INTER-PROCESS COMMUNICATION AND SYNCHRONISATION: **Lesson-13: semaphore**

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" ,
Raj Kamal, Publs.: McGraw-Hill, Inc.

1. Semaphore

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" ,
Raj Kamal, Publs.: McGraw-Hill, Inc.

Semaphore

- OS provides the semaphore IPC functions for creating, releasing and taking of the semaphore

- As the event flag, token mutex (resource key for resource locking and unlocking resource onto for other processes) and counting semaphore.

Semaphore

- OS provides a function (OSSemPost) for semaphore as notice for an event occurrence

- OSSemPost facilitates inter-task communication for notifying (through a scheduler event control block) a waiting task section [using OSSemPend] to the running state upon an event at the running task section at an ISR or task

<u>Semaphore</u>…

- Semaphore can be used as a mutex (<u>mu</u>tually <u>ex</u>clusive) to permit access to a set of codes (in a thread or process).

A process using the mutex *locks* on to a critical section in a task.

Semaphore…

- Semaphore can be used as a counting semaphore, which facilitates multiple inter-task communications

- Semaphore can be used in case of producer–consumer type problems (for example, use of a bounded buffer, which can't be sent bytes more than the buffer capacity)

<u>Semaphore</u>…

- Semaphores can be a P and V semaphore-pair in the POSIX standard semaphore IPC.

2008

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.

7

Semaphore Functions

1. OSSemCreate─ to create a semaphore and to initialize

2. OSSemPost ─ to send the semaphore to an event control block and its value increments on event occurrence. (Used in ISRs as well as in tasks).

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.

Semaphore Functions

3. OSSemPend ─ to wait the semaphore from an event, and its value decrements on taking note of that event occurrence. (Used in tasks).

Arguments are semaphore variable name, time out period, and error handler

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.
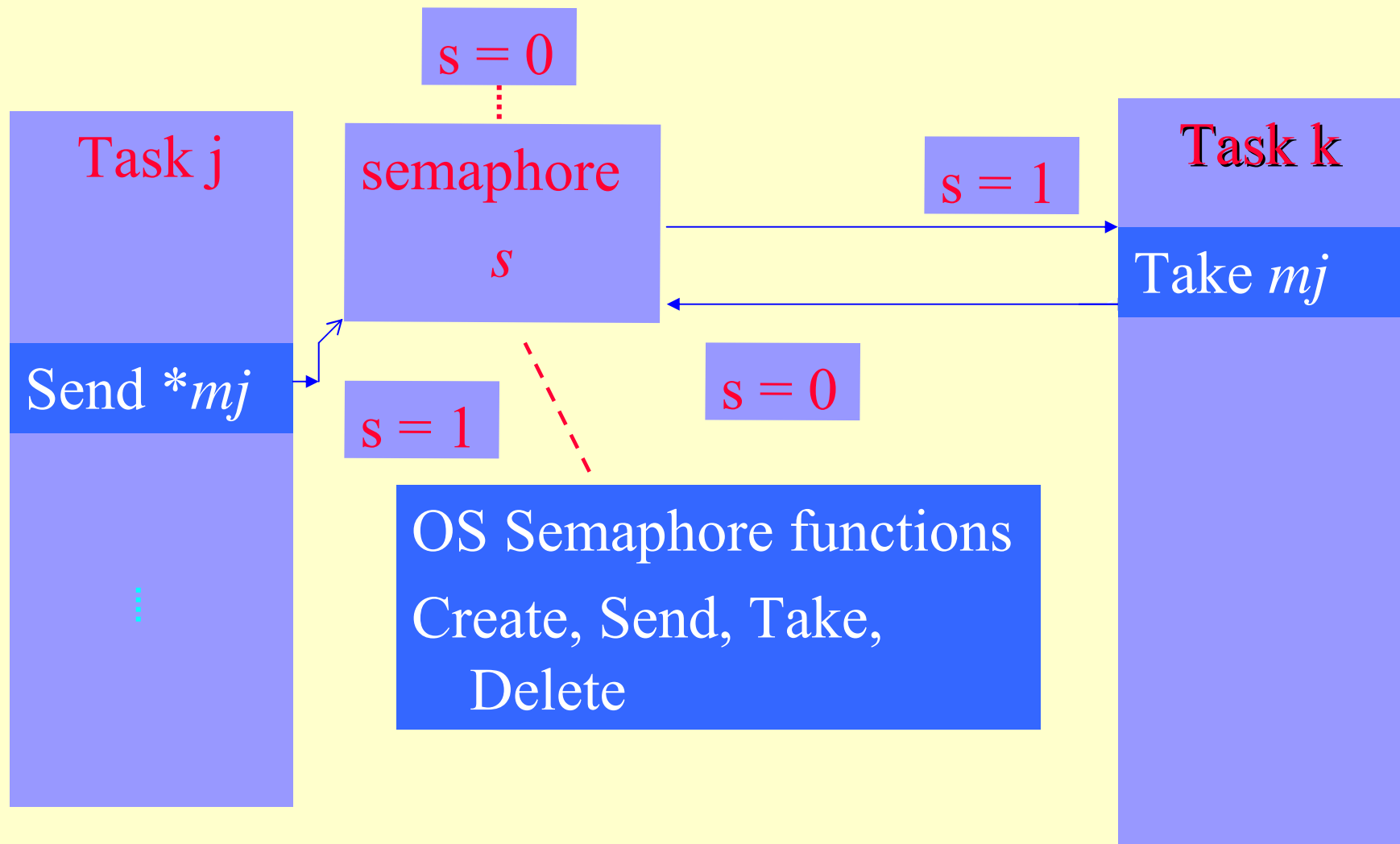
9

Semaphore Functions…

4. OSSemAccept─ to read and returns the present semaphore value and if it shows occurrence of an event (by non zero value) then it takes note of that and decrements that value. [No wait. Used in ISRs and tasks.]

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.

Semaphore Functions…

5. OSSemQuery ─ to query the semaphore for an event occurrence or non-occurrence by reading its value and returns the present semaphore value, and returns pointer to the data structure OSSemData. The semaphore value does not decrease.

The OSSemData─ data structure to point to the present value and a table of the tasks waiting for the semaphore. (Used in tasks)

Tasks *j* releasing a semaphore into an OS_event block and waiting task *k* taking that and starting

s = 0

Task j

semaphore

s

Send **mj*

s = 1

OS Semaphore functions
Create, Send, Take,
Delete

s = 1

Task k

Take *mj*

s = 0

Summary

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.

We learnt

- An OS provides the IPC functions for creating and using semaphores as the event flags, Mutex for resource key (for resource locking and unlocking onto a process) and as the counting and P-V semaphores.

Chapter-7 L13: "Embedded Systems - Architecture, Programming and Design" , Raj Kamal, Publs.: McGraw-Hill, Inc.

We learnt

- OS provides the IPC functions Create, Post, Pend, Accept and Query for using semaphores. The time out and error handling function can be provided with Pend function as arguments.

End of Lesson-13 on Semaphore