Must Provide a Solution on a Chip – from concept to delivery

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From Concept to Delivery…

Driving The Digital Lifestyle

'Zoran' is the Hebrew word for 'Silicon'

'Zoran' in Chinese means 'Excellence'

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Connect, Share, Entertain™ – Anywhere & Anytime
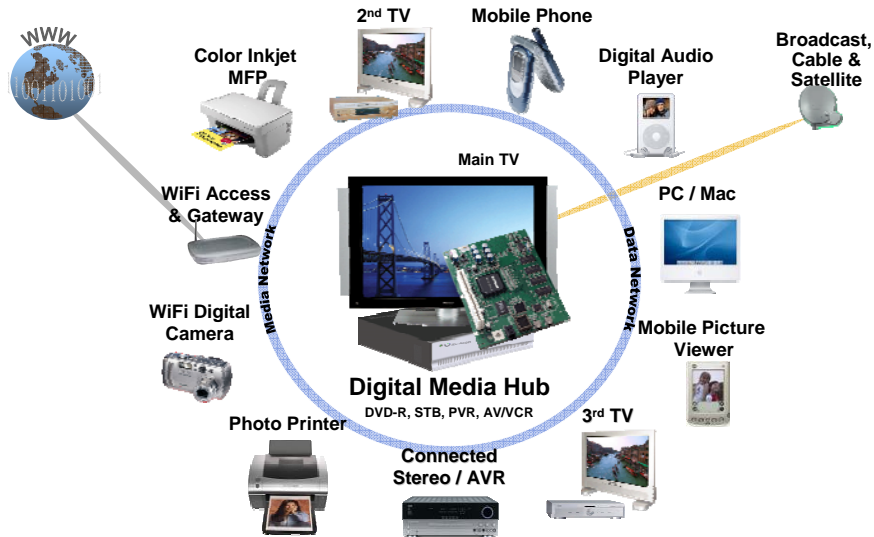
Digital Entertainment Markets
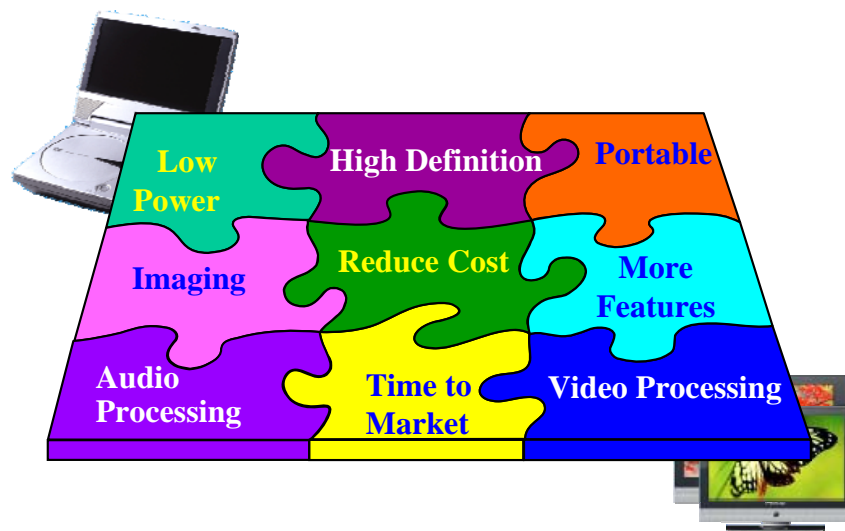
Low Power — High Definition — Portable

Imaging — Reduce Cost — More Features

Audio Processing — Time to Market — Video Processing

Zoran Provides a Complete Solution

- ► Need a "Solution-on-a-Chip"
  - ► Rich in features (but low cost)
  - ► Full software stack
    - ► *Low level drivers*
    - ► *Many applications*
  - ► Ready reference design
- ► Adapt to rapidly changing market demands
- ► Reuse & Innovate
  - ► Reuse HW modules
    - ► *Integrate, integrate, integrate*
  - ► Reuse SW modules
    - ► *Multiple various processors*
    - ► *Legacy expertise*
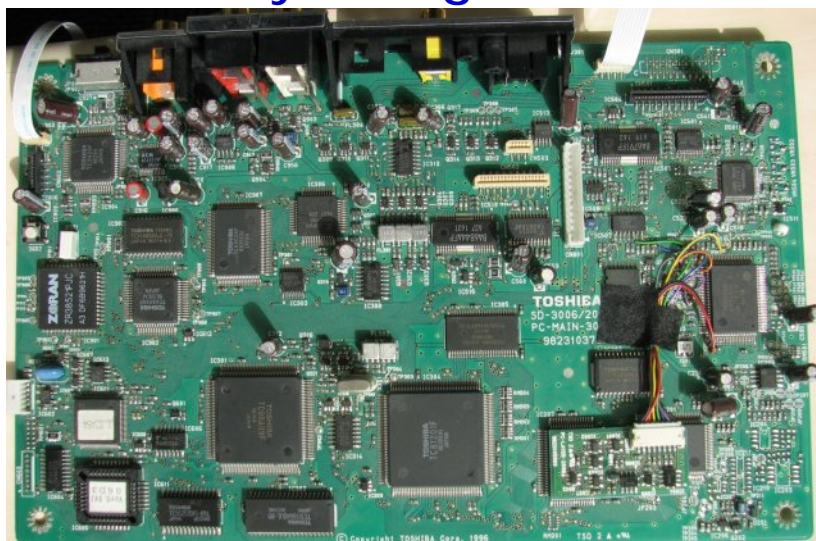 - ► Innovative solutions to new requirements
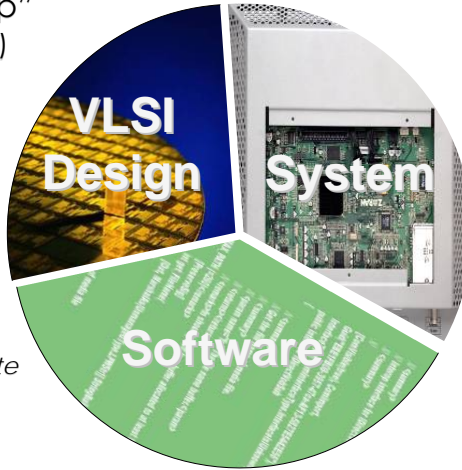
VLSI Design

System

Software

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DVD Player

10 years ago…

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DVD Player

1 year ago...
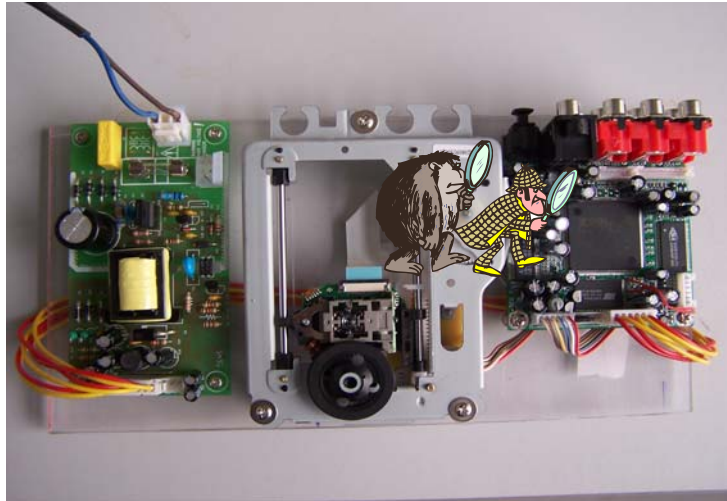
DVD Player Platform Integration
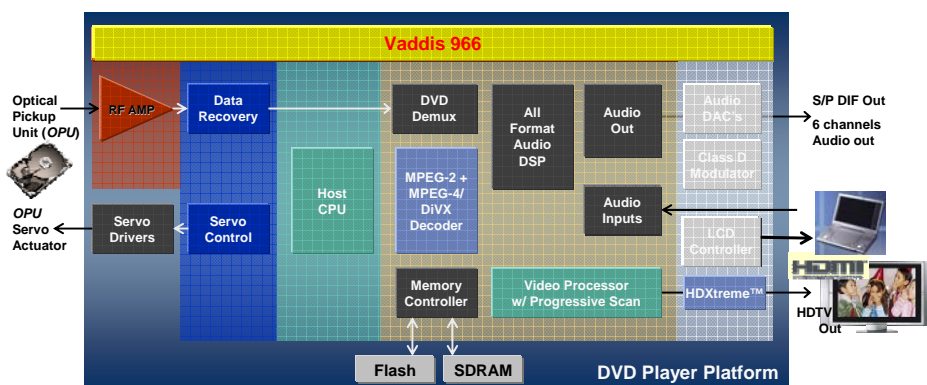
Vaddis 862: First fully digital DVD System Solution

Integrated LCD Controller Requirements

► Various Interfaces
  ► Analog (alternated) **RGB**
  ► Digital
    ► *Serial (RGB,GBR)*
    ► *Parallel 8/18/24 bits*

► Various sizes and resolutions

► Different control signals timing and constraints

► Various pixels arrangements

RGB Stripe   RGB Delta
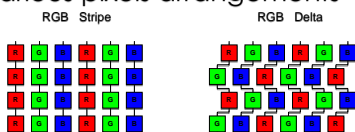
► Image and video processing
  ► Support PAL and NTSC
  ► Enable display modes of 16:9 and 4:3 aspect ratios
  ► Adjust image parameters (brightness, contrast, color, tint)
  ► YUV→RGB conversion (different for MPEG and JPEG)

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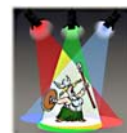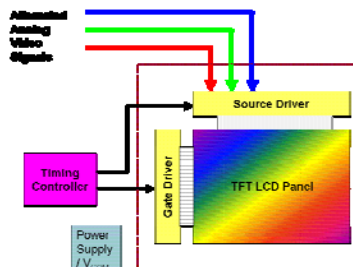
Portable DVD: Previous Solution

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Portable DVD based on Vaddis966L
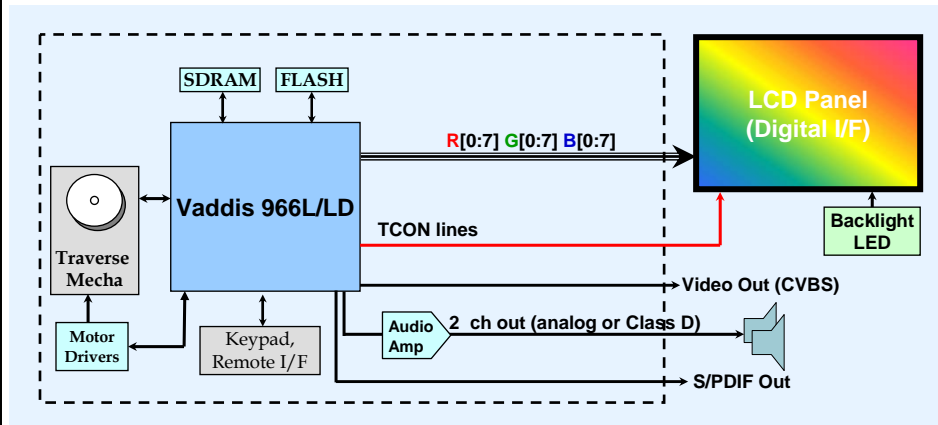
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Integrated LCD Timing Controller

► Programmable
  ► Can generate various timing and control signals

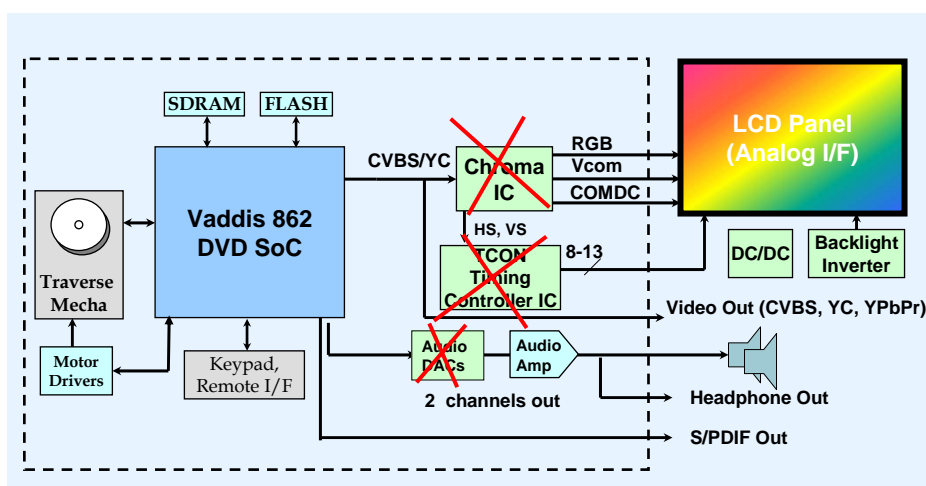|																			
Set12bits	Set STV to 1	0	1	0	0	0	0	0	1	0	0	0	1	1	0	1	0x410D
Set6msb	Set OEV for t1 cycles	0	0	0	0	0	0	1	0	1	21						0x0295
Set6msb	Set CKV for t2 cycles	0	0	0	0	0	0	1	1	1	12						0x038C
Set12bits	Reset OEH & OEV, Set VCOM to 0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0x4082
RepeatSame	Repeat the same for t3 more cycles	1	0	1	7												0xA007
Set6msb	Set OEH for t4 cycles	0	0	0	0	0	0	1	1	0	9						0x0309
Set6msb	Reset CKV for t5 Cycles	0	0	0	0	0	0	1	0	0	35						0x0223
Set12bits	Set STH for 1 (t6) cycle	0	1	0	0	0	0	1	1	1	0	0	0	1	0	0	0x4312
Set12bits	Reset STH	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0x4102
RepeatSame	Repeat the same for t7 more cycles	1	0	1	493												0xA1ED
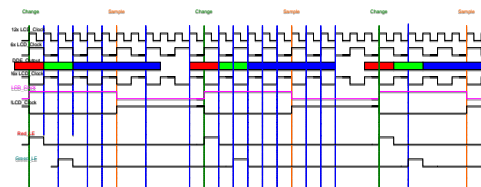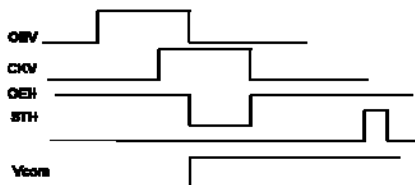
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More Gadgets based on Vaddis966L…

► Car DVD

► Picture Frame

From Portable DVD to High-Definition

► High definition Blu-ray BD-DVD player
  ► x6 resolution of standard definition
  ► New compression standards
  ► Must keep legacy red-laser capabilities
  ► High quality video and audio
  ► Time to market
► Challenges
  ► Designing an Advanced Multi-Standard High Definition Video Decoder
  ► Memory bandwidth allocation
  ► SW development for Massively Parallel System on a Chip
    ► *Performance "hungry" applications*
    ► *Inter-processor communication and synchronization*
    ► *Control many integrated modules*
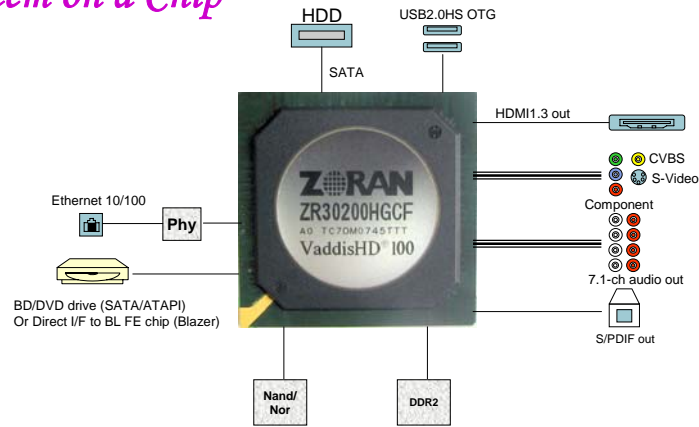   ► *Write software for several processors of various types*

VaddisHD™ 100 Solution

System on a Chip

HDD

USB2.0HS OTG

SATA

HDMI1.3 out

ZORAN
ZR30200HGCF
AD TC7DM0745TTT
VaddisHD 100

CVBS
S-Video
Component

Ethernet 10/100

Phy

7.1-ch audio out

BD/DVD drive (SATA/ATAPI)
Or Direct I/F to BL FE chip (Blazer)

S/PDIF out

Nand/
Nor

DDR2

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VaddisHD™ HW Architecture

MPSoC, remember?!

ATAPI Drive	ATAPI	**Driver / Secure CPU** MIPS, 32 bit, ICache, DCache Secure execution	**Application CPU** MIPS, 32 bit, ICache, DCache MMU

ATAPI Drive — ATAPI

SATA Drive x2 — PHY SATA (2)

External FE chip — Interface to BL FE

Flash Cards — Memory Card Reader/Writer

USB Port x2 — USB 2.0HS (OTG)

SmartCard — SmartCard

Guestbus
I2C
UARTs
SPI

Remote Control — Infra Red Receiver

Ethernet — Ethernet MAC+Phy

Driver / Secure CPU
MIPS, 32 bit, ICache, DCache Secure execution

Application CPU
MIPS, 32 bit, ICache, DCache MMU

DVD DRM Engine
CSS, CPR/PM, VCPS, AACS, BD+

AVZ
Multi Standards Decoder
MPEG-2, H.264, VC-1, MPEG-4

Display Output
Graphics
De-interlacer | Scaler | Video Enhancements | Blend
NTSC/ PAL Encoder
HDMI 1.3 Tx

Digital Video Out
Analog Video Out

HDMI1.3

DVD PS/TS Demux

Memory Interface
MIF Arbitration
Nano 0 | Nano 1

PLLs, DTO Power Management

ZDSP (Audio DSP)
MPEG1 L I,II,III, AC3, AAC,AAC+,WMA, WMA Pro, Dolby Digital+, DTS,DTS+,

Analog audio
I²S (10 ch.)
Class D

IEC958 (S/PDIF)

xtal

DDR2 (x16)

DDR2 (x16)

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The Memory Challenge

- ▶ Demanding memory requirements
  - ▶ Available bandwidth
    - ▶ *Utilization, frequency*
  - ▶ Footprint
    - ▶ *Size (width, depth, number of DRAM chips)*
  - ▶ Cost affecting system BOM
    - ▶ *Cost of memory chips*
    - ▶ *Cost of package*
      - ▶ #of pins to support DRAMs
      - ▶ Power
- ▶ Bandwidth allocation schemes
  - ▶ Adaptive priorities
  - ▶ Support various type of clients
    - ▶ *High bandwidth clients*
      - ▶ use on-chip buffers to compensate latency
        - ▶ Cost/Performance
    - ▶ *Low latency clients*
   - ▶ Processing is stalled till memory transfer is completed
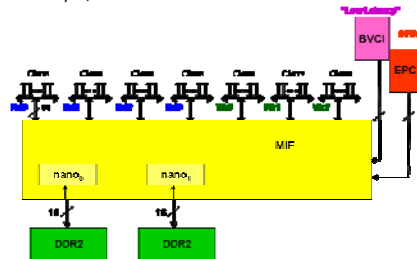
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# AVZ – Multi-standards Video Decoder

- ▶ AVZ is an advanced multi-standard high definition video decoder core
- ▶ Supported video compression standards:
  - ▶ *MPEG-4 part 10 (AVC/H.264)*
  - ▶ *VC-1*
  - ▶ *MPEG-4 part 2 / DivX / Xvid*
  - ▶ *MPEG-1/2*
- ▶ AVZ challenges:
  - ▶ Support 4 different standards
    - ▶ Different stream compression techniques
      - ▶ VLC – different tables for different standards
      - ▶ CABAC (Context Adaptive Binary Arithmetic decoding)
    - ▶ Different header syntax
    - ▶ Different MV calculations
    - ▶ Different transforms
  - ▶ High definition resolution requires high throughput
    - ▶ *parallel processing*
    - ▶ *extra HW acceleration*
  - ▶ Several proprietary processors
    - ▶ *AVP*
    - ▶ *SIMD*
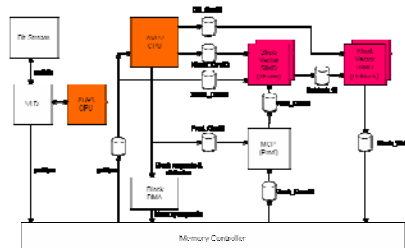
VaddisHD™ Software Architecture
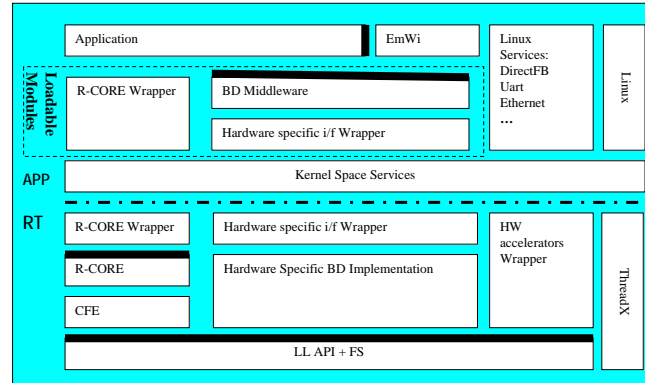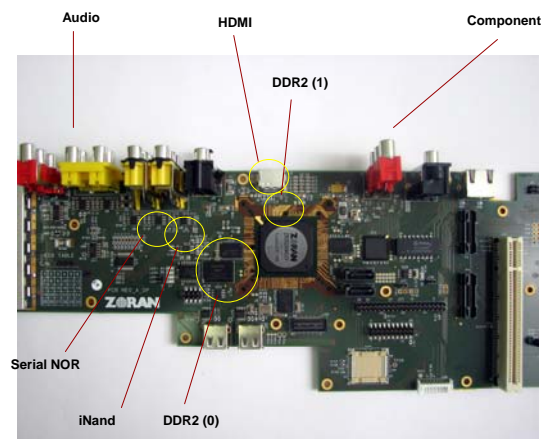

Dual CPU architecture
    ThreadX OS for Real-time CPU
    Linux Kernel for Application CPU
Inter-Processor Communication

VaddisHD™ 100 Demo Board for BD-DVD

MultiMedia HD player/TVMM

- ► HD-TVMM
  - ► Integrated into HDTV, enabling playback from USB-key or HDD or Ethernet
- ► HD-Player
  - ► Portable box
  - ► Playback of various content via HDMI1.3 1080p
- ► IP-VOD
  - ► Ethernet connectivity
  - ► DRM

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Rakefet

'Rakefet' is the Hebrew

name for ...

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