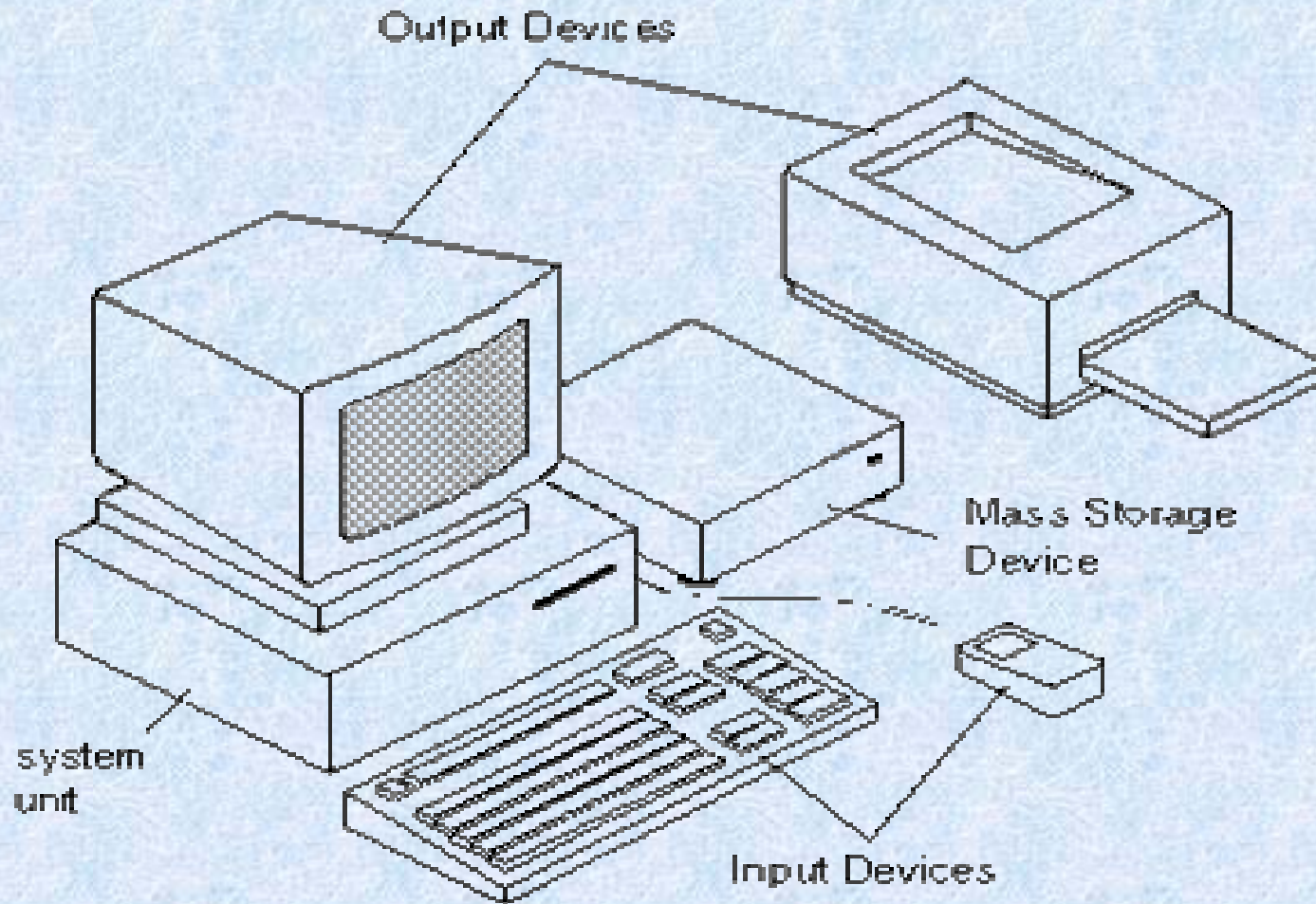


General Definitions

- A **Computer** is a programmable machine.
- The two principal characteristics of a computer are:
- It responds to a specific set of instructions in a well-defined manner.
- It can execute a prerecorded list of instructions (a program).
- Modern computers are electronic and digital .
- The actual machinery wires, transistors, and circuits is called hardware. the instructions and data are called software.

General Definitions (cont..)



Fig

General Definitions (cont..)

- All general-purpose computers require the following hardware components:
- **Memory:** Enables a computer to store, at least temporarily, data and programs.
- **Mass storage device :**Allows a computer to permanently retain large amounts of data. Common mass storage devices include disk drives and tape drives.
- **Input device:** Usually a keyboard and mouse are the input device through which data and instructions enter a computer.

General Definitions (cont..)

- **Output device:** A display screen, printer, or other device that lets you see what the computer has accomplished.
- **Central processing unit (CPU):** The heart of the computer, this is the component that actually executes instructions.
- In addition to these components, many others make it possible for the basic components to work together efficiently.
- For example, every computer requires a bus that transmits data from one part of the computer to another.

General Definitions (cont..)

- Computers can be generally classified by size and power as follows, though there is considerable overlap:
- **Personal computer:** A small, single-user computer based on a microprocessor.
- In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.
- **Working station** : A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.

General Definitions (cont..)

- **Minicomputer** : A multi-user computer capable of supporting from 10 to hundreds of users simultaneously.
- **Mainframe** : A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.
- **Supercomputer** : An extremely fast computer that can perform hundreds of millions of instructions per second.

General Definitions (cont..)

Minicomputer:

- A midsized computer. In size and power, minicomputers lie between workstations and mainframes .
- A minicomputer, a term no longer much used, is a computer of a size intermediate between a microcomputer and a mainframe.
- Typically, minicomputers have been stand-alone computers (computer systems with attached terminals and other devices) sold to small and mid-size businesses for general business applications and to large enterprises for department-level operations.

General Definitions (cont..)

- In recent years, the minicomputer has evolved into the "mid-range server" and is part of a network. IBM's AS/400e is a good example.
- The AS/400 - formally renamed the "IBM iSeries," but still commonly known as AS/400 - is a midrange server designed for small businesses and departments in large enterprises and now redesigned so that it will work well in distributed networks with Web applications.

General Definitions (cont..)

- The AS/400 uses the PowerPC microprocessor with its reduced instruction set computer technology. Its operating system is called the OS/400.
- With multi-terabytes of disk storage and a Java virtual memory closely tied into the operating system, IBM hopes to make the AS/400 a kind of versatile all-purpose server that can replace PC servers and Web servers in the world's businesses, competing with both Wintel and Unix servers, while giving its present enormous customer base an immediate leap into the Internet.

General Definitions (cont..)

Workstation:

- 1) A type of computer used for engineering applications (CAD/CAM), desktop publishing, software development, and other types of applications that require a moderate amount of computing power and relatively high quality graphics capabilities.
 - Workstations generally come with a large, high-resolution graphics screen, at least 64 MB (mega bytes) of RAM, built-in network support, and a graphical user interface.

General Definitions (cont..)

- Most workstations also have a mass storage device such as a disk drive, but a special type of workstation, called a diskless workstation, comes without a disk drive.
- The most common operating systems for workstations are UNIX and Windows NT.
- In terms of computing power, workstations lie between personal computers and minicomputers, although the line is fuzzy on both ends.
- High-end personal computers are equivalent to low-end workstations. And high-end workstations are equivalent to minicomputers.

General Definitions (cont..)

- Like personal computers, most workstations are single-user computers. However, workstations are typically linked together to form a local-area network, although they can also be used as stand-alone systems.
- In networking, *workstation* refers to any computer connected to a local-area network. It could be a workstation or a personal computer.

General Definitions (cont..)

- **Mainframe:** A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously. In the hierarchy that starts with a simple microprocessors (in watches, for example) at the bottom and moves to supercomputer at the top, mainframes are just below supercomputers.
- In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs.
- But supercomputers can execute a single program faster than a mainframe. The distinction between small mainframes and minicomputers is vague, depending really on how the manufacturer wants to market its machines.

General Definitions (cont..)

- **Microcomputer:** The term *microcomputer* is generally synonymous with personal computer, or a computer that depends on a microprocessor.
- Microcomputers are designed to be used by individuals, whether in the form of PCs, workstations or notebook computers.
- A microcomputer contains a CPU on a microchip (the microprocessor), a memory system (typically ROM and RAM), a bus system and I/O ports, typically housed in a motherboard.

General Definitions (cont..)

- **Microprocessor:** A silicon chip that contains a CPU. In the world of personal computers, the terms *microprocessor* and CPU are used interchangeably.
- A **microprocessor** (sometimes abbreviated **μP**) is a digital electronic component with miniaturized transistors on a single semiconductor integrated circuit (IC).
- One or more microprocessors typically serve as a central processing unit (CPU) in a computer system or handheld device.
- Microprocessors made possible the advent of the microcomputer.

General Definitions (cont..)

- At the heart of all personal computers and most working stations sits a microprocessor.
- Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.
- Three basic characteristics differentiate microprocessors:
- Instruction set: The set of instructions that the microprocessor can execute.
- Bus width : The number of bits processed in a single instruction.

General Definitions (cont..)

- Clock speed : Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.
- In both cases, the higher the value, the more powerful the CPU. For example, a 32 bit microprocessor that runs at 50MHz is more powerful than a 16-bit microprocessor that runs at 50MHz.
- In addition to bus width and clock speed, microprocessors are classified as being either RISC (reduced instruction set computer) or CISC (complex instruction set computer).

General Definitions (cont..)

- **Supercomputer:** A supercomputer is a computer that performs at or near the currently highest operational rate for computers.
- A supercomputer is typically used for scientific and engineering applications that must handle very large databases or do a great amount of computation (or both).
- At any given time, there are usually a few well-publicized supercomputers that operate at the very latest and always incredible speeds.

General Definitions (cont..)

- The term is also sometimes applied to far slower (but still impressively fast) computers.
- Most supercomputers are really multiple computers that perform parallel processing.
- In general, there are two parallel processing approaches: symmetric multiprocessing (SMP) and massively parallel processing (MPP).

General Definitions (cont..)

- **Microcontroller:** A highly integrated chip that contains all the components comprising a controller.
- Typically this includes a CPU, RAM, some form of ROM, I/O ports, and timers.
- Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task - to control a particular system.
- A microcontroller differs from a microprocessor, which is a general-purpose chip that is used to create a multi-function computer or device and requires multiple chips to handle various tasks.

General Definitions (cont..)

- A microcontroller is meant to be more self-contained and independent, and functions as a tiny, dedicated computer.
- The great advantage of microcontrollers, as opposed to using larger microprocessors, is that the parts-count and design costs of the item being controlled can be kept to a minimum.
- They are typically designed using CMOS (complementary metal oxide semiconductor) technology, an efficient fabrication technique that uses less power and is more immune to power spikes than other techniques.

General Definitions (cont..)

- **Controller:** A device that controls the transfer of data from a computer to a peripheral device and vice versa.
- For example, disk drives, display screens, keyboards and printers all require controllers.
- In personal computers, the controllers are often single chips.
- When you purchase a computer, it comes with all the necessary controllers for standard components, such as the display screen, keyboard, and disk drives.

General Definitions (cont..)

- If you attach additional devices, however, you may need to insert new controllers that come on expansion boards.
- Controllers must be designed to communicate with the computer's expansion bus.
- There are three standard bus architectures for PCs - the AT bus, PCI (Peripheral Component Interconnect) and SCSI.
- When you purchase a controller, therefore, you must ensure that it conforms to the bus architecture that your computer uses.

General Definitions (cont..)

- Short for *Peripheral Component Interconnect*, a local bus standard developed by Intel Corporation.
- Most modern PCs include a PCI bus in addition to a more general IAS expansion bus.
- PCI is also used on newer versions of the Macintosh computer.
- PCI is a 64-bit bus, though it is usually implemented as a 32 bit bus. It can run at clock speeds of 33 or 66 MHz.
- At 32 bits and 33 MHz, it yields a throughput rate of 133 MBps.

General Definitions (cont..)

- Short for *small computer system interface*, a parallel interface standard used by Apple Macintosh computers, PCs, and many UNIX systems for attaching peripheral devices to computers.
- Nearly all Apple Macintosh computers, excluding only the earliest Macs and the recent iMac, come with a SCSI port for attaching devices such as disk drives and printers.
- SCSI interfaces provide for faster data transmission rates (up to 80 megabytes per second) than standard serial and parallel ports. In addition, you can attach many devices to a single SCSI port, so that SCSI is really an I/O bus rather than simply an interface

General Definitions (cont..)

- Although SCSI is an ANSI standard, there are many variations of it, so two SCSI interfaces may be incompatible.
- For example, SCSI supports several types of connectors.
- While SCSI has been the standard interface for Macintoshes, the iMac comes with *IDE*, a less expensive interface, in which the controller is integrated into the disk or CD-ROM drive.
- The following varieties of SCSI are currently implemented:
- **SCSI-1:** Uses an 8-bit bus, and supports data rates of 4 MBps.

General Definitions (cont..)

- **SCSI-2:** Same as SCSI-1, but uses a 50-pin connector instead of a 25-pin connector, and supports multiple devices. This is what most people mean when they refer to plain *SCSI*.
- **Wide SCSI:** Uses a wider cable (168 cable lines to 68 pins) to support 16-bit transfers.
- **Fast SCSI:** Uses an 8-bit bus, but doubles the clock rate to support data rates of 10 MBps.
- **Fast Wide SCSI:** Uses a 16-bit bus and supports data rates of 20 MBps.

General Definitions (cont..)

- **Ultra SCSI:** Uses an 8-bit bus, and supports data rates of 20 MBps.
- **Wide Ultra2 SCSI:** Uses a 16-bit bus and supports data rates of 80 MBps.
- **SCSI-3:** Uses a 16-bit bus and supports data rates of 40 MBps. Also called *Ultra Wide SCSI*.
- **Ultra2 SCSI:** Uses an 8-bit bus and supports data rates of 40 MBps.

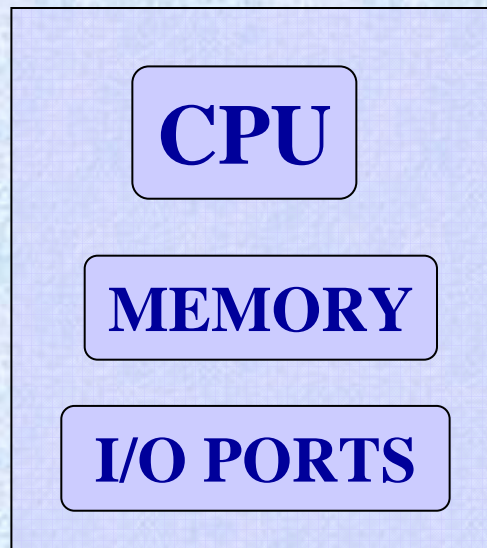
General Definitions (cont..)

- **Embedded system:** A specialized computer system that is part of a larger system or machine.
- Typically, an embedded system is housed on a single microprocessor board with the programs stored in ROM.
- Virtually all appliances that have a digital Interface- watches, microwaves, VCRs, cars -utilize embedded systems.
- Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program.

General Definitions (cont..)

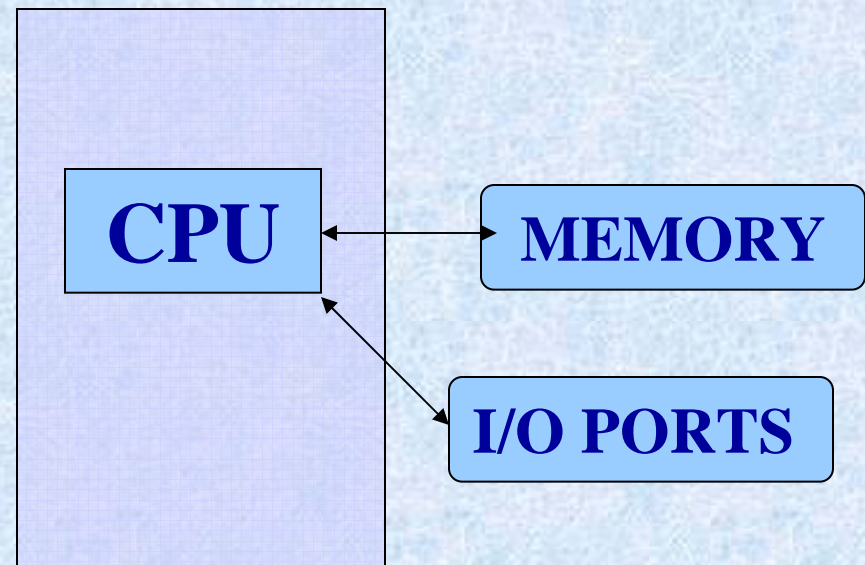
Micro Controller

- It is a single chip
- Consists Memory, I/o ports



Micro Processor

- It is a CPU
- Memory, I/O Ports to be connected externally



General Definitions (cont..)

Definitions :

- A **Digital Signal Processor** is a special-purpose CPU (Central Processing Unit) that provides ultra-fast instruction sequences, such as shift and add, and multiply and add, which are commonly used in math-intensive signal processing applications.
- A **digital signal processor (DSP)** is a specialized microprocessor designed specifically for *digital signal processing*, generally in real time.

General Definitions (cont..)

Digital

- *operating by the use of discrete signals to represent data in the form of numbers.*

Signal

- *a variable parameter by which information is conveyed through an electronic circuit.*

Processing

- *to perform operations on data according to programmed instructions.*

General Definitions (cont..)

Digital Signal processing

- changing or analysing information which is measured as discrete sequences of numbers .
- **Digital signal processing (DSP)** is the study of signals in a digital representation and the processing methods of these signals.
- DSP and analog signal processing are subfields of signal processing.

General Definitions (cont..)

DSP has three major subfields:

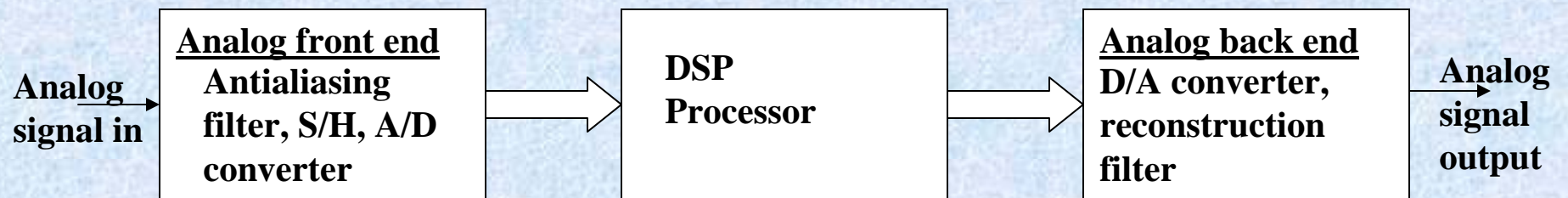
- Audio signal processing, Digital image processing and Speech processing.
- Since the goal of DSP is usually to measure or filter continuous real-world analog signals, the first step is usually to convert the signal from an analog to a digital form, by using an analog to digital converter.
- Often, the required output signal is another analog output signal, which requires a digital to analog converter.

General Definitions (cont..)

Characteristics of Digital Signal Processors:

- Separate program and data memories (Harvard architecture).
- Special Instructions for SIMD (Single Instruction, Multiple Data) operations.
- Only parallel processing, no multitasking.
- The ability to act as a direct memory access device if in a host environment.
- Takes digital data from ADC (Analog-Digital Converter) and passes out data which is finally output by converting into analog by DAC (Digital-Analog Converter).
- analog input-->ADC-->DSP-->DAC--> analog output.

General Definitions (cont..)



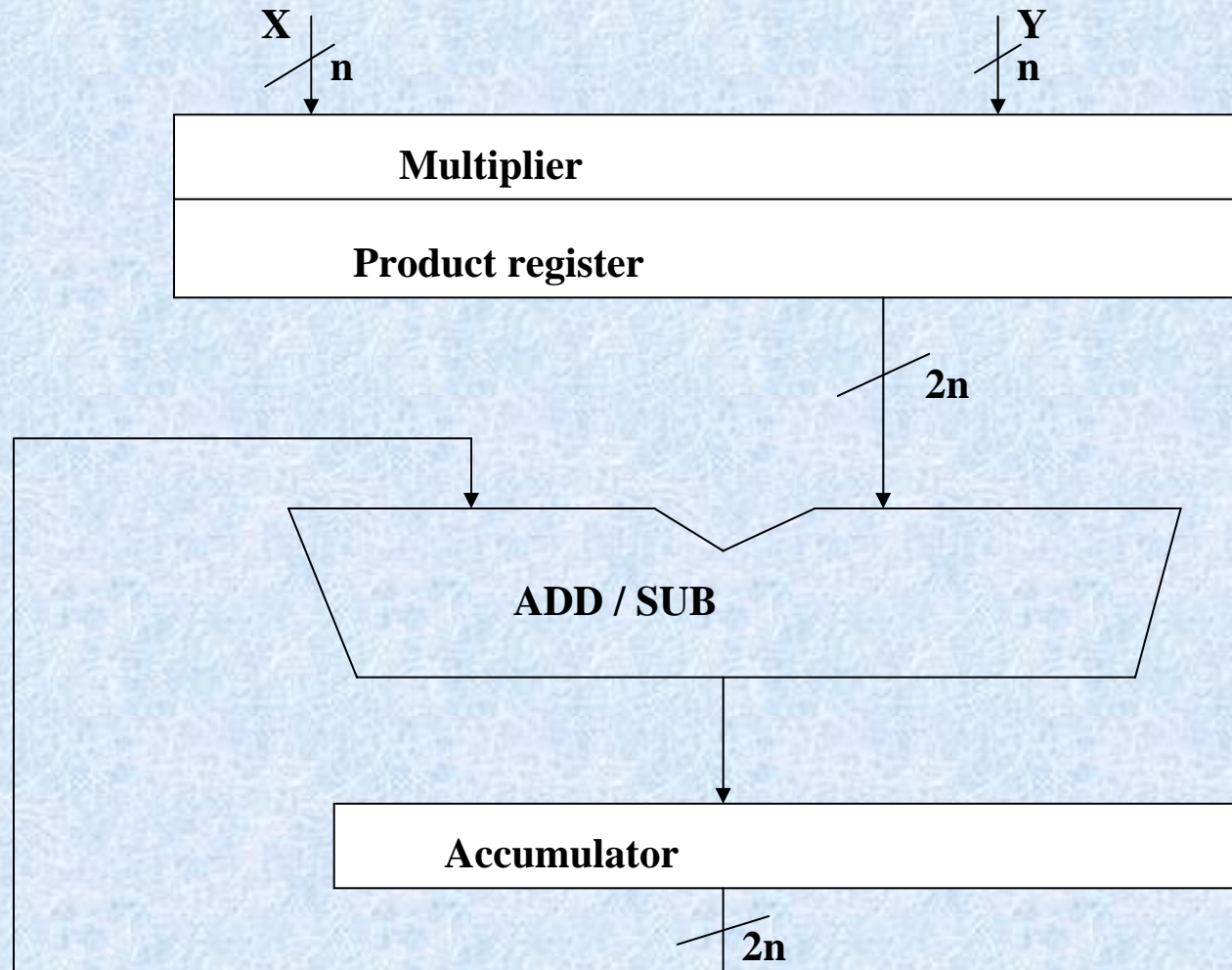
DAP System

General Definitions (cont..)

Multiply-accumulate hardware:

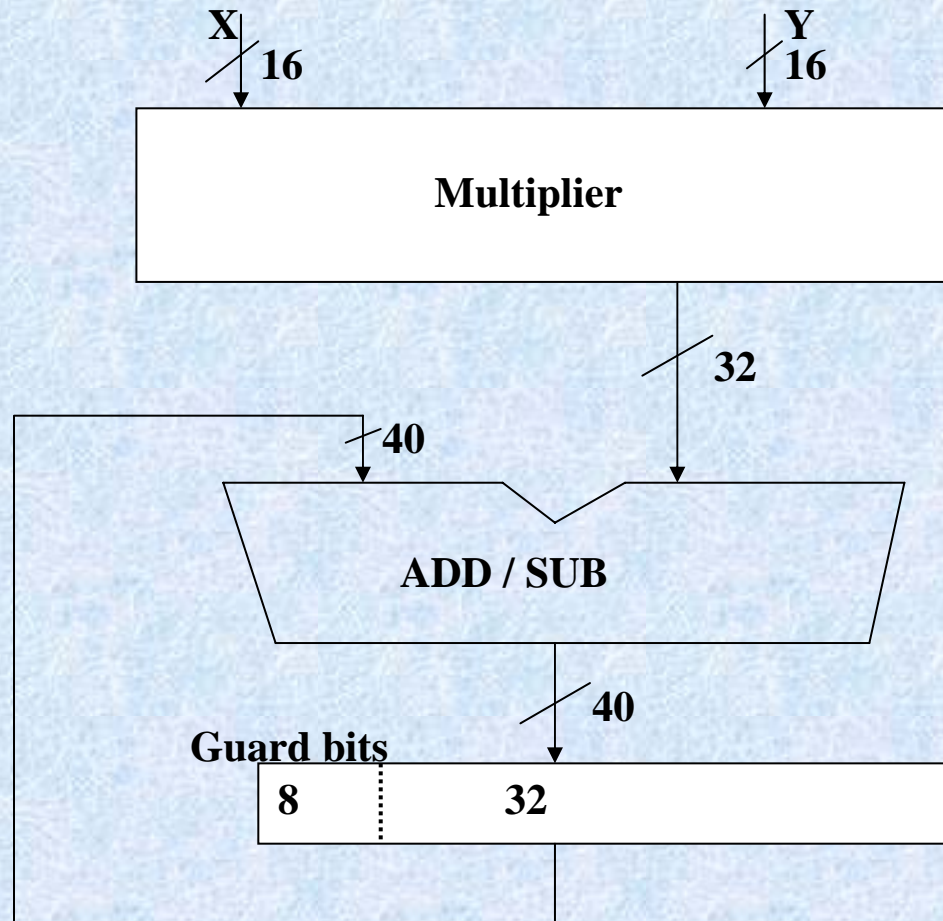
- Multiply accumulate is the most frequently used operation in digital signal processing.
- In order to implement this efficiently, the DSP has an hardware multiplier, an accumulator with an adequate number of bits to hold the sum of products and at explicit multiply-accumulate instructions.
- *Harvard architecture*: in this memory architecture, there are two memory spaces. Program memory and data memory.

General Definitions (cont..)



A MAC unit

General Definitions (cont..)

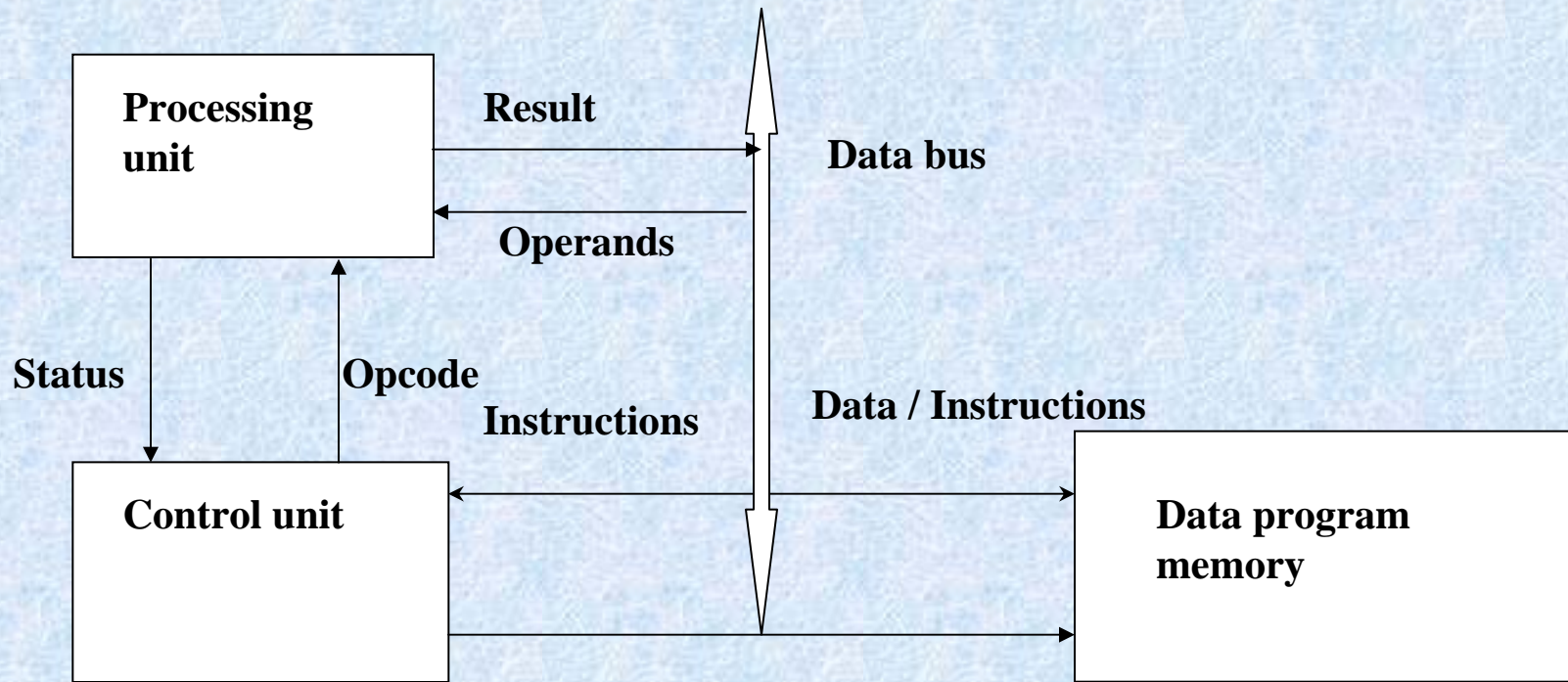


A MAC unit with accumulator guard bits

General Definitions (cont..)

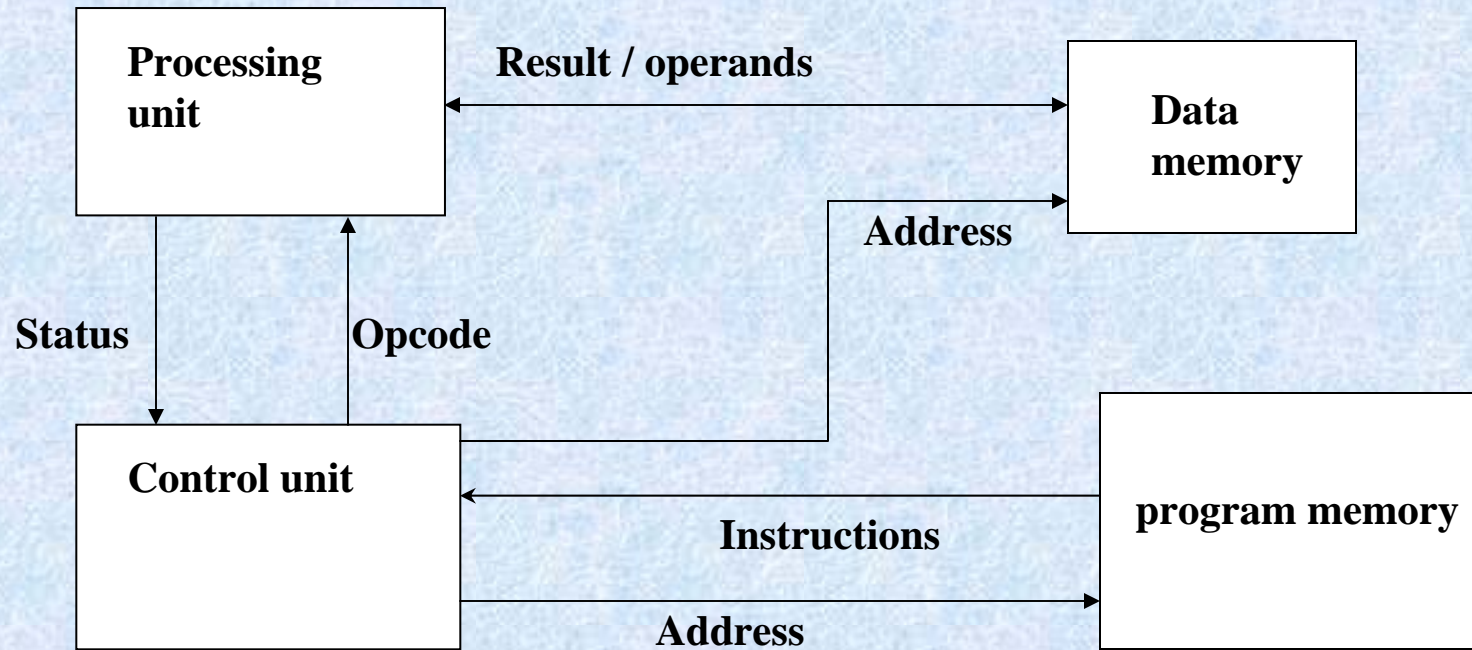
- The processor core connects to these memory spaces by two separate bus sets, allowing two simultaneous access to memory. This arrangement doubles the processor memory bandwidth.
- ***Zero-overhead looping***: one common characteristics of DSP algorithms is that most of the processing time is split on executing instructions contained with relatively small loops.
- The term zero overhead looping means that the processor can execute loops without consuming cycles to test the value of the loop counter, perform a conditional branch to the top of the loop, and decrement the loop counter.

General Definitions (cont..)



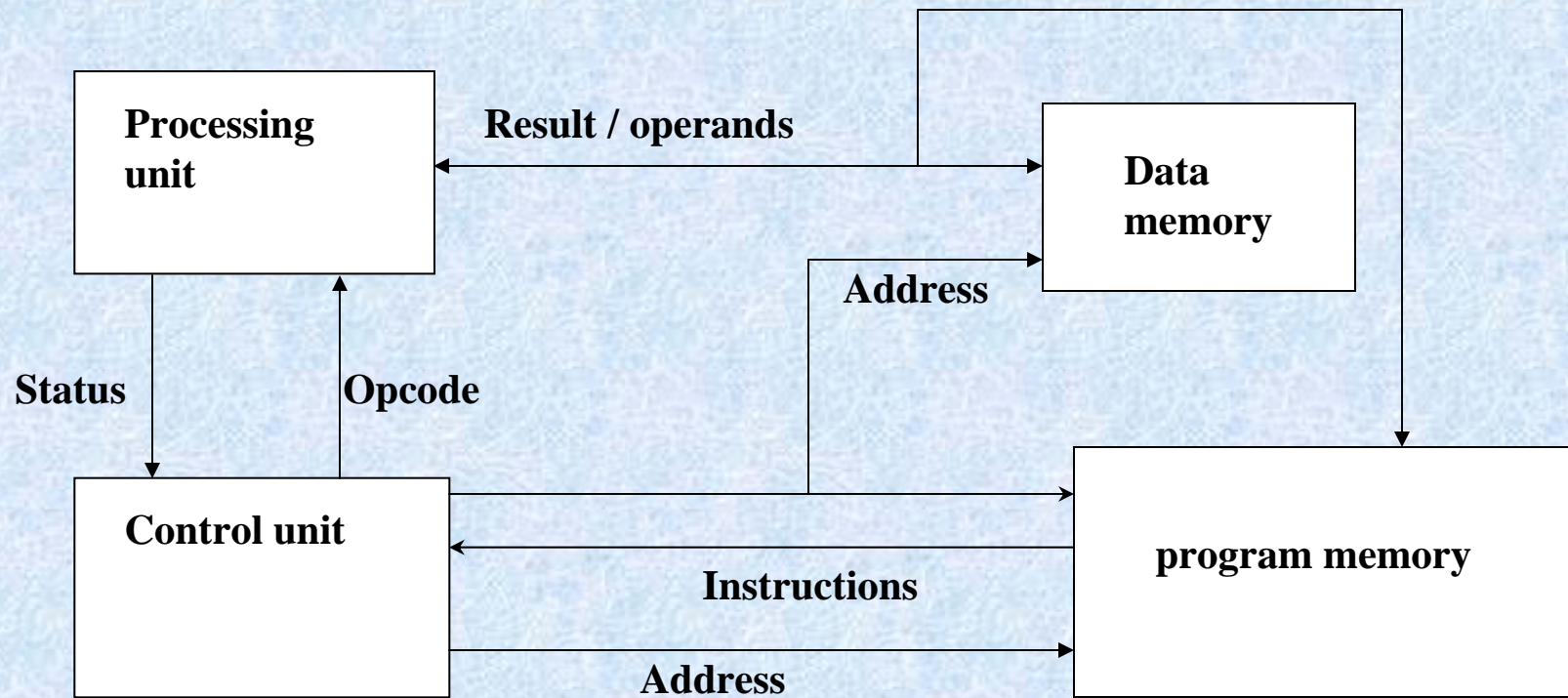
Von Neuman Architecture

General Definitions (cont..)



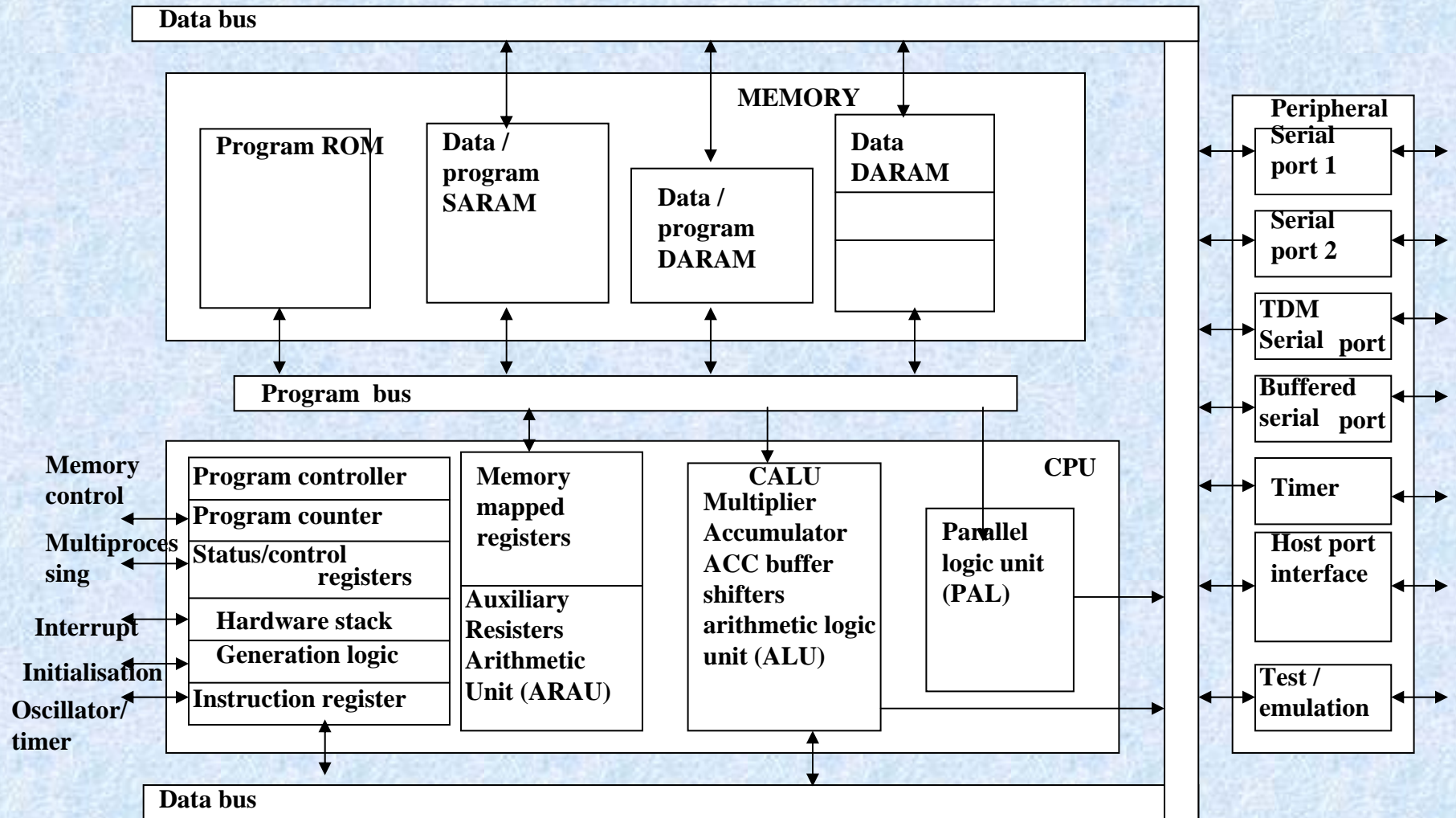
Harvard Architecture

General Definitions (cont..)



Modified Harvard Architecture

General Definitions (cont..)



Internal Architecture of the TMS320C5X DSP

General Definitions (cont..)

- The advantages of DSP are :

Versatility:

- digital systems can be reprogrammed for other applications (at least where programmable DSP chips are used)
- digital systems can be ported to different hardware (for example a different DSP chip or board level product)

Repeatability:

- digital systems can be easily duplicated
- digital system responses do not drift with temperature

General Definitions (cont..)

- digital systems do not depend on strict component tolerances.

Simplicity:

- some things can be done more easily digitally than with analogue systems
- DSP is used in a very wide variety of applications but most share some common features:
- they use a lot of multiplying and adding signals .
- they deal with signals that come from the real world.
- they require a response in a certain time.

General Definitions (cont..)

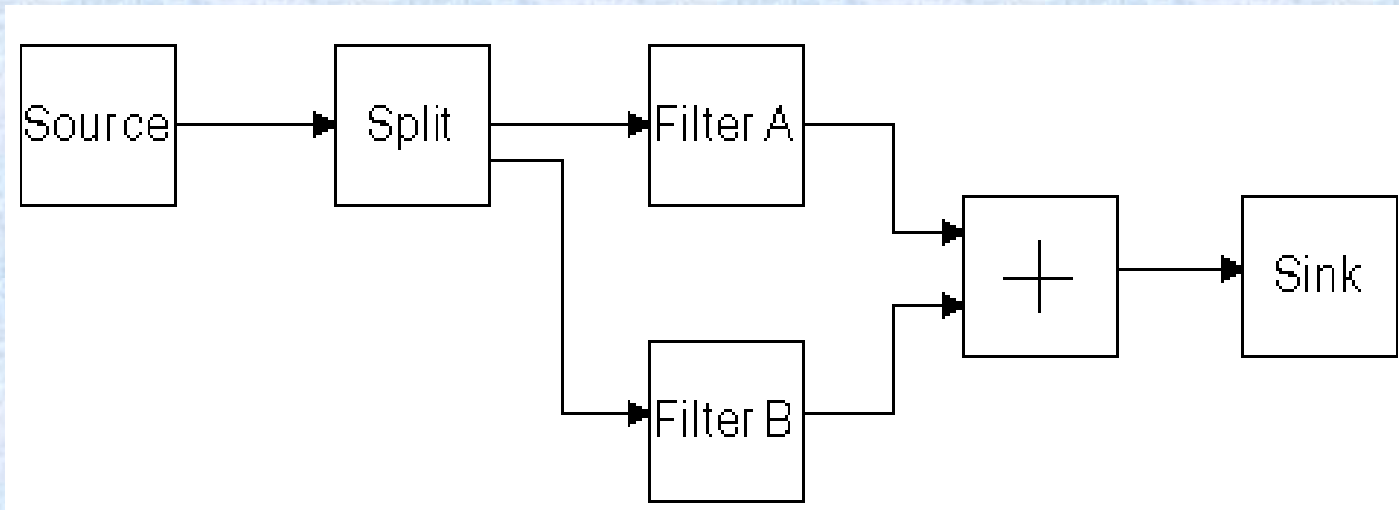


Figure : A block diagram (or dataflow graph)

General Definitions (cont..)

- What is the difference between a DSP and a microprocessor ?
- The essential difference between a DSP and a microprocessor is that a DSP processor has features designed to support high-performance, repetitive, numerically intensive tasks.
- In contrast, general-purpose processors or microcontrollers (GPPs / MCUs for short) are either not specialized for a specific kind of applications (in the case of general-purpose processors), or they are designed for control-oriented applications (in the case of microcontrollers).

General Definitions (cont..)

- Features that accelerate performance in DSP applications include:
- Single-cycle multiply-accumulate capability; high-performance DSPs often have two multipliers that enable two multiply-accumulate operations per instruction cycle; some DSP have four or more multipliers.
- Specialized addressing modes, for example, pre- and post-modification of address pointers, circular addressing, and bit-reversed addressing.

General Definitions (cont..)

- Most DSPs provide various configurations of on-chip memory and peripherals tailored for DSP applications. DSPs generally feature multiple-access memory architectures that enable DSPs to complete several accesses to memory in a single instruction cycle.
- Specialized execution control. Usually, DSP processors provide a loop instruction that allows tight loops to be repeated without spending any instruction cycles for updating and testing the loop counter or for jumping back to the top of the loop

General Definitions (cont..)

- DSP processors are known for their irregular instruction sets, which generally allow several operations to be encoded in a single instruction.
- For example, a processor that uses 32-bit instructions may encode two additions, two multiplications, and four 16-bit data moves into a single instruction.
- In general, DSP processor instruction sets allow a data move to be performed in parallel with an arithmetic operation. GPPs/MCUs, in contrast, usually specify a single operation per instruction

General Definitions (cont..)

- What is really important is to choose the processor that is best suited for your application.
- If a GPP/MCU is better suited for your DSP application than a DSP processor, the processor of choice is the GPP/MCU.
- It is also worth noting that the difference between DSPs and GPPs/MCUs is fading: many GPPs/MCUs now include DSP features, and DSPs are increasingly adding microcontroller features.