



Essential Concepts of Complex SOC Design for products like OMAP and DaVinci

Dr. Karl Zhao – DigiLink Software
President & CEO



Brad Lane – Texas Instruments
West Area Digital Applications Manager





DaVinci & OMAP SOC “System on a chip”

- **DaVinci & OMAP truly integrate an entire embedded “system” into a single device.**
 - ARM, DSP, USB, Video ports
- **This integration offers huge benefits:**
 - **System Cost**
 - **Power**
 - **Form Factor**
 - **Performance**



Highly integrated
SOCs enable
leading edge
products



MSP430 vs. OMAP/DaVinci

**So why are OMAP/DaVinci
“different”?**

Answer: Complexity

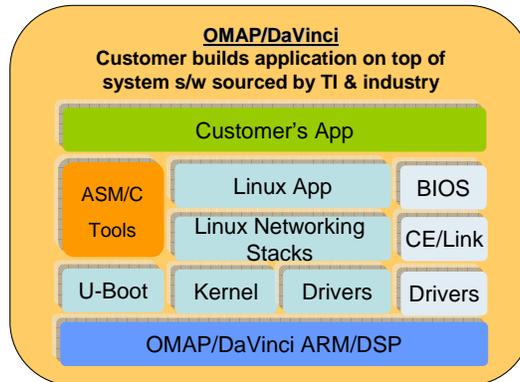
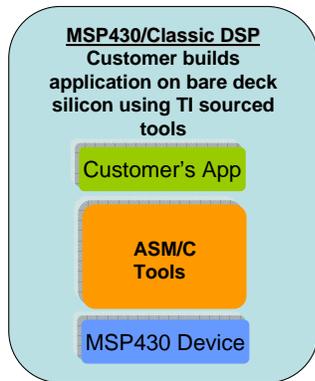
Question:

Have you fully accounted for how this dramatically increased integration (and resulting complexity) affects your design methodology and the support models of your suppliers?



So, how can you develop successfully with OMAP/DaVinci?

By using a combination of industry standard and proprietary s/w components, TI enables customers to start their development at the “application level” vs.. starting with the bare deck device.





Agenda

Concepts of Complex SOC Design

- **Dissection of S/W Architectures**
- **TI Software Deliverables and Support paths**
 - Linux and OS options
 - Codecs
- **System Frameworks and Applications**
 - Flash, AV sync, GUI's Graphics 
- **Best Practices - Conclusion**

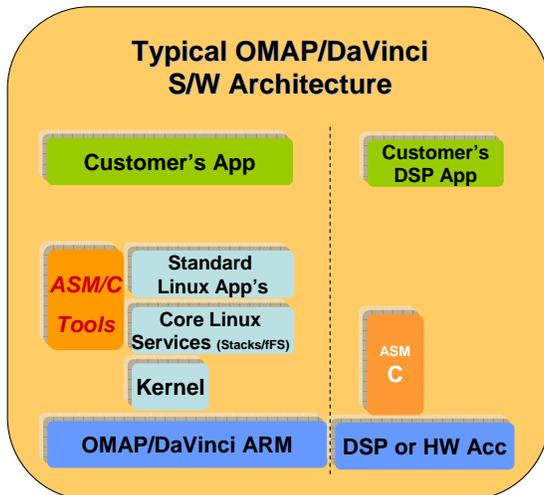


Part 1: Dissection of S/W Architectures



Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



OSs: Linux/WinCE/other

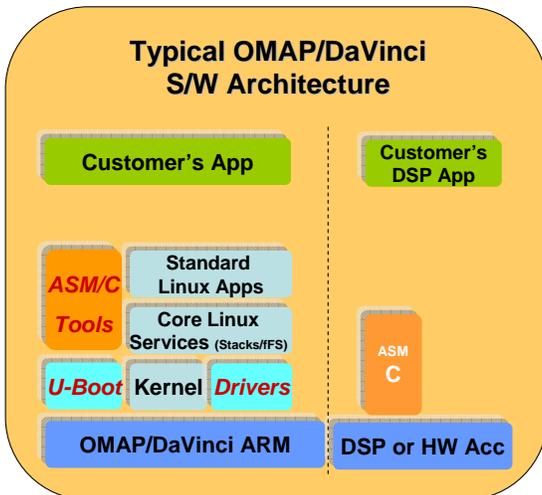
OS's offer customers a "standard" interface to extract useful work from a processor. TI helps establish OS ports and may distribute OS kernels (Linux) as part of our development platforms. However, TI does not have any ownership in creating, maintaining or supporting the core OS components. There are commercial and open source OS options available on OMAP/DaVinci. OS's support many useful services and applications from it's ecosystem.

 = Industry Standard OS S/W Component



Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



OS PSP Package (DvSDK):

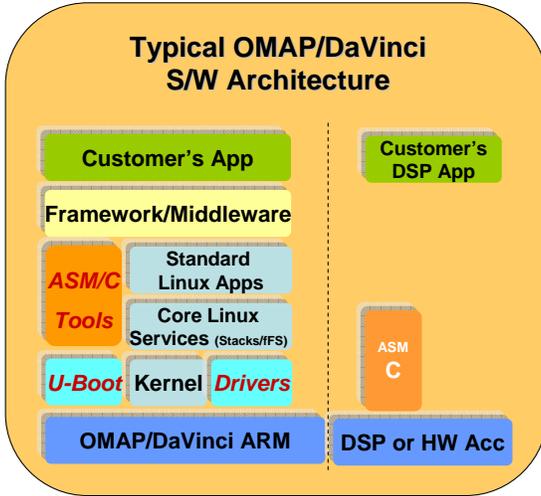
OS's are created in a generic way so they are not bound to any specific processor. In order to use an OS for any specific device, like OMAP or DaVinci someone must port a device specific PSP/LSP s/w package. This work may be completed by TI, the OS vendor, a 3P, the Open Source community or the customer. This s/w is what connects the OS to the h/w and will regulate the functionality and performance of the system.

- = Industry Standard OS S/W Component
- = PSP/BSP Package: multiple sources



Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



Frameworks/Middleware

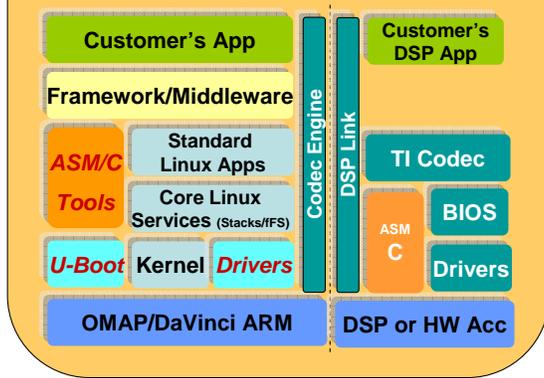
These are application specific s/w packages that use the underlying services enabled by the OS, that enable targeted functionality: MythTV, AVME, browsers (ANT), DRM, VOIP, QT, Flash. There is a large and growing number of these packages from commercial and open source entities. For targeted EE, TI may provide demo or production ready solutions.

- = Industry Standard OS S/W Component
- = PSP Package: multiple sources
- = Frameworks/Middleware: multiple sources



Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



DaVinci S/W Components

TI provides customers with a standardized s/w method to accelerate applications with our DSP & H/W co-processors. This includes our DSP-specific OS (BIOS), drivers, and the Codec Engine Framework. TI also provides optimized A/V codecs for common applications.

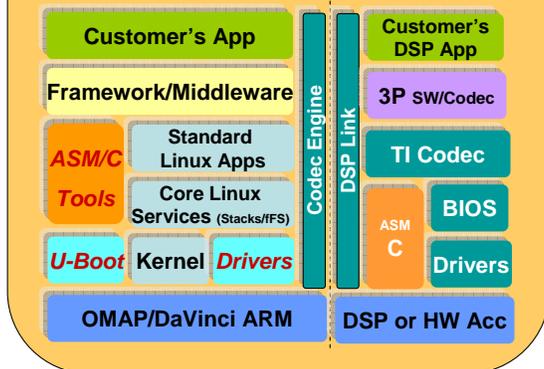
- = Industry Standard OS S/W Component
- = PSP Package: multiple sources
- = Frameworks/Middleware: multiple sources
- = DaVinci S/W components : come from TI





Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



3P DSP S/W Components

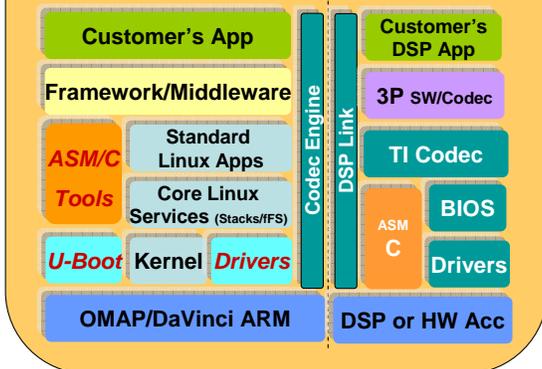
TI has a large DSP s/w 3P ecosystem with optimized s/w for many different applications: (A/V codecs, AEC, analytics, VOIP, audio effects, image processing). In many cases this s/w is what differentiates our customers products and wins TI the socket.

- = Industry Standard OS S/W Component
- = PSP Package: multiple sources
- = Frameworks/Middleware: multiple sources
- = DaVinci S/W components : come from TI
- = 3P DSP S/W components : multiple sources



Dissection of S/W Architectures

Typical OMAP/DaVinci S/W Architecture



Customers Application

Ultimately you, the customer, is responsible for integrating this complex matrix of s/w components. As you can imagine the challenges in debugging s/w problems in these types of systems are very high.

- = Industry Standard OS S/W Component
- = PSP Package: multiple sources
- = Frameworks/Middleware: multiple sources
- = DaVinci S/W components : come from TI
- = 3P DSP S/W components : multiple sources
- = Customer App : customer





Part 2: TI codecs, OS, S/W collateral and support models on OMAP and DaVinci

What should you expect from TI.



Codec Bundles Available on eStore

www.ti-estore.com - click on DSP – Embedded Software
or www.ti.com/codecbundles

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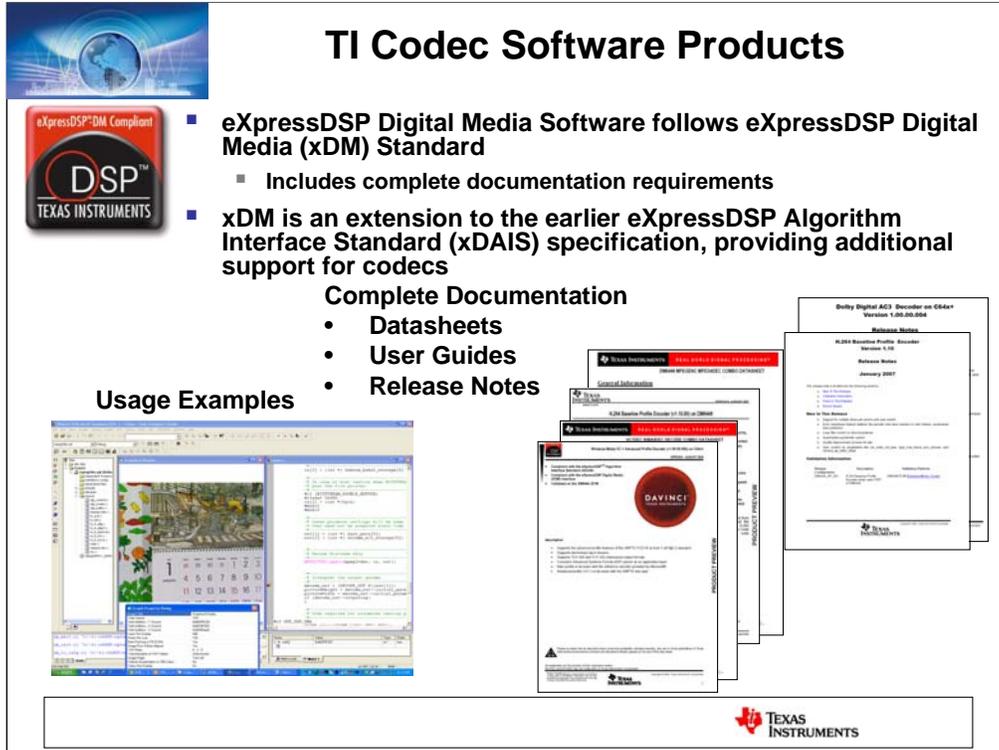
DSP: Embedded Software

Code	Name	Price	Availability	
DM355SBAUDIO1P	DM355S Codec Bundle AUDIO - PRODUCTION (MP3, WMA, AAC LC, AEC)	\$10,000.00	FREE with Discount Code	Add to Basket
DM643XBB01P	DM643x Codec Bundle BASIC - PRODUCTION (H.264, MPEG-4, MPEG-2, JPEG, G.711, NDK)	\$20,000.00	FREE with Discount Code	Add to Basket
DM644XBB01P	DM644x Codec Bundle BASIC - PRODUCTION (MPEG-4, MPEG-2, JPEG, G.711)	\$20,000.00	FREE with Discount Code	Add to Basket
DM646XBB01P	DM646x Codec Bundle BASIC - PRODUCTION (H.264, MPEG-2, JPEG, G.711)	\$20,000.00	FREE with Discount Code	Add to Basket
DM648BB01P	DM647/8 Codec Bundle BASIC - PRODUCTION (H.264, MPEG-4, G.711, NDK)	\$20,000.00	FREE with Discount Code	Add to Basket
TMD5NDK	Network Developer's Kit (NDK) TCP/IP Stack	\$5,000.00	In Stock	Add to Basket

NOW AVAILABLE! – Get started today with FREE* production-ready, easy-to-use audio and video codec bundles for digital media processors based on DaVinci™ technology. Bundles include NDK, G.711, JPEG, MPEG-2, H.264 BP and MPEG-4 SP codecs.

* Production license fee will be waived if customer accepts electronic production click-wrap license and receives software via download from TI.





TI Codec Software Products

eXpressDSP Digital Media Software follows eXpressDSP Digital Media (xDM) Standard

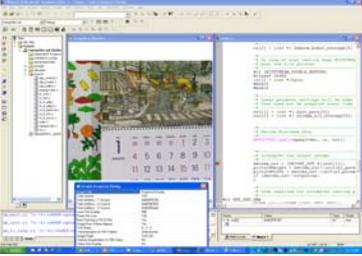
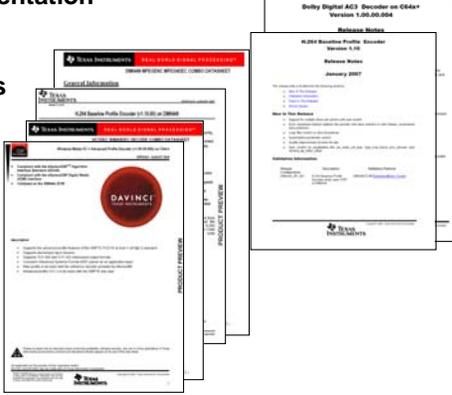
- Includes complete documentation requirements

xDM is an extension to the earlier eXpressDSP Algorithm Interface Standard (xDAIS) specification, providing additional support for codecs

Complete Documentation

- Datasheets
- User Guides
- Release Notes

Usage Examples

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eXpressDSP digital media software is xDM compliant

Another important component to software as a product is complete documentation, which we have specified as a requirement for every algorithm sold through this program.

Preliminary datasheets and user guides are available, but can only be shared with customers under NDA.



Popular Operating System Options

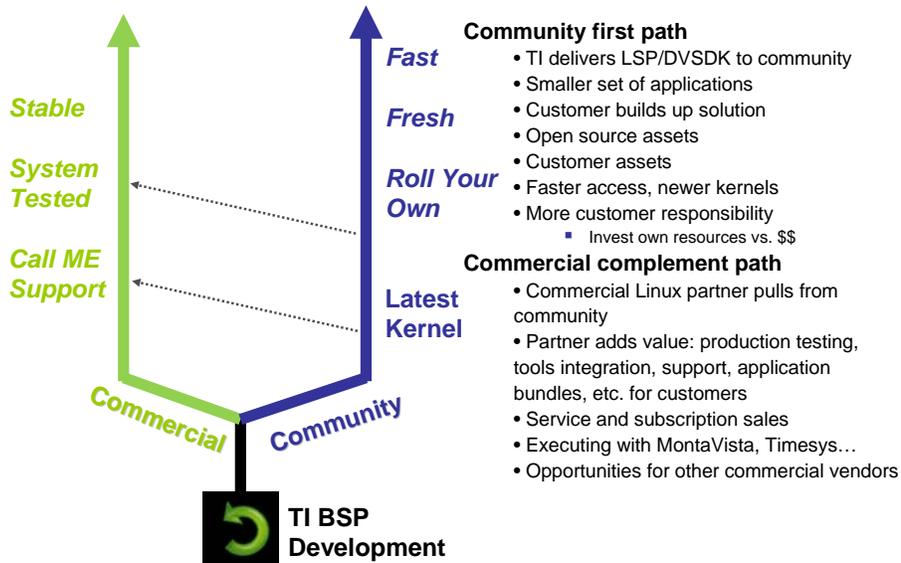
Tool / Top features	OS	Device Support	Key Features
	DSPBIOS	DaVinci™, OMAP™, C6000™, C5000™, C2000™	<ul style="list-style-type: none"> ▪ IDE and royalty free DSPBIOS ▪ Low level debug of ARM ▪ DSP development and Debug ▪ Co-debug of ARM & DSP
	Linux	DM644x, DM6467, DM335, DM355	<ul style="list-style-type: none"> ▪ stable, pre-tested, supportable code base ▪ Production licensing through TI ▪ Indemnification
	Integrity Linux	DM644x, OMAP35x	<ul style="list-style-type: none"> ▪ MULTI debug environment for DSP and ARM
	Linux	DM644x, DM6447, DM3x, OMAP35x	<ul style="list-style-type: none"> ▪ GNU Toolchain
	Linux	OMAP35x, DM6467 and DM644x (coming soon)	<ul style="list-style-type: none"> ▪ web-based software subscription ▪ An initial Linux platform, pre-compiled for the processor ▪ Customize-able Eclipse-based IDE
	WinCE	OMAP35x	Extensive experience and expertise with WinCE development WinCE 6 BSP
	WinCE	DaVinci	



- Here is a one page summary of our current OS offering and map to the processors.
- This is not a complete list of all the embedded OS vendors that are working with TI today as many are in the process of implementing their ports based on investment and customer demand.
- You have a couple of options for Linux including not shown here and Open Source Linux following that was kicked off in June.
- See me afterward to discuss Open Source.



TI processor customers can CHOOSE your Linux path: Community or Commercial





Good References

Greg Kroah Hartman on kernel development

- <http://www.youtube.com/watch?v=L2SED6sewRw>

Cost of Deployment Models

- See: “Embedded Linux Total Cost of Development Analyzed”
- At: <http://www.embeddedforecast.com/>

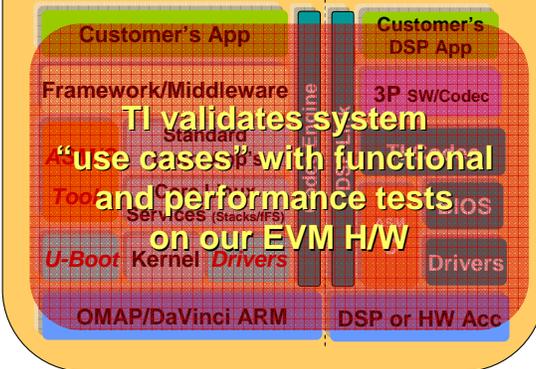
DaVinci™ technology & OMAP™ platform community resources

- wiki: <http://wiki.davincisp.com/> or <http://wiki.omap.com/>
- Wiki documents mailing list, git repositories, etc



Use Cases and the "Tool Chain Reaction"

Typical OMAP/DaVinci S/W Architecture



Use Cases

A use case defines the specific h/w and s/w configuration TI used to test the functionality of the PSP s/w on the EVM. Customers should be able to reproduce similar results from the PSP.

If customers deviate from either the TI tool chain or the tested modes of functionality TI will be able to provide very limited support.

Make sure you review TI's supported PSP use cases





Appendix from Linux Driver Data Sheet

Texas Instruments DM644x/DM355

- 1.1 Device Drivers Summary
- 1.2 Limitations Summary
- 1.3 Linux Base Port Overview
 - 1.3.1 Toolchain and Version Information
 - 1.3.2 Tested Modes
 - 1.3.3 Timers
- 1.4 LSP/PSP Version Information
- 1.5 Documentation Support
- 2 Linux Kernel Device Drivers
 - 2.2 Video Drivers
 - 2.2.2 Video Display Driver-V4L2
 - 2.2.3 Video Display Driver-FBDev
 - 2.2.4 Video Capture Driver
 - 2.2.5 IPIPE Driver
 - 2.2.6 Previewer Driver
 - 2.2.7 Resizer Driver
 - 2.2.8 H3A Driver
 - 2.3 Audio Driver
 - 2.4 Ethernet Drivers
 - 2.5 USB Drivers
 - 2.6 IDE ATA Driver
 - 2.7 MMC/SD Driver
 - 2.8 NAND Driver
 - 2.9 NOR Driver
 - 2.10 UART Driver
 - 2.11 I2C Driver
 - 2.12 SPI Driver
 - 2.13 PWM Driver
 - 2.14 Watchdog Driver
 - 2.15 GPIO
 - 2.16 EDMA
 - Appendix A – U-Boot Overview



Each Software component/supplier has it's own unique support model

S/W Component	Support Options	Comments
Core OS (Linux, WinCE...)	OS Vendor (MV), Open Source	Monta Vista, Greenhills(Integrity), Mistral, Bsquare, Communities
PSP Package	Supplier of PSP package	TI for Linux DvSDK(PSP) only* Otherwise it's the PSP vendor or OS community
Frameworks Middleware	Suppliers of framework or middleware package	Huge number of options depending on the customers s/w ecosystem.
DaVinci S/W components*	Mainly TI, potentially a 3P*	TI supports issues with DSP tools, BIOS, Codec Engine....
TI Codecs*	TI or ASP (Authorized SW Partner)*	TI direct support limited. Customers may need to contract ASP for support
3P S/W or Codecs	3P	Customers should make sure 3P's are contractually bound to support
Customers App (System integration)	<i>The customer (and everybody involved in the deal.)</i>	Incredibly difficult to isolate system failures. Resolutions are case specific.

*Yellow text indicates what TI directly supports





Do your own research!

- There is no one right choice
- Each project and team has its own needs
- However, many people underestimate what it takes to “DIY”?
 - Make an informed choice
 - Think about what is required for the whole product and product lifecycle
 - Learn from others



Part 3: System Frameworks and Applications Flash, AV sync, GUI's Graphics

**Things above and beyond what TI
provides as standard support
software and chip collateral.**



Conquering the SW Complexity



- **Linux application development and integration**
 - Graphics, enhanced user experience
 - Multiple UI framework: native & flash-based
- **Audio / Video Framework**
 - Adding AV sync and Media container support
 - TI offers only elementary stream codec I/O
- **Expanded video codec offering**
 - Flash video support: Sorenson Spark 3, On2 VP6/7, H.264
 - Proprietary algorithms
- **Custom development services**
 - Porting, optimization, customization on ARM or DSP
- **Key to success is working together**
 - Customer, DigiLink & TI
 - Objective: bringing product quickly to market





DME SW on TI DaVinci/OMAP



- **MapLib**
 - Standard file container support
 - Flash Video (FLV)
 - MPEG-2 Program Stream
 - MPEG-2 Transport Stream
 - MP4 File Format
 - A/V De-muxing & synchronization
- **MspLib**
 - A/V codecs
 - Spark3 decoder
 - VP6 decoder
 - MP3 decoder
 - H.264 encoder/decoder
 - MPEG4 encoder/decoder
 - AAC/LC encoder/decoder
 - JPEG encoder/decoder
 - Advanced video enhancement
- **GuiLib**
 - DirectFB (DFB)-based GUI
 - Adobe FlashLite-based GUI
- **NetLib**
 - Streaming support
 - HTTP
 - RTSP



DME Application Areas



Major Verticals

- Video on Demand
- In-Flight Entertainment
- Automotive Entertainment
- Digital Signage
- Video Surveillance

Consumer Products

- IP-Set Top Box
- Digital Media Adapter
- Portable Media Player
- Smart Phone
- Networked Appliances

Expanded applications based on ARM only DaVinci/OMAP Parts





Case Study 1

Previous Generation

- Analog solution
- Simple user interface
- Standalone
- Hard to upgrade
- Hard to maintain
- Product only

Next Generation

- Digital solution
- Rich media experience
- Networked
- Easy to upgrade
- Easy to maintain
- Service platform

DigiLink

- Digital media player software license (MapLib)
- Displayer manager (GuiLib)
- Firmware development service
- Full customer development & integration
- On-going maintenance and support





Case Study 2

Previous Generation

- Old compression
- Simple user interface
- Hard to integrate
- Hard to upgrade
- Hard to maintain

Next Generation

- Advanced compression
- Rich media experience
- Easy to integrate
- Easy to upgrade
- Easy to maintain

DigiLink

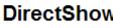
- End-to-end streaming media software license (MapLib & NetLib)
- Displayer manager (GuiLib)
- Firmware development service
- On-going maintenance and support





Part 4: Best Practices and Conclusions

TI Developer Network - Software

System Integrators	
 	    
Browser, GUI, Flash & Media Player	
   	    
AV Frameworks <i>(including proprietary)</i>	
 	  
ARM Codecs, Libraries & Software Modules	
     	Drivers & Connectivity
Operating Systems	
     	CardAccess
DSP Codecs, Algorithms, Libraries & Software Modules	
      	TEXAS INSTRUMENTS

Baseport – Code Compatible

Bridge

 Bridge is ported alpha 9/30

 IVA shuttle is eliminated by Helios4

IVA Codecs to be ported

DSP Codecs move to IVA2

Graphics Code Compatible

Theia Code Compatible



Best Practices

- **Fully understand your S/W architecture before selecting your h/w or engaging in any s/w licensing contracts.**
 - Have detailed use cases documented for all peripherals, codecs and GUIs!
 - Test codecs before you license them! (*especially TI codecs*)
 - Have clear compliance testing specifications outlined for all major s/w components, especially ones you are outsourcing.
 - What OS makes the most sense? (Cost, boot time, security, framework..)
 - What codec do you really need? Where is your content coming from?

- **Be realistic about s/w integration complexity, scope of internal expertise, and development schedules.**
 - Cost of Third Party s/w and support may be justified.
 - The best solution might be to engage with multiple third parties.

- **Get some training**
 - Take TI's 4-Day classes – DaVinci Workshop, C6x Code Opt workshop...
 - Industry training (Bsquared, Free Electrons...)

- **Plan ahead - what if things don't work - the development schedule slips?**
 - Have clearly outlined support terms in place with all your s/w providers.
 - Have clauses in place to extend support beyond initial support period!
 - What if you have field failures with a 3P s/w codec 2 years from now?

Ultimately system integration is owned by you “the customer”



Who moved my cheese?

- DaVinci & OMAP truly integrate an entire embedded “system” into a single device.
 - ARM, DSP, USB, Video ports
- This integration offers huge benefits:
 - System Cost
 - Power
 - Form Factor
 - Performance
- This integration also introduces new challenges:
 - *The key to successful product development is to fully understand your S/W architecture and have a bullet proof s/w integration plan.*





Thank You