TI Developer Conference
March 7-9, 2007 • Dallas, TX

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How to Rapidly Prototype Using the DaVinci™ DVSDK

A Video Security over IP (VSIP) IP-Netcam Example

Loc Truong
Catalog DSP Applications

Agenda

- Scope
- VSIP Backgrounder
- IP-Netcam System Aspects
- Matching with DaVinci™ DVSDK Content
- Summary
- Examples of IP-Netcam using DaVinci™ DVEVM

Scope

- Session illustrates how to use DVSDK as a *rapid prototype* vehicle for DM644x-based applications, in this case VSIP, to create an IP network camera (IP-netcam) using DVSDK.
- *Rapid* ***Prototyping*** is “the process of quickly putting together a working model (a prototype) in order to test various aspects of a design, illustrate ideas or features and gather early user feedback” - http://en.wikipedia.org

Rapid Prototyping with DVSDK

Scope

VSIP Backgrounder

IP-Netcam System Aspects

Matching with DaVinci™ DVSDK Content

Summary

Examples of IP-Netcam using DVEVM

VSIP Backgrounder

- Rapidly growing security market
- Market currently mixed with analog and digital solutions
- Pros and cons of analog (CCTV) solution:
  - ✓ Reliable (low-tech)
  - ✓ Infrastructure available
  - ↓ Limited scalability in performance to meet today's demands
  - ↓ Not so secured (remember spy movies!)
  - ↓ Limited mobility
  - ↓ Has limit on distance of remote operators
  - ↓ DVR solution not very robust

VSIP Backgrounder

- Pros and Cons of Digital Solution
  - ↓ New technology (digital has its challenges)
  - ↓ Developing infrastructure
  - ✓ More reliable (more redundancy can be built-in)
  - ✓ Scalable (both in performance and deployment standpoints)
  - ✓ More intelligent (smart cameras) via Video Content Analysis
  - ✓ Data and transport can be secured
  - ✓ Can be operated very remotely
  - $ More cost-effective

→ Digital solution's advantages far outweigh analog counterpart, creating strong demand for VSIP solutions

Video Content Analysis Examples

People Counting

Traffic Pattern

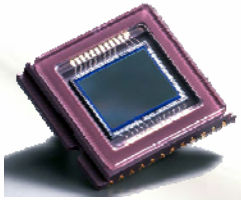
Perimeter Protection

License Reading

Parking Enforcement

Digital technology with VCA enables VSIP to take on large tasks or remove the drudgery out of the surveillance task.

Differentiating Features of IP-Netcam



Good Reliable Hardware:
Camera lens & CCD sensor
Pan/ Tilt/ Zoom, PoE
Local storage, Size



Perimeter Protection
License Plate Reading
Parking Enforcement

Intelligence (VCA):
Motion Detection
Object Recognition/ Tracking
Face Recognition

$$Y = \sum_{i=1}^{count} coeff_i * x_i$$

Compression and Networking:
MPEG4 SP, H.264 BP, G.711, etc.
TCP/IP, HTTP, RTP, RTSP,
SMNP, DNS, DHCP, etc.

To meet challenges of IP networks, VSIP needs a **programmable processor** to constantly adapt to changing conditions

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VSIP Backgrounder

- Types of IP-Net cameras:
  - Differences in camera sensor & lens type, level of intelligence, and robustness of features (PTZ, local storage, video quality and resolution, security, etc.) determine the product mix.
  - Intelligence include different types of *Video Content Analysis (VCA)* techniques such as motion detection (e.g. used in Intrusion Detection), object recognition (e.g. counting applications), object tracking, face recognition (e.g. security screening).
  - An *http web server* is usually included for remote control and administration and/ or video streaming. Depending on the configuration, the camera has names such as web-cam, internet camera, network camera, etc.
  - Video streaming can range from simple MJPEG to MPEG4 or H.264 *video compression* over various *IP protocols* such as TCP/IP, FTP, HTTP, RTP and RTSP at different resolutions and number of streams.
- To meet challenges of IP networks, VSIP needs a **programmable processor** to constantly adapt to changing conditions.

IP-Netcam Examples

D-Link™ DCS-6620 Network Camera:
- User selectable MJPEG or MPEG4 SP up to D1
- PTZ, 2-way audio
- CCD image sensor with auto-focus, auto-iris, AGC

CoVi™ CVQ-21xx MultiStream HD Camera:
- Supports 1280 x 720 (3fps), D1/ CIF/ QCF (30fps)
- MPEG4 SP encode
- ePTZ
- proprietary PoE
- optional 160GB to 320GB HDD

Prototype IP-Netcam Specs

Our prototype needs the following features:

1. Capture D1-res YUV video from analog camera
2. Video compression (encoder selected later)
3. HTTP server
4. TCP/IP stack
5. Local display
6. Non-volatile storage for program and settings
7. Head-room for VCA (feature selected later)

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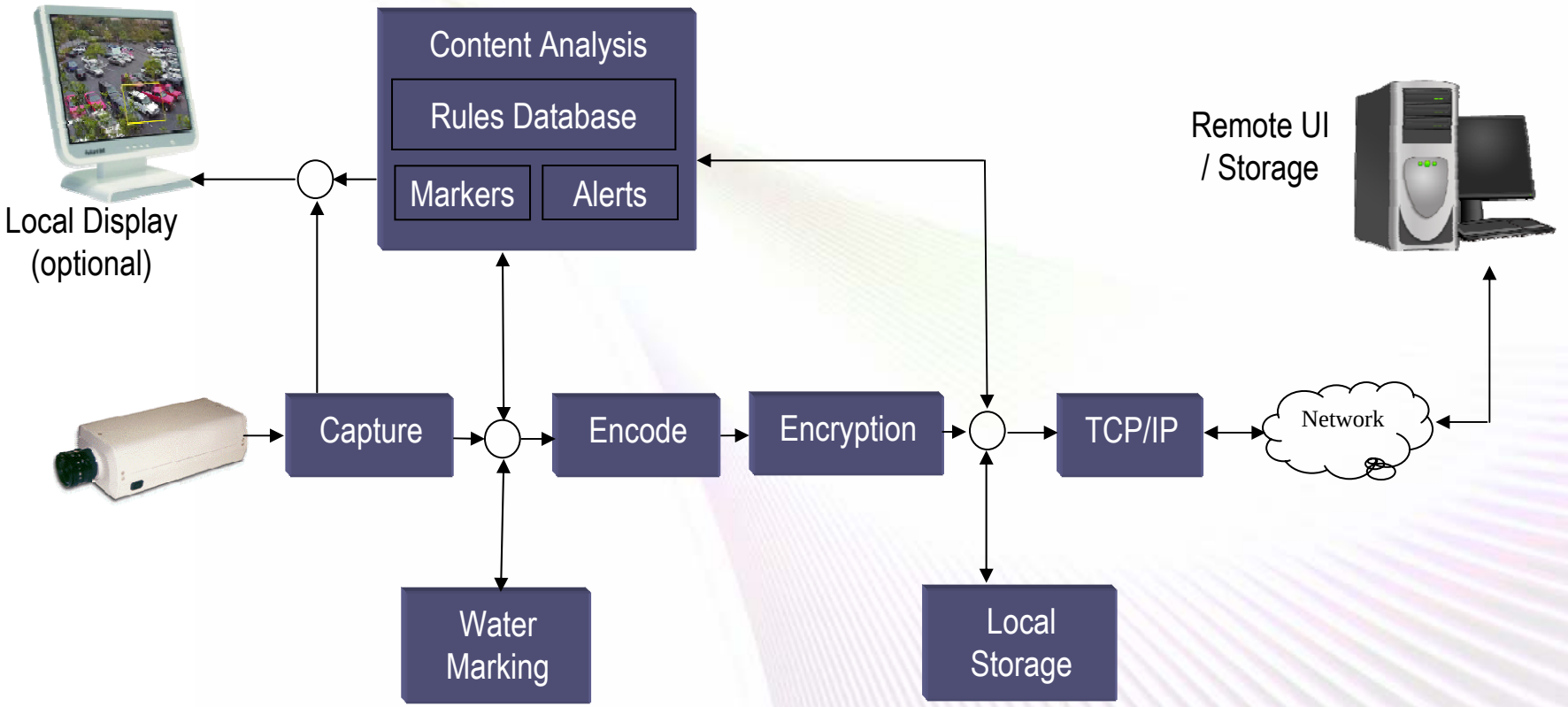
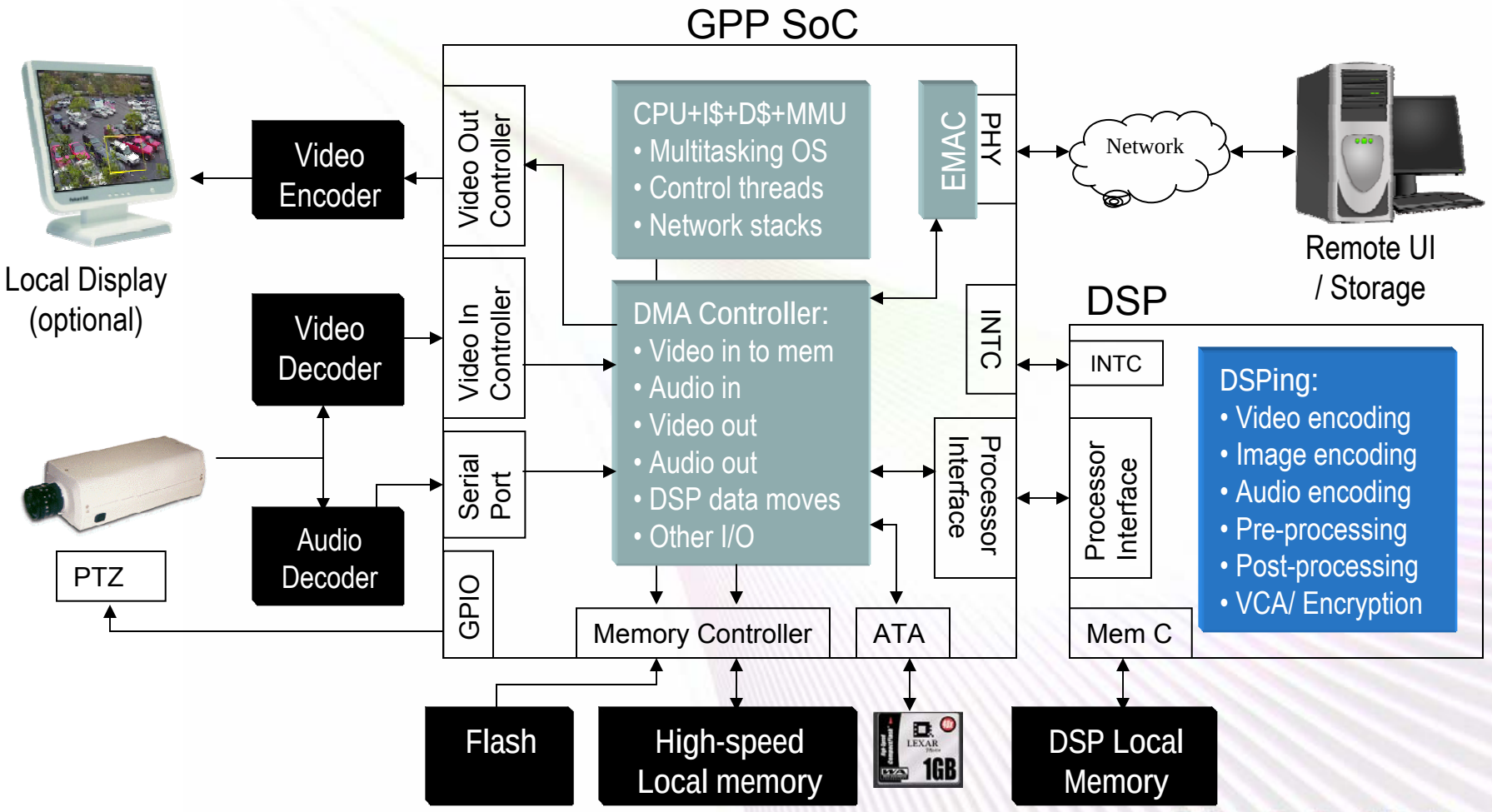
Typical Smart Surveillance System *



(*) Courtesy eInfoChips

Typical IP-Netcam System Block Diagram



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How About Non-SoC Solutions?

There are alternative approaches to high MIPs requirements for VSIP Net-cams

GPP+ Discrete Accelerators

- ✓ Single prog model
- ✓ Need high MIPs
- ↓ Fixed feature set
- ↓ Long ASIC design cycle
- ↓ High FPGA cost

Discrete GPP+DSP

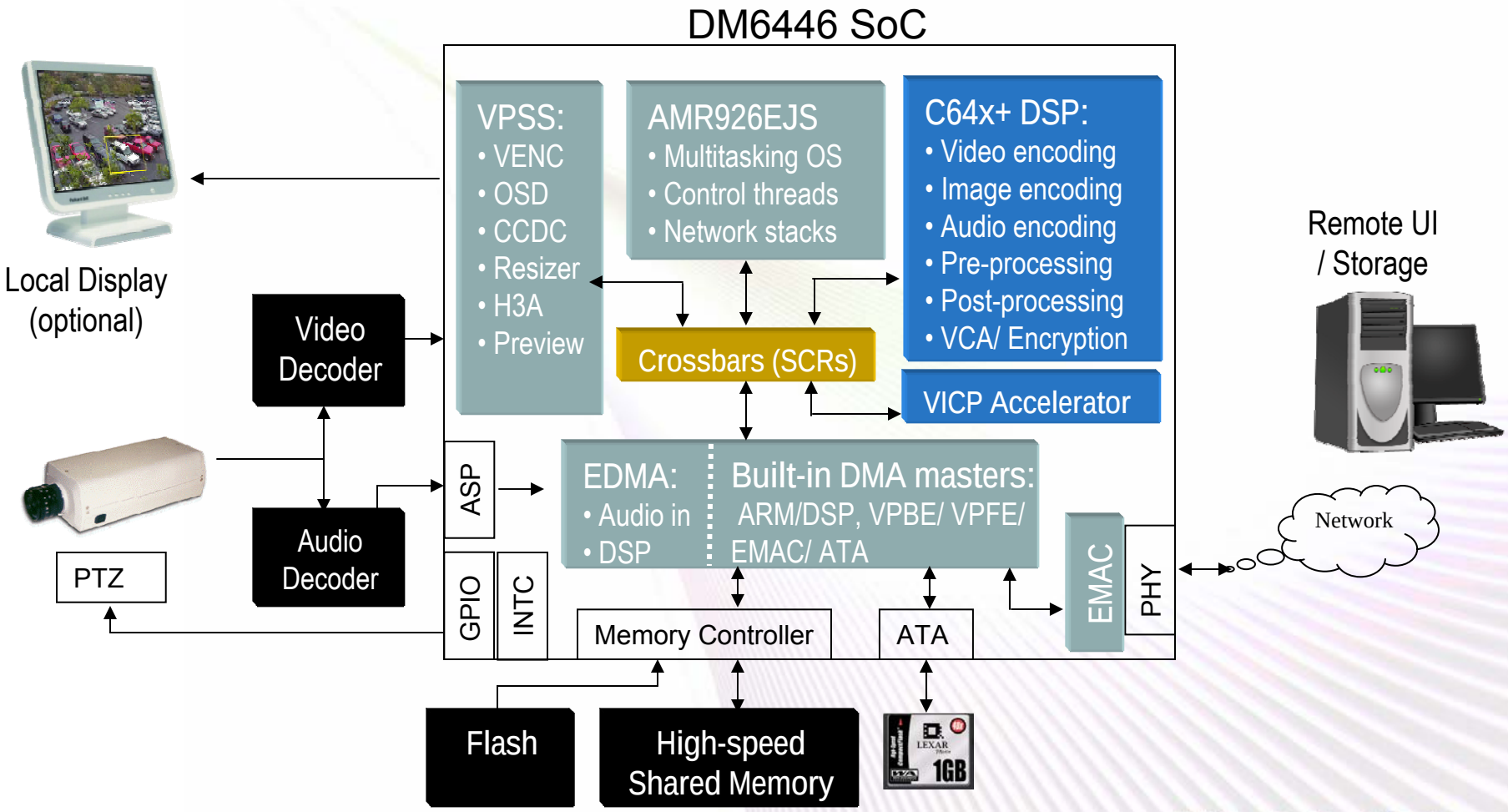
- ✓ Flexible feature set
- ✓ Easy upgrade
- ↓ High total MIPs
- ↓ Complex design
- ↓ Dual prog model

DSP only

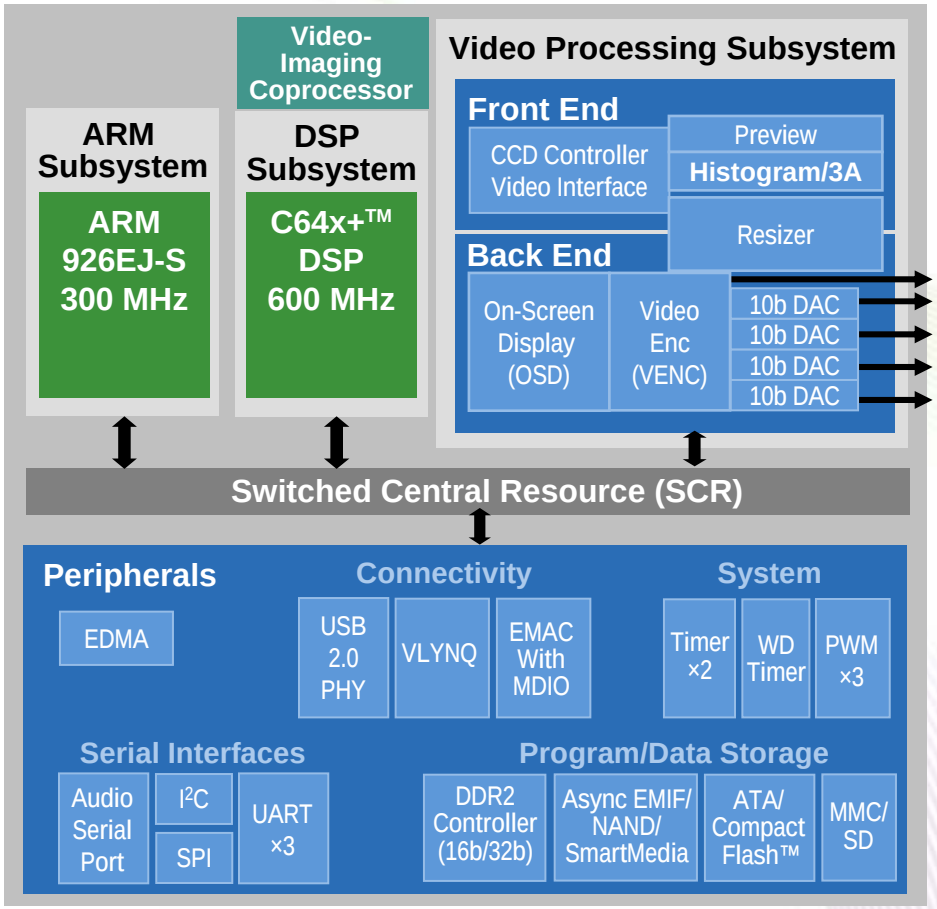
- ✓ Simpler design
- ✓ Single prog model
- ✓ Flexible feature set
- ↓ Need high MIPs

DM644x processors combine the best from these solutions in a small package using GPP + DSP + Accelerators

DM6446-based IP-Netcam System BD



Is DM644x a fit for IP-NetCam?



Key Applicable Features:

- 300MHz ARM926EJS for control threads and networking stacks
- 600MHz c64x+ DSP core for compression and analytics
- H/W VICP accelerator
- 64-Channel EDMA
- Video Processing Sub-system with built-in NTSC/PAL encoder and On-Screen Display (OSD)
- Built-in I/Os
- High-speed internal busses
- DDR2 controller
- NOR/ NAND memory I/F
- Small BGA 16x16mm package

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DM644x DVEVM & DVSDK

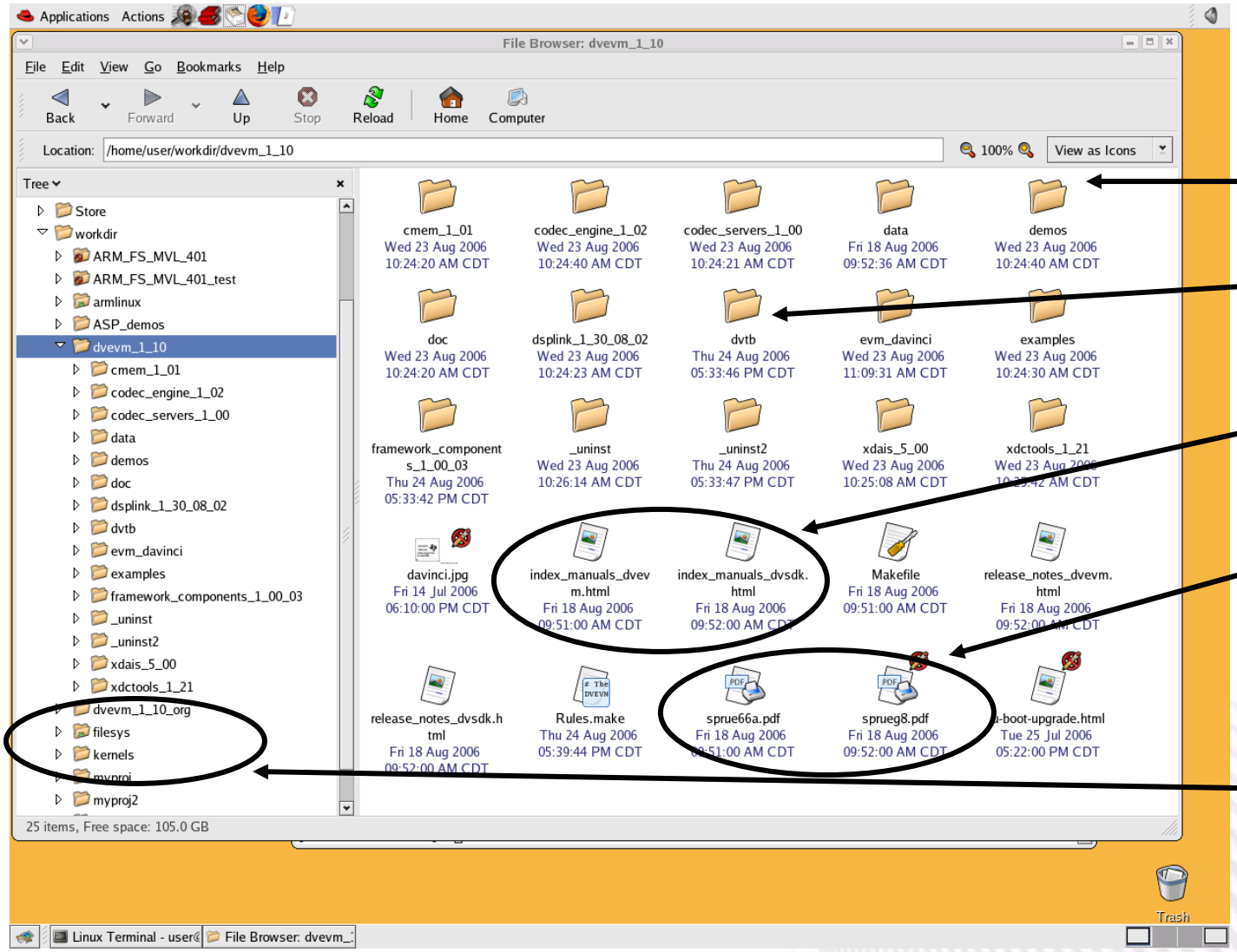
DVEVM Kit:
- Evaluation Module
- Camera, LCD, mic, remote
- TI-demo MV Linux Support Package
- VISA Demos
- SoC Visualizer
- DV Test Bench (DVTB)
- XDC Configurations Tool Kit
- Access to www.ti.com/dvevmupdates

DVSDK Packages:
- Base:
  - -TI Linux-host c6x code generation tools
  - - DSP-side DSP/BIOS content

"-L" package:
- MVL subscription (one-year access to support and updates at www.mvista.com)
- DevRocket 2.0

"-3L" package:
-DVSDK–L package + Spectrum Digital XDS-560 USB Emulator

Installed DVSDK at a-glance



Demo source

DV Test Bench

DVEVM/SDK links to docs

DVEVM/SDK GSG

Copy of MVL ARM kernel & file system

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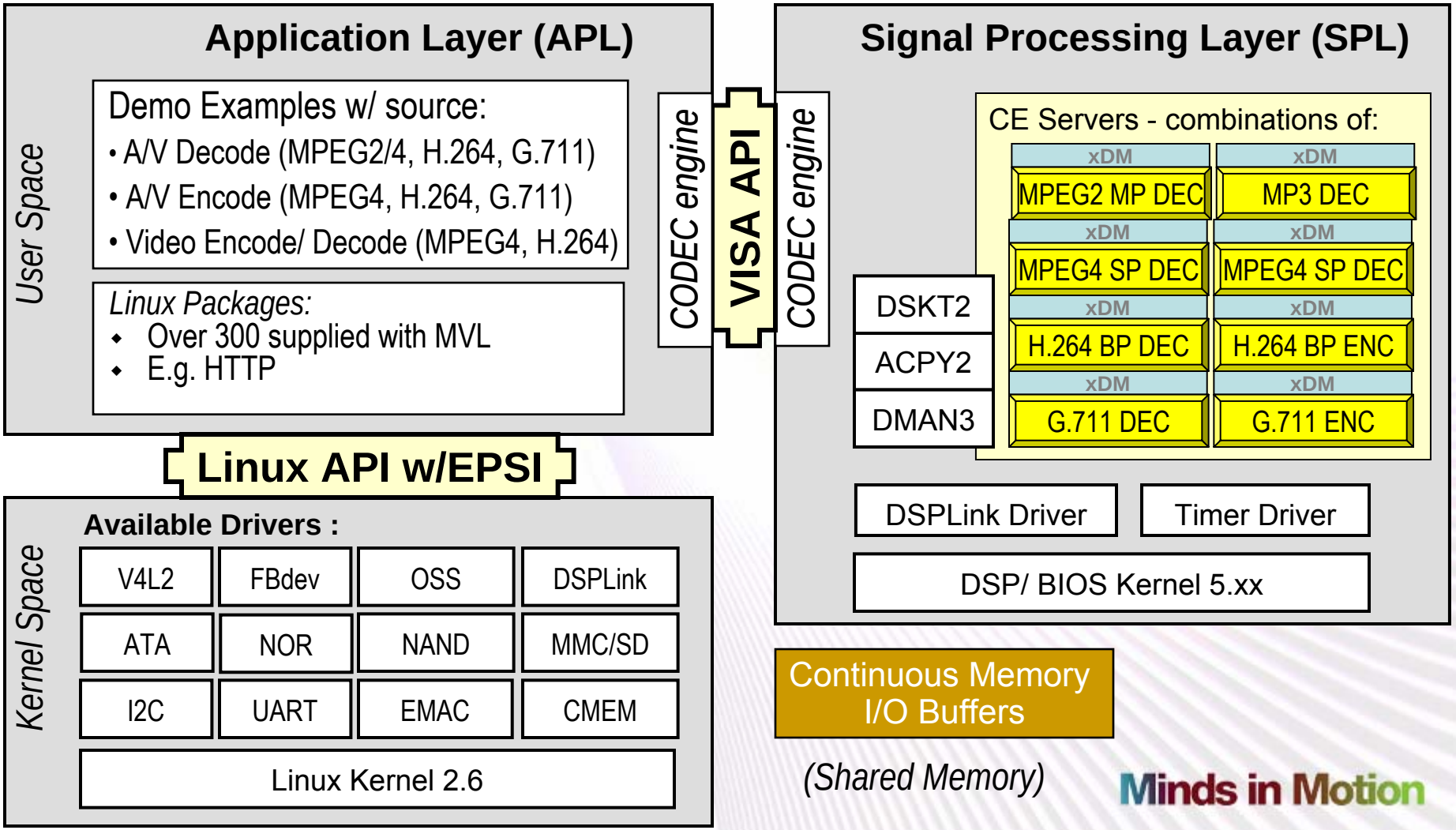
DVSDK Software Framework



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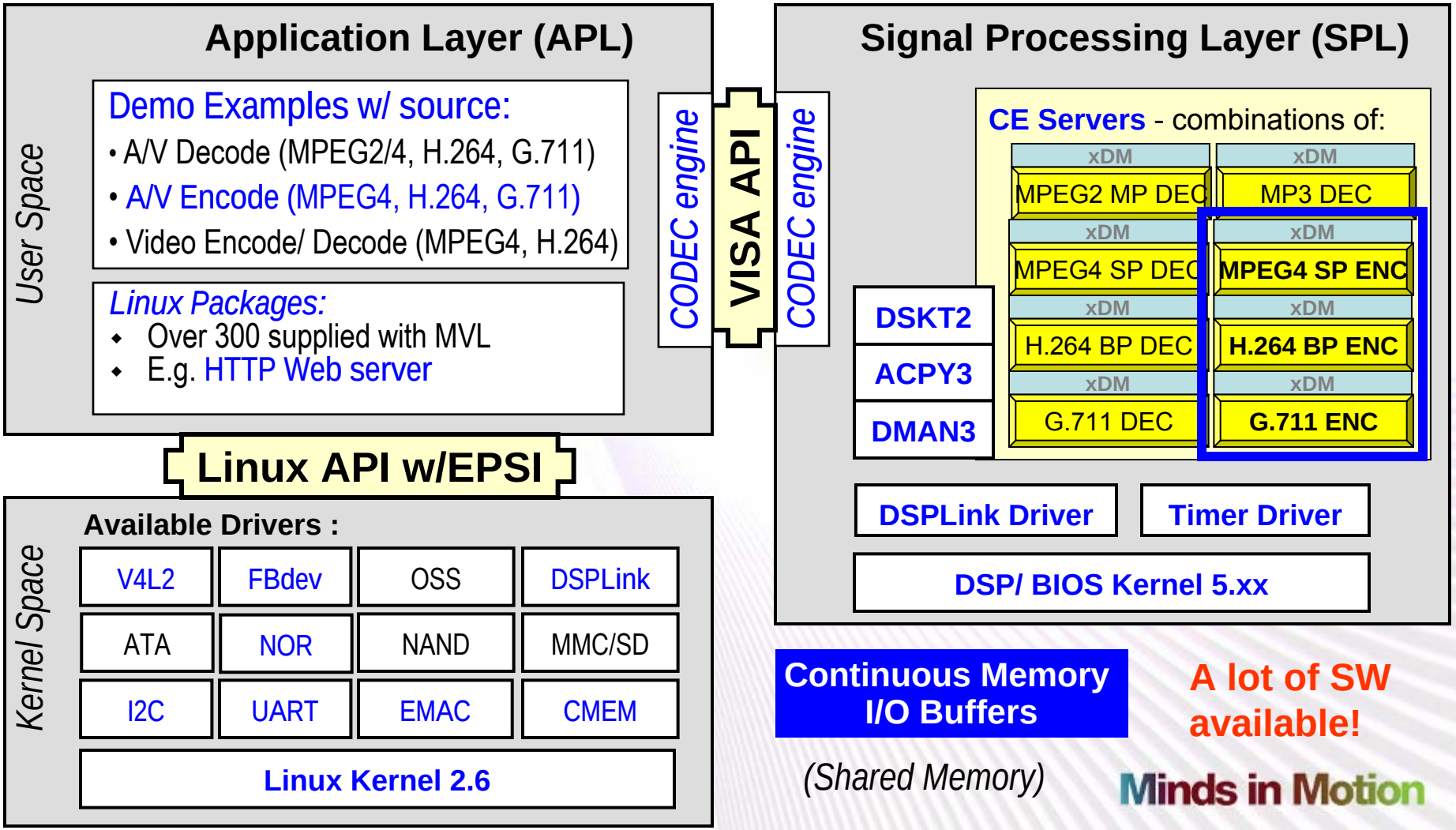
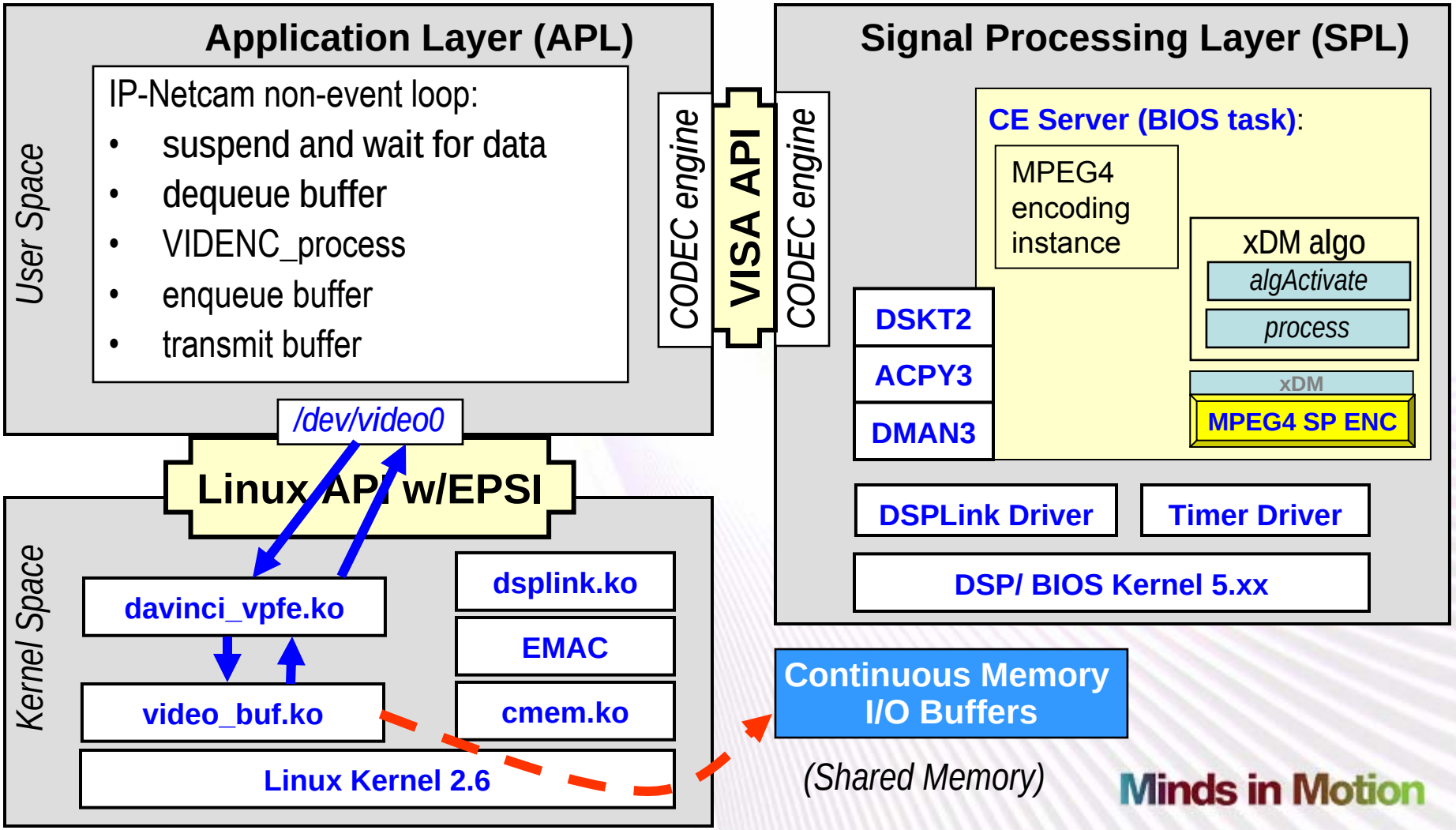
Software Needed in Prototype (blue)



Calling Sequence – Capture



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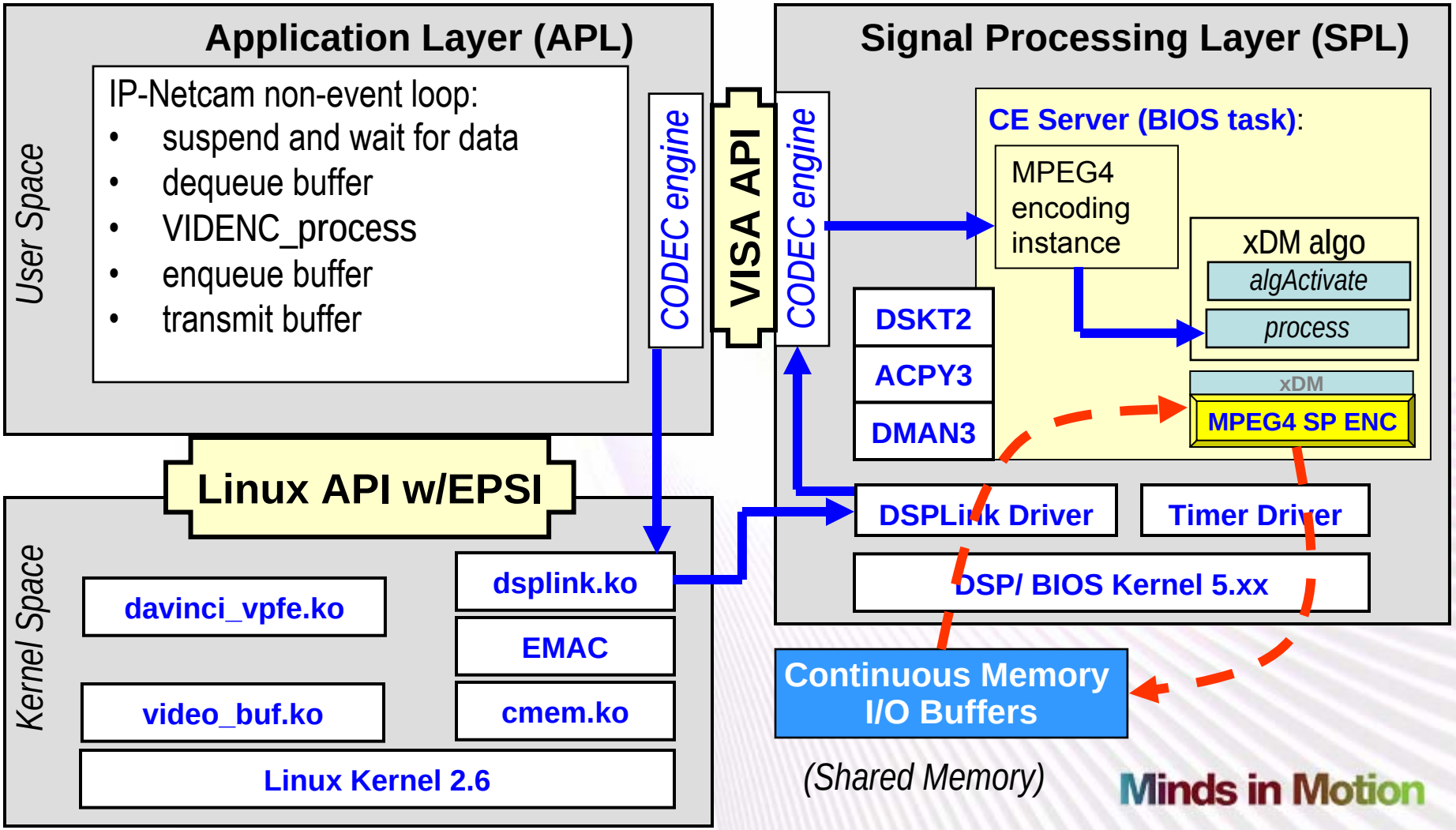
Calling Sequence – Encode



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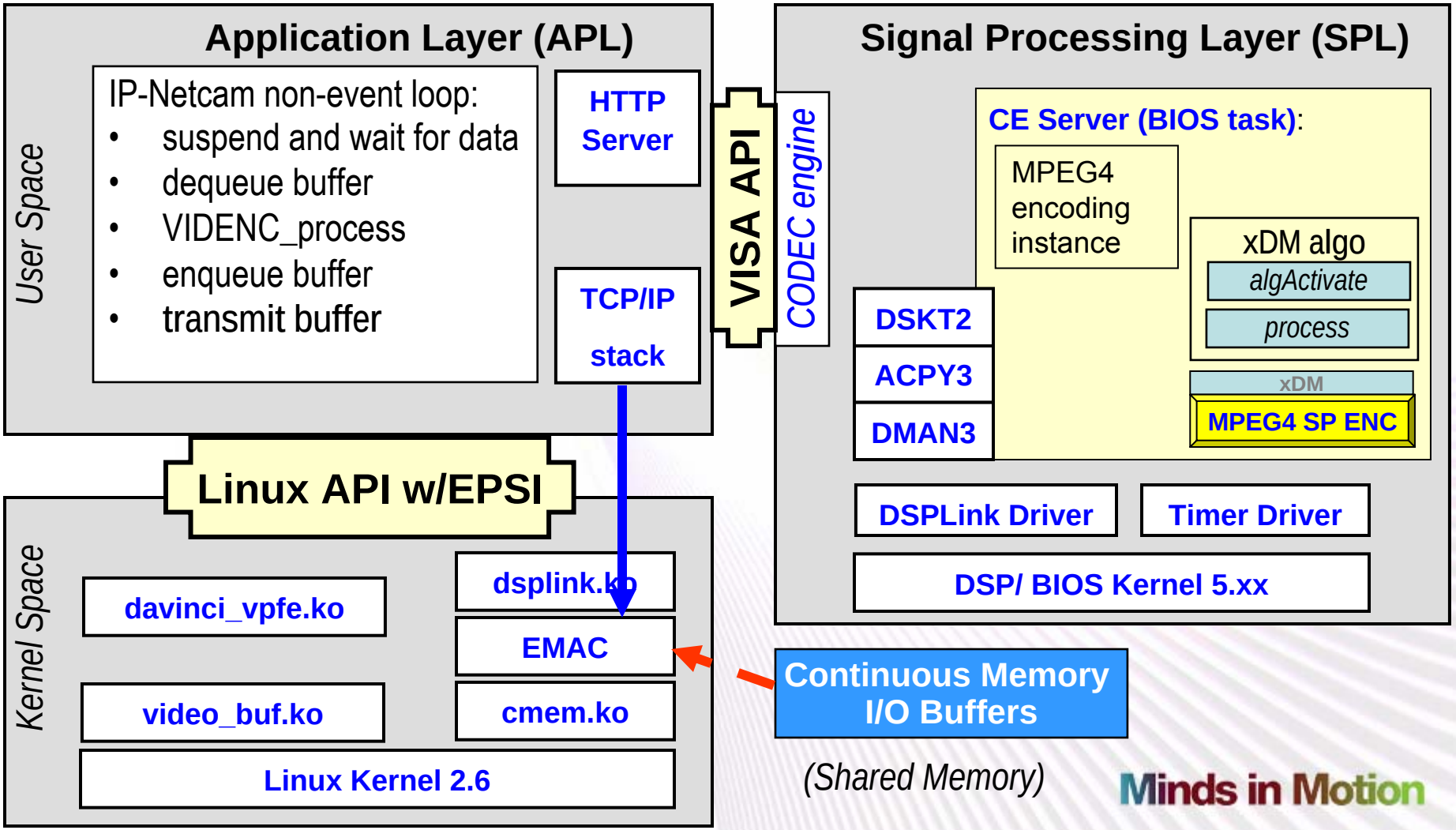
Calling Sequence – Transmit



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Putting It All Together

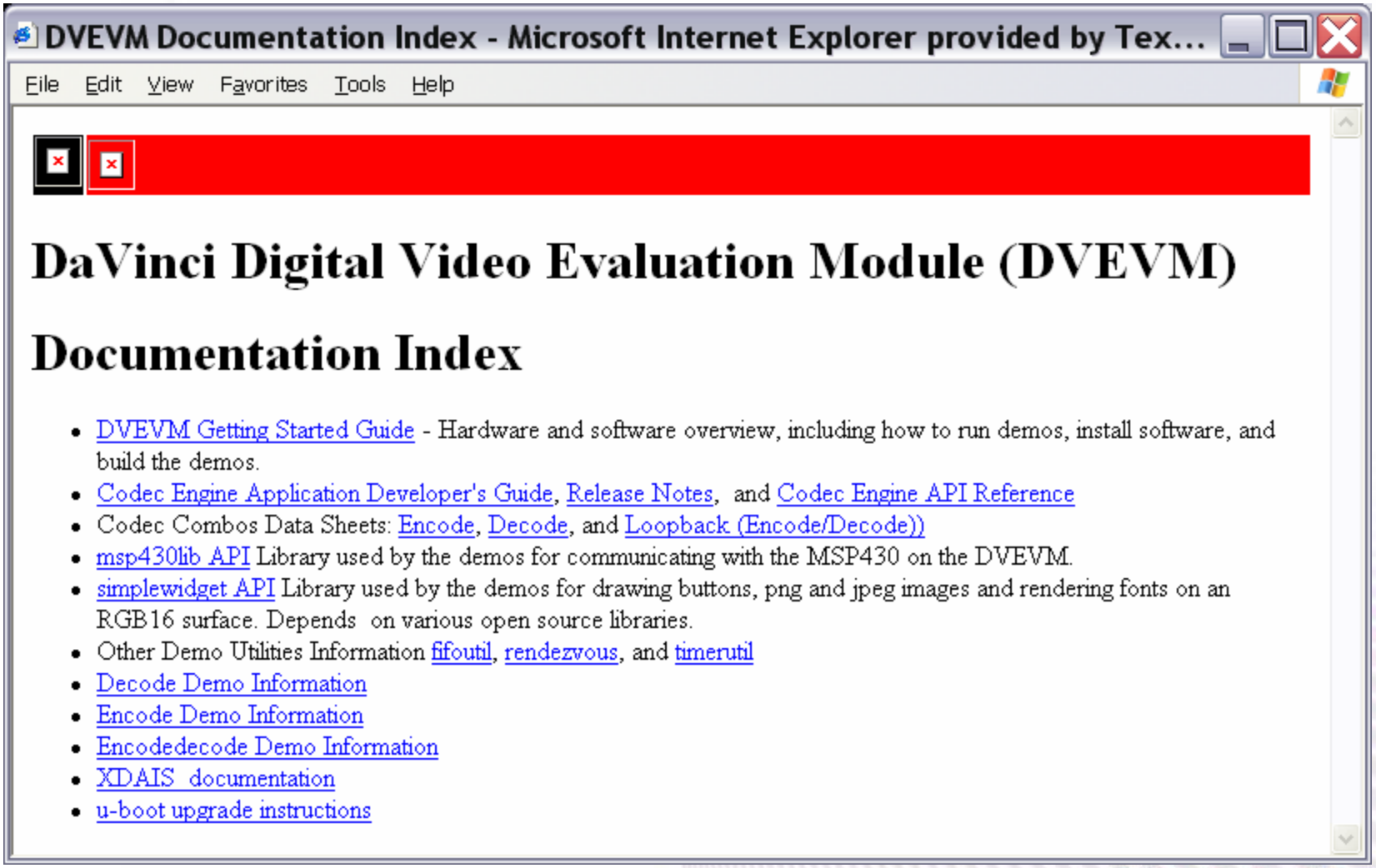
- The DVSDK encode demo source code is explained in detail in SPRAA96.
- Once you are satisfied with the application, it can be inserted in the file system. The boot-loader, Linux kernel and file system can be flashed to the built-in NOR or NAND flash on the DVEVM.
- How to do this for a minimum system with just an HTTP server is described in SPRAAH2 application note.
- These app notes can be found at the DM6446 folder at http://focus.ti.com/docs/prod/folders/print/tms320dm6446.html or by searching www.ti.com using the codes.

IP-Netcam Rapid Prototyping DVSDK Usage Tips

- Save development tool set-up time using *Getting Started Guides*
- Quick access to documentation is via *dvevmindex.html* and *dvsdkindex.html* under ~/dvevm_1_10
- Check out encode demo source to see how to use V4L2 driver to capture video under ~/dvevm_1_10/demos
- Copy kernel source to your workspace first before make xconfig and rebuild kernel
- Use a copy of the MVL arm file system for modifying or adding content for your target file system
- Install tools under /opt (default)
- Register your DVEVM so you can access www.ti.com/dvevmupdates
- Subscribe to davinci linux open source list at

http://linux.davincidsp.com/mailman/listinfo/davinci-linux-open-source

Links to DVEVM/ DVSDK Documentation

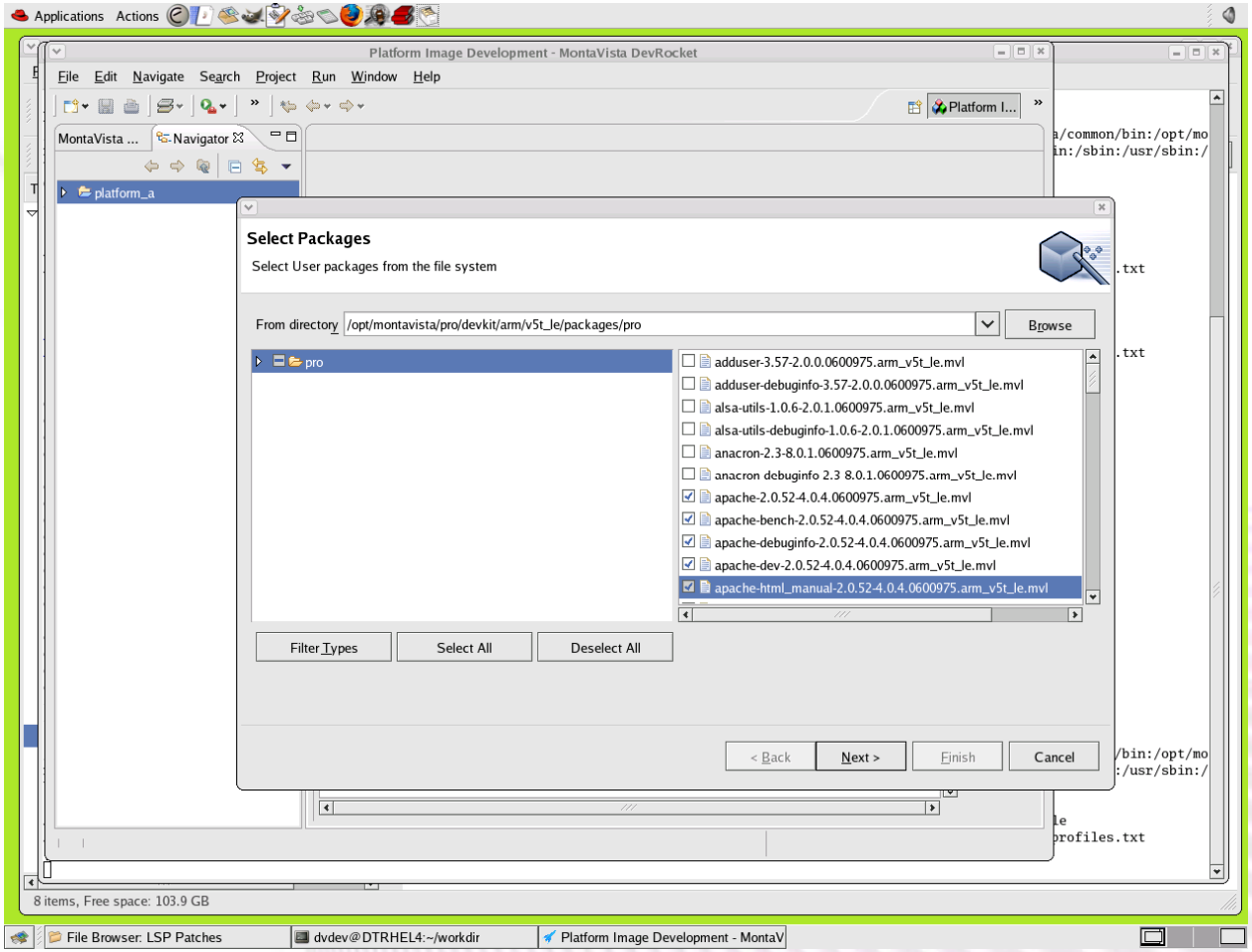


DevRocket can simplify Platform Building process

Main Features:

-Eclipse-based IDE
- Version control (CVS)
- Uses gdb, kgdb
- Supports kernel building
- “ platform building
- Assess system timing, usage, latency, etc.
- Target control tools

Great way to manage >300 packages in MVLinux distro E.g.add Apache HTTP server to your target file system by selecting it from the list of packages



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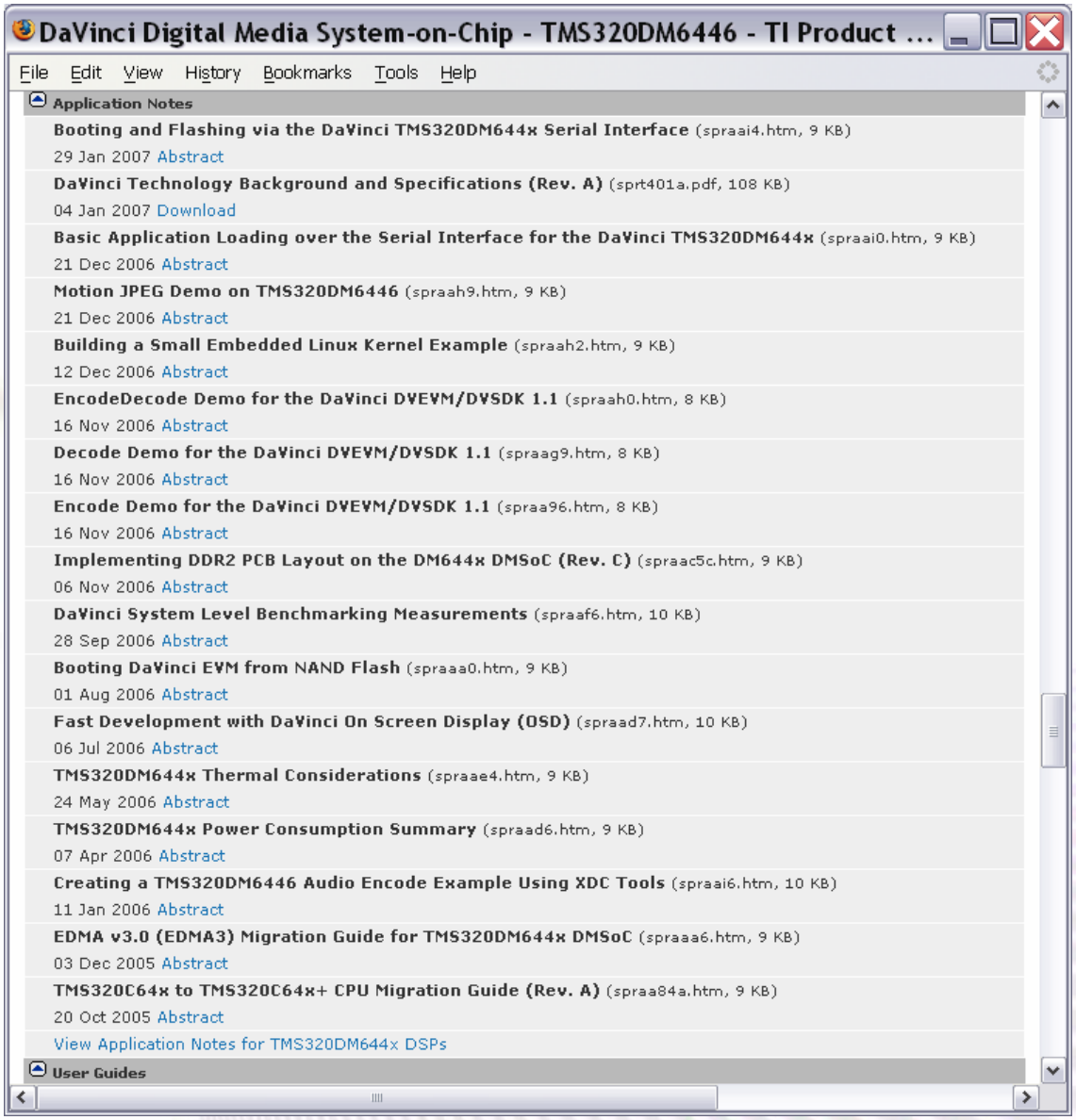
Summary

- DVEVM kit contains all necessary hardware to create a IP-Netcam prototype
- Available Linux drivers, open-source Linux packages and encode Codec Engine server from DVSDK can be used to create basic IP-Netcam software framework or base platform
- This H/W & S/W prototype can help jump start the development process to leave more time to add further enhancements, optimization and testing to create a real product. That's the *DaVinci effect*!

The Next Steps:

- Take advantage of DaVinci™ DM644x DVEVM and DVSDK rich set of features to rapid prototype your product concepts. DVEVM information is at http://focus.ti.com/docs/toolsw/folders/print/tmdxevm6446.html
- Jump start your team with TTO DaVinci™ workshop more info is at http://focus.ti.com/docs/training/traininghomepage.jhtml
- Contact your local TI office for a free evaluation of TI DaVinci™ VISA codecs or find out more at http://www.go-dsp.com/forms/TIDigitalMediaSWCM/index.htm
- In addition, DaVinci™ network of Authorized Software Providers (ASPs) and TI DSP third parties can provide customized assistance to shorten your design cycle time.

List of Currently Available DM644x Application Notes:



@ http://focus.ti.com/docs/prod/folders/print/tms320dm6446.html

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“Ready-to-Go” Solution

Web Viewer Application with GUI

H.264, MPEG4, JPEG, G.7xx

Object Video Content Analytics

Codec Engine
DSP/BIOS™ Link
DSP/BIOS™

MontaVista Linux

Firmware & Drivers

Production Ready Hardware

DAVINCI
TEXAS INSTRUMENTS

- **Rapid market entry**
- **Optimized BOM**
- **eInfochips Support Team**

ObjectVideo OnBoard
INTELLIGENT VIDEO

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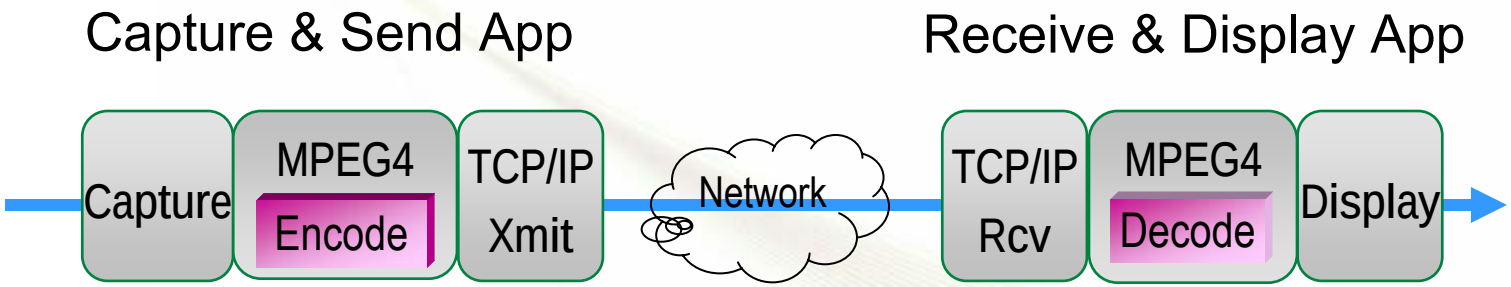
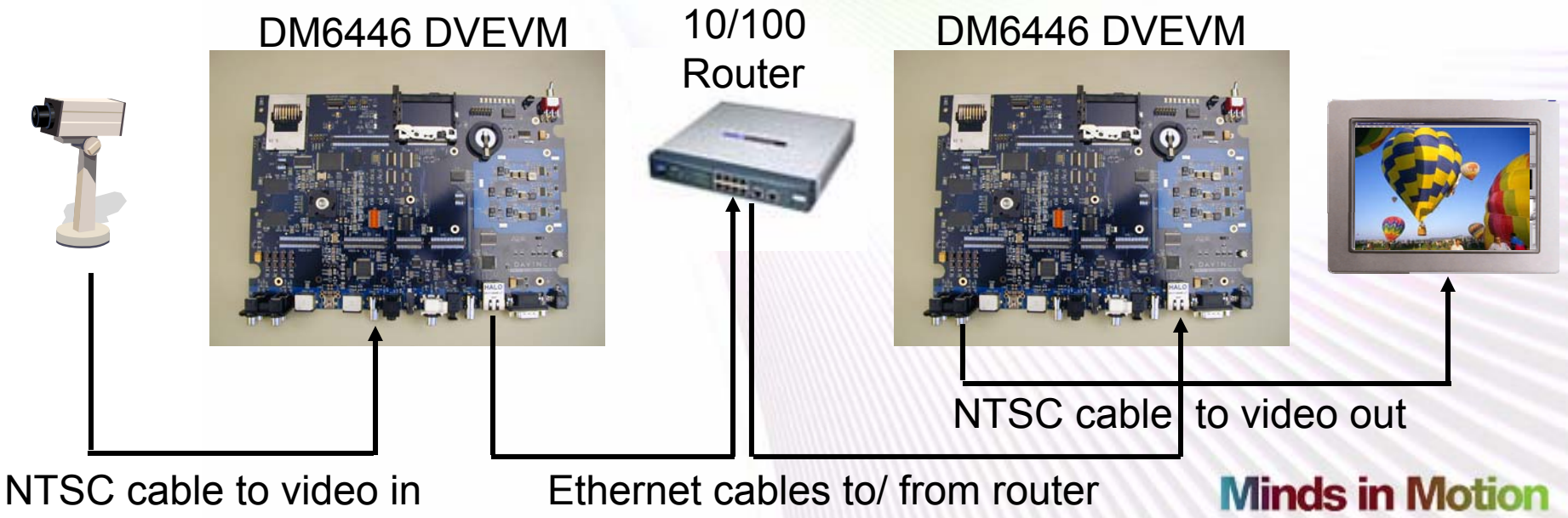
Hands-on Demos

- TCP/IP Client/ Server IP Netcam Demo
  - The DaVinci™ DVEVM is used in a configuration where it captures analog video, compress in MPEG4 format and stream via TCP/ IP to another DVEVM which decompresses the video for display (CCTV model)
- MJPEG Demo
  - The DaVinci™ DVEVM runs an Apache HTTP server to stream JPEG images. User can view captured video live via any Web Browser

Digital CCTV via TCP/ IP IP-Netcam Demo





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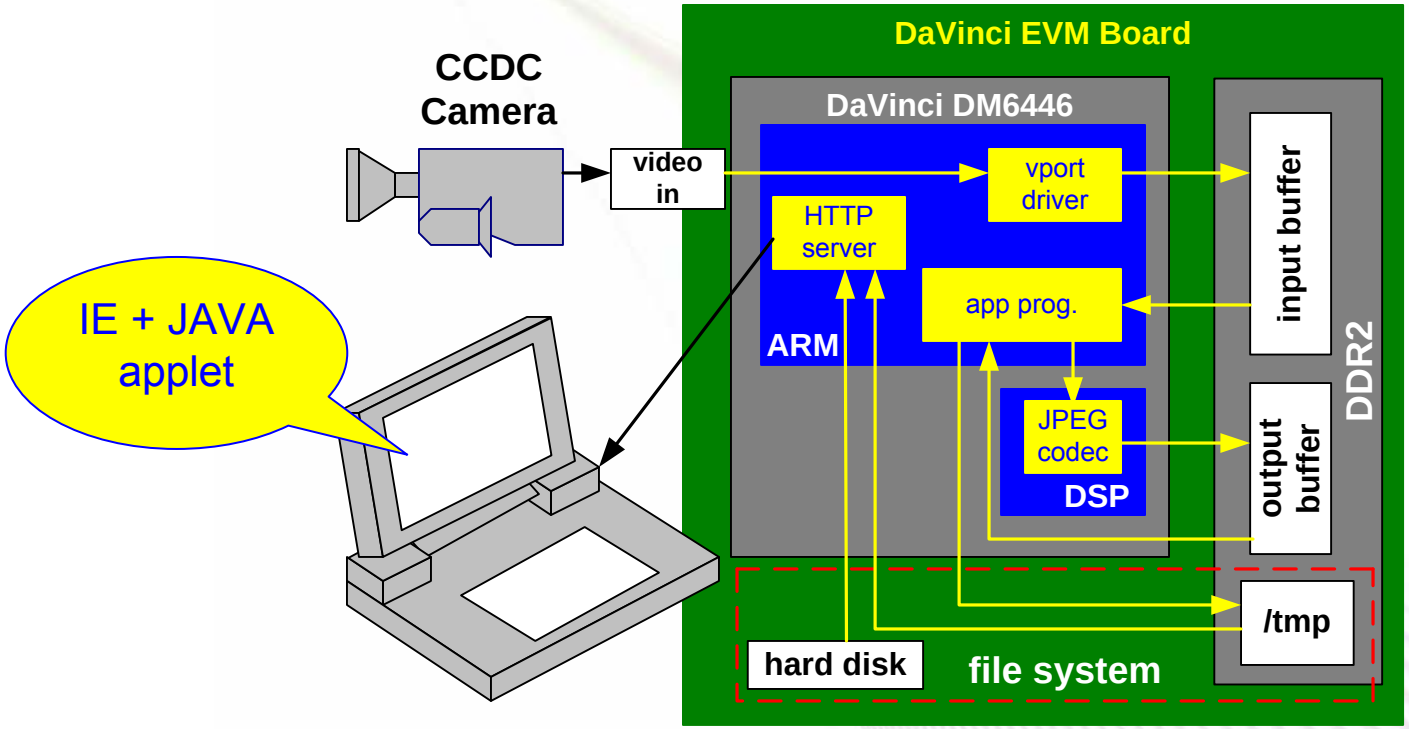
MJPEG Demo



Note: this demo is available as app note SPRAAH9

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Q&A