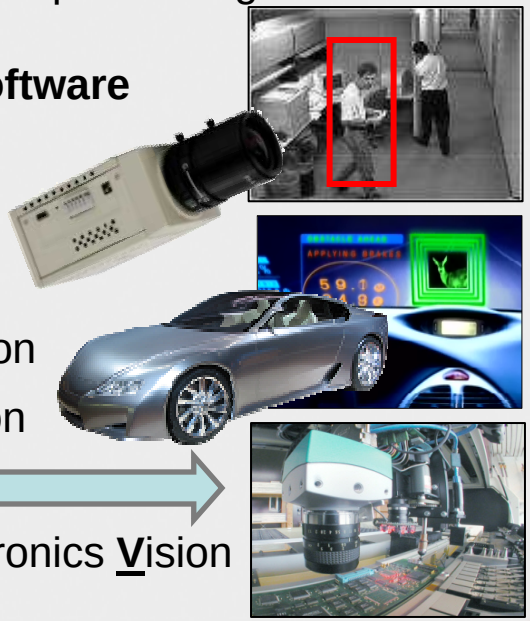
VLIB is:

A collection of 50+ royalty-free kernels for

- Background modeling & subtraction
- Object feature extraction
- Tracking, recognition
- and low-level pixel processing

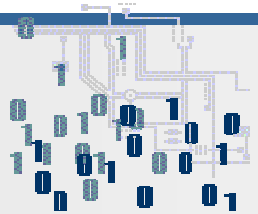
An extensible software foundation for:

- Video Analytics
- Game Vision
- Automotive Vision
- Embedded Vision
- Machine Vision
- Consumer electronics Vision



VLIB speeds video analytics development & increases performance up to 10X

Available now, royalty-free library includes 50+ software kernels

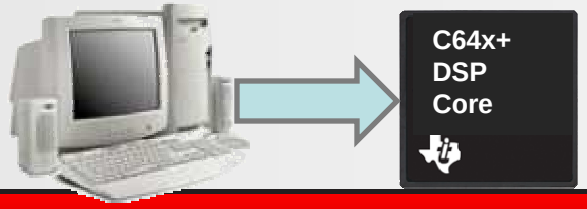


www.ti.com/vlibrequest

4X–10X pixel processing improvement over standard C code

- Provides higher resolution & frame rate
- Enables more advanced features
- Allows use of lower cost C64x+ DSPs

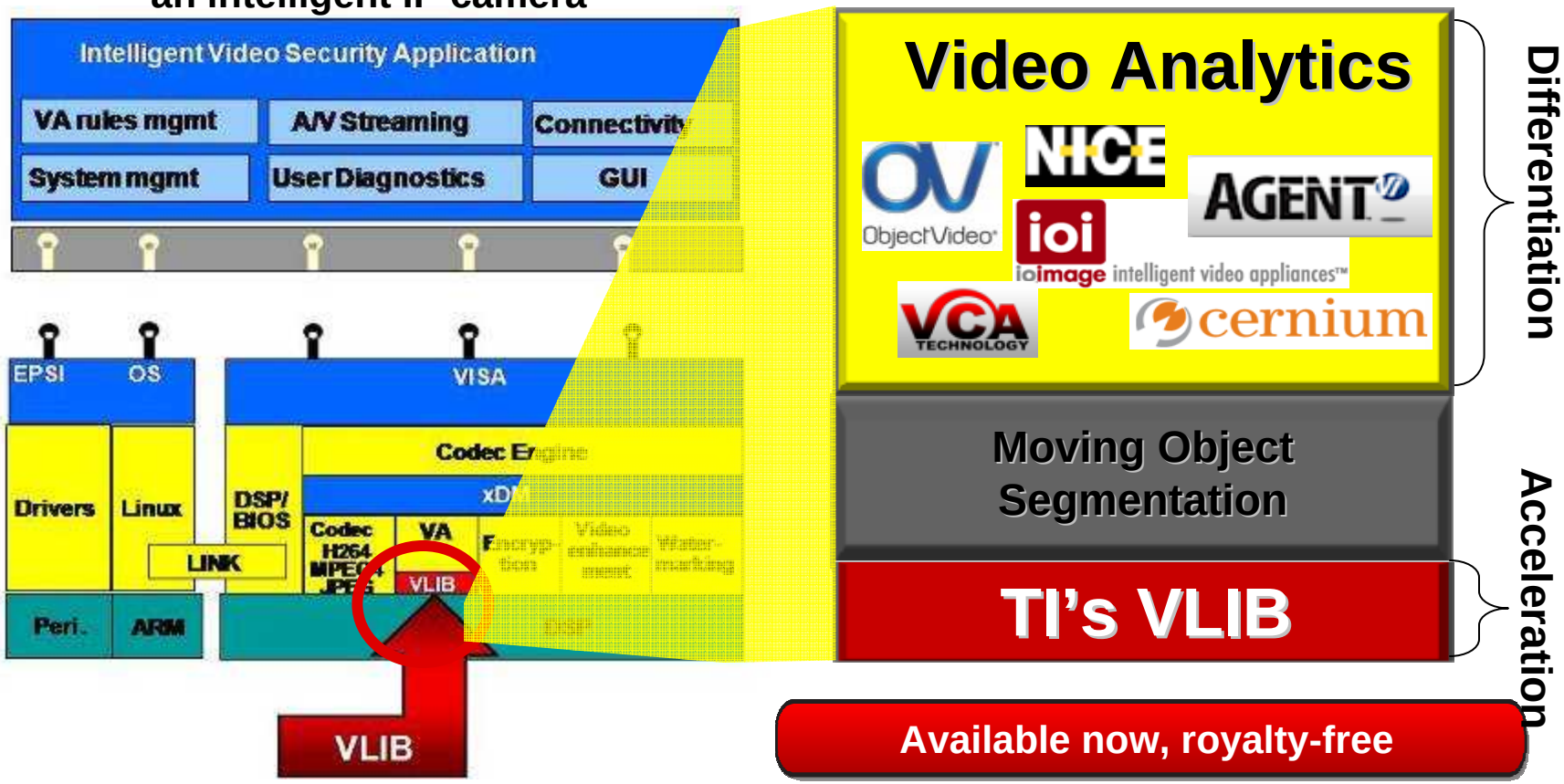
Accelerates SW porting and reduces development time by 36 man months



PCs to TI's C64x+ DSP core

Available now, royalty-free library includes 50+ software kernels

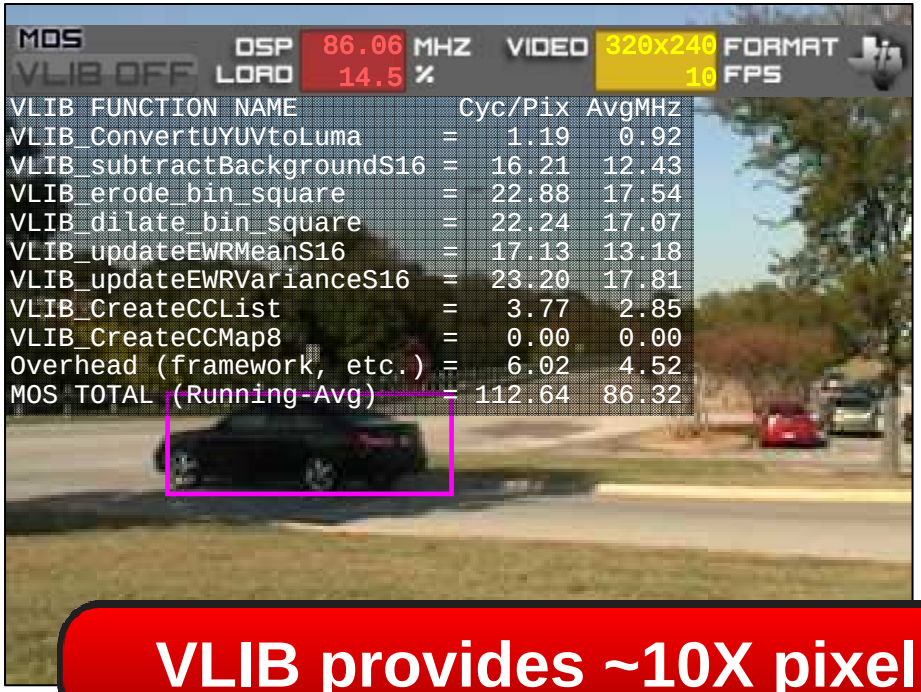
Software stack for an intelligent IP camera



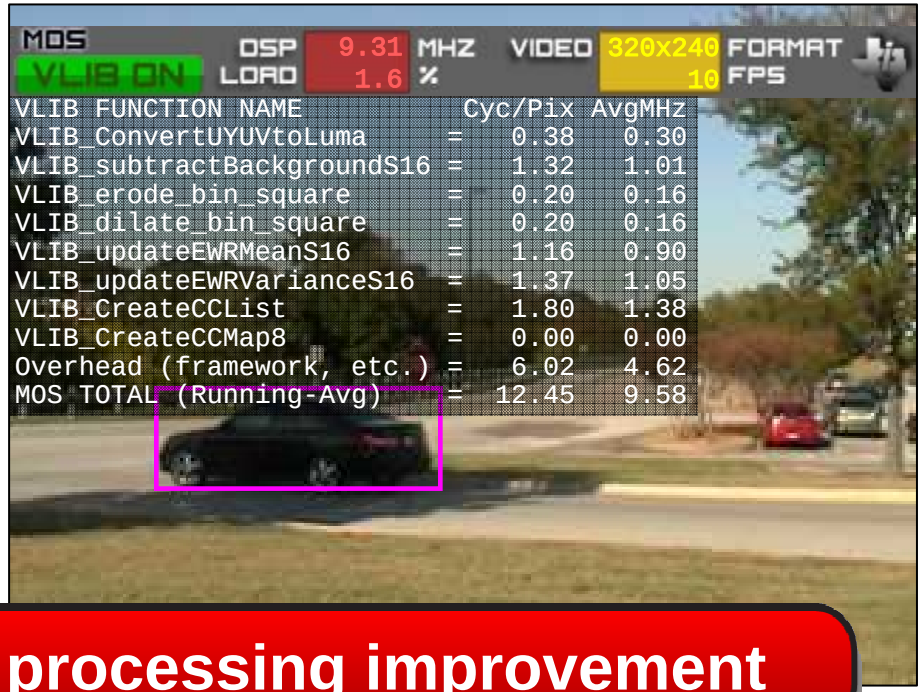
VLIB provides ~10X pixel processing improvement over standard C code

VLIB demo: gray “status bar” at the top contains VLIB ON/OFF indicator, DSP processor loading, and video format and frames per second.

VLIB off: utilizing 14.5% total processing power, 86 MHz



VLIB on: utilizing 1.6% total processing power, 9 MHz



VLIB provides ~10X pixel processing improvement

VLIB provides ~10X pixel processing improvement: key algorithms for Moving Object Segmentation

VIDEO

Luma Extraction

VLIB_ConvertUY UV to Luma

Background Subtraction

VLIB_subtract Background S16

Morphological Operations

VLIB_erode_bin_ square

VLIB_dilate_bin_ square

Connected Components

VLIB_CreateCCList

VLIB_CreateCCMap8

OBJECTS

delay

Background Maintenance

VLIB_updateEWR MeanS16

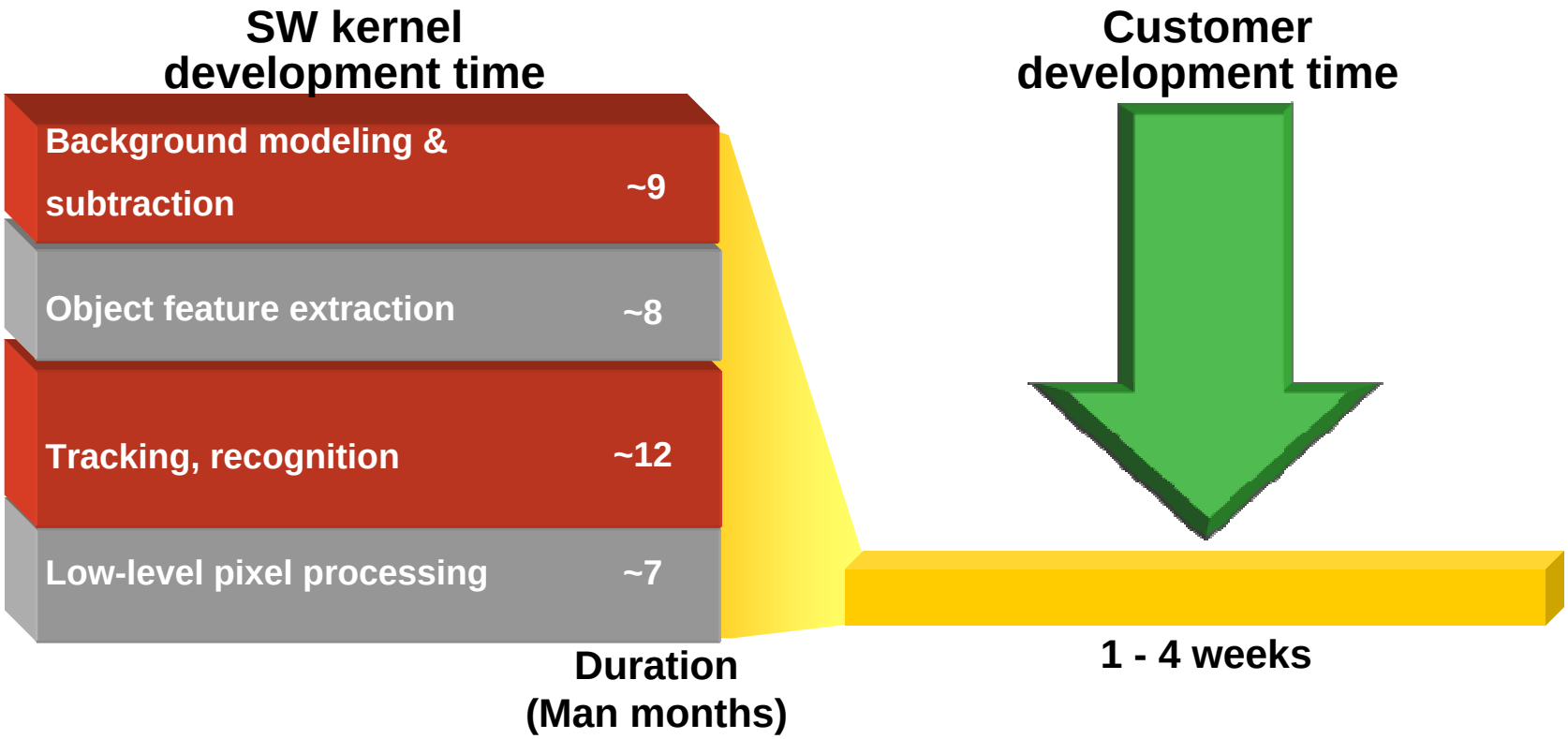
VLIB_updateEWR VarianceS16

BACKGROUND MODEL

VLIB

- Provides higher resolution & frame rate
- Enables more advanced features
- Allows use of lower cost C64x+ DSPs

Accelerates SW porting & reduces development time by 36 man months



- Brand new development can reduce optimization from 36 man months down to 1 week.
- Existing customers have migrated C code to C64x+ DSPs with VLIB in 4 weeks.

Moving Object Segmentation
16-bit precision, single Gaussian model

C64x+ MHz requirements *(VLIB ON, *)*

	@ ***5 fps***	@ ***10 fps***	@ ***30 fps***
QVGA	5	9	27
CIF	6	11	36
VGA	18	36	108
D1	21	41	123
HD 720p	54	110	333
HD 1080p	122	245	735

* assuming 50% overhead

Get started today with VLIB

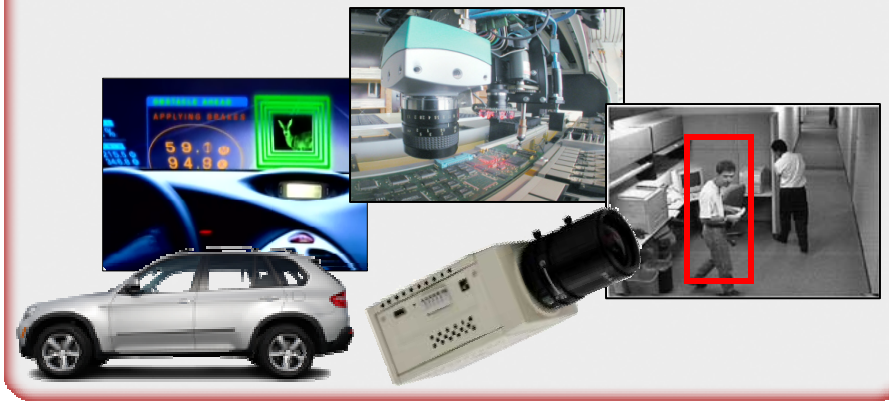
Step 1: Customers can leverage any C64x/C64x+ based development tool to use VLIB 2.0. For beginners, TI recommends the DM6437 DVDP.

Step 2: Get approval from TI. Visit www.ti.com/VLIBrequest to fill out contact form

Step 3: Upon approval, download VLIB at no cost and receive:

- Library of 50+ kernels
- Documentation: User's Guide
- Demo (requires DM6437 DVDP)
- Test scripts

Customers can immediately begin developing their video or vision system



DM6437 DVDP, $495

VLIB available now, royalty-free

TI's VLIB software library has been updated to VLIB 2.0

- VLIB 2.0 now consists of 50+ royalty free software kernels as well as Simulink and PC testing capabilities
  - **Added features allow existing TMS320C64x customers to leverage VLIB 2.0 in their video and automotive vision designs**
  - **Still allow pixel processing performance up to 10X over standard C code on TI's TMS320C64x+™ DSPs**

- What's new in VLIB 2.0 vs. version 1.0 ?
  - **Optimized functions for TMS320C64x DaVinci™ DSP core support (example: DM642)**
  - **Simulink blocks to enable MathWorks model-based design**
  - **Bit-exact version for testing on PC**
  - **6 additional functions including Bit mask packing/unpacking, 16-bit IIR filter, L1 distance**

- For current customers
  - **the new VLIB 2.0 Video/Vision Library will be delivered to you via TI's new myRegistered Software portal. Please watch for an email coming to you with subject: "TI Software Activation ID" from myregistered_software@list.ti.com. It will contain your activation instructions and Activation ID. You must follow these steps in order to download VLIB v2.0.**

- For new users
  - **go to www.ti.com/vlibrequest to fill out VLIB Approval Request form**

Differentiate with Advanced Analytics

3.) License Analytics Application SW from TI Partners

- **Object Video – www.objectvideo.com**
- **Cernium – www.cernium.com**
- **AgentVI – www.agentvi.com**
- **VCA Tech – www.vcatechnology.com**
- **Mate – www.mate.co.il**