INTER-PROCESS COMMUNICATION AND SYNCHRONISATION:

Lesson-15: Queue

1. IPC Queue functions

Queue and Mailbox

- Some OSes provide the mailbox and queue both IPC functions
- Every OS provides queue IPC functions.
- When the IPC functions for mailbox are not provided by an OS, then the OS employs queue for the same purpose.

Queue IPC features

- OS provides for inserting and deleting the message-pointers or messages.
- Each queue for a message need initialization (creation) before using the functions in the scheduler for the message queue.

Queue IPC features

- There may be a provision for multiple queues for the multiple types or destinations of messages. Each queue have an ID.
- Each queue either has a user definable size (upper limit for number of bytes) or a fixed pre-defined size assigned by the scheduler.

Queue IPC features

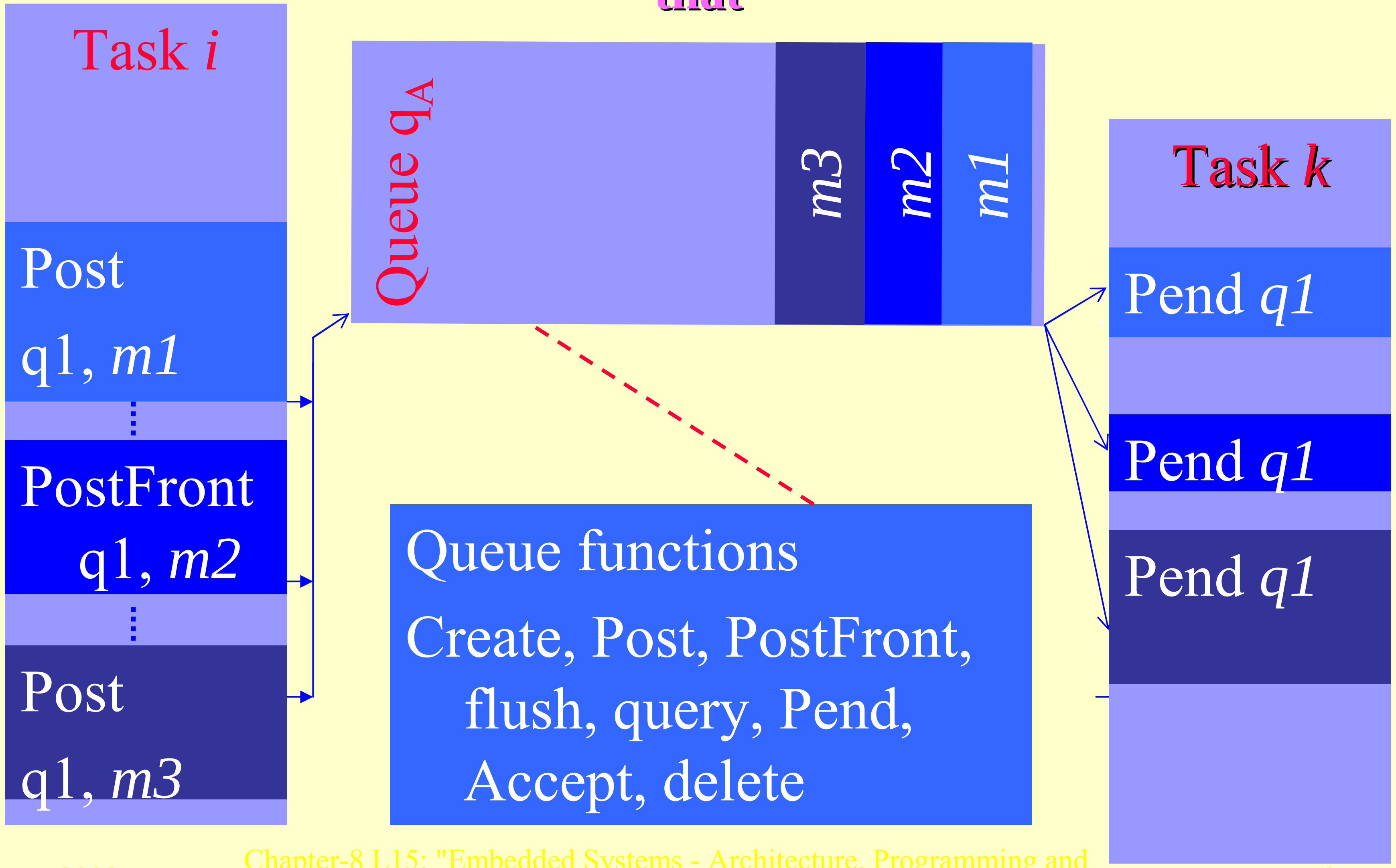
- When an RTOS call is to insert into the queue, the bytes are as per the pointed number of bytes.
- For example, for an integer or float variable as a pointer, there will be four bytes inserted per call. If the pointer is for an array of 8 integers, then 32 bytes will be inserted into the queue.

Queue IPC features

- When a queue becomes full, there may be a need for error handling and user codes for blocking the task(s). There may not be self-blocking.

2. Queue Related Functions at the OS

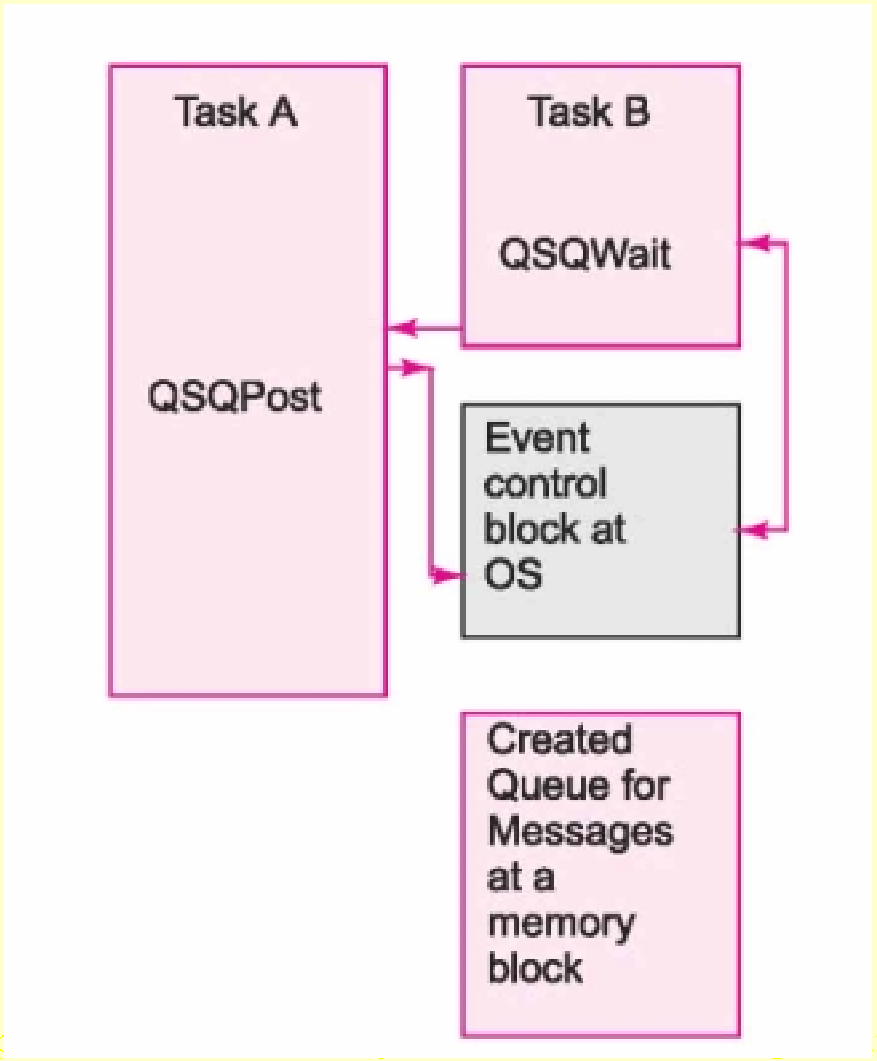
Tasks *i* sending messages into a queue q1 and task *k* receiving that



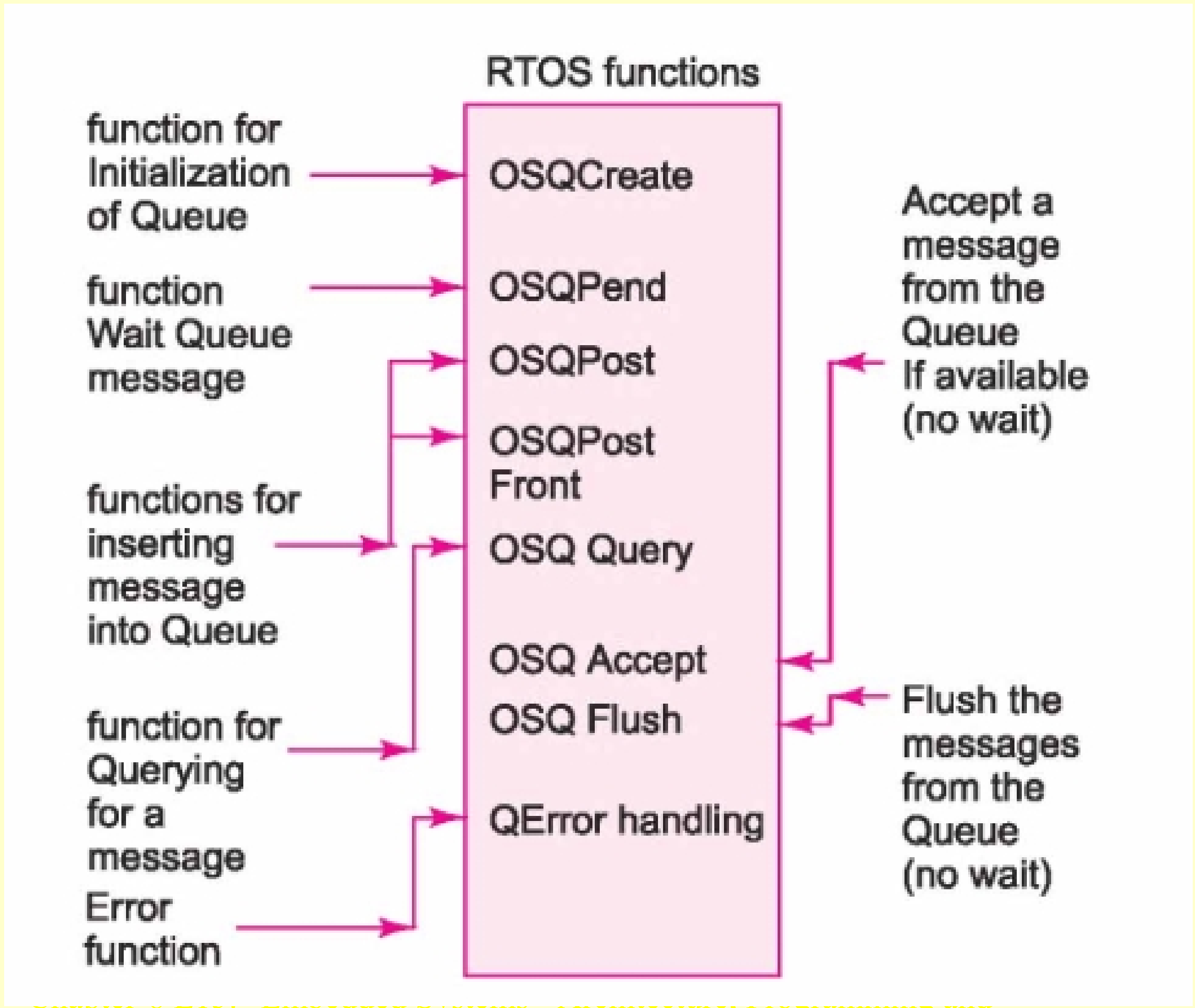
Queue functions

Create, Post, PostFront, flush, query, Pend, Accept, delete

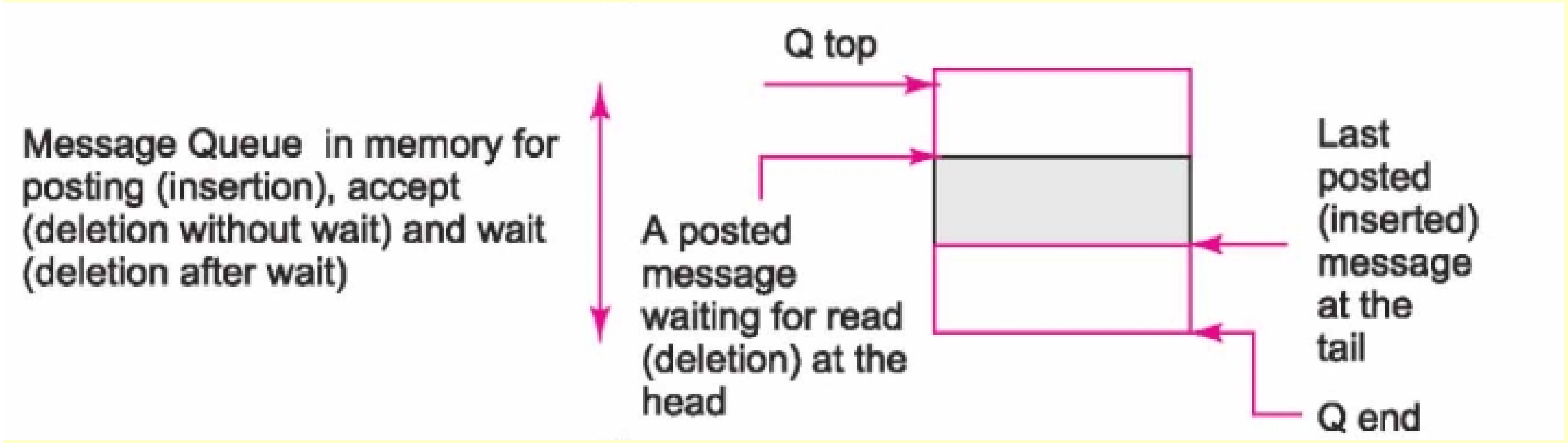
Memory-blocks at OS —- for for queue inserting, deleting and other functions


Task A
QSQPost
Task B
QSQWait
Event control block at OS
Created Queue for Messages at a memory block

Memory Block for OS Queue IPC functions


RTOS functions
OSQCreate
OSQPend
OSQPost
OSQPost Front
OSQ Query
OSQ Accept
OSQ Flush
QError handling
function for Initialization of Queue
function Wait Queue message
functions for inserting message into Queue
function for Querying for a message
Error function
Accept a message from the Queue If available (no wait)
Flush the messages from the Queue (no wait)

Queue messages block


Q top
Message Queue in memory for posting (insertion), accept (deletion without wait) and wait (deletion after wait)
A posted message waiting for read (deletion) at the head
Last posted (inserted) message at the tail
Q end

Queue IPC functions

- OSQCreate— to create a queue and initialize the queue message, blocks the contents with front and back as queue-top pointers, *QFRONT and *QBACK, respectively.
- OSQPost — to post a message to the message block as per the queue back pointer, *QBACK. (Used by ISRs and tasks)

Queue IPC functions...

- OSQPend – to wait for a queue message at the queue and reads and deletes that when received. (Wait, Used by tasks.)

Queue IPC functions...

- OSQAccept ─ to read the present queue front pointer after checking its presence yes or no and after the read the queue front pointer increments (No wait. Used by ISRs and tasks)
- OSQFlush ─ to read queue from front to back, and deletes the queue block, as it is not needed later after the *flush* the queue front and back points to QTop, pointer to start of the queue. (Used by ISRs and tasks)

Queue IPC functions...

- OSQQuery─ to querythe queue message-block when *read* and but the message is not deleted. The function returns pointer to the message queue *QFRONT if there are the messages in the queue or else null. It return a pointer to data structure of the queue data structure which has   *QFRONT, number of queued messages, size of the queue and. table of tasks waiting for the messages from the queue. [Query is used by tasks.]

Queue IPC functions...

- OSQPostFront ─ to send a message as per the queue front pointer, *QFRONT. Use of this function is made in the following situations. A message is urgent or is of higher priority than all the previously posted message into the queue (Used in ISRs and tasks)

3. IPC Queue functions Application Example

Task_Director_Output in Robot Orchestra

static void Task_*Director_Output (void *taskPointer)* **{**

.

while (1) {

.

/* Codes for inserting musical notes into the queue */

for (OSQEntries = 0; OSQEntries < OSQSize; OSQEntries ++)

Task_Director_Output in Robot Orchestra

{OSQPost (QDirector, *note*)} /* Post for the Queue QDirector messages upto the OSQSize /*

.

};

Task Player Input in Robot Orchestra

static void Task*_Player_Input (void *taskPointer)* **{**

.

while (1) {

.

/* Codes for deleting notes from the queue */

for (OSQEntries = OSQSize; OSQEntries >0 ; OSQEntries ––)

Task Player Input in Robot Orchestra

note (i) = OSQPend (QDirector, *0*, *err)* /* Post for the mailbox message and *userInput, which equaled null now equals userInput message pointer*/*

.

};

Summary

We learnt

- OS provides the IPC functions
- Create, Post, PostFront, Pend, Accept, Flush and Query for using message queues.
- The time out and error handling function can be provided with Pend function argument.

We learnt

- An OS provides the IPC functions for creating and using queues as the messages in FIFO and priority message) modes

End of Lesson-15: Queue