DEVICE DRIVERS AND INTERRUPTS SERVICE MECHANISM

Lesson-1: Programmed I/O (*busy and wait*) method for ports and devices, and the need for interrupt driven IOs

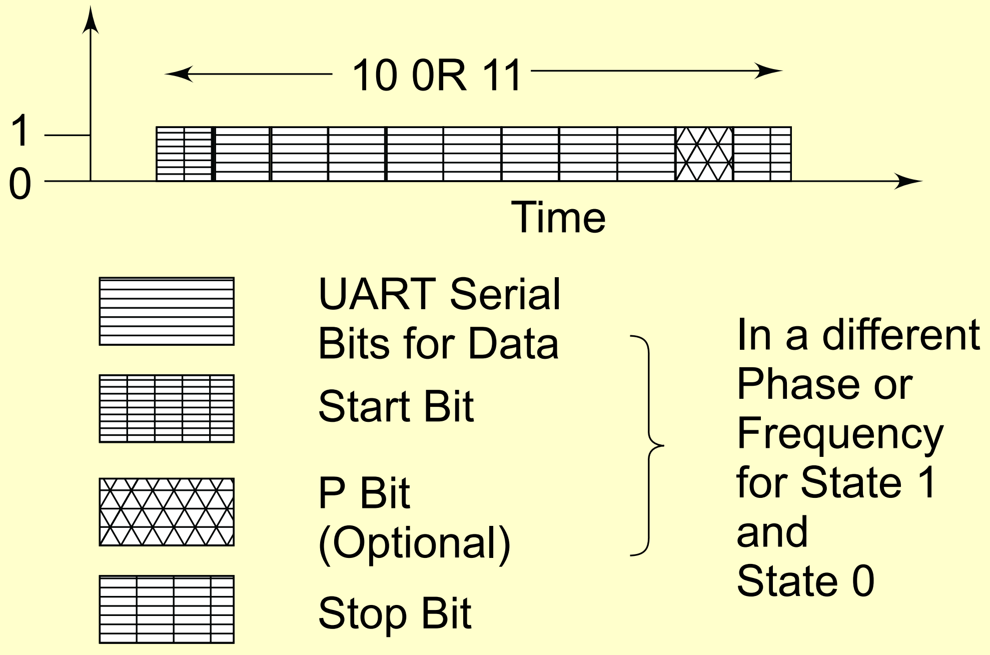
Programmed IOs approach from ports and devices

- Processor is continuously busy in executing the program related to input or output from the port and waits for the input ready or output completion
- Processor is continuously busy in executing the program related to device functions and waits for the device status ready or function completions

Example— A 64-kbps UART Input

- When a UART transmits in format of 11-bit per character format, the network transmits at most 64 kbps ÷ 11 = 5818 characters per second, which means every 171.9 µs a character is expected.
- Before 171.9 µs, the receiver port must be checked to find and read another character assuming that all the received characters are in succession without any in-between time-gap

Format of bits at UART protocol


10 0R 11
1
0
Time
UART Serial Bits for Data
Start Bit
P Bit (Optional)
Stop Bit
In a different Phase or Frequency for State 1 and State 0

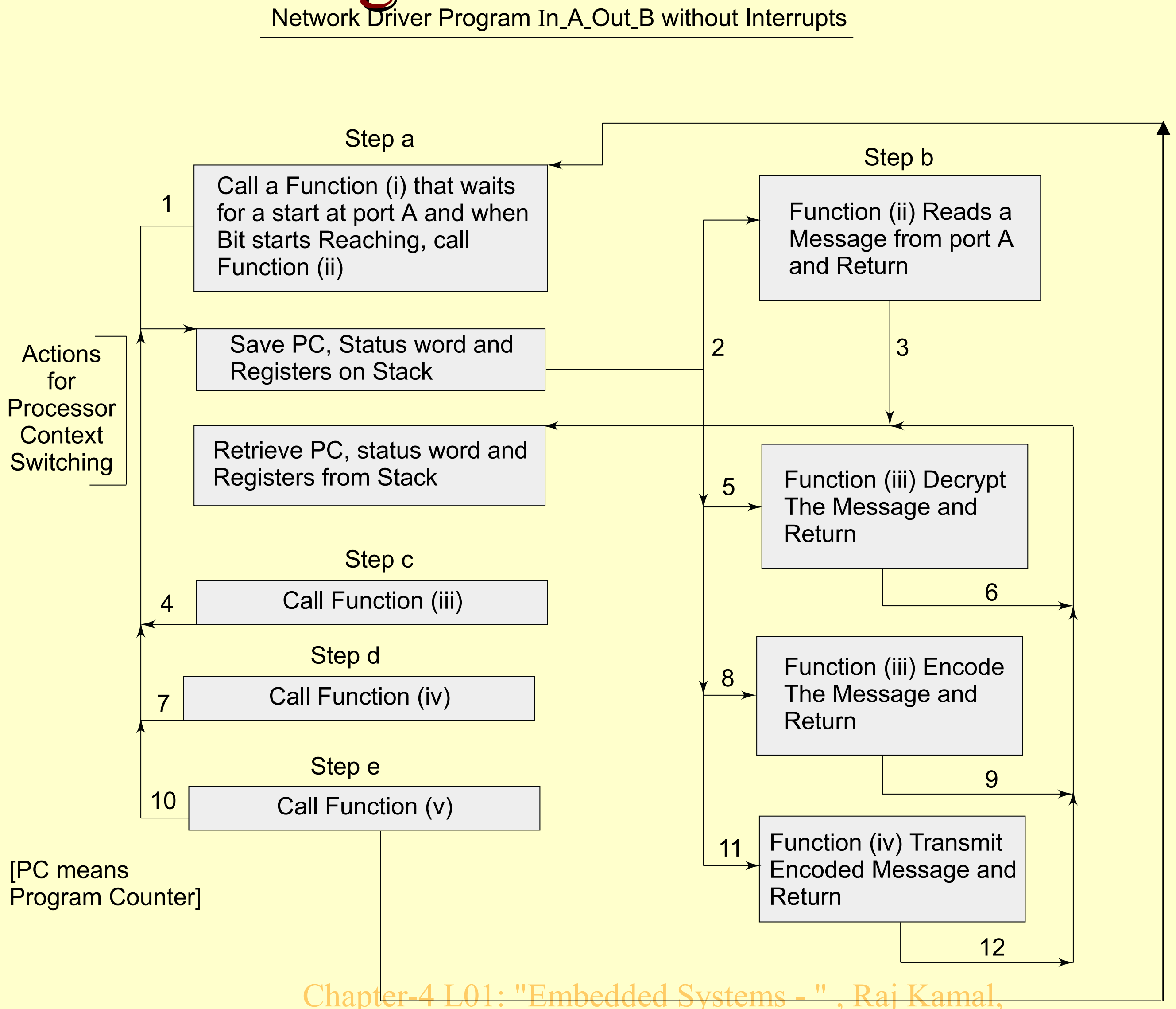
Ports A and B with no interrupt generation and interrupt service (handling) mechanism

- Port *A* be in a PC, and port B be its modem input which puts the characters on the telephone line.
- Let *In_A_Out_B* be a routine that receives an input-character from Port A and re-transmits the character to Port *B* output.

In_A_Out_B routine

- Has to cyclically call the following steps *a* to *e* and executes the cycles of functions *i* to *v*, thus ensuring the modem port *A* does not miss reading the character

Programmed IO Method


Network Driver Program In_A_Out_B without Interrupts
Step a
Call a Function (i) that waits for a start at port A and when Bit starts Reaching, call Function (ii)
1
Save PC, Status word and Registers on Stack
Actions for Processor Context Switching
Retrieve PC, status word and Registers from Stack
Step b
Function (ii) Reads a Message from port A and Return
2
3
Function (iii) Decrypt The Message and Return
5
6
Step c
Call Function (iii)
4
Step d
Call Function (iv)
7
Function (iii) Encode The Message and Return
8
9
Step e
Call Function (v)
10
Function (iv) Transmit Encoded Message and Return
11
12
[PC means Program Counter]

In_A_Out_B routine

- Call function *i*
- Call function *ii*
- Call function *iii*
- Call function *iv*
- Call function v
- Loop back to step 1

Steps a, b and c

- Step *a*: Function *i*— Check for a character at port A, if not available, then wait
- Step *b*: Function *ii*— Read Port *A* byte (character for message) and return to step *a* instruction, which will call function *iii*
- Step *c*: Function *iii*— Decrypt the Message and return to step *a* instruction, which will call function *iv*

Steps d and e

- Step *d*: Function *iv*— Encode the Message and return to step *a* instruction, which will call function *v*.
- Step *e*: Function *v* — Transmit the encoded message to Port B and return to step *a* last instruction, which will start step *a* from beginning

Step *a*

- Does Polling— Polling a port means to find the status of the port— whether ready with a character (byte) at input or not.
- Polling must start before 171.9 µs because characters are expected at 64 kbps/11 bit format.

Condition in which no character misses

- If the program instructions in four steps b, c, d and e (functions *ii* to *v)* take total running time of less than 171.9 µs then the above programmed IO method works

Problems with Programmed IOs approach from ports and devices

1. (a) The program must switch to execute the *In_A_Out_B* cycle of steps *a* to *e* within a period less than 171.9 µs. (b) Programmer must ensure that steps of *In_A_Out_B* and any other device program steps never exceed this time.

Problems with Programmed IOs approach from portas and devices

2. When the characters are not received at Port *A* in regular succession, the waiting period during step *a* for polling the port can be very significant.
3. Wastage of processor times for the waiting periods is the most significant disadvantage of the present approach

Problem with Programmed IOs approach from ports and devices

4. When the other ports and devices are also present, then programming problem is to poll each port and device, and ensure that program switches to execute the *In_A_Out_B* step *a* as well as switches to poll each port or device on time and then execute each service routines related to the functions of other ports and devices within specific time intervals such that each one is polled on time.

Problems with Programmed IOs approach from ports and devices

5. The program and functions are processor and device specific in the above busy-wait approach, and all system functions must execute in synchronization and timings are completely dependent on periods of software execution

IO based on an interrupt from Port *A*

- Instead of continuously checking for characters at the port *A* by executing function (*i*) we can first call step *a* when a modem receives an input character, sets a status bit in its status register and interrupts Port *A*. The interrupt should be generated by port hardware.
- In response to the interrupt, an interrupt service routine ISR_ PortA _Character executes─ an efficient solution in place the wait at step *a* (poll for input character)

Application of programmed IOs

- In case of single purpose processor and dedicated IOs or device functions with continuous device status polling

Summary

We learnt

- Programmed IOs from ports and devices is when processor is busy with the IO or device functions only and waits for the port or device status ready for sending or receiving data and
- Useful for single purpose processor for the IOs and device-functions
- Wastage of processor times for the waiting periods (for polling for input status)─_most significant disadvantage
- Interrupt generation alternative to wait for the device or port status

End of Lesson 1 of Chapter 4