基于**DM365**的
网络摄像机参考设计

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TEXAS
INSTRUMENTS

议程

- DM365平台特色

- IP网络摄像机参考设计

- DM365网络摄像机现场演示

Multi-format HD Video Jumpstarts Camera- and Playback- driven Designs

Digital signage
- MPEG-4 at 1080p
- H.264 at 720p

IP security camera
- H.264 1080p at 10 fps

Personal media player
- MPEG-4 at 1080p
- H.264 at 720p
- MPEG-2, VC1

DM365 Platform:
HD multi-format video
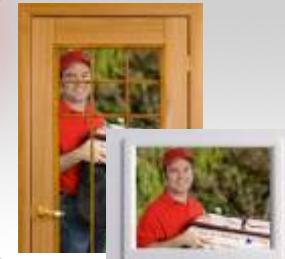Advanced image processing
Multimedia
Connectivity

Multi-channel DVR
- MPEG-4 at 1080p
- H.264 at 720p

Video doorbell
- MPEG-4 at 1080p
- H.264 at 720p

Baby monitor
- MPEG-4 at 1080p
- H.264 at 720p

HD web cam
- MPEG-4 at 1080p
- H.264 at 720p

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3

Pixel-perfect 1080p HD Video Flexibility

Multi-format HD video with H.264 up to 1080p

- 1080p H.264 at 10 fps optimized for video surveillance
- 1080p MPEG-4 at 24 fps
- 720p H.264, MPEG-4 at 30 fps

H.264, MPEG-4, MPEG-2, MJPEG & VC1

Flexibility without complexity

- Integrated Image Signal Processing (ISP)
- Multi-format, multi-rate, multi-stream, multi-channel
- Production-ready codec bundles

Face detection   **Auto white balance**
Noise filtering   **Auto focus**
Video stabilizer   **Auto exposure**
Edge enhancement

Up to 25% system cost savings

- Peripheral integration
- ISP eliminates use of expensive optics

EMAC, USB 2.0, RTC, DDR2 . . .

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Video Quality & Compression Efficiency
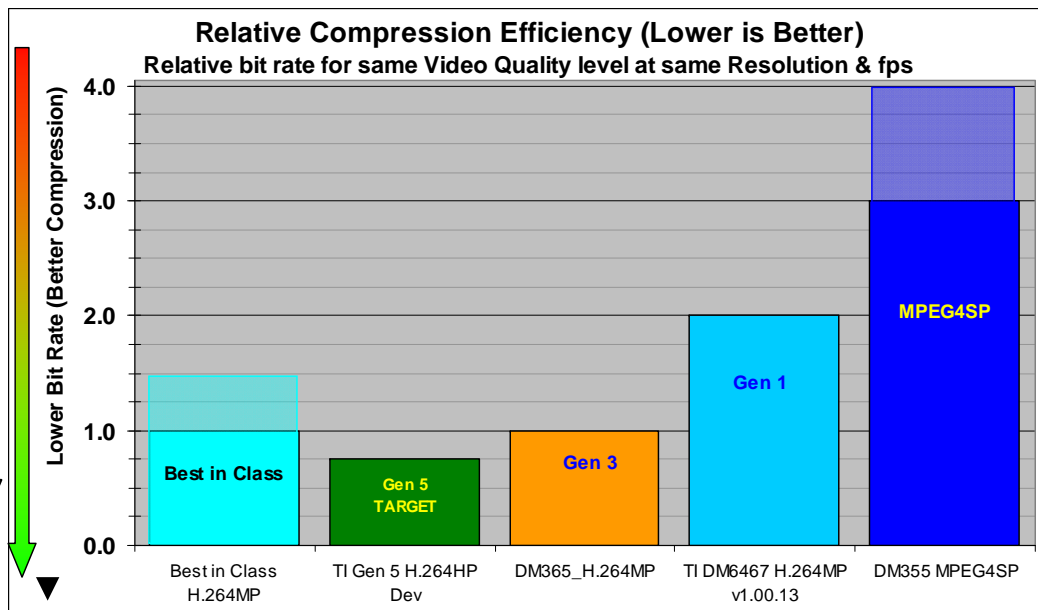
How do we evaluate video quality

- 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 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

Relative Compression Efficiency (Lower is Better)
Relative bit rate for same Video Quality level at same Resolution & fps

- 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
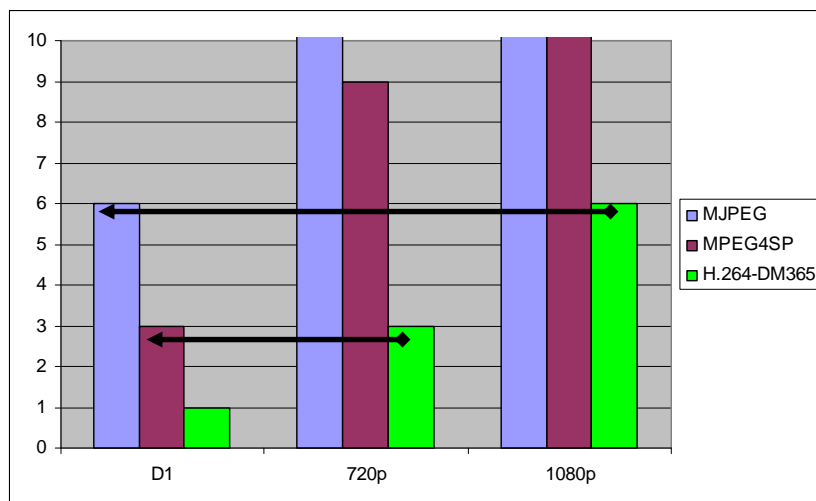
- TI H.264 technology gives HD video at SD bit rates

  720p video at same bit rates as D1 MPEG4

  1080p video at same bit rates as D1 MJPEG

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DM365 Video Processing Sub-System
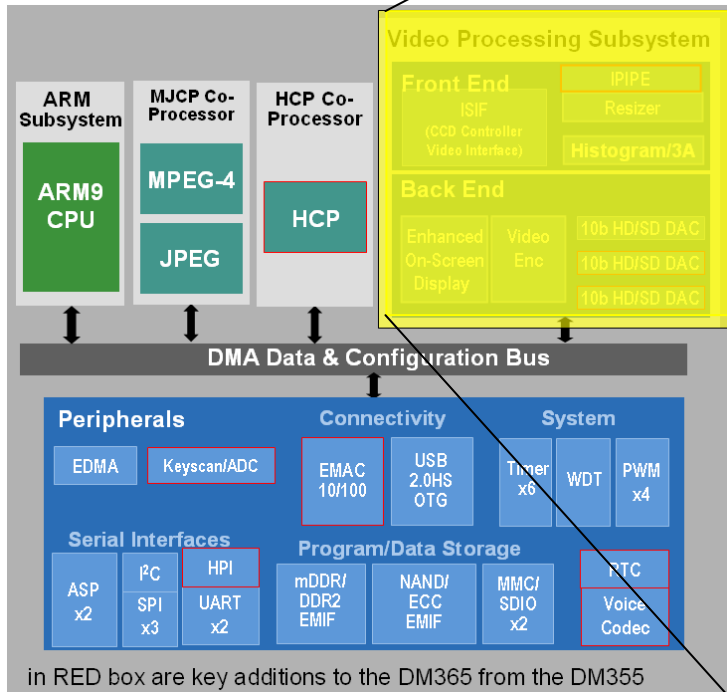
H3A: AE/AWB/AF 3A Statistics

LDC: Lens Distortion Correction module

HW Face Detect Engine

IMCOP Imaging Coprocessor *Advanced Image Processing Features*

IPIPE (Image Pipe)
- **DPC - defect pixel correction**
- **Noise Filter – 2D NF**
- **Advanced Color Mapping 3D-LUT**
- **DC Offset before WB**
- **Advanced CFA Interpolation**
- **Edge Enhancer**
- **False Color Suppression**
- **Re-Sizer -** supports 2 different size output images
- **Histogram**
- **LSC – Lens Shading Correction**

OSD: Enhanced On Screen Display

VPSS: Video Processing Sub-System

Video Processing Subsystem

Front End
ISIF (CCD Controller Video Interface)
IPIPE
Resizer
Histogram/3A

Back End
Enhanced On-Screen Display
Video Enc
10b HD/SD DAC
10b HD/SD DAC
10b HD/SD DAC

ARM Subsystem
ARM9 CPU

MJCP Co-Processor
MPEG-4
JPEG

HCP Co-Processor
HCP

DMA Data & Configuration Bus

Peripherals
EDMA
Keyscan/ADC

Connectivity
EMAC 10/100
USB 2.0HS OTG

System
Timer x6
WDT
PWM x4

Serial Interfaces
ASP x2
I²C
HPI
SPI x3
UART x2

Program/Data Storage
mDDR/ DDR2 EMIF
NAND/ ECC EMIF
MMC/ SDIO x2
RTC
Voice Codec

in RED box are key additions to the DM365 from the DM355

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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

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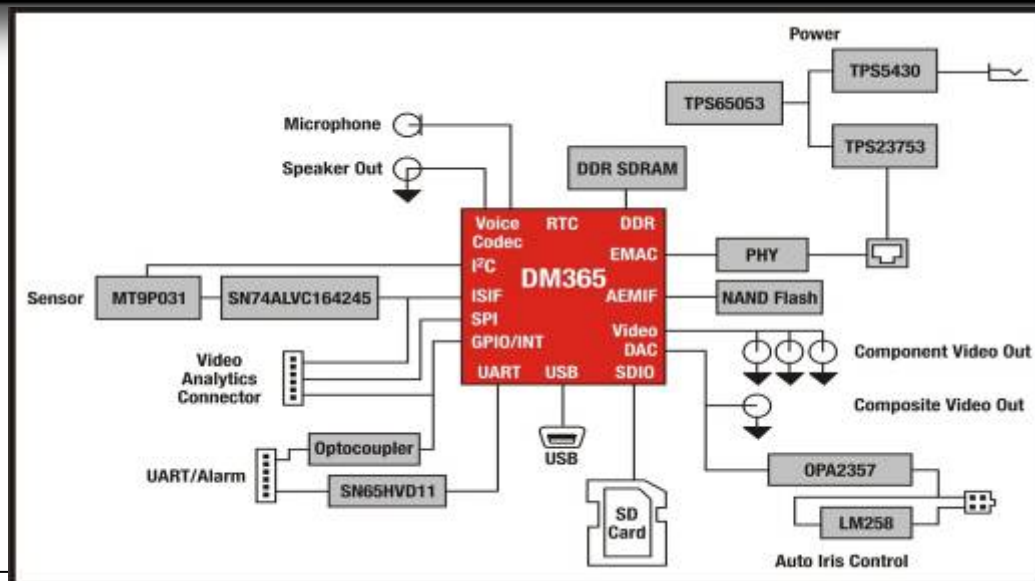# TI & Appro IP Camera Reference Design
--- DM365IPNC-MT5

Hardware features

- **TI TMS320DM365 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)**

- **Integrated video analytics HW connector**
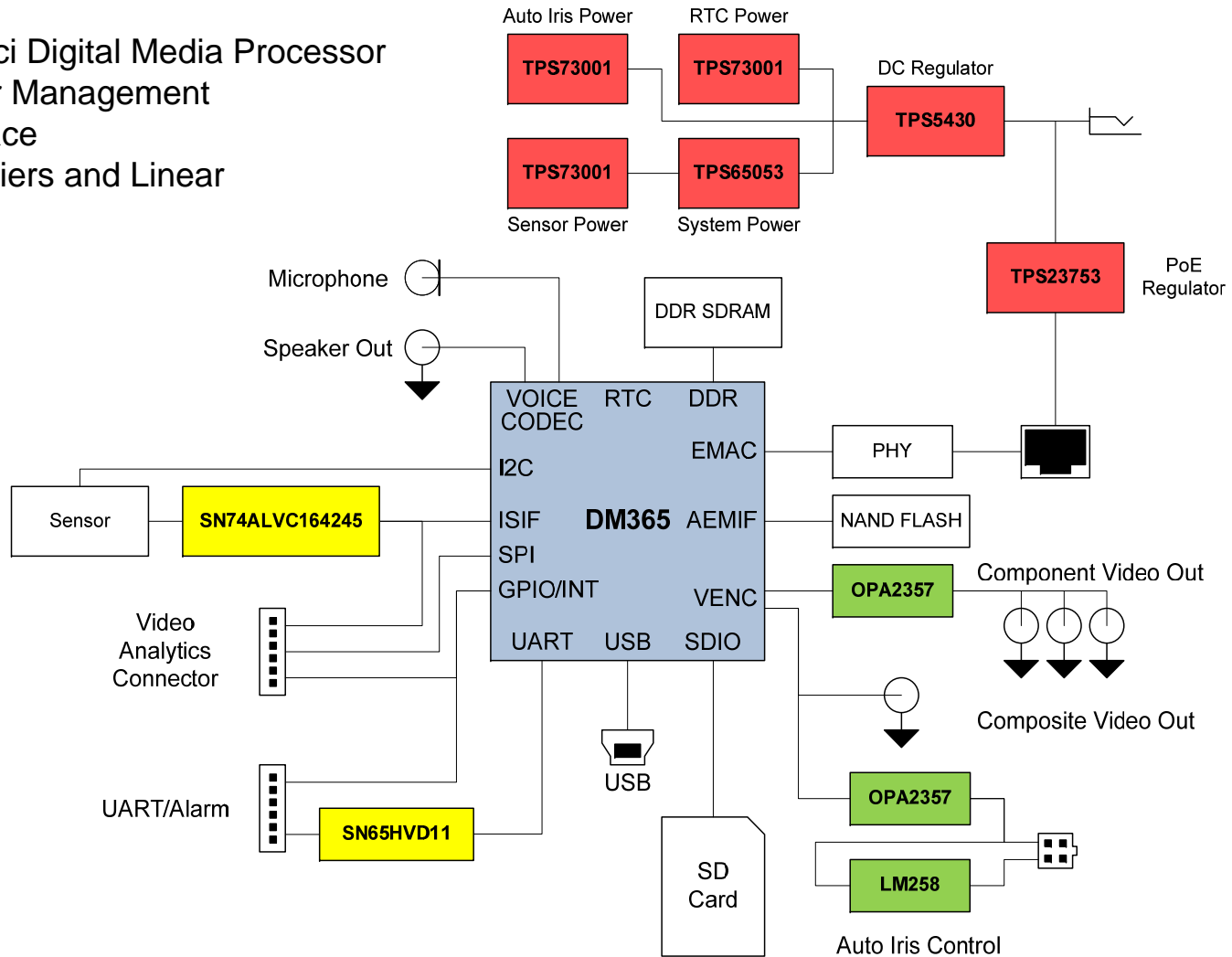
- **Power over Ethernet, Audio, SD storage**

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**
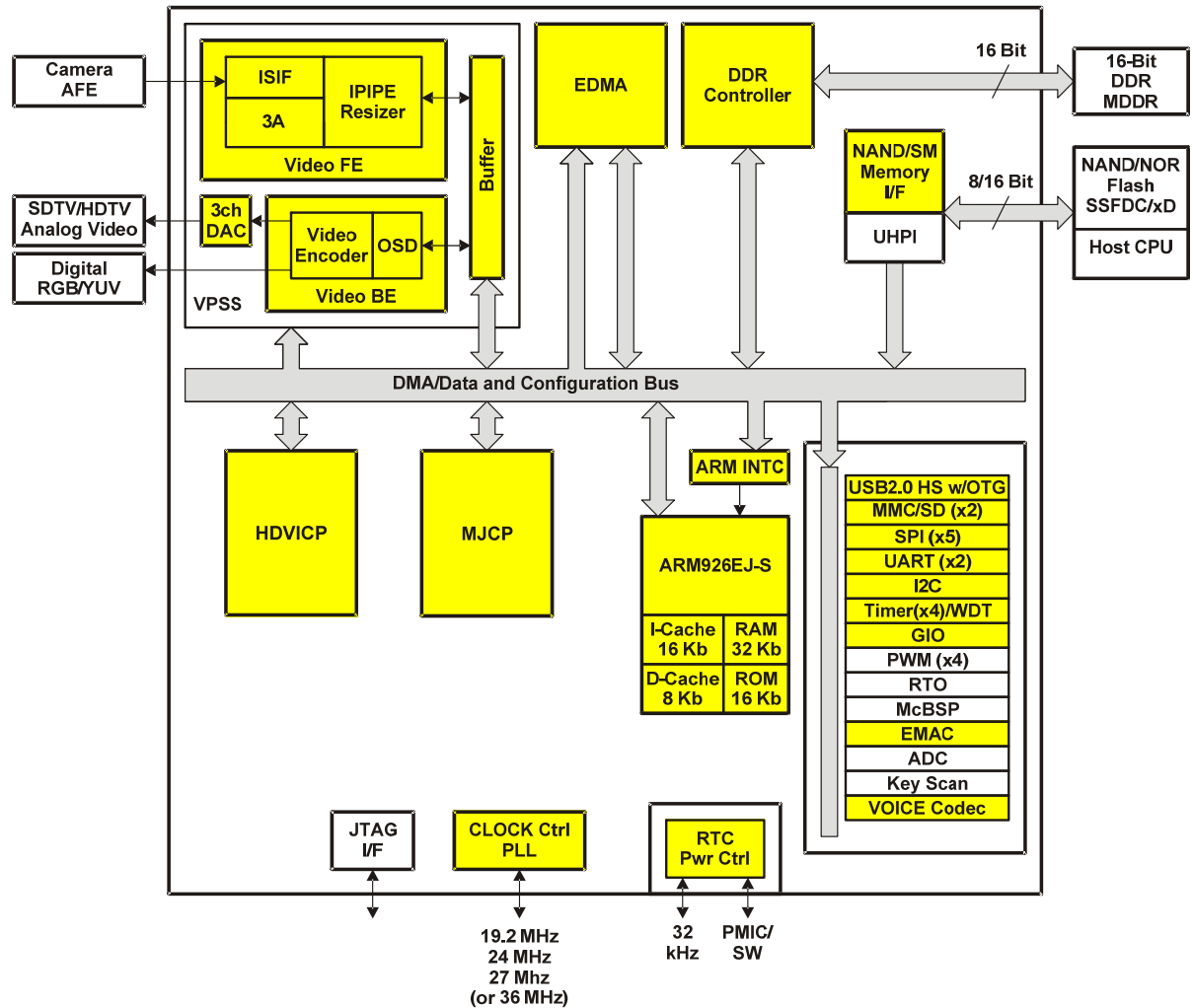
DM365 IP Camera Block Diagram

Davinci Digital Media Processor
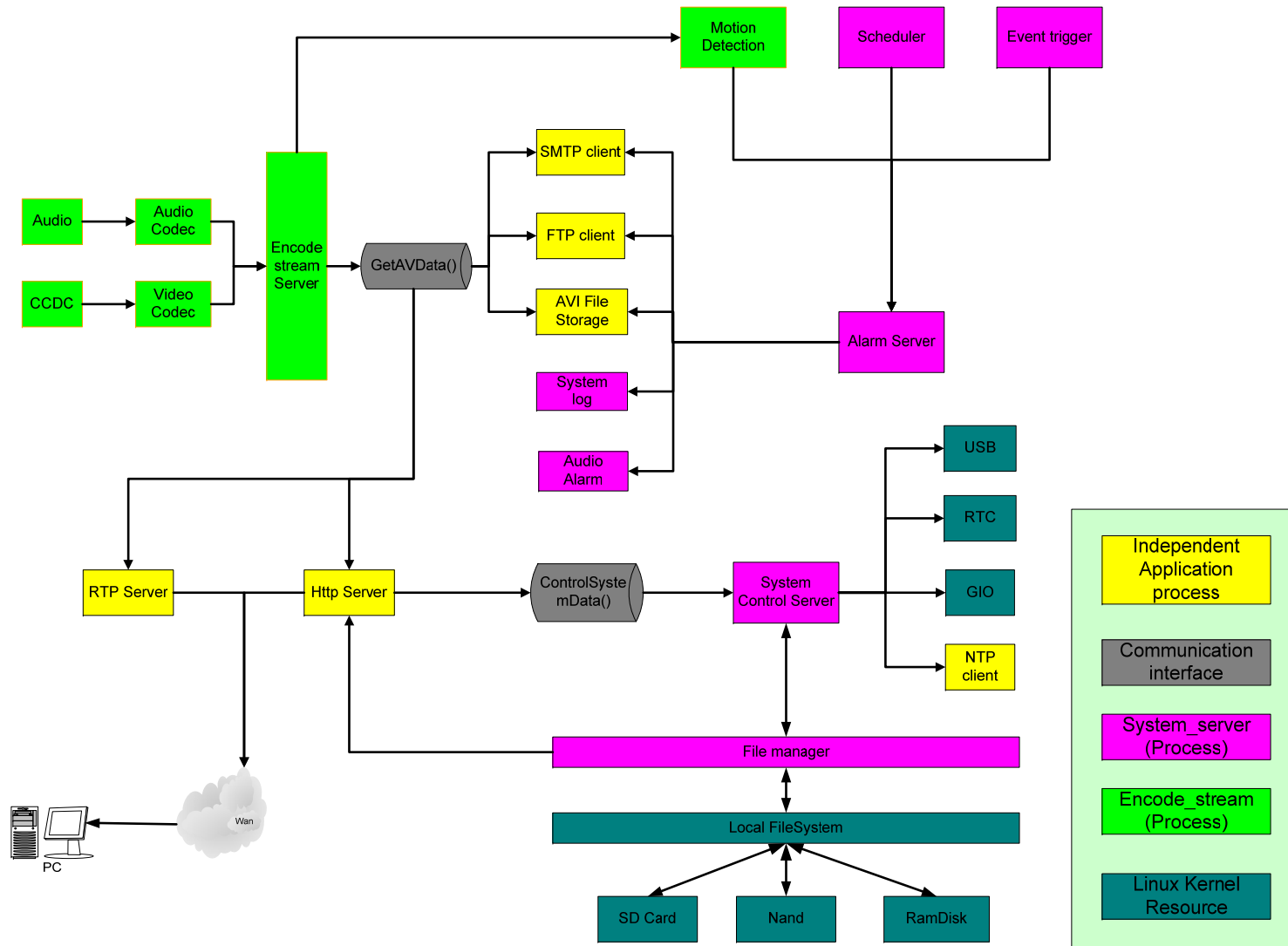Power Management
Interface
Amplifiers and Linear

Auto Iris Power **TPS73001**
RTC Power **TPS73001**
DC Regulator **TPS5430**

Sensor Power **TPS73001**
System Power **TPS65053**

PoE Regulator **TPS23753**

Microphone

Speaker Out

DDR SDRAM

VOICE CODEC RTC DDR

EMAC — PHY

I2C

Sensor — **SN74ALVC164245** — ISIF **DM365** AEMIF — NAND FLASH

SPI

GPIO/INT VENC — **OPA2357** — Component Video Out

Video Analytics Connector

UART USB SDIO

Composite Video Out

USB

UART/Alarm — **SN65HVD11**

SD Card

OPA2357

LM258

Auto Iris Control

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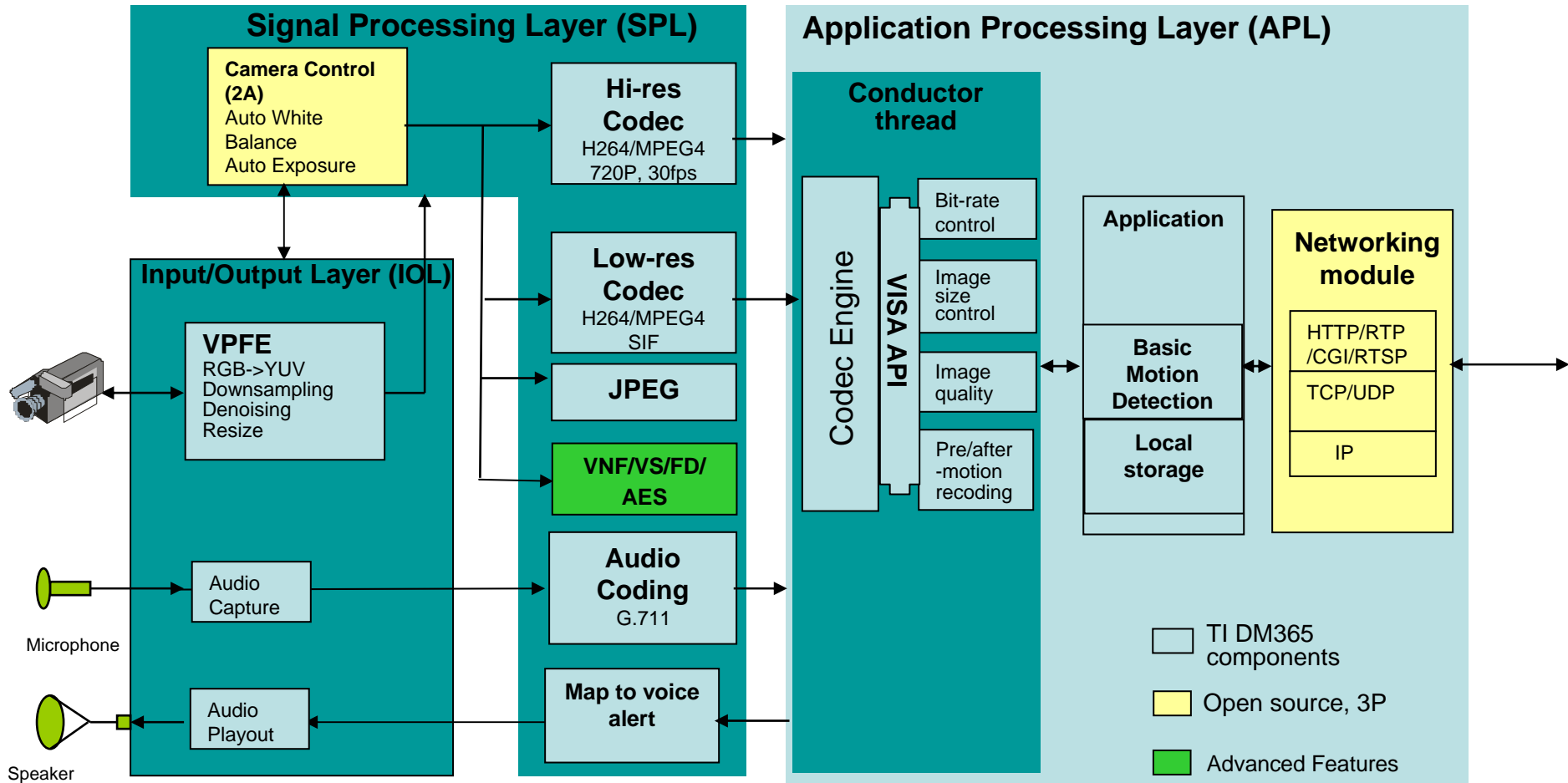
DM365 Camera SOC

DM365 is a Camera System on a Chip

• Reference design utilizes a high percentage of the chip resources

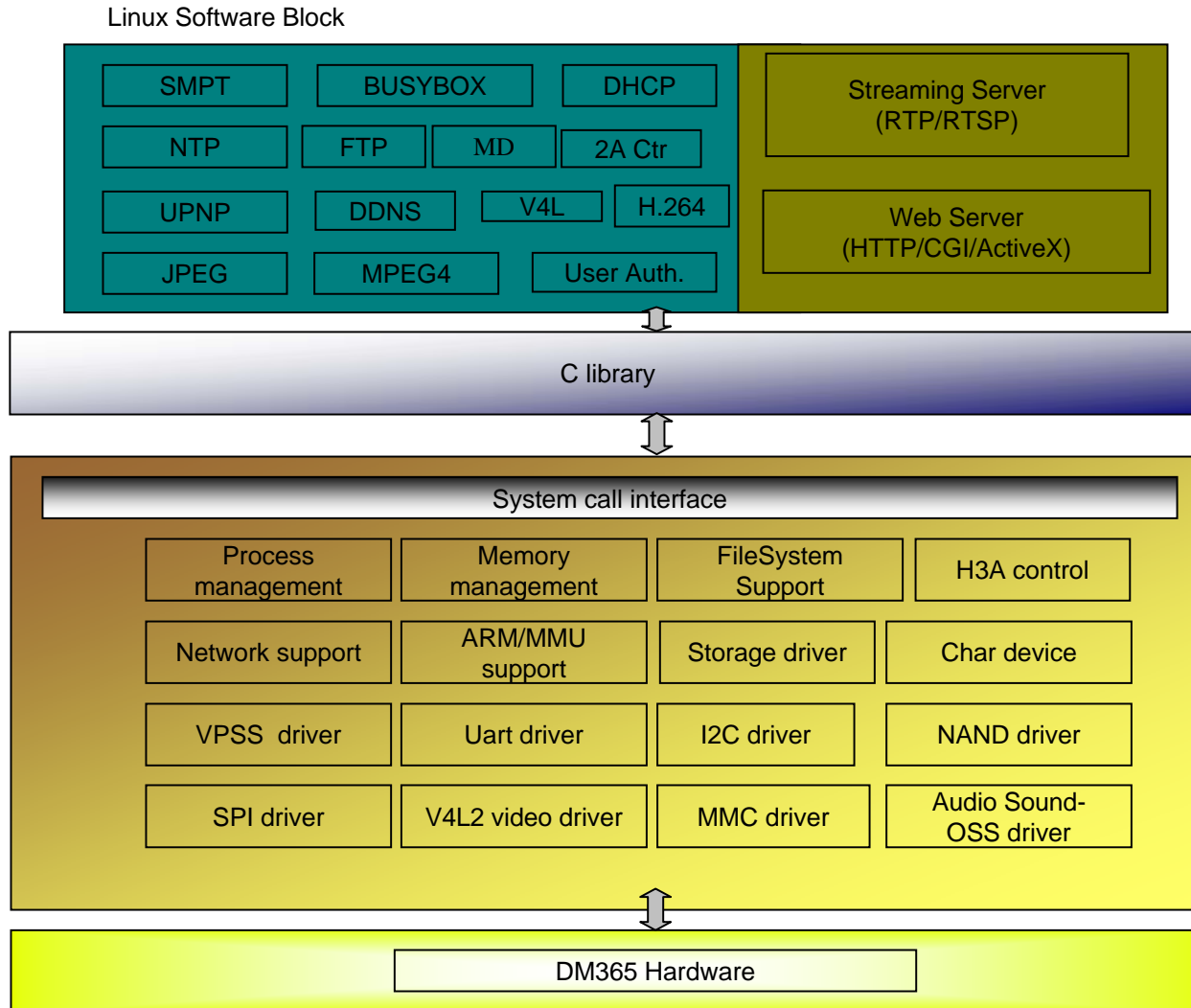• Provides high value (bang for the buck)

IPNC Top-level SW Design

DM365 IPNC Processing Modules

Signal Processing Layer (SPL)

Camera Control (2A)
Auto White Balance
Auto Exposure

Input/Output Layer (IOL)

VPFE
RGB->YUV
Downsampling
Denoising
Resize

Audio Capture

Microphone

Audio Playout

Speaker

Hi-res Codec
H264/MPEG4
720P, 30fps

Low-res Codec
H264/MPEG4
SIF

JPEG

VNF/VS/FD/ AES

Audio Coding
G.711

Map to voice alert

Application Processing Layer (APL)

Conductor thread

Codec Engine

VISA API

Bit-rate control

Image size control

Image quality

Pre/after -motion recoding

Application

Basic Motion Detection

Local storage

Networking module

HTTP/RTP /CGI/RTSP

TCP/UDP

IP

TI DM365 components

Open source, 3P

Advanced Features

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DM365 IPNC SW Overview

Linux Software Block

SMPT	BUSYBOX	DHCP
NTP	FTP	MD	2A Ctr
UPNP	DDNS	V4L	H.264
JPEG	MPEG4	User Auth.

Streaming Server (RTP/RTSP)

Web Server (HTTP/CGI/ActiveX)

C library

System call interface

Process management	Memory management	FileSystem Support	H3A control
Network support	ARM/MMU support	Storage driver	Char device
VPSS driver	Uart driver	I2C driver	NAND driver
SPI driver	V4L2 video driver	MMC driver	Audio Sound-OSS driver

DM365 Hardware

Codec Combos In DM365 IPNC

Main use cases

- H264, 720P, 30fps, 1-6Mbps + H264 CIF, 15-30 fps 64kbps - 512kbps + Motion Detection + G.711 speech codec

- H264, 720P, 30fps, 1-6Mbps + JPEG, VGA 15fps + Motion Detection + G.711 speech codec

- H264, 720P, 30fps, 1-6Mbps + H264, CIF,15fps 64kbps -512kbps + JPEG 5fps, VGA + G711

Software based on TI framework

- Codec Engine

- VISA API abstraction

- Standard TI DM365 Codec (HW)

Networking Connectivity and Application

- **HTTP server**

  Popular and easy to modify - BOA.

  Minimized the memory usage - single thread.

  Dynamic HTML supported - CGI.

  RFC 2616 compatible.

  ActiveX is used to enable H264/MPEG4/MJPEG streaming

- **RTP/RTSP**

  LIVE555 Streaming Media

  Source-code libraries for standards-based RTP/RTCP/RTSP multimedia streaming supports VLC media player

  Payload-type identification - Indication of what kind of content is being carried.

  Time stamping - allow synchronization and jitter calculations.

  RFC 1889 compatible.

DM365 Boosts Image Quality for IP Cameras with TI's 5th Generation Image Signal Processing (ISP)

Video noise filter (VNF365)
Improves image quality, cuts noise & clarifies details

Video stabilization (VS365)
Increases visual quality & image bit rate

DM365
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VNF: lighting (VNF365)
Enables better low-light imaging

Face detection (FD365)
For faster identification

VNF: compression (VNF365)
Increases video compression efficiency
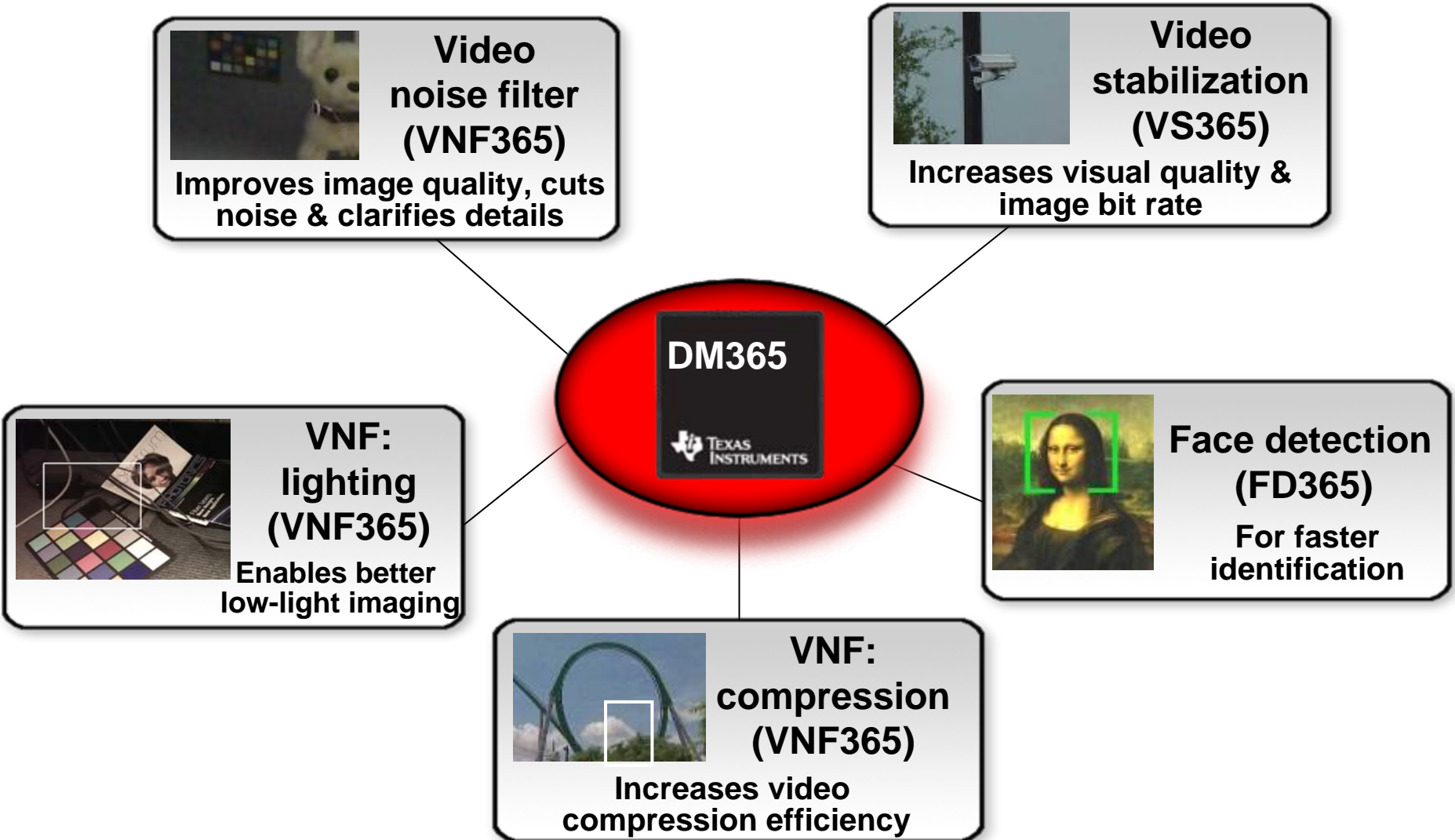
TI KATANA Noise Reduction (2D-NF)
Cut the Noise, Save the Detail

➔ Noise is removed but important details are preserved

Without 2D-NF   **With 2D-NF**

➔ Image quality are improved

TEXAS INSTRUMENTS
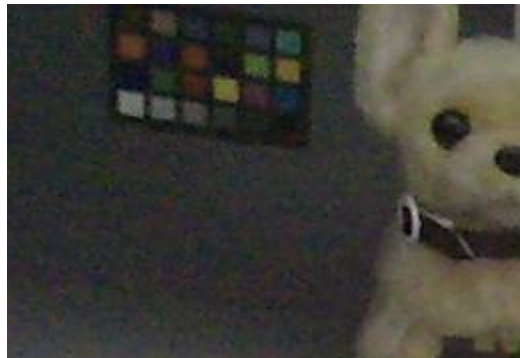
TI VNF365 Enables Low Light Imaging

Dark condition without VNF365

MPEG-4
710Kbps CVBR
VGA 30fps

Dark condition with VNF365
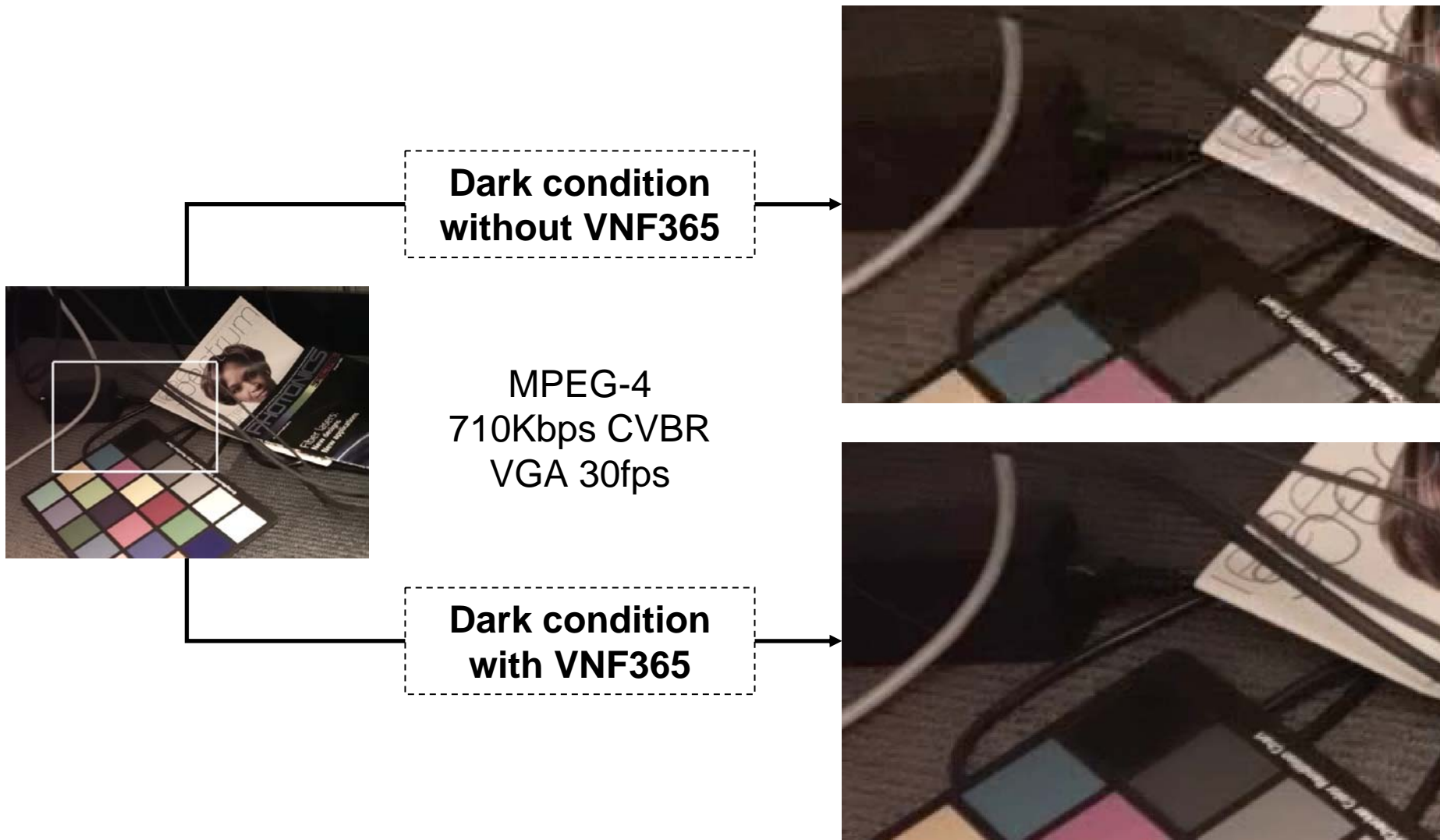
DM365 ISP Tuning Tool

- Camera S/W

    Real time ISP parameter update through Ethernet

    Updated ISP parameter storage in NAND

    Raw, YUV capture

    Customized parameters tuning through Ethernet

- 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 &

Schedules
Beta Version – e/o April09
GA Version – July09

PC

GUI	Shell

Tuning Algorithms

Image Tune Message API

Communication Link

Ethernet

CAM

Communication Link

Image Tune Message API

Status   CMD, Parameters

CMD 0 Handler

Image Tuning Control Thread   CMD 1 Handler

CMD .. Handler

Status   CMD, Parameters   CMD N Handler

CMD Handler

TEXAS INSTRUMENTS
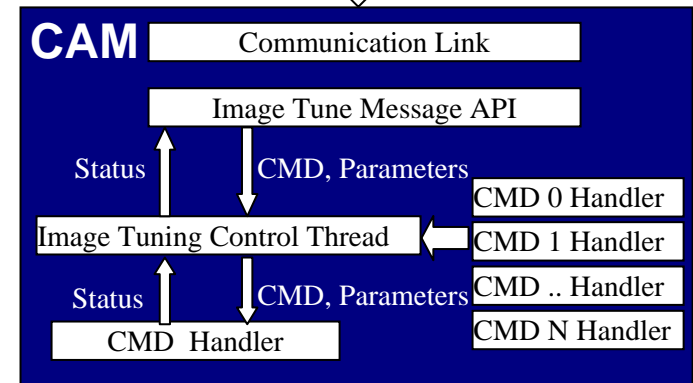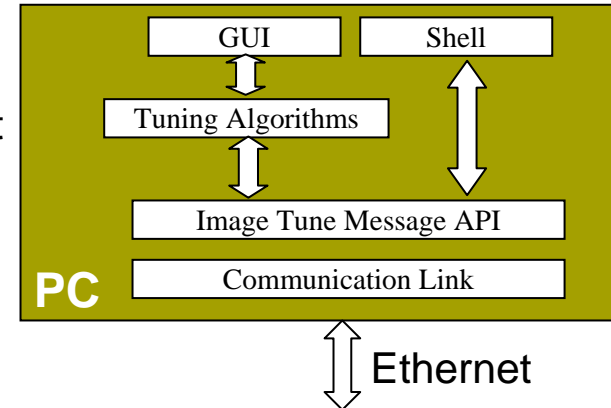
Image Tuning Tools User Interface

Semi-automatic tuning
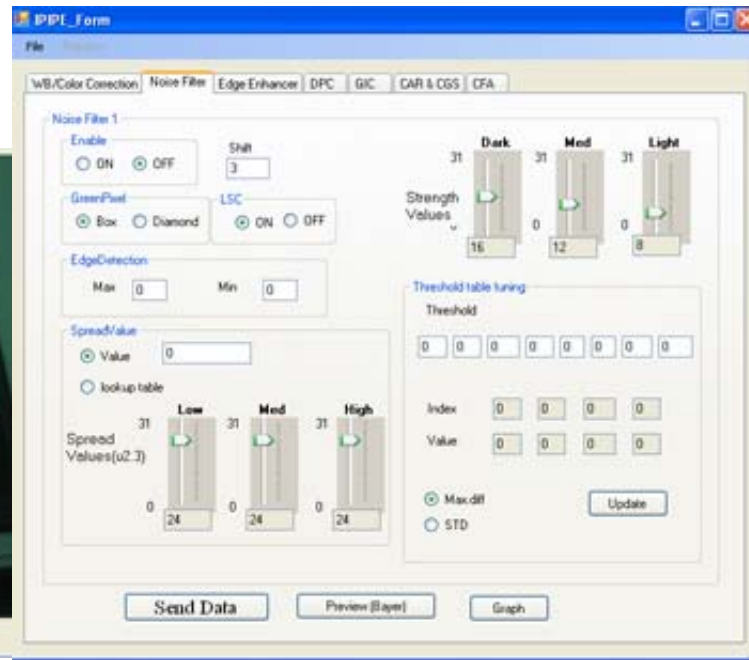
GUI-based tuning

Command-line tuning

Image Tuning: Lens Distortion Correction
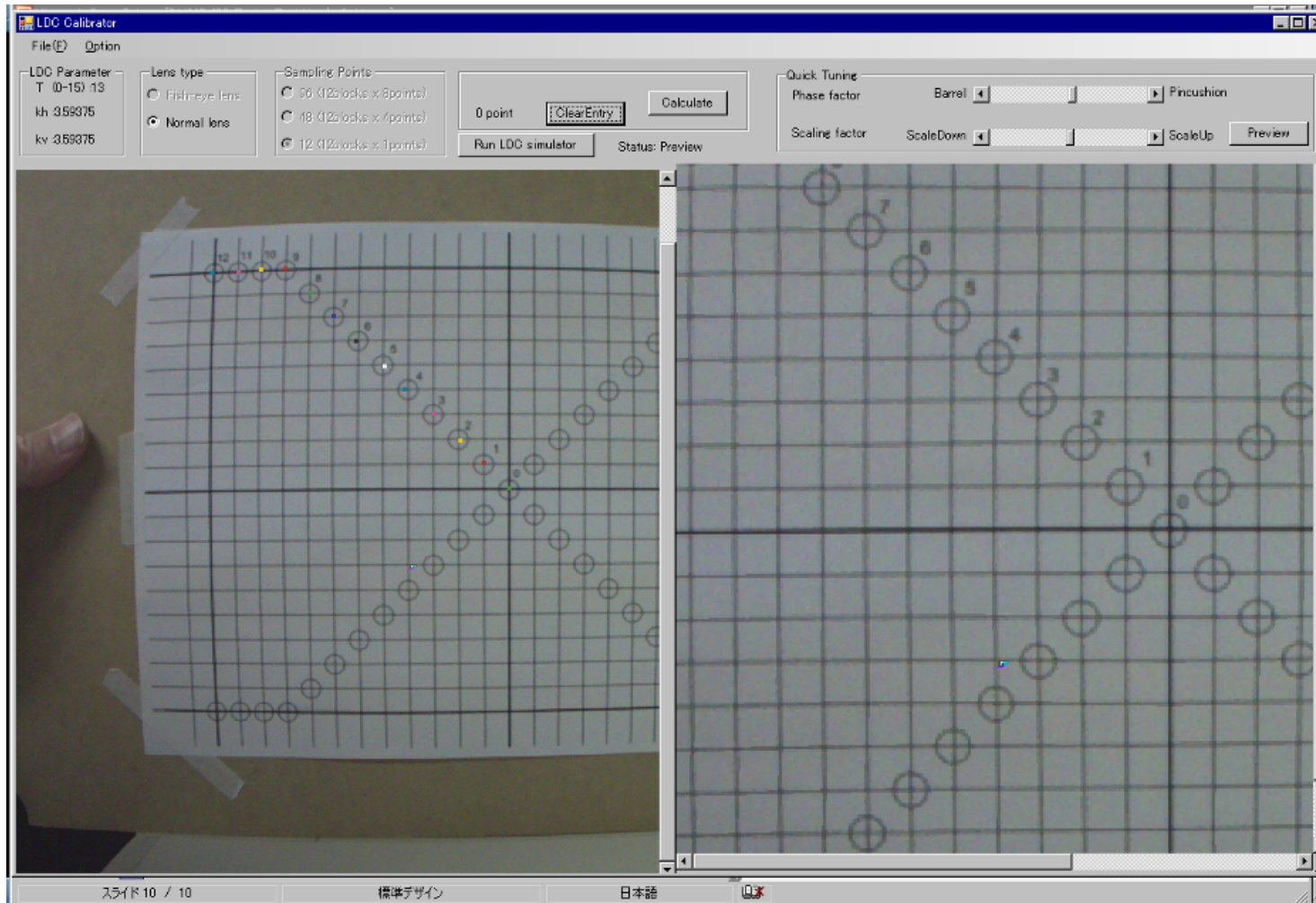
Image Tuning: Noise Filter

DM3xx IP NetCamera GUI

User Interface

The user of the IPNetCam will use the standard web browser. There will be HTML and CGI (Dynamic HTML) based web pages used as a user interface. The CGI scripts will be used to transfer the user data from web browser to HTTPS server on the IPNetCam. The user will be interacting to the IPNetCam using the web browser.

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Get Started Today with Production-ready, DM365-based Reference Designs

DM365IPNC-MT5: $795

With production agreement:
- Schematic & Gerber files
- Royalty-free Linux based IP camera application
- Source code included

www.ti.com/ipcamera

Order entry open now

Schedules
Beta Version – Now
GA Version – July09

DM365网络摄像机现场演示

Thank You!

www.ti.com.cn/processors