

**Sony Computer Entertainment**

**Introduction to  
PlayStation  
Technology  
and Development**

# **AGENDA**

- **Business of the PlayStation**
- **Architecture of PlayStation**
- **Impact of Architecture on Game Design**
- **Marketing Message as it Impacts Game Design**
- **Q & A**

# PLAYSTATION BUSINESS OVERVIEW

- Design, focus and positioning:  
PlayStation is a GAME machine
- PlayStation is CD-based to reduce media costs, risk and turnaround with CD media
- Advanced developer tools and 3rd party support resources

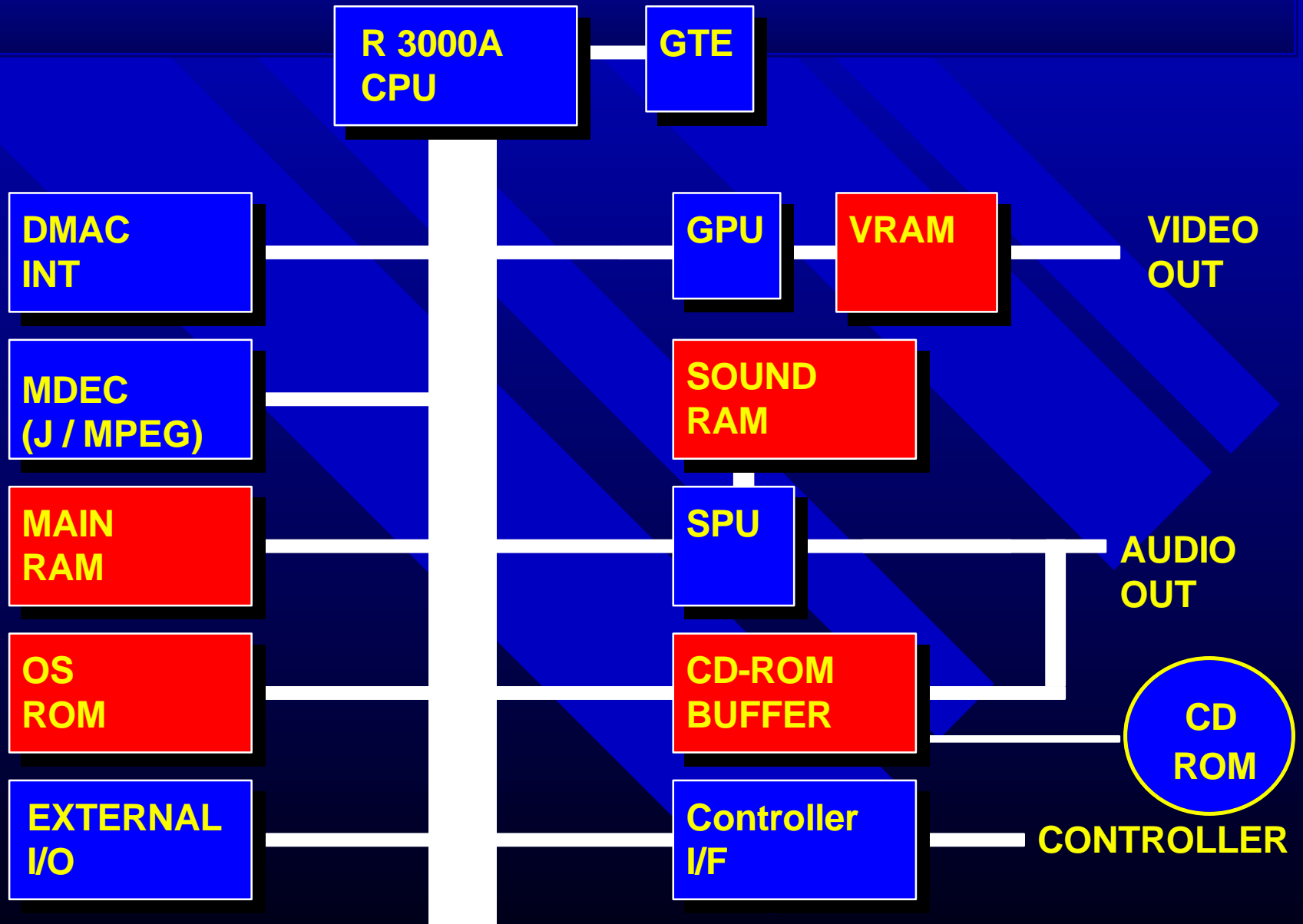
# **PLAYSTATION IS A GAME MACHINE = REAL-TIME**

- **Optimized for 3D Computer Graphics Generated in Real-Time**
- **Optimized for CD-Quality Stereo Audio Generated in Real-Time**
- **Other Functionality Including Digital Video Decompression in Real-Time**
- **500 MIPS Total Processing Power**

**PLAYSTATION TECHNOLOGY**

# **Technology Overview**

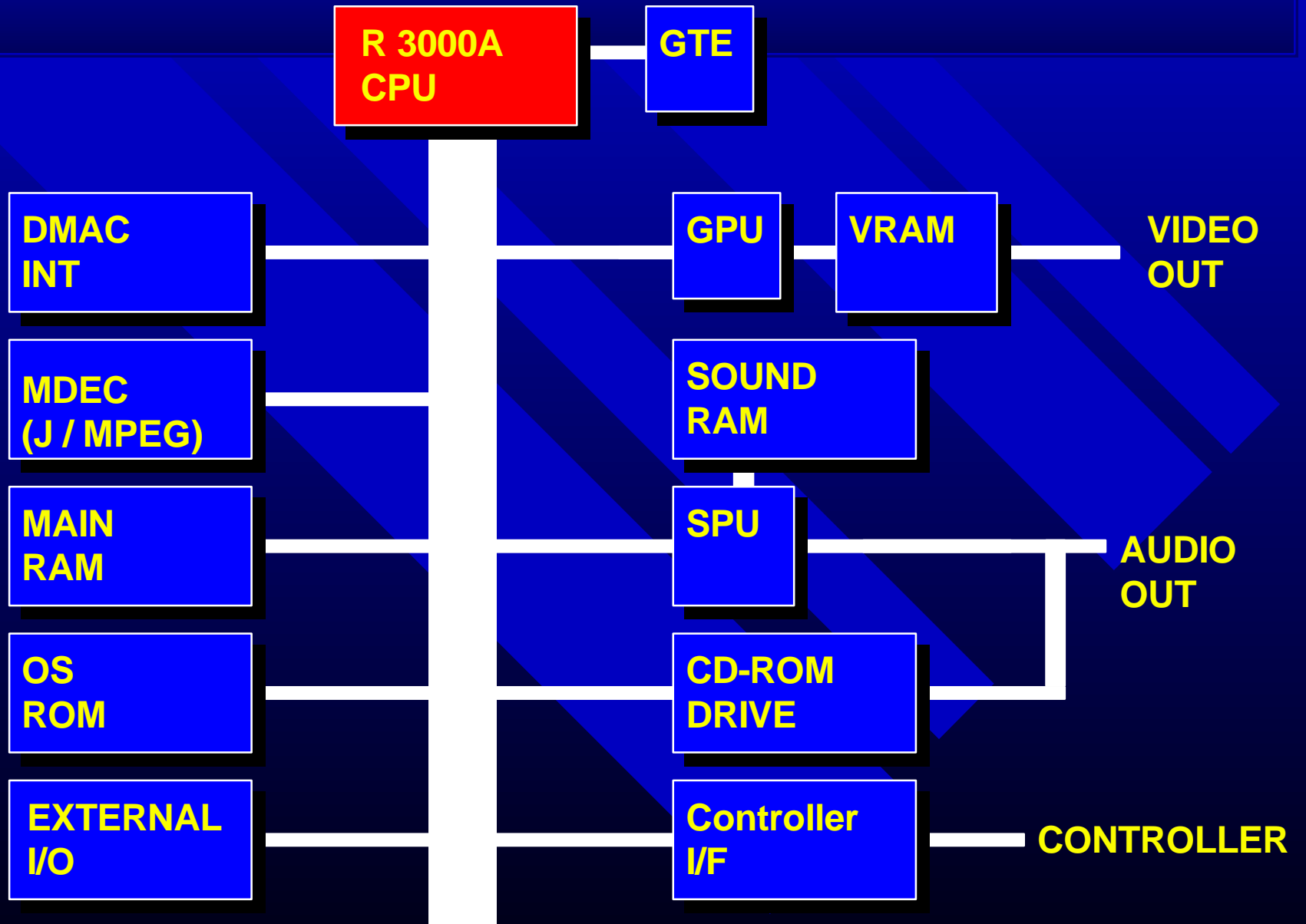
# SYSTEM ARCHITECTURE



# MEMORY CONFIGURATION

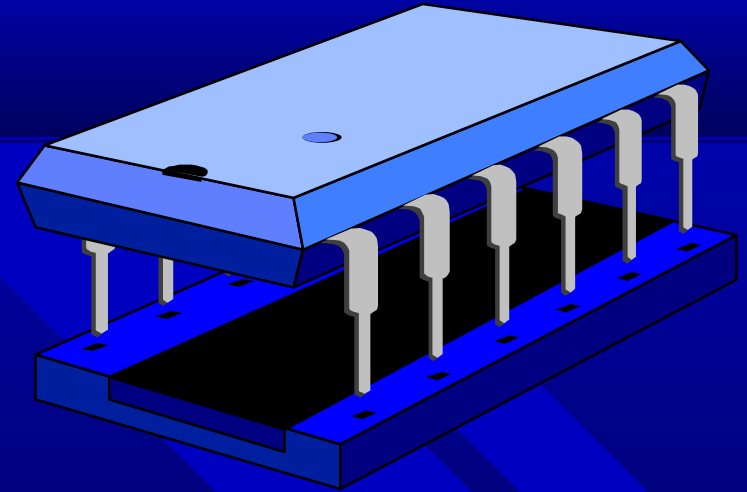
- **Main RAM** 2 MB
- **VRAM** 1 MB
- **Sound RAM** 512 KB
- **CD ROM buffer** 32 KB
- **OS ROM:** 512 KB

# SYSTEM ARCHITECTURE





# CPU



- R3000A from MIPS/SGI
- 32 bit RISC processor

- Clock
- Operating performance
- Instruction Cache
- Data Cache

- BUS:

**33MHz**

**30 MIPS**

**4KB**

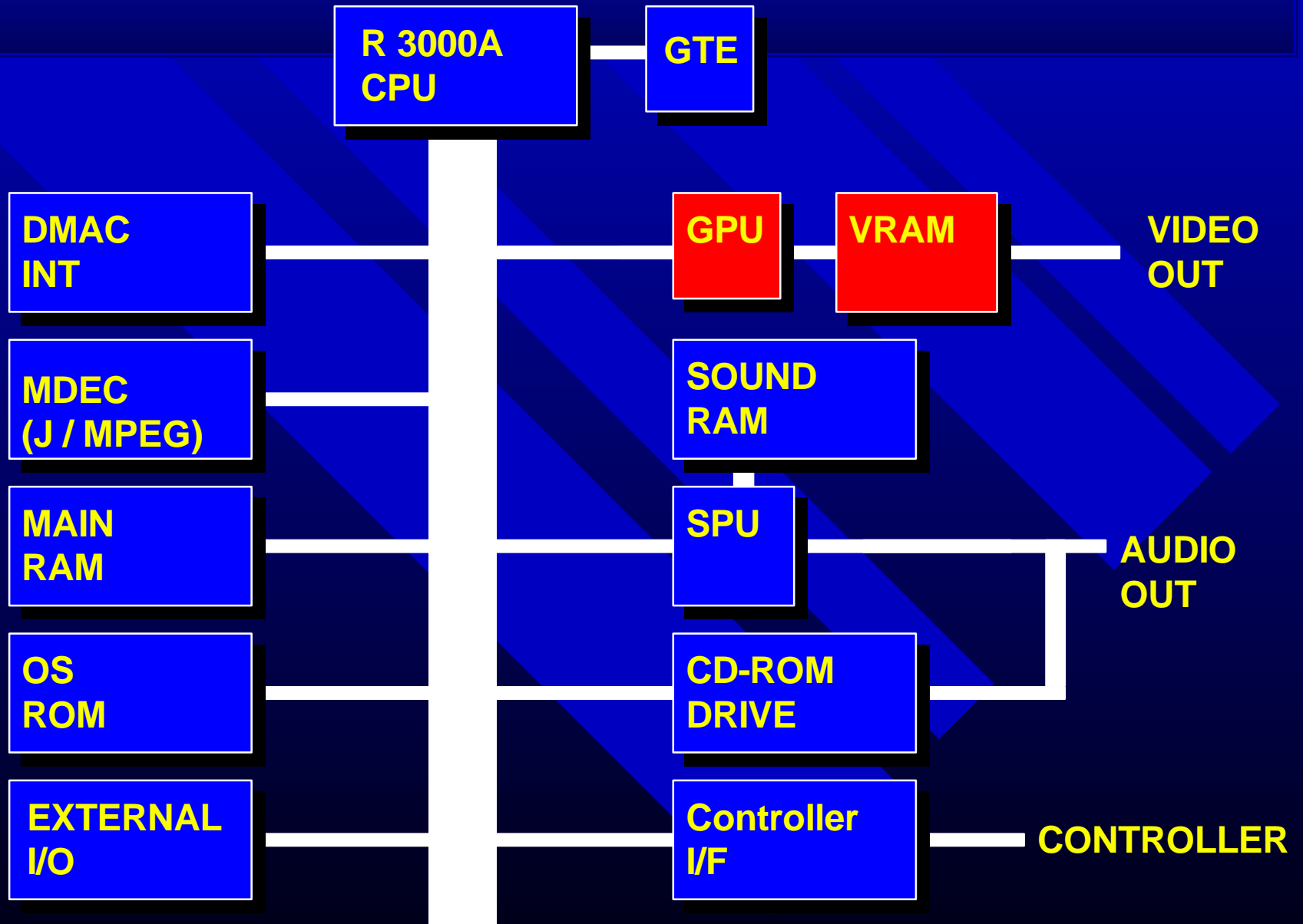
**1KB**

**132 MB/sec.**

# CPU Optimizations

- **Stay in I-Cache! - 4KB**
  - Optimize code to run in tight loops
  - Check to see that loops stay in the Cache
- **Use ScratchPad - 1KB**
  - Optimize to see data stays in Cache
- **View CPU cycles as a limited resource**

# SYSTEM ARCHITECTURE



# GRAPHICAL CAPABILITY

- **DISPLAY RESOLUTION**

MODE	RESOLUTION	SCAN
	(H x V)	
0	256 x 240	NON-INTERLACED
1	320 x 240	
2	512 x 240	
3	640 x 240	
4	256 x 480	INTERLACED
5	320 x 480	
6	512 x 480	
7	640 x 480	

# GRAPHICAL CAPABILITY

- **COLOR DEPTH**

MODE	COLOURS	GPU FUNCTION
4 bit	16	YES
8 bit	256	YES
15 bit	32,768	YES
24 bit	16,777,216	N/A

- **All calculations are performed to 24 bit accuracy**

# SPRITE SPECIAL EFFECTS

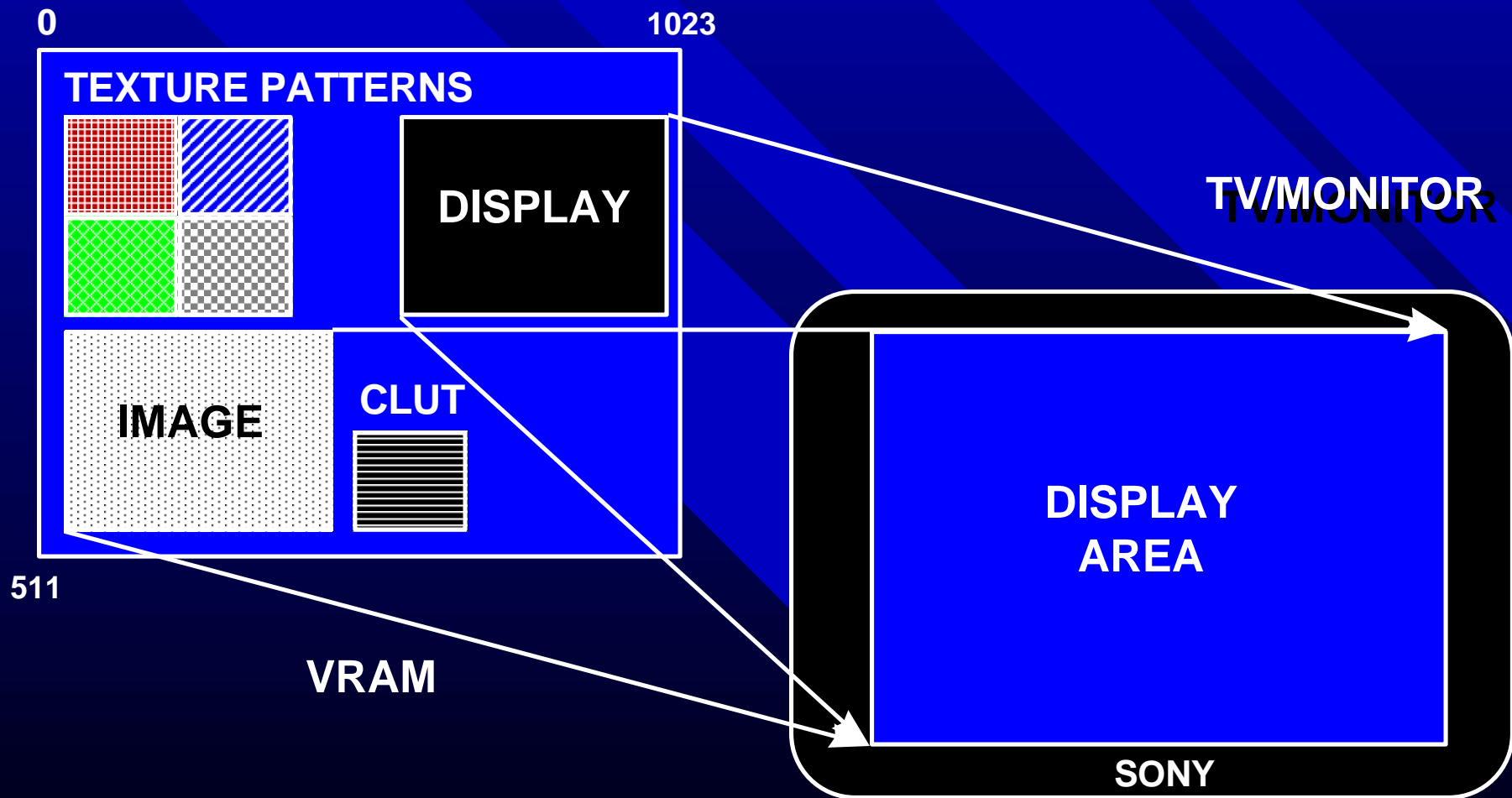
- **Rotation**
- **Scaling up/down**
- **Warping**
- **Transparency**
- **Fading**
- **Priority**
- **Vertical and horizontal line scroll**

# **HARDWARE RENDERED POLYGONS (GPU)**

- **Rendered in hardware**
  - **Upto 360K polygons/sec.**
- **Texture mapping**
- **Flat or Gouraud shading**

# GRAPHICAL CAPABILITY

- VRAM and display control



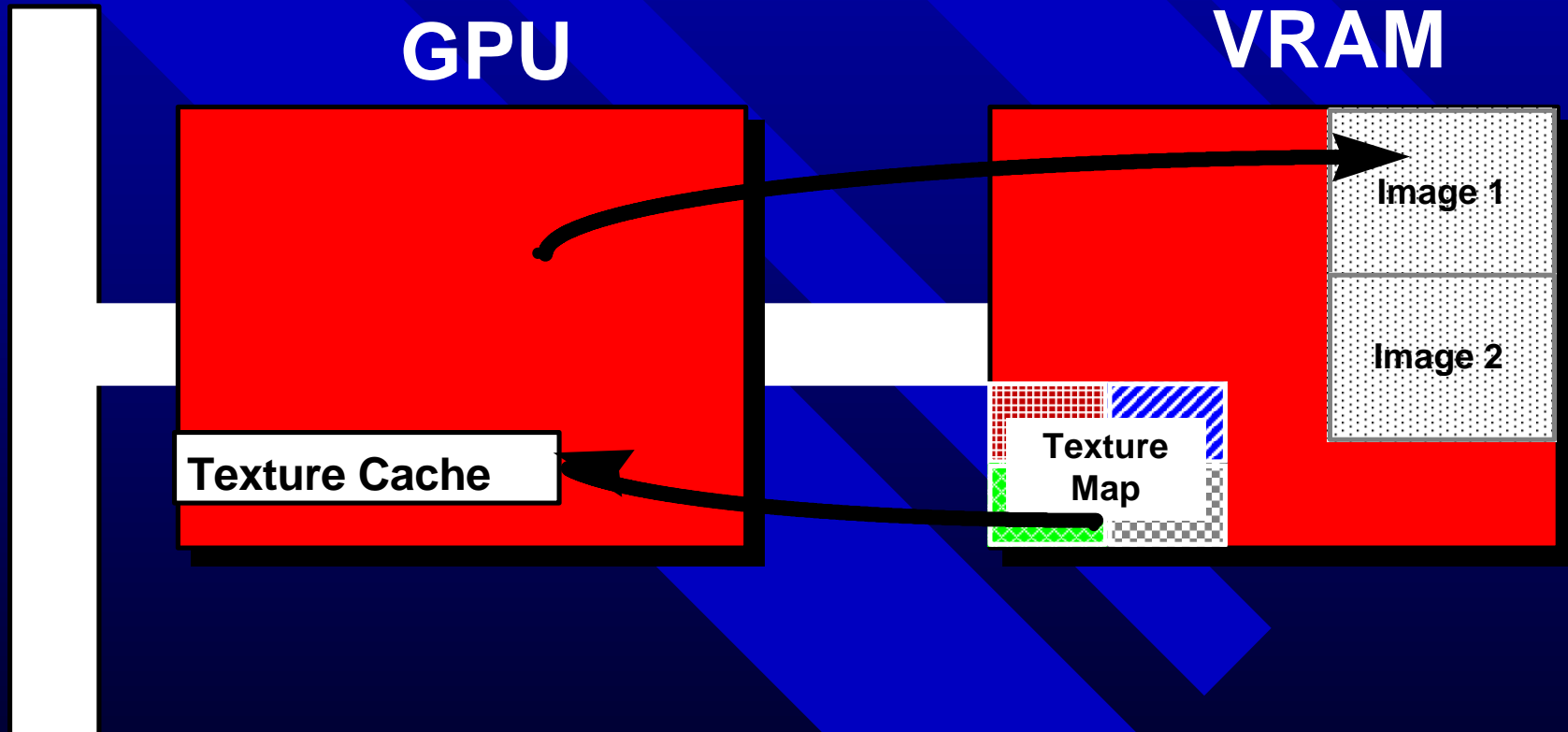


# Optimizing the GPU

Main Bus

GPU

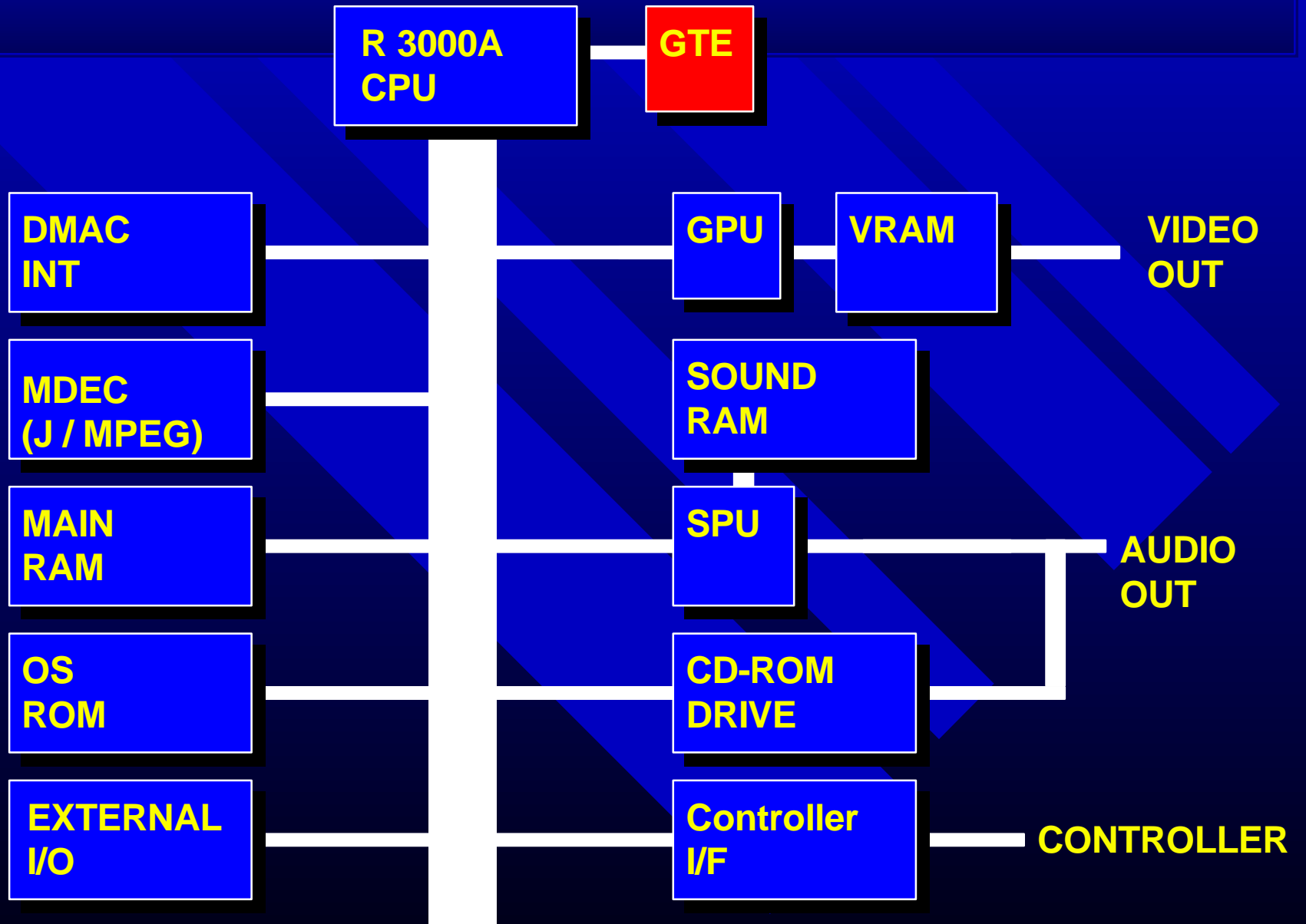
VRAM



# **Optimizing the GPU**

- **Optimize Sorting Lists**
- **Optimize for Texture Cache**

# SYSTEM ARCHITECTURE



# GEOMETRY ENGINE (GTE)

- **Operating performance:** **66 MIPS**
- **3D polygon transformations:**

**Type**

**Per second**

**Flat shaded**

**1.5 M**

**Gouraud, textured and  
light sourced**

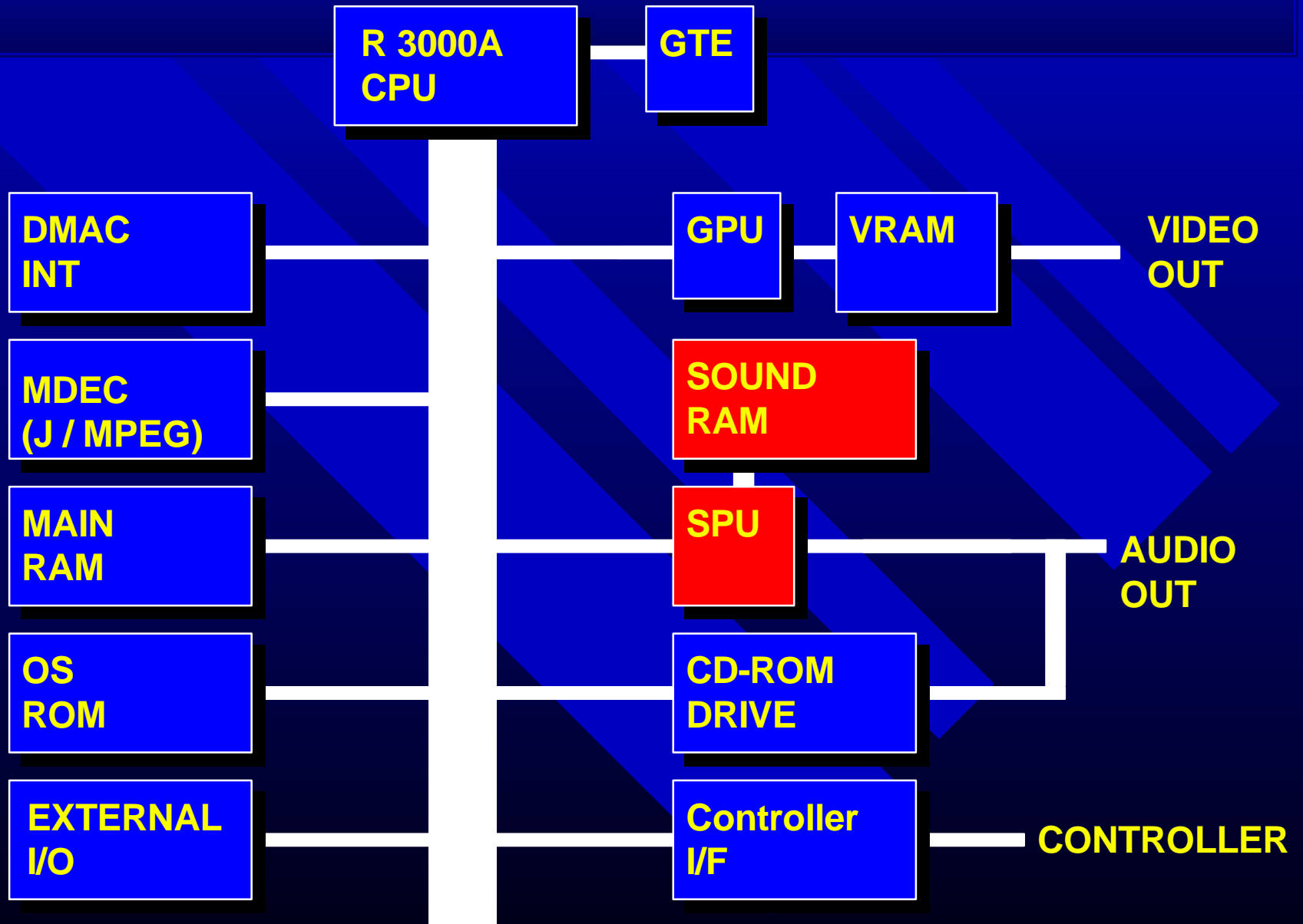
**500K**

- **GTE performs high speed matrix multiplies**

## Optimizing the GTE

- **Figure out what you do not have to draw!**
- **Use Inline Functions (DMPSX)**

# SYSTEM ARCHITECTURE



# **SOUND PROCESSOR (1)**

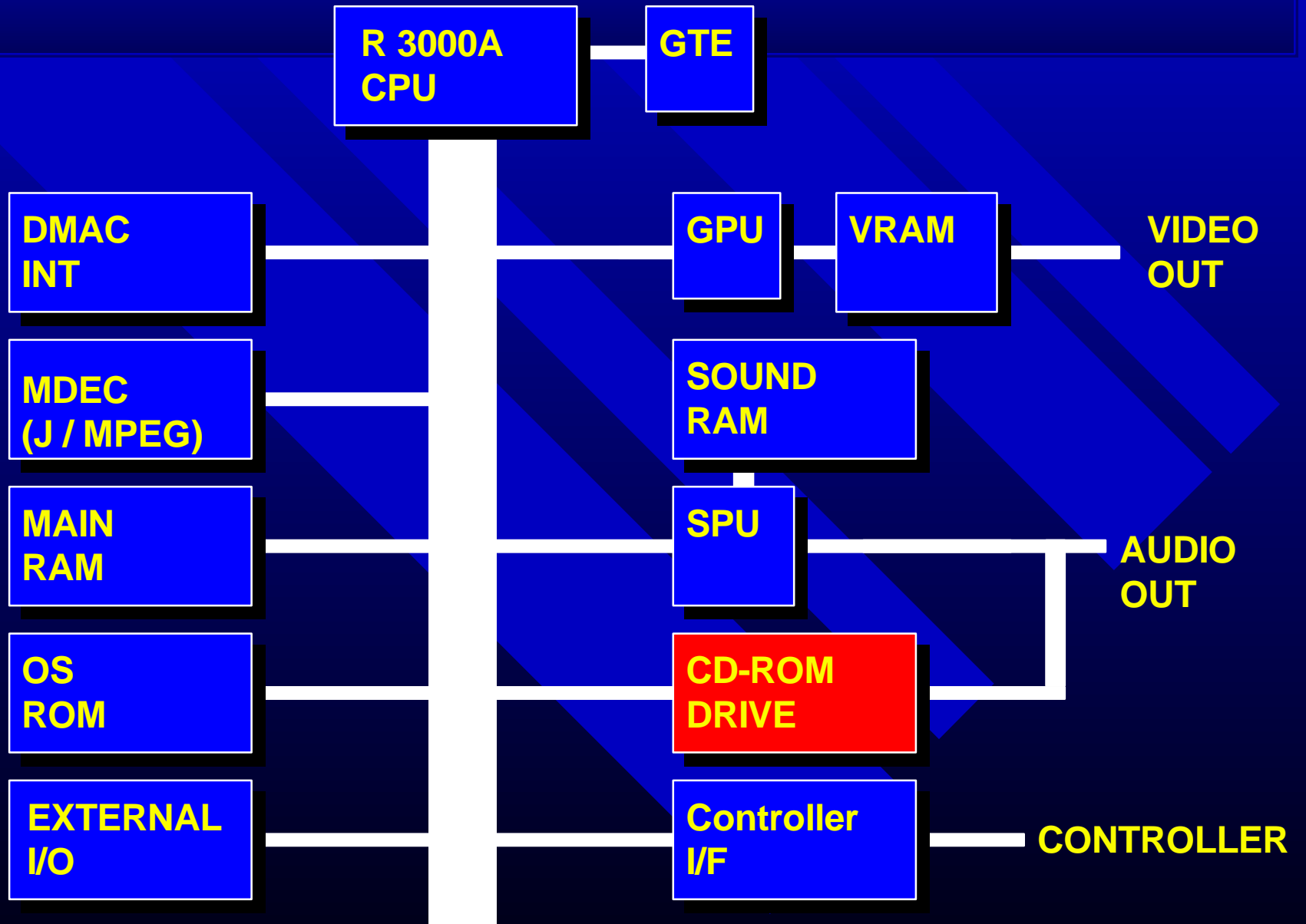
- **PCM Type Audio**
- **24 Channels**
- **up to 44.1KHz,**
- **up to 16 bit**
- **Digital effects include:**
  - **Pitch Modulation**
  - **Envelope**
  - **Looping**
  - **Digital Reverb**

## **SOUND PROCESSOR (2)**

- **Flexible and Dynamic Architecture**
- **Load Sampled Sounds into Memory**
- **Load MIDI Instruments into Memory**
- **Load Special Audio Effects into Memory (e.g. Reverb)**
- **Stream Audio from the CD**



# SYSTEM ARCHITECTURE



# CD-ROM DRIVE

- **Data Transfer Rate (DMA TO RAM)**

**150 KB/sec.  
300 KB/sec.**

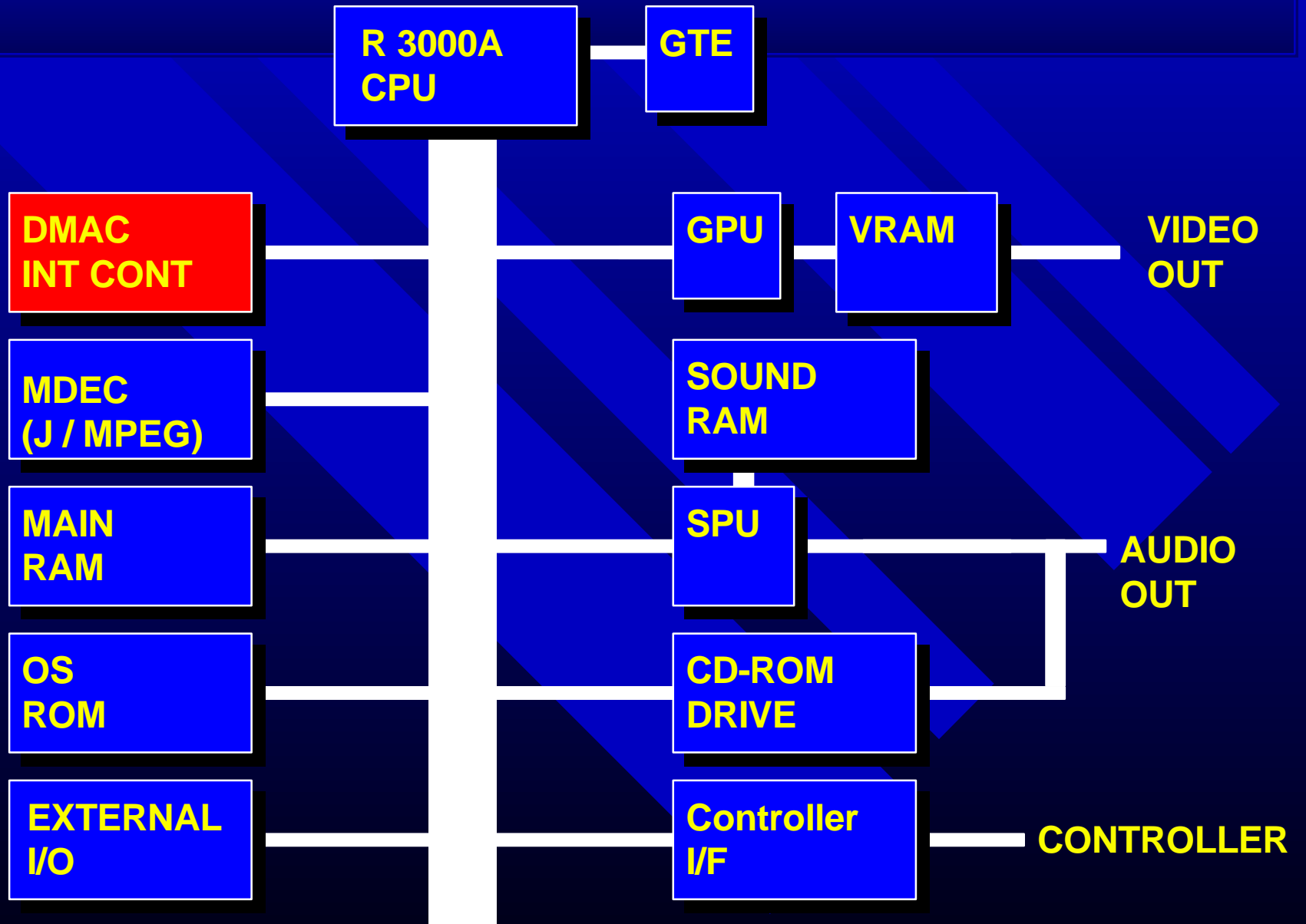
**(Normal)  
(Double speed)**

- **Maximum Capacity** **660MB**

- **Features**

- **Audio CD play**
- **PCM**
- **Movie Replay**

# SYSTEM ARCHITECTURE



# **DMAC: DMA ARCHITECTURE**

## **Six Channel DMA Architecture**

**RAM**

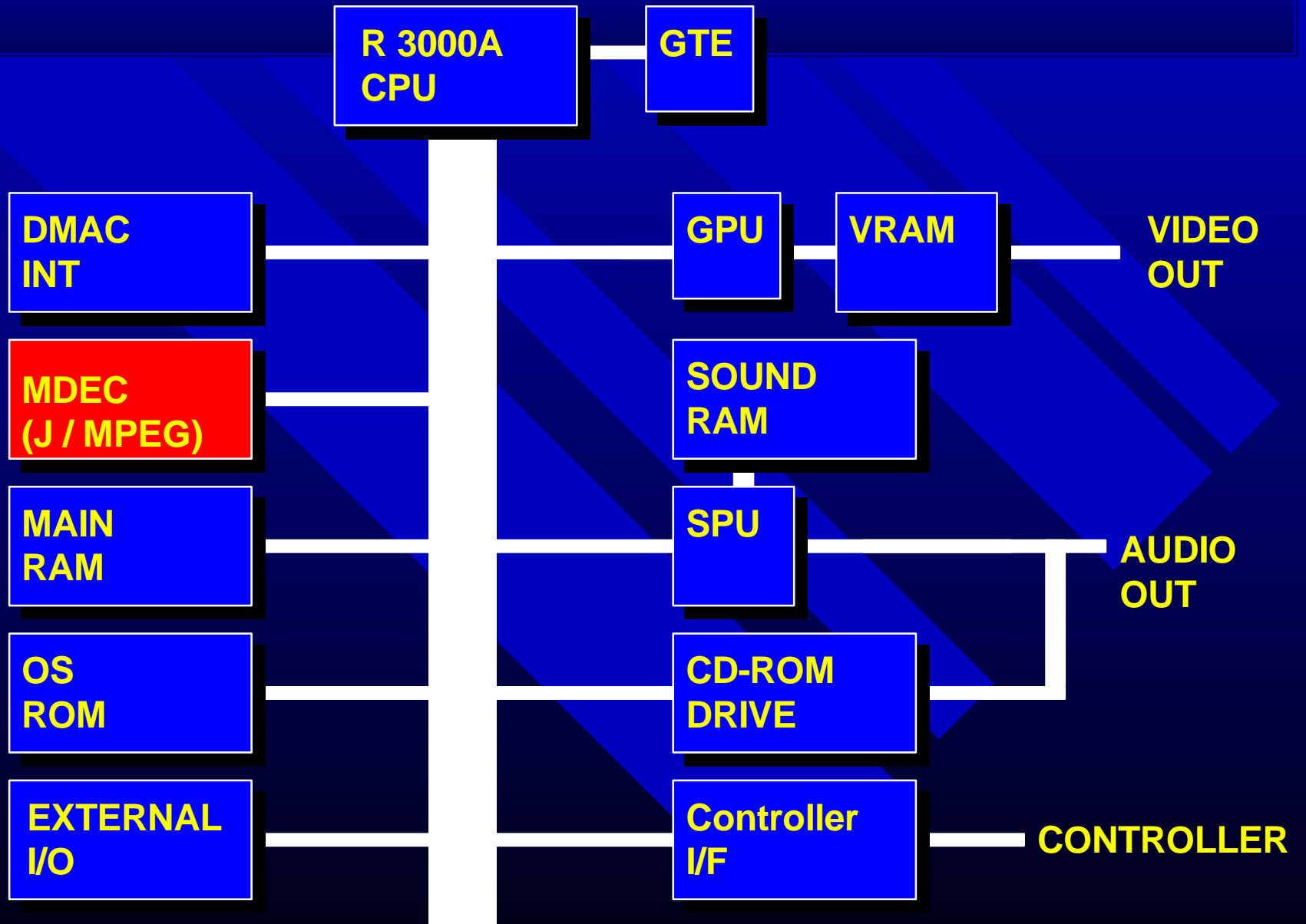


**GPU  
SPU  
MDEC  
CD ROM  
External I/O**

# **INT: INTERRUPT CONTROLLER**

- **Event Acknowledge**
- **Event mask**

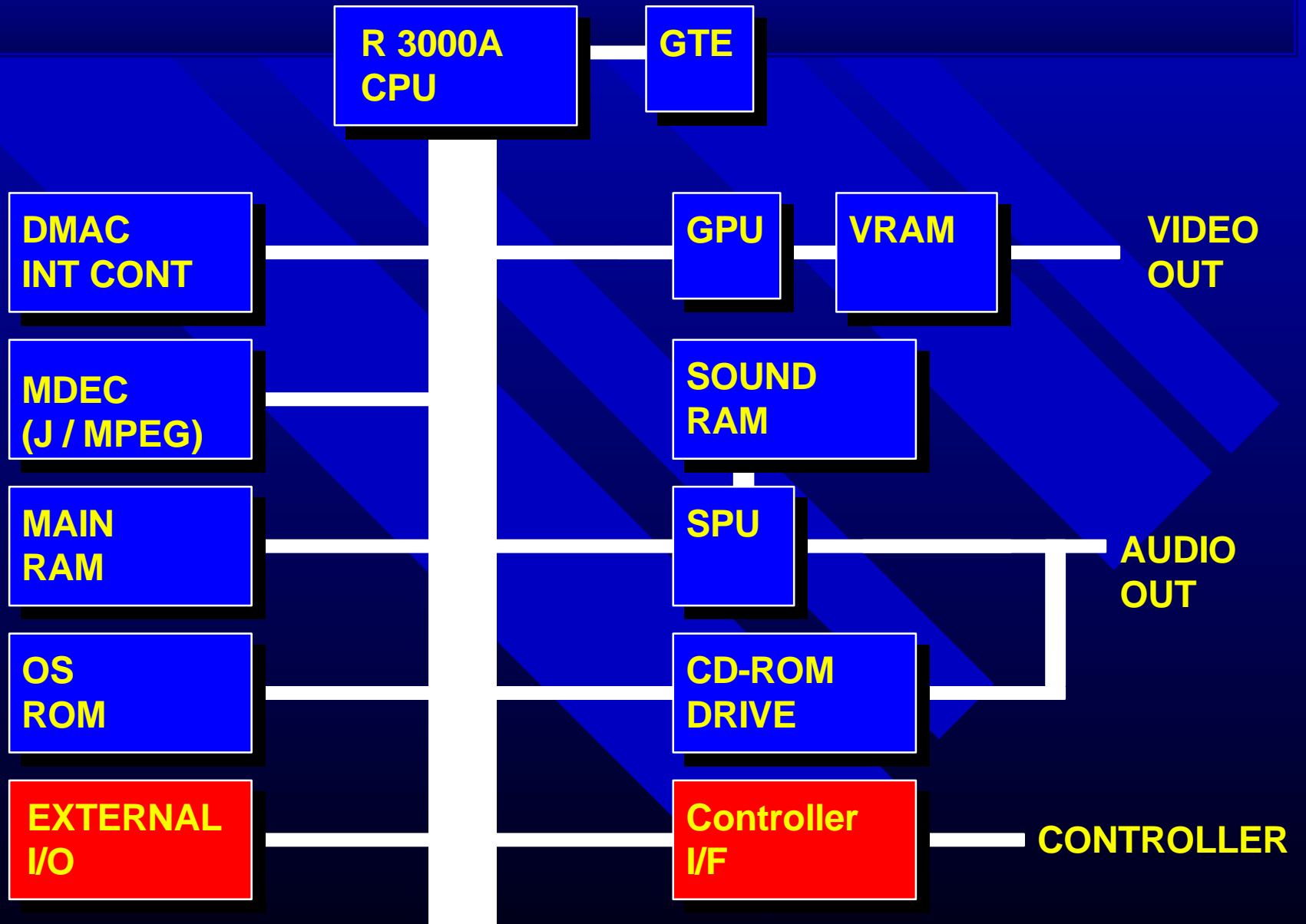
# SYSTEM ARCHITECTURE



# **DATA DECOMPRESSION ENGINE (MDEC)**

- **Operating performance** **80 MIPS**
- **Directly connected to CPU bus**
- **Motion JPEG DCT Engine**
- **Huffman Decoding is done in R3000**

# SYSTEM ARCHITECTURE





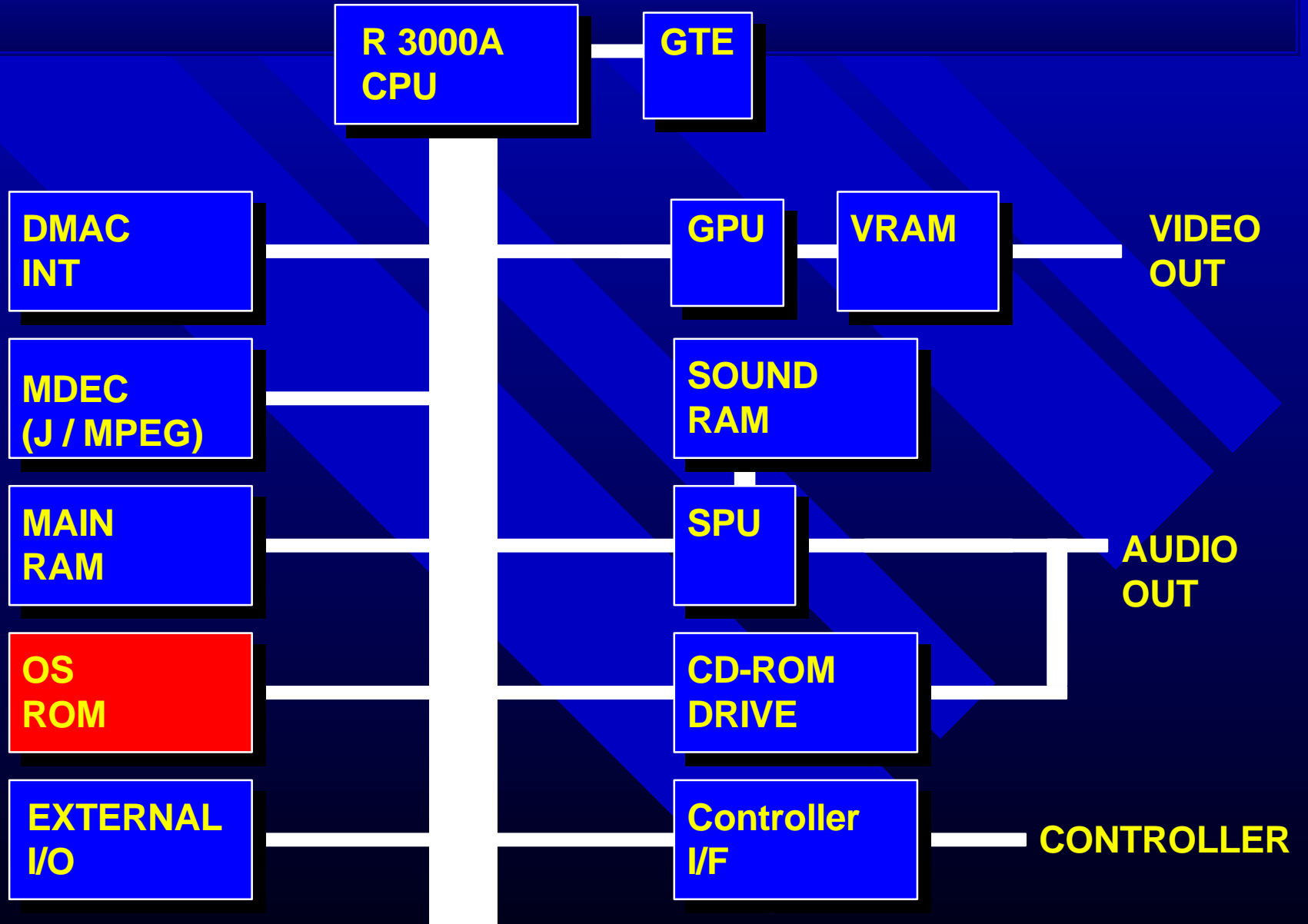
# I/O SYSTEM OVERVIEW

- **Control Pad**
  - Two serial connectors
- **Backup RAM**
  - Two PCMCIA-like removable cards
  - 128 KB Flash Memory; larger configurations possible
  - OS support for File Save, Retrieve and Remove
- **Serial Port I/O**
  - Asynchronous Data Transfer
  - Other peripherals

# **I/O Optimizations**

- **Plan ahead for multiple controllers**
- **Plan for Combat Cable!**
- **Use Combat Cable as Placeholder for Future Network Capability**

# SYSTEM ARCHITECTURE



# **PLAYSTATION OPERATING SYSTEM**

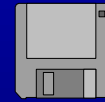
- **Designed by game engineers for game engineers**
- **512KB ROM**
- **Small 64KB RAM footprint**
- **UNIX-like operating architecture**
- **Full pre-emptive multitasking OS**
- **Multi-threaded task handling**
- **Full interrupt logic control**
- **Full suite of device drivers**

# **Architecture for Games**

- **Design Games to use Real-Time 3D Graphics**
- **Optimize for Frame Rates of 30 to 60 FPS**
- **Design Audio as an Integral Part of Game, not Background**

# DEVELOPMENT TOOLS OVERVIEW

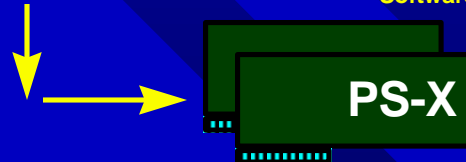
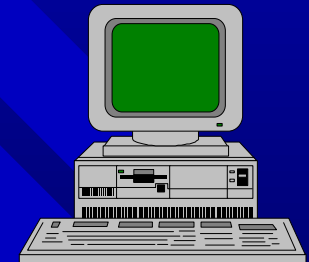
## Programmer Tool Kit



Software

System S/W  
Development  
Environment:  
GNU C/C++  
Assm, Debug,  
etc.

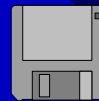
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## Graphic Artist Tool Kit



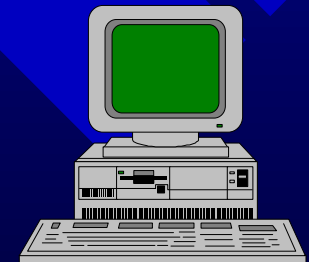
Graphic Artist Board



Software

Starter Kit  
Sprite Editor  
3D Graphics Tool

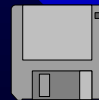
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## Sound Artist Tool Kit



Sound Artist Board



Software

Converters

+



# **Marketing Message**

- **Viral Campaign**
- **Hidden Messages that need to be uncovered - like a game**
- **Challenges to the viewer/consumer - like a game**

# Commercials



# ReCap

- **Understand the Business - Games**
- **Understand the Architecture**
- **Optimize for the Architecture**
- **Understand the Marketing**
- **Let us try to Help!**



**Questions?**