

Devices and Buses for Device-Networks -

Lesson-1: IO Devices
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I/O Types and Examples

- A serial port for serial communication
- Serial communication means that over a given line or channel one bit can communicate and the bits transmit at periodic intervals generated by a clock
- A serial port communication is over short or long distances.

I/O Types and Examples

- A Parallel port is a port for parallel communication
- Parallel communication means that multiple bits can communicate over a set of parallel lines at any given instance.
- A Parallel port communicates within the same board, between Ics or wires over very short distances of at most less than a meter

I/O Types and Examples

- Serial and parallel ports of I/O devices can be classified in to following I/O types:
 - i) Synchronous serial input
 - ii) Synchronous serial output
 - iii) Asynchronous serial UART input
 - iv) Asynchronous serial UART output
 - v) Parallel port one bit input
 - vi) Parallel one bit output
 - vii) Parallel port input
 - viii) Parallel port output

1. Definition of a Device

- Any peripheral or component or utility that interfaces externally or internally to a computer system ports or buses, which then enables certain specific action or part of application by interaction with the computer basic hardware.

Examples

- LCD display, mice, modem, timer, keypad are the devices. Timer is an internal device and keyboard is an IO device in a computer system

Device Program

- Most external and internal devices needs a program that enables certain specific action or part of application. The program is called device driver. [Chapter 4 Lesson 1]

Device IO Port

- External devices interface through a port to the computer buses. Port has a set of addresses through which device connects and then a device program does the IO operations.

2. Importance of the IO Devices

- IO operations (IO devices operate through the ports) are the important main operations in most embedded systems. For examples, router, switch, mobile phone.
- IO devices are important part of a system

3. IO Device Types

- 1) *Serial Input device*- Audio Input, Video Input, Network Input, Serial IO bus Output , Remote Device Input
- 2) *Serial Output device*- Audio Output, Video Output, Network Output, Serial IO bus Output, Remote Device Control Output

ISR Concept

- Interrupt means event, which invites the attention of processor for some action on the hardware or software event.

ISR Concept

1. When a device or port is ready, a device or port generates an interrupt or when it completes the assigned action, it generates an interrupt. This interrupt is called hardware interrupt

ISR Concept

2. When software run-time exception condition is detected, either processor hardware or software instruction generates an interrupt. This interrupt is called software interrupt or trap or exception
 - In response to interrupt, an ISR is executed

Interrupt Vector

Interrupt vector is a memory address to which the processor vectors.

The processor transfers the program counter to the interrupt vector new address on an interrupt

Interrupt Vector

Using this address, the processor services that interrupt by executing corresponding ISR.

The memory addresses for vectoring by the processor are processor or microcontroller specific.

Vectoring is as per the provisions in interrupt-handling mechanism.

Interrupt Vector Table

4. Three ways of communication between the devices

- ☐ Synchronous,
- ☐ Iso-synchronous
- ☐ Asynchronous

Synchronous Communication

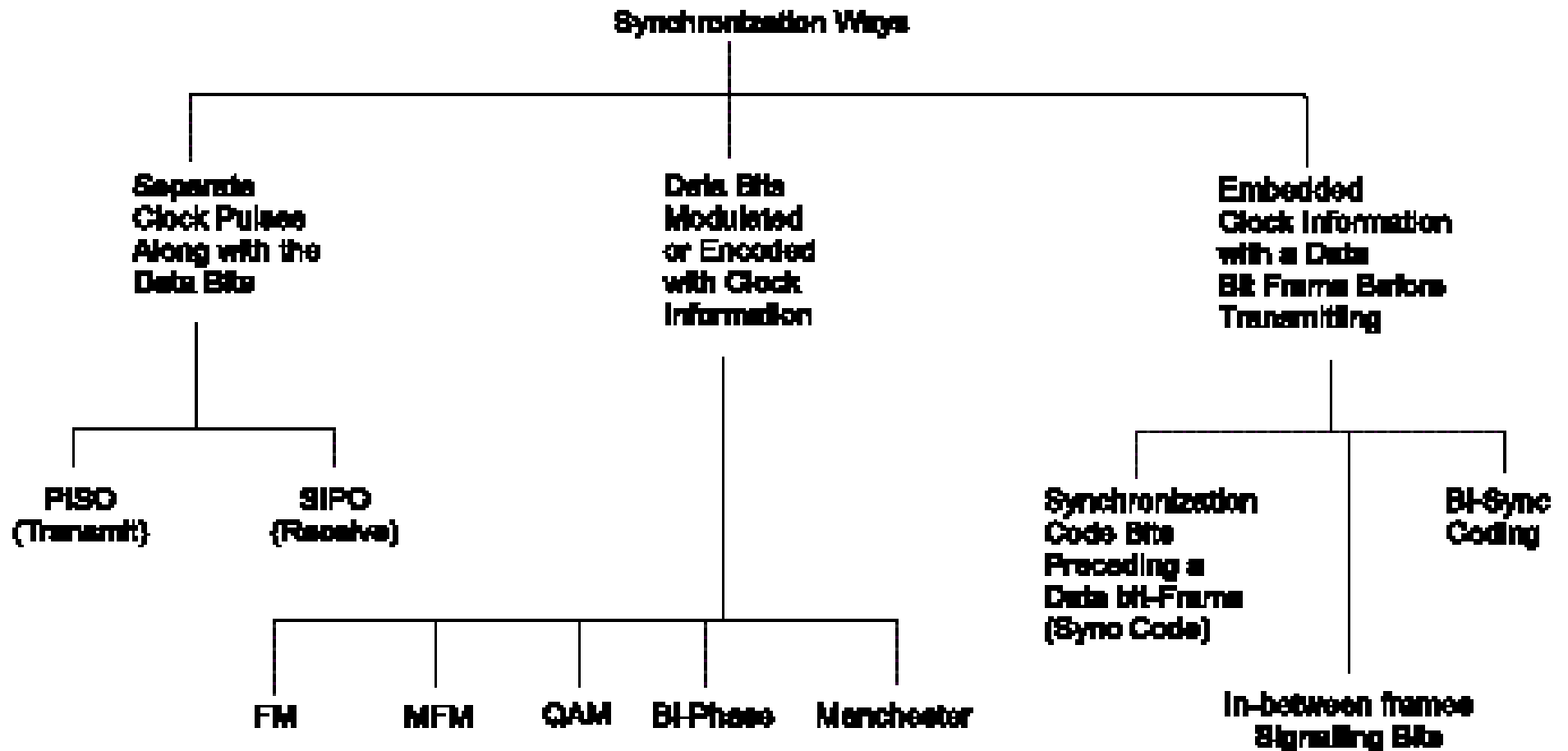
- ❑ Clock information is transmitted explicitly or implicitly in synchronous communication. The receiver clock continuously maintains constant phase difference with the transmitter clock. Bits of a data frame maintain uniform phase difference and are sent within a fixed maximum time interval

Iso Synchronous Communication

- ❑ Clock of receiver maintains constant phase difference with the transmitter clock in Iso-synchronous communication.

Bits of a data frame can be sent within a variable maximum time interval

Ten ways of Transmitting Synchronous Serial bits



Asynchronous Communication

- ❑ Clocks of receiver and transmitter are independent. Bits of a data frame have variable phase differences and may not be sent within any prefixed time interval. Example: UART Serial communication, Telephone line communication. Each successive byte can have variable time-gap

Handshaking

- Handshaking means that the source and destination first exchange the signals between them before they communicate the data bus

Two Modes of communication between the devices and computer system

- ❑ Full Duplex – Both devices or device and computer system simultaneously communicate each other
- ❑ Half Duplex – Only one device can communicate with another

Timing and Counting Devices

A computer system need at least one timing device (to function as system clock). System clock is one that on each tick interrupts the system and initiates a process

Timing and Counting Devices

The counts are stored and incremented on each pulse

A counting device is a device that counts the input for events that may occur at irregular or regular intervals.

The count gives the number of input events or pulses since it was last read

Examples

- Real Time Clock, Pulse Accumulator Counter, Watchdog Timer, Serial Communication rate-control timer, OS timer for task scheduling
- Both hardware timers and software timers are used in the systems [Sections 3.2 and G.6 for details]

Watchdog Timer

- Watchdog timer is a timing device that can be set for a preset time interval, and an event must occur during that interval else the device will generate the timeout signal.

Watchdog Timer

- For example, we anticipate that a set of tasks must finish within 100ms.
- The watchdog timer disables and stops in case the tasks finish within 100ms.

Watchdog Timer

- The watchdog timer generates interrupts after 100ms and executes a routine that runs because the tasks failed to finish in the anticipated interval.
- A software task can also be programmed as a watchdog timer.
- A microcontroller may also provide for the watchdog timer.

Watchdog Timer

- The watchdog timer has a number of applications.
- One application in a mobile phone is that the display is turned off in case no GUI interaction takes place within a specified time.
- The interval is usually set at 15, 20, 25, or 30s in a mobile phone. This saves power.

Watchdog Timer

- Another application in a phone is that if a given menu is not selected by a click within a preset time interval, another menu can be presented or a beep can be generated to invite user's attention

Watchdog Timer

- An application in a temperature controller is that if a controller takes no action to switch off the current within the preset time, the current is switched off and a warning signal raised, indicating controller failure.
- Failure to switch off current may cause a boiler in which water is heated to burst.

End of Lesson 1 of Chapter 3