

## HDTV 수신기 구현 기술 및 개발 동향

2001. 11. 22  
함 철 희

Digital Media R&D Center  
Samsung Electronics Co., LTD.

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11-22-2001

## Digital TV 특징

● 16:9 대 화면 / 현장감

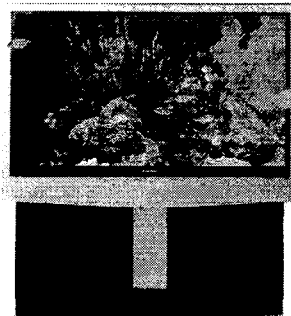
- 고화질 (기존 TV보다 화소수가 5배)
- 고음질 (5.1 채널의 Surround System)

● 영상 정보의 고능률 디지털 압축 / 전송

- 채널당 3~4개의 SD급 방송 또는 1~2개의 HD급 방송
- 새로운 정보 서비스 제공 (Data 방송 / Interactive 서비스)
- 타 디지털 미디어와의 호환성

● 암호화 및 균일한 품질의 서비스 제공

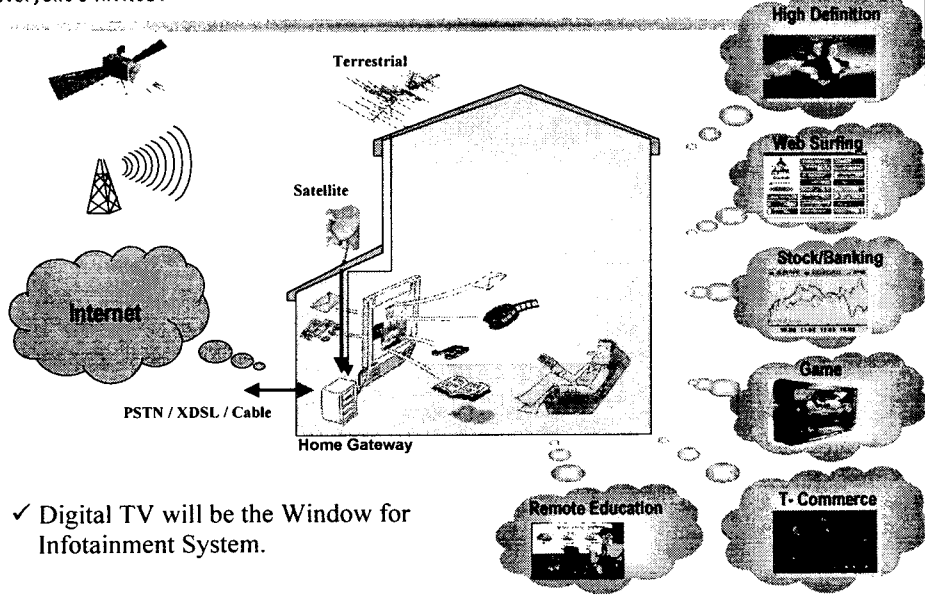
- 유료 서비스 제공



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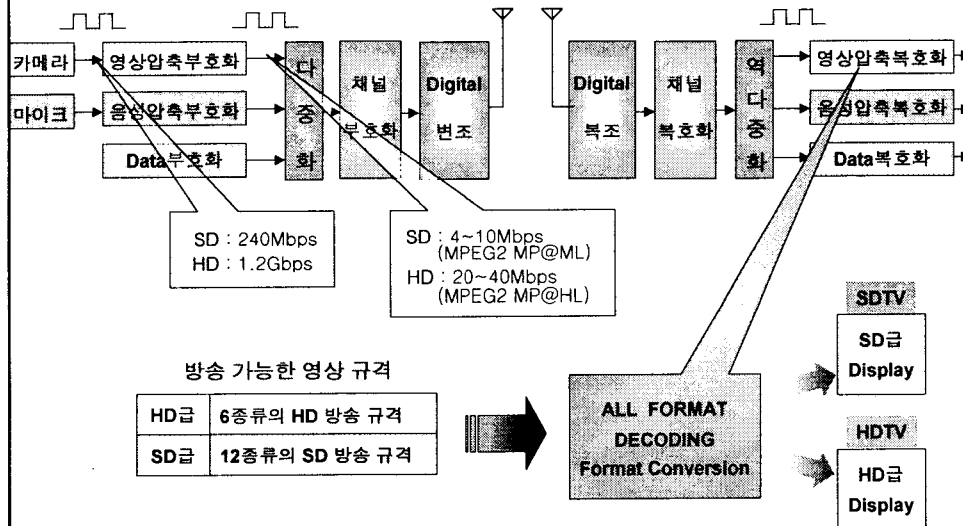
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### DTV를 통한 생활 변화



✓ Digital TV will be the Window for Infotainment System.

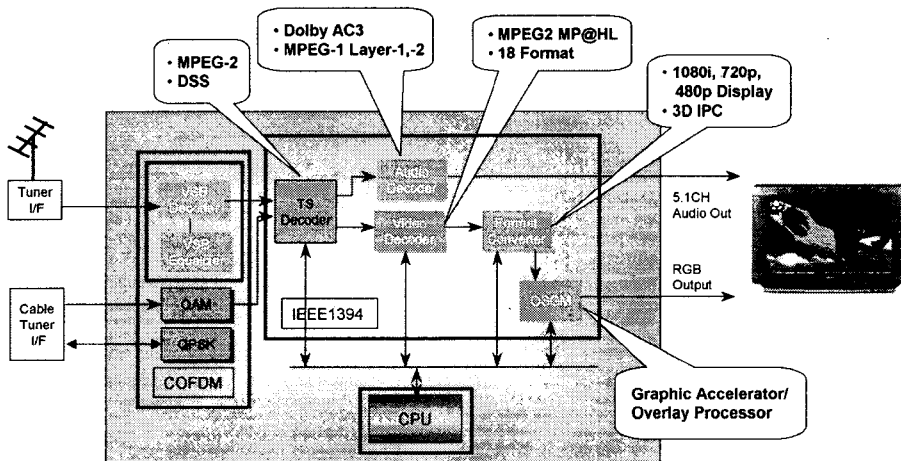
### Digital TV System Block Diagram



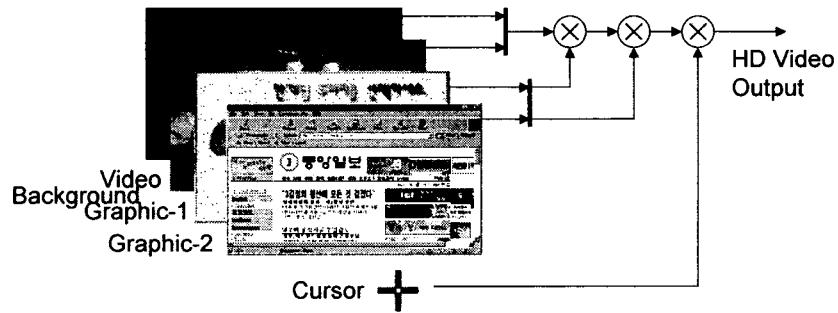
## ATSC Standard Video Format

Vertical Lines	Pixels	Aspect Ratio	Picture Rate
1,080	1,920	16:9	24P, 30P, 60I
720	1,280	16:9	24P, 30P, 60P
480	704	16:9	24P, 30P, 60P, 60I
480	704	4:3	24P, 30P, 60P, 60I
480	640	4:3	24P, 30P, 60P, 60I

## HDTV 수신기의 개념도



## Physical Display Planes of Source Decoder



Independent control of each display plane.

## Source Decoder의 기능 요구 사항 - I

### Data Broadcasting Support ( Video Decoding / Format Conversion / Graphic)

- 4SD Decoding & Display
- HD + SD
- Dual HD Decoding
- *PIG (Arbitrary Video Scaling)*
- Multiple PIP, POP
- *3D IPC (Interface-to-Progressive Conversion)*
- **Back Ground + Video + 2 Graphic + Cursor Planes**
- *Multiple Hardware Graphic Planes*
- Graphic Acceleration (Block Copy, Line Draw, Block Fill, Raster operation)
- *Various Memory Configuration* (DDR, SDRAM)

### **HD / SD Interface support**

- ITU-R 601 digital input/output, NTSC/PAL analog output
- ITU-R 709 digital input/output, RGB analog output

### **World Wide DTV support (ATSC 60Hz & 50Hz Version)**

- Video Input Format of USA, Australia, China
- 480p, 720p, 1080i, 60Hz / 59.94Hz output  
(Monitor 480i, 60Hz / 59.94Hz)
- 576p, 720p, 1080i, 50Hz output (Monitor 576i, 50Hz)

### **HDD 관련 동작모드**

- ☞ TV 시청 & 녹화
- ☞ Time Shift 시청
- ☞ Time Shift 시청 & 녹화

### **Settop Box와의 호환 동작**

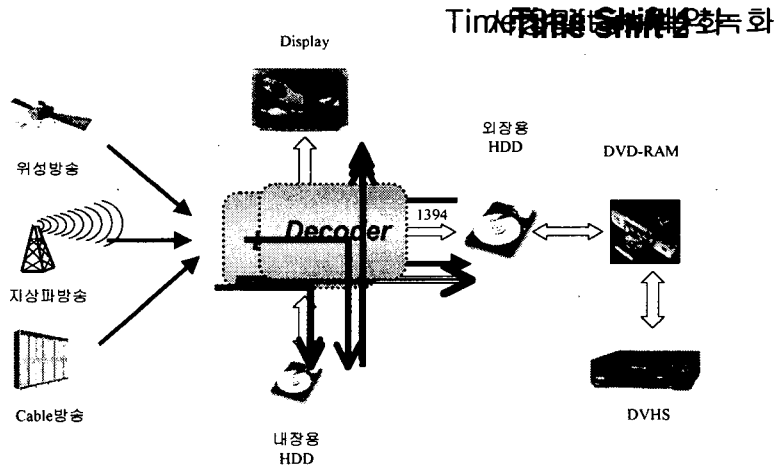
- ☞ EIA 775 지원

### **Copy Protection 지원**

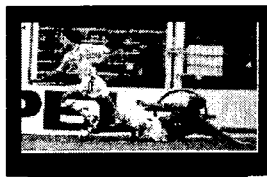
- ☞ OpenCable 용 Copy Protection
- ☞ HDD용 Copy Protection
- ☞ 1394용 Copy Protection

### **Flexible Interface**

# PVR 기능



# Various Display Functions - I



Pillar Box

Panorama (quadratic)

16:9 Display

Aspect Ratio(AR): 4:3 / 16:9  
 Display Format:  
 480P / 720P / 1080I  
 50 / 59.94 / 60 Hz  
 Configurable H/V Sync  
 Format Conversion for  
 multi-format source.  
 3-D IPC for SD source.



Letter Box

Pan/Scan

4:3 Display

## Various Display Functions - II

### Picture-In-Picture(PIP)



PIP display for  
two motion picture



Sub-picture: scalable(1/2 ~ 1/4)  
: flexible re-positioning

## Various Display Functions - III



Double Screen



Multiple POP



Multiple POP

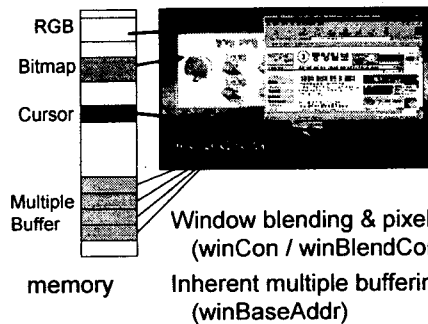


Multiple POP

Flexible POP composition  
No limitation on sub-picture size/positioning

## OSG - Basic Function

Various window data type  
- bitmap  
- graphic(YCrCb / RGB)

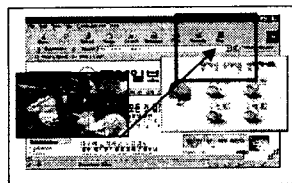


HW cursor  
- Blinking control  
- Arbitrary shape

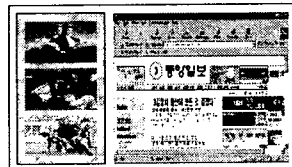
Window blending & pixel blending(16 level)  
(winCon / winBlendCon / winDataType)

Inherent multiple buffering(animation)  
(winBaseAddr)

## Picture-In-Graphic



Video  
- Flexible resizing/re-positioning  
- Display order control



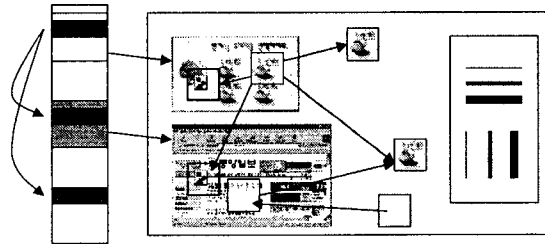
Channel Icon  
- One motion picture  
- Multiple still picture

Independent control of video & graphic plane



## Graphic Accelerator

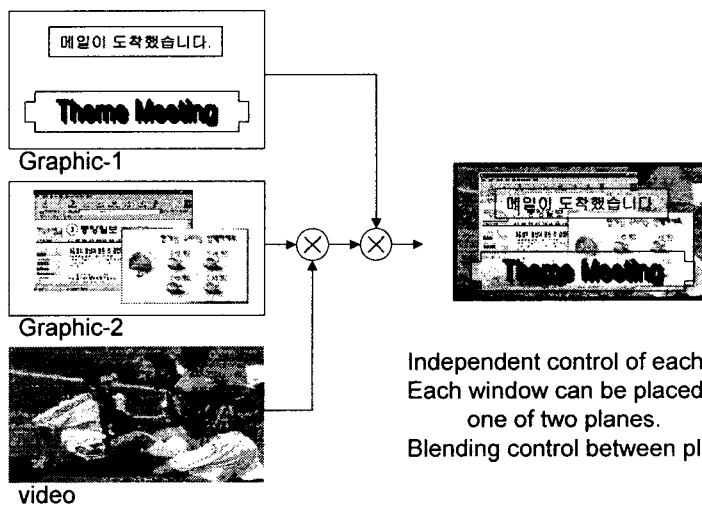
- Block copy
- Intra/Inter window block copy
  - Data type conversion



Line draw  
Rectangle draw  
Fill rectangle

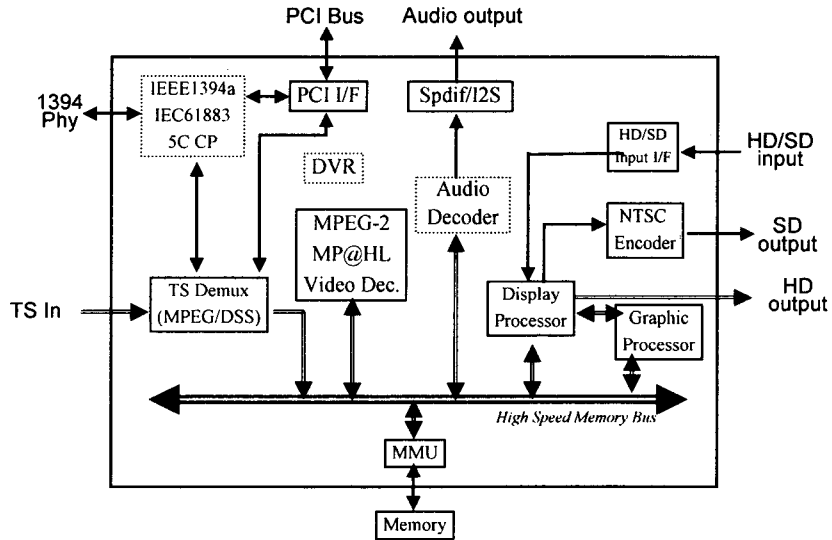
- Raster operation
- Intra/Inter window
  - AND / OR / EOR
  - Blending(8 level)

## Video & Graphic Mixer

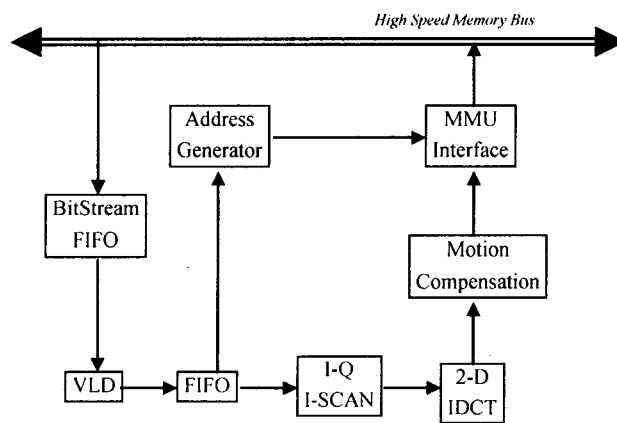


Independent control of each plane.  
Each window can be placed on  
one of two planes.  
Blending control between planes.

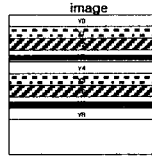
## Architecture of Source Decoder



## MPEG-2 Video Decoder

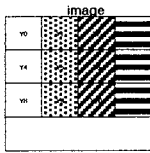


## MPEG-2 Video Decoder - Frame 저장 방식



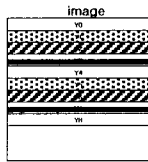
### 1. 순차 저장 방식

장점: 메모리 낭비 없음.  
단점: bank interleaving 적용 불가  
BW loss



### 2. Macro block 단위

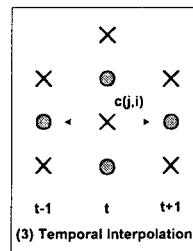
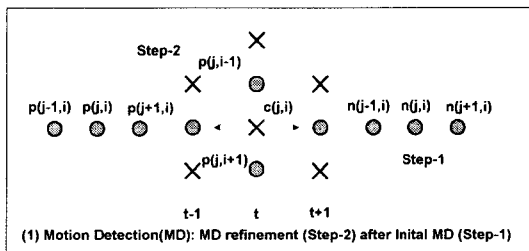
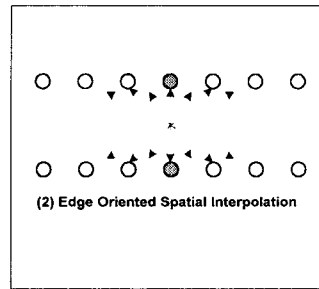
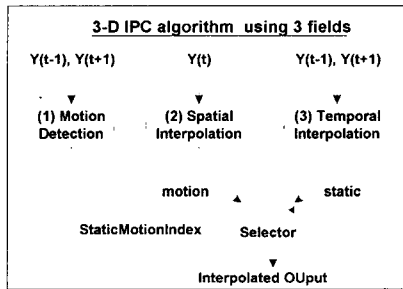
MB-WR BW 항상  
메모리 접근 방법 복잡  
MB read시 BW loss

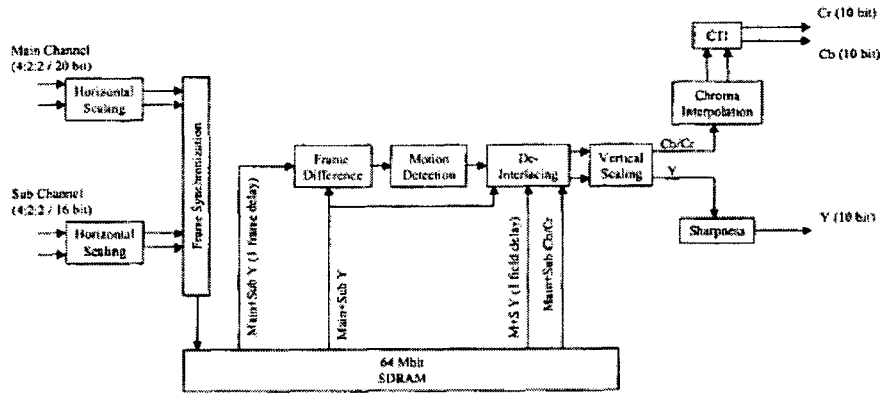


### 3. Line(image)/Page(memory) 저장

Field 단위의 line(image)/page(memory) 저장  
- Bank interleaving이 효율적임.  
- Field MC(worst case)에 적합.

## 3-D Interlace to Progressive Conversion

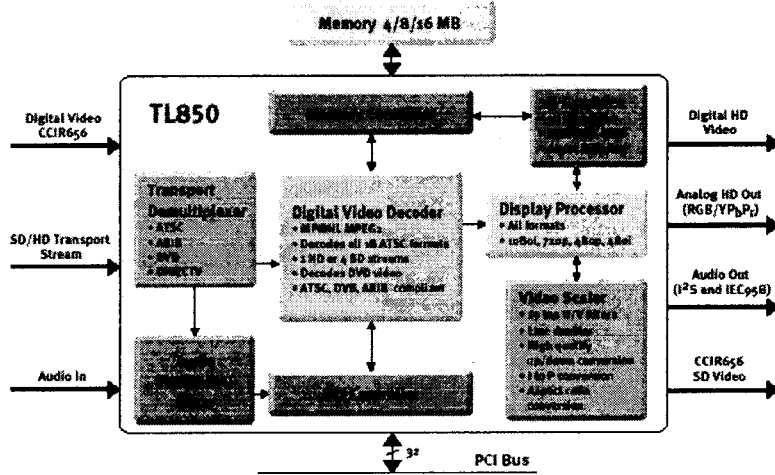




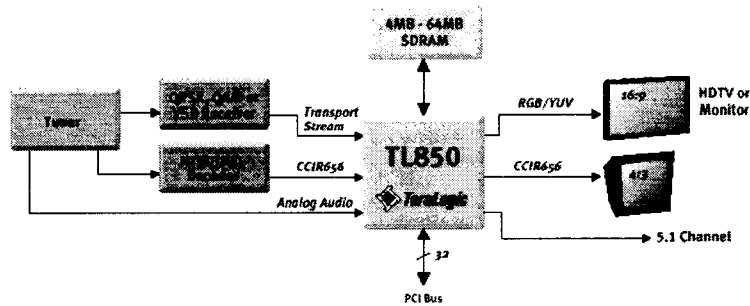
□ Available source decoder vendors:

- ☐ TeraLogic
- ☐ LSI Logic (C-Cube)
- ☐ STMicroelectronics
- ☐ Philips
- ☐ BroadCom
- ☐ 삼성
- ☐ LG
- ☐ Others.

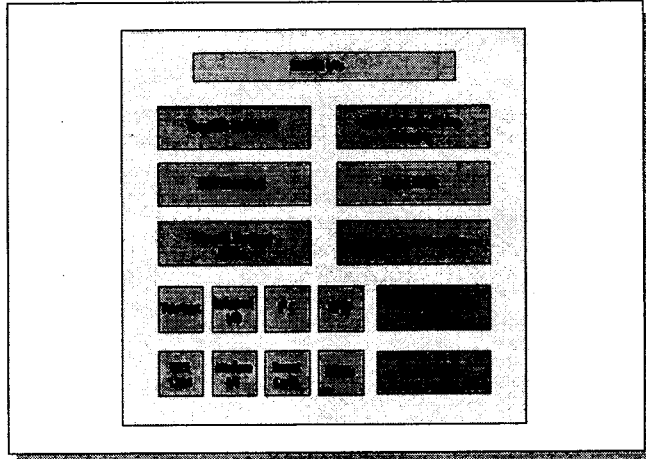
### TeraLogic - TL850 Block Diagram



### TeraLogic - TL850 System Diagram



## LSI Logic – Block Diagram of SC2000



## LSI Logic - AVIA-9600 Family

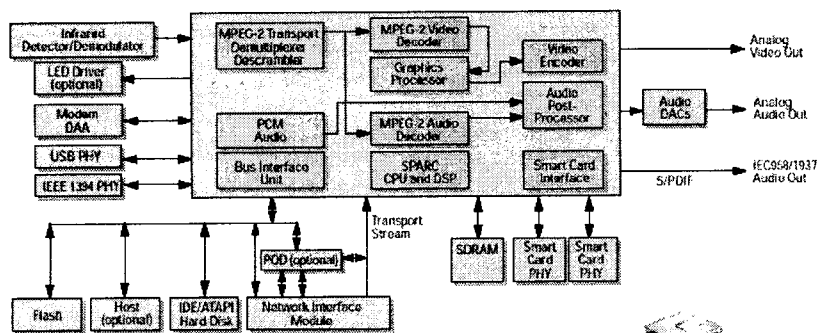


Figure 1. Fully Configured Set-Top Box Design Using the AVIA-9600



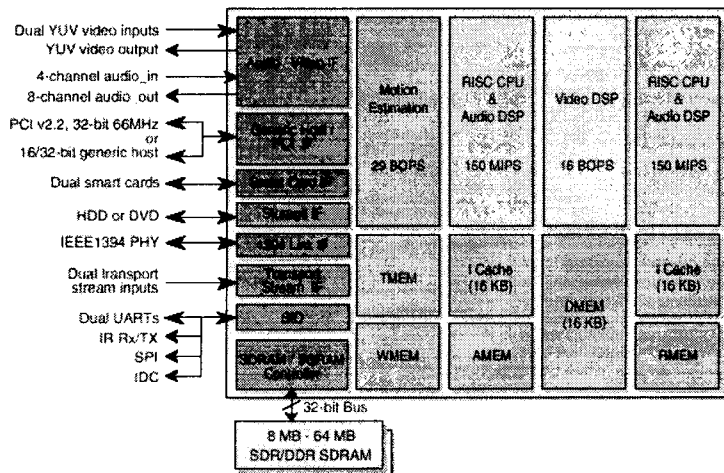
## LSI Logic - Features of AViA-9600

System	CPU	150 MHz, microSPARC V8, 16K+16K cache/512MB
	Host Interfaces	PCI, Fire, PowerPC, Creative, SMI
	Peripheral Interfaces	IEEE 1394 (with 5G copy protection), USB Host, IDC, SPI, IR (transmit/receive), I2C, IEEE 1284 Peripheral, two UARTs, modem DAA
Video	Card Sockets	Two SmartCard, PCID/IEEE1394/USB/CI
	Disk Drive	IDE/ATAPI
	Memory	4 - 128 Mbytes SDRAM (SDR or ODR) or SGRAM
	JTAG	Boundary Scan and Debug Port
	Decoding Standards	MPEG-1, MPEG-2, MP@ML
	Compressed Resolutions	<ul style="list-style-type: none"> <li>720, 704, 640, 544, 528, 480, 352, 320 x 480 and 352 x 240 @ 30Hz and 24 Hz</li> <li>720, 704, 640, 544, 528, 480, 352 x 576 and 352 x 288 @ 25 Hz</li> <li>384 x 240 @ 24 Hz</li> </ul>
	Aspect Ratios	4:3, 16:9, 20:9, DTC Active Format Descriptor
	Video Encoder	NTSC, PAL, SECAM, 6 DACs
	Graphics Subsystem	<ul style="list-style-type: none"> <li>Display List Processor, supports unlimited number of planes and (overlapping) regions, picture-in-graphics (PIG)</li> <li>Flicker filter, selectable per region</li> <li>Continuous video scaling</li> <li>256 levels of alpha blending</li> <li>Two 256x32CLUTs supporting fast dynamic reload</li> <li>Two Copy Engines</li> <li>Color Expander</li> <li>NABTS Teletext decode</li> <li>Digital video input</li> </ul>
	Audio	Decoding Standards
Output Channels		<ul style="list-style-type: none"> <li>6-channel PCM and SPDIF (IEC-1937/IEC-958);</li> <li>Dolby Digital or MPEG-2 5.1 downmixed to Dolby ProLogic or 2-channel PCM</li> </ul>
Physical Transport	Stream Parsing	MPEG-2 ISO 13818-2, up to 80 Mbps
	PIQ Filtering	Hardware section filters with CAM, 32 PIDs
	Descrambling	DVB, DES
	Input Voltages	3.3 V - 5% (I/O), 1.8 V - 5% (Core)
Physical Transport	Clock Frequencies	Input = 13.5 or 27MHz, Operating = 150 MHz
	Packaging	308 Ball Grid Array

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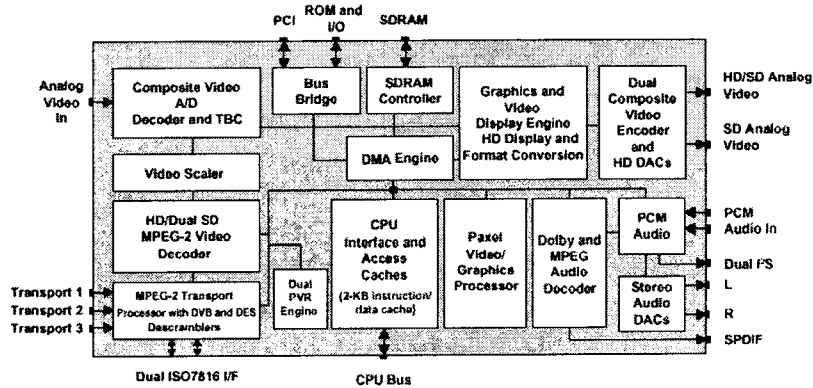
## LSI Logic DoMiNo Network Media Processor



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Summary of Specifications	
AV Codec	Dual-stream, full-duplex, SD/HDV audio and video codec
Encode/Decode Formats	MPEG-2 (MP@ML, MP@HL, MPEG-1), MPEG-4 (H.263+), DV, AC-3, DDC, MLP, AAC
File System Support	DVD-VR (RTRW), DVD-V, UDE
Display Formats	NTSC (480i), PAL (576i), ATSC (480i, 720p, 1080i)
Encryption/Decryption	CPM, CPRM, CSS, DES, SC, etc.
Video I/O	Dual CCIR 656 YUV inputs, CCIR 656, 16-bit YUV or 24-bit RGB output
Audio I/O	Dual stereo audio inputs, dual 8 channel stereo audio outputs
Video Networking	Dual transport: stream inputs, IEEE1394 link interface
Graphics	32-bit RGBA with 8-bit alpha blending, multi-plane 2D graphics with OSD, flicker filter, video scaler
Memory Controller	RM-64MB SDR or DDR SDRAM, 32-bit, 140.5MHz, 1.76bytes/second
System Expansion Bus	32-bit, 66MHz PCI 2.2 or 16-/32-bit generic host bus, master or slave
System I/O	IBC, SPI, IR Tx/Rx, dual UARTs, dual smart card interfaces ATAPI/IDE and DVD
JTAG	IEEE1149.1 compliant boundary scan and PCB assembly testing
Input Voltages	1.5V (5V tolerant) I/O, 3.3V DRAM, 1.8V core
System Clock	13.5MHz or 27MHz
Package	388 pin or 398 pin BGA





## Broadcom – Features of BCM7020

### BCM7020 FEATURES

- ATSC-compliant, All-Format MP@HL MPEG-2 Video dual decoder with Personal Video Recording feature
  - Dual channel decode with simultaneous standard-definition (SD) display of each channel content
  - Single channel high-definition (HD) decode with simultaneous display of both HD and scaled SD content
  - Simultaneous dual record, dual playback Personal Video Recording (PVR) with encryption
  - Six on-chip video DACs
- Dolby Digital (AC-3)/MPEG multichannel audio decoder with SPDIF output
- Stereo audio DACs
- Advanced 2D/3D-effects graphics engine
  - Studio-quality text and graphics at HD resolution
  - Supports multiple layers and windows
- NTSC/PAL analog video decoder
- NTSC/PAL/HD video encoder
- Bus bridge to memory, local bus, and PCI
- POD support including DVS 213 DES descrambler
- DVT and DC2-compliant transport demultiplexer with DVB, DES, and Multi2 descramblers
- Support for 64 PIDs and 64 section filters

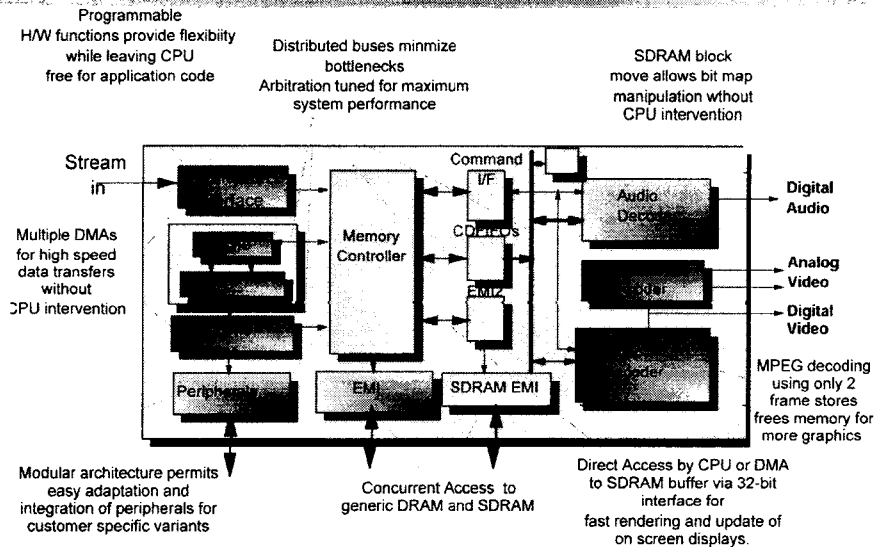
### SUMMARY OF BENEFITS

- Provides a cost-effective solution for high-definition and standard-definition video and graphics systems common to cable and satellite applications.
- PVR capability enables personal viewing and scheduling, Video-On-Demand (VOD), and VCR "trick mode" effects on any video stream.
  - Encryption ensures copy protection of recorded programming content
- Includes simultaneous high-definition and standard-definition analog output for watch and record capability.
- Advanced 2D-graphics system allows applications such as internet browsers and electronic program guides to deliver studio-quality text and graphics on television monitors.
- 3D effects create studio-quality screen transitions and adds a whole new dimension to electronic program guides.
- PCI interface allows for direct connection of cost-effective SuperIO devices.
- High-performance DMA capability can be used for cable modem traffic.
- Broadcom-developed device drivers enable rapid-software development cycle.
- Supports DVS POD requirements.

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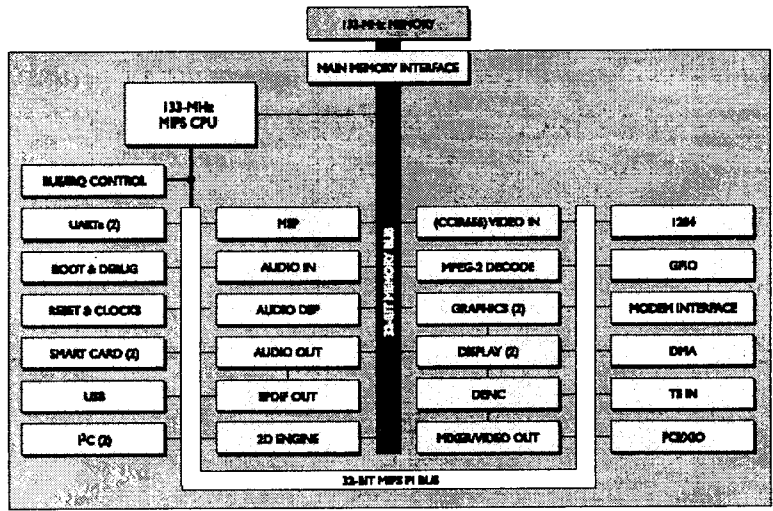
## STMicroelectronics - OMEGA Architecture



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# Philips – Conceptual Architecture of PNX8320



# Philips - Reference Board of PNX8320

