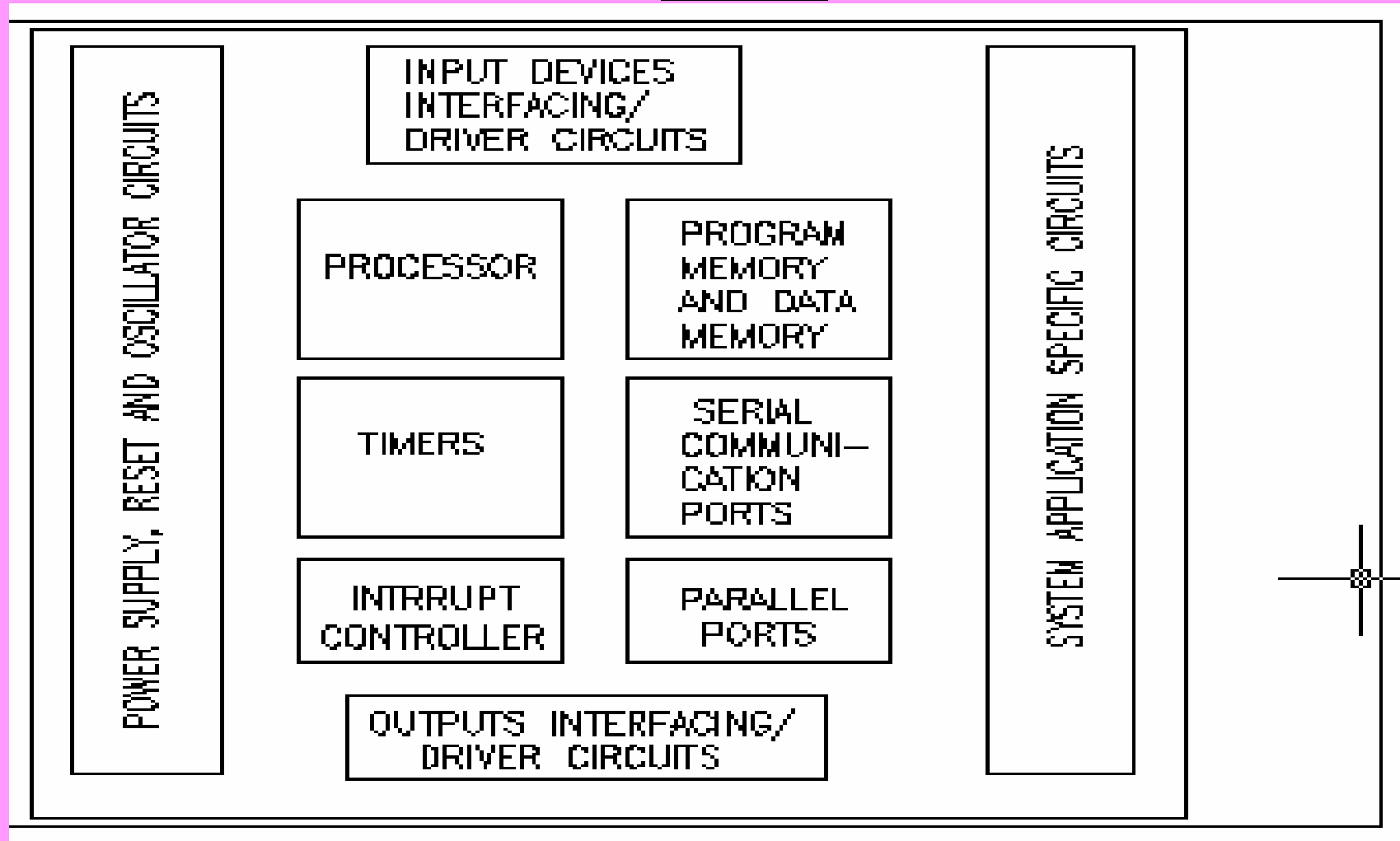


Chapter 1 Lesson 2:
PROCESSOR IN EMBEDDED
SYSTEM

Hardware units in the Embedded Systems

Typical Embedded System Hardware units



Processor

- Program Flow and data path Control Unit (CU) —includes a fetch unit for fetching instructions from the memory

Processor

- Execution Unit (EU) —includes circuits for arithmetic and logical unit (ALU), and for instructions for a program control task, say, data transfer instructions, halt, interrupt, or jump to another set of instructions or call to another routine or sleep or reset

System designer considerations

- Processor Instructions in the Instruction set
- Processor ability to solve the complex algorithms used in meeting the deadlines for their processing.
- Maximum bits in operand (8 or 16 or 32) in a single arithmetic or logical operation.
- Internal and External bus-widths in the data-path

System designer considerations

Clock frequency in MHz and processing speed –

- Million Instructions Per Second (*MIPS*) or
- Million Floating Point Instructions Per Second (*MFLOPS*) or
- *Dhrystone*– an alternate metric for measuring processing performance. Refer Section 2.6

1a. General purpose microprocessor

For example, Intel 80x86, Sparc, or
Motorola 68HCxxx

1b. Embedded general purpose processor

- Fast context switching features, use of on-chip Compilers, for example, Intel® XScale™

Applications Personal Internet Client
Architecture-based PDAs, cell phones
and other wireless devices,

2. Application Specific Instruction-Set Processor (ASIP)

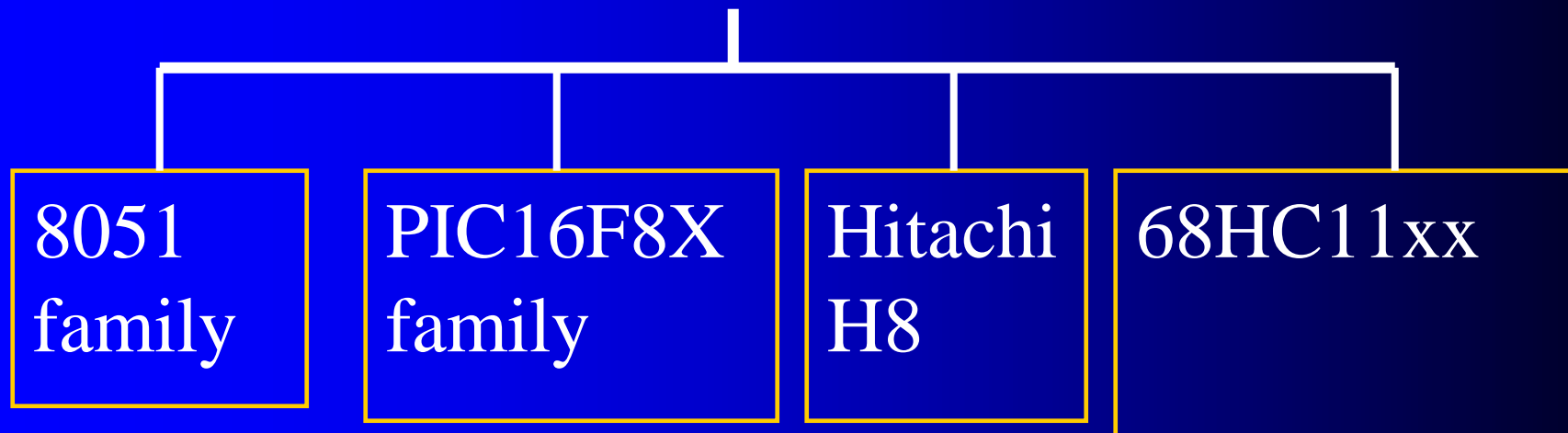
(a) Microcontroller — Intel, Motorola, Hitachi, TI, Philips and ARM, ...

For example, an Intel® — MCS51, Philips® 51XA, 51MX, or

Motorola — 68HC11, 68HC12, 68HC16

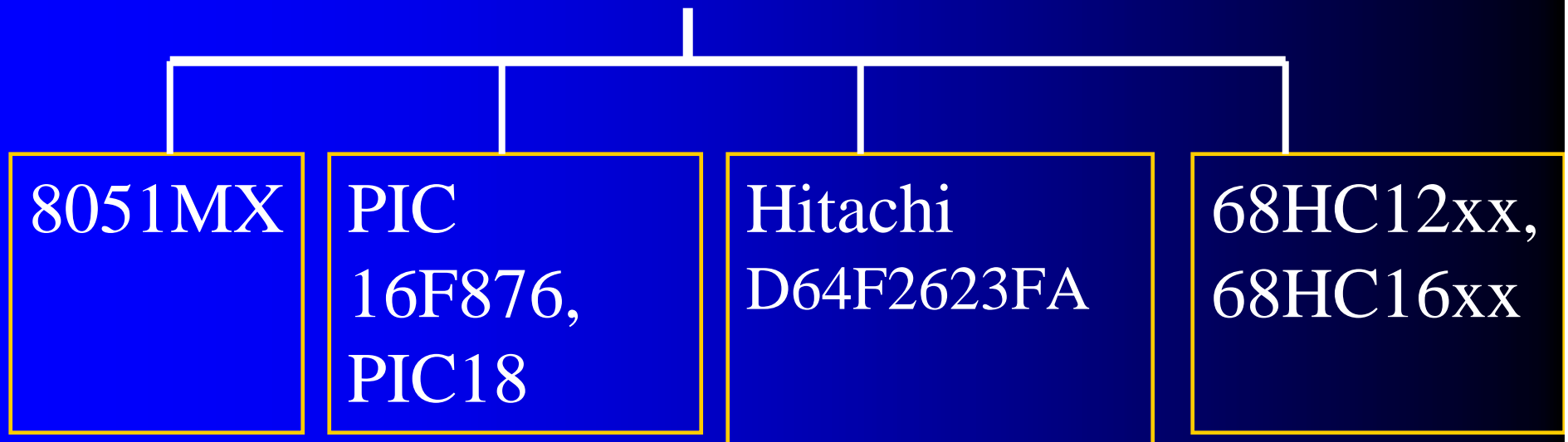
Commonly used exemplary microcontrollers in small scale embedded systems

Small Scale Embedded System 8/16-bit Microcontroller



Commonly used exemplary microcontrollers in medium scale embedded systems

Medium Scale Embedded System 16-bit Microcontroller



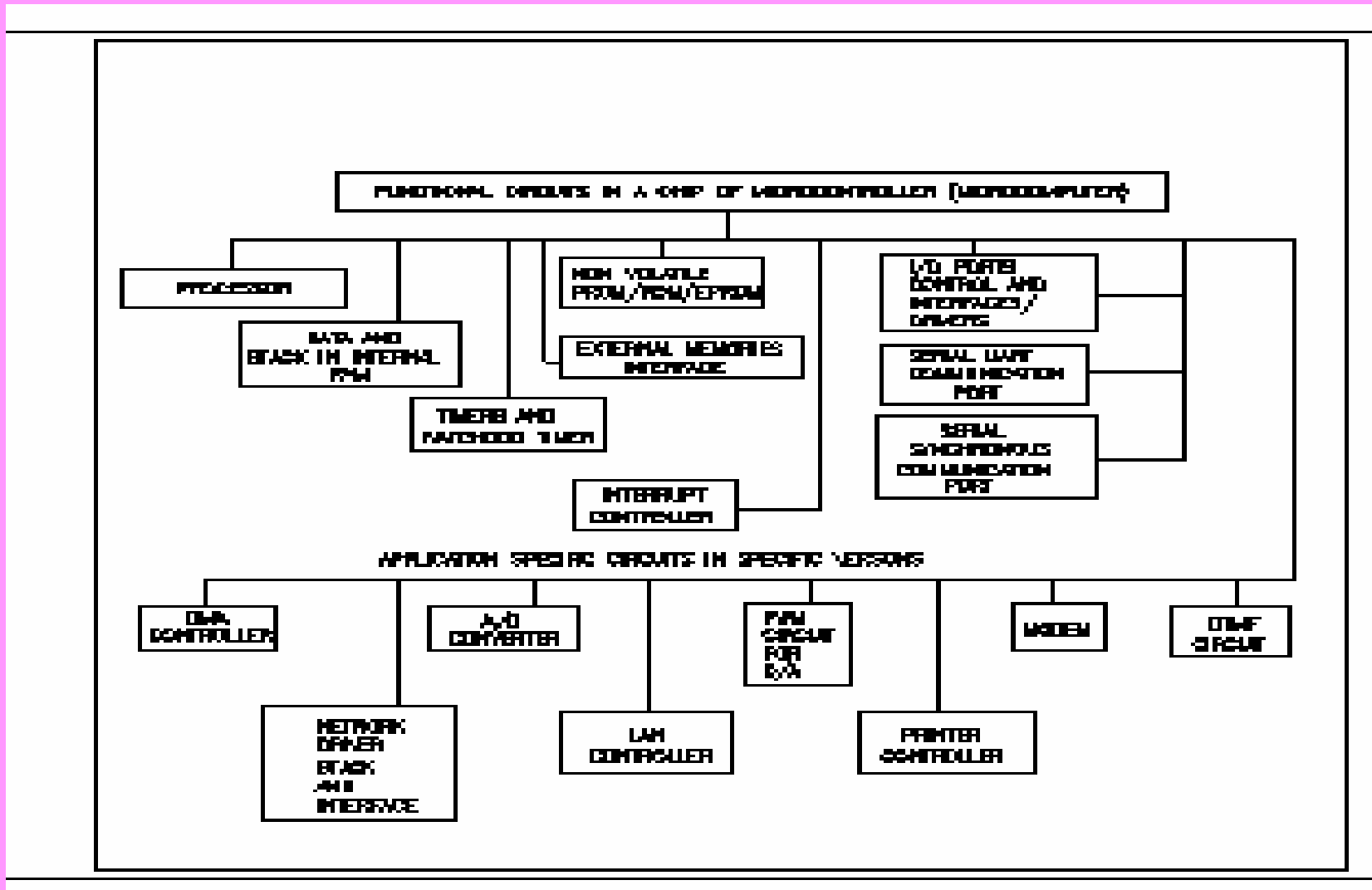
Commonly used exemplary microcontrollers in large-scale embedded systems

Large Scale Embedded System 32-bit
Microcontroller

ARM family Cortex-M3, Atmel AT91 series, ST10 series, Philips LPC 2000 series, Texas Instrument C16x and TMS470R1B1M, Samsung S3C44B0X

Hitachi SH7045F

Subunits in a Microcontroller



Application Specific Instruction-Set Processor (ASIP)

- (b) DSP or
- (c) Media processor or
- (d) IO processor or
- (e) Network processor or
- (f) A domain specific processor

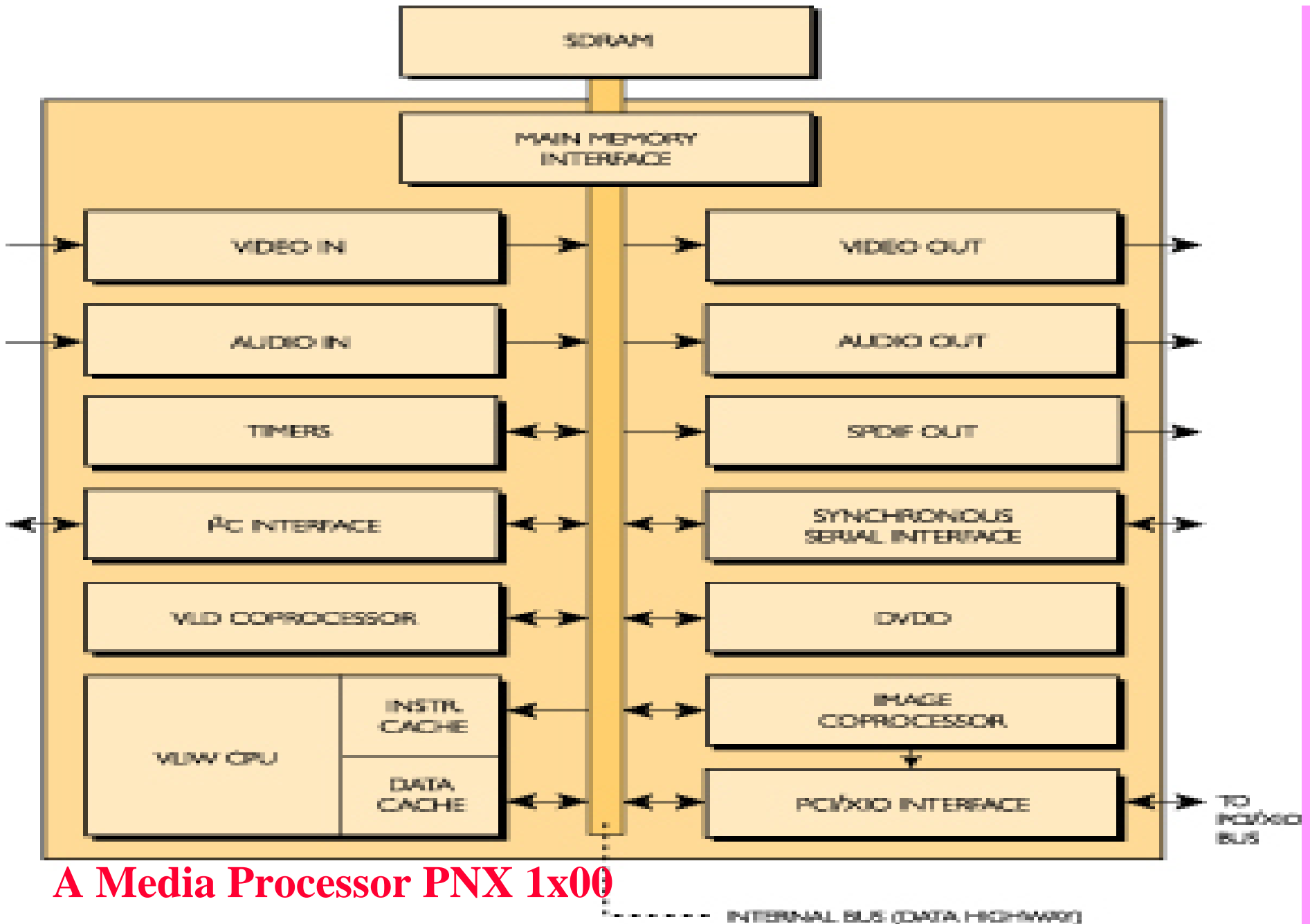
(b) DSP

Typically a

- Texas Instruments- C28x Series, C54xx or C64xx or
- Analog Devices SHARC or TigerSHARC,
- Motorola 5600xx

(d) Media processor

TI DSP TMS320DM310 or Trimedia
Phillips Media Processor 1x00
series for Processing Streaming and
Data Networks and Image, Video
and Speech: PNX 1300, PNX 1500
(2002)



A Media Processor PNX 1x00

3. GPP or ASIP core (s)

- GPP or ASIP Integrated into either an Application Specific Integrated Circuit (ASIC), or a *Very Large Scale Integrated Circuit (VLSI)* circuit or a FPGA core integrated with processor unit(s) in a VLSI (ASIC) chip

4. Application Specific System Processor (ASSP)

Typically a set top box processor
or mpeg video-processor or
network application processor
or mobile application processor

5. Single purpose processor or Application Specific Instruction processor

- Floating point Coprocessor
- CCD Pixel coprocessor and image codec in digital camera
- Graphic processor
- Speech processor
- Adaptive filtering processor

- Encryption engine
- Decryption engine
- Communication protocol stack processor
- Java accelerator

Use of Accelerator Cores:

Examples

- Java Accelerator *Nazonin Communications* Java codes run 15 to 60 Times fast,
- Video Accelerator for fast Video processing

6. Multi core processors or multiprocessor system using GPPs

Examples

- Multiprocessor system for Real time performance in a video-conference system,
- Embedded firewall cum router,
- High-end cell phone, ...

Summary

We learnt

- (i) overview of hardware units,
- (ii) Processor (s) used in the systems: general purpose processor, ASIPs (microcontroller, DSP, Media processor, ..), single purpose processor and multi-processor, ...

End of Lesson 2