Chapter 11

Real Time Operating System

Lesson 03

Inter process Communication (IPC)

Inter process communication

- Inter Task Message
- A task can not call another task
- A task can only put information or message at a task control block
- The OS examines task control block at each tick of the system clock
- How the signal or token or message sent to another task?

Inter-process Communication using a Signal

- Signal is like software interrupt
- Signal communicated when a software interrupt instruction executes

Inter-process Communication using a Signal

- Signal means a call for action on an event after which the system runs a signal-handler task, similar to running of an interrupt service routine on an interrupt
- Several times, when one task finishes certain set of codes then only the system should start other task
- The signal can be used for doing this

Signal -A simplest IPC

IPC: Stands for Inter-process communication

A task executes a function ‘send-signal’

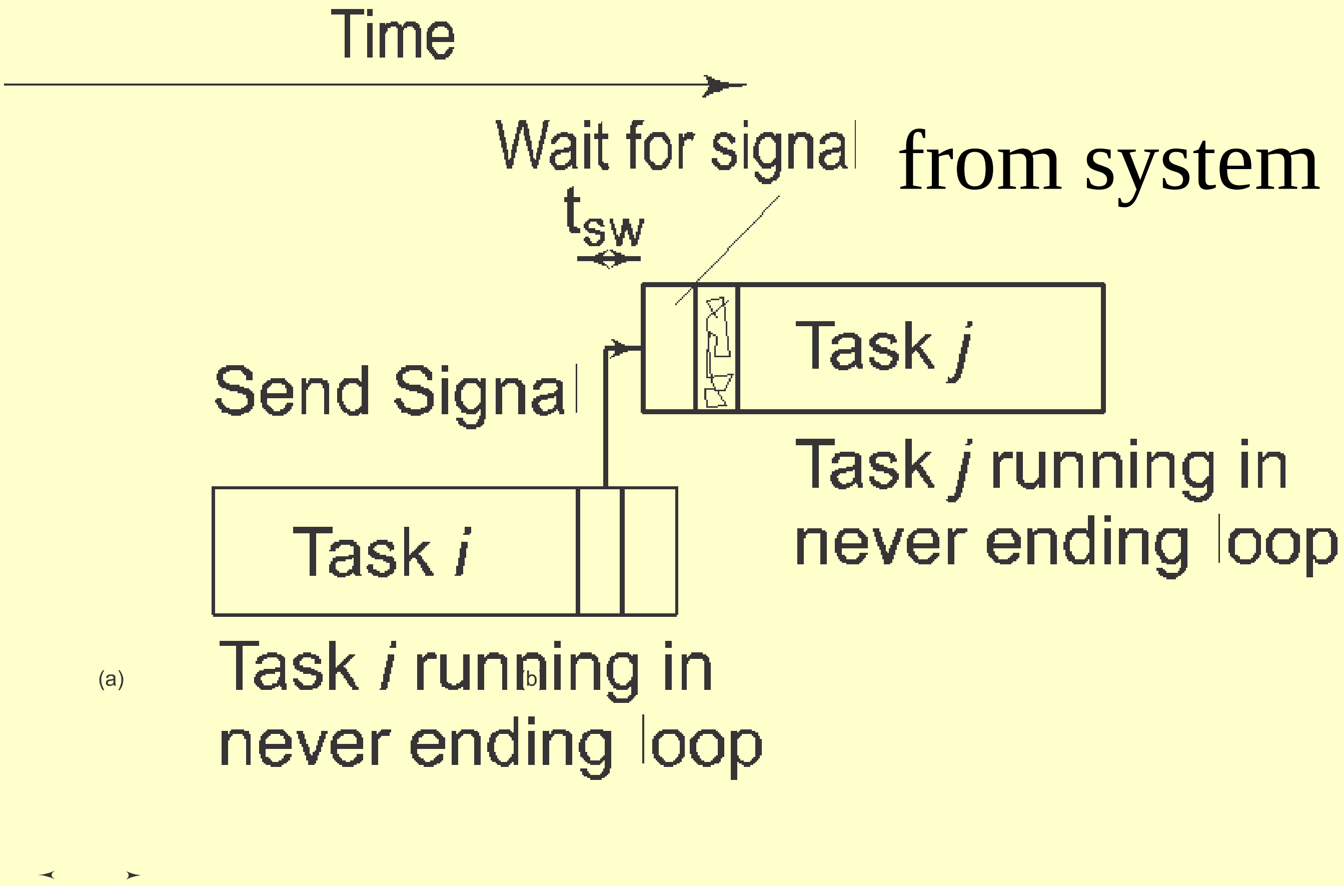
Another task waits for the signal and is started by OS on execution of the send-signal function

Example- A function os_send_signal (2) executes at task 1

so that a task 2 with at a function os_wait (K_SIG,0, 0) starts after OS gets signal ‘2’

Two tasks Example for the ECG recorder

- Tasks run at two different times
- One task *i* on finishing a set of actions, sends a signal to the system using a signalling instruction
- The system passes the signal to waiting second task *j*
- Then the *j* runs



Time

Wait for signal from system

t_{sw}

Send Signal

Task *j*

Task *j* running in never ending loop

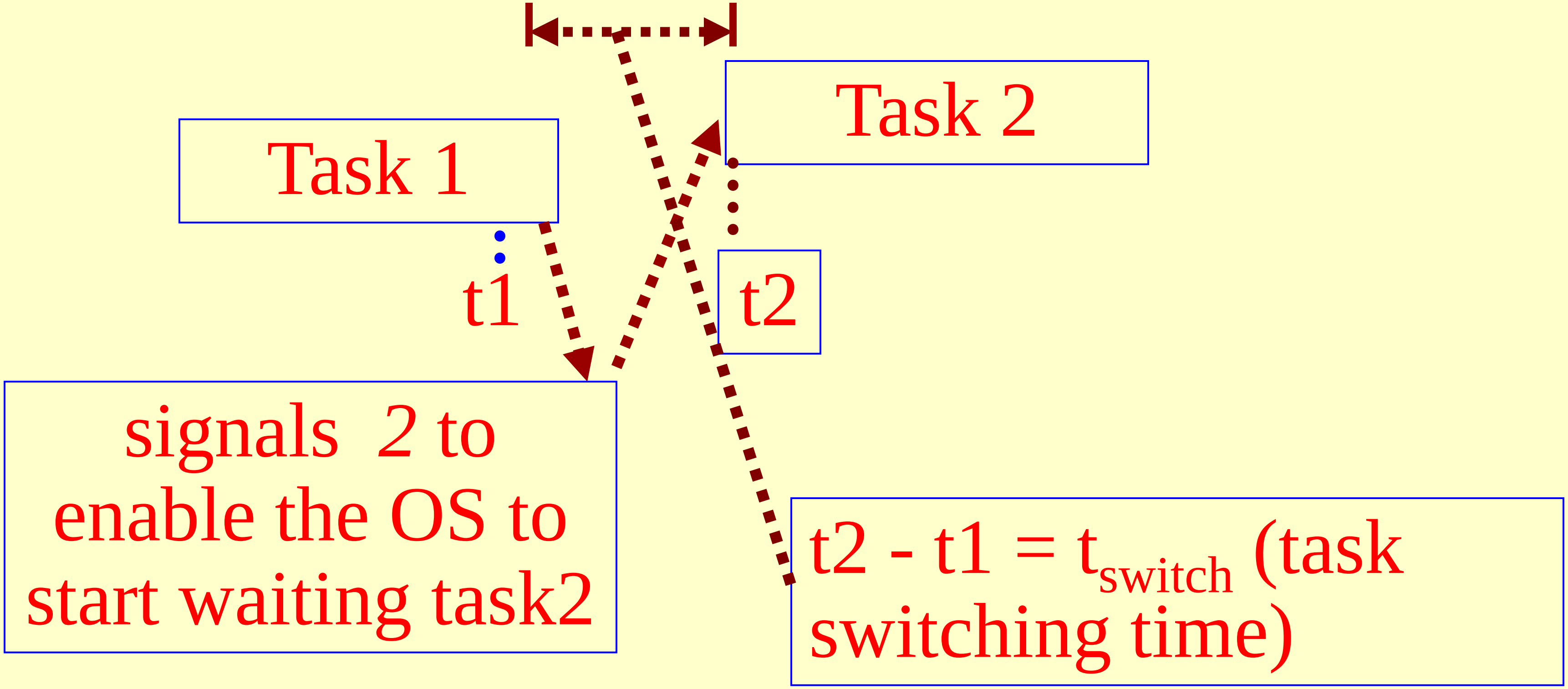
Task *i*

Task *i* running in never ending loop

(a)

(b)

Signal between Two Tasks



Task 1

Task 2

t1

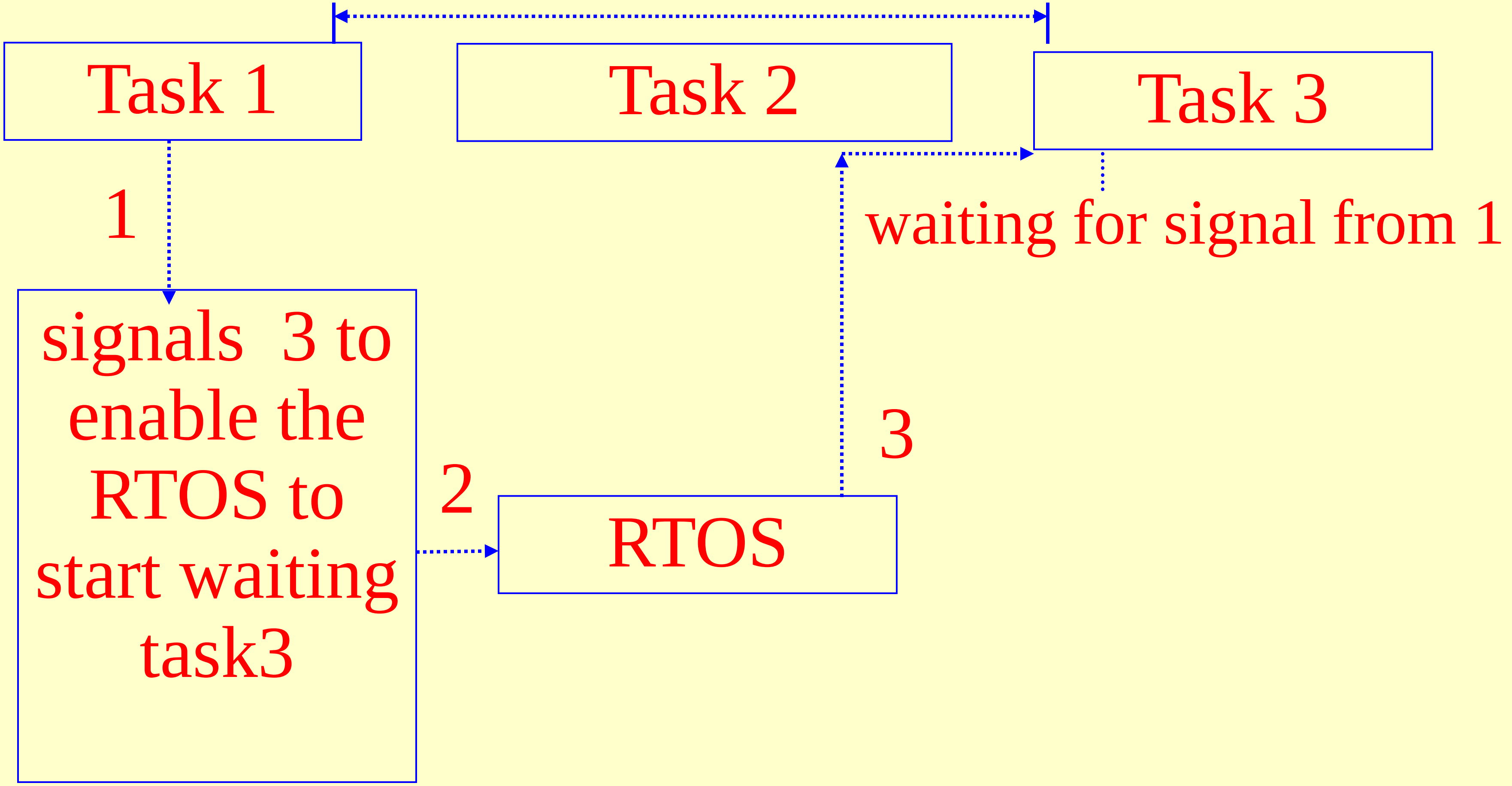
t2

signals 2 to enable the OS to start waiting task2

t2 - t1 = t_{switch} (task switching time)

Example of 3 tasks

Example - Task 1 and 3 Synchronisation



Task 1

Task 2

Task 3

1

waiting for signal from 1

signals 3 to enable the RTOS to start waiting task3

2

3

RTOS

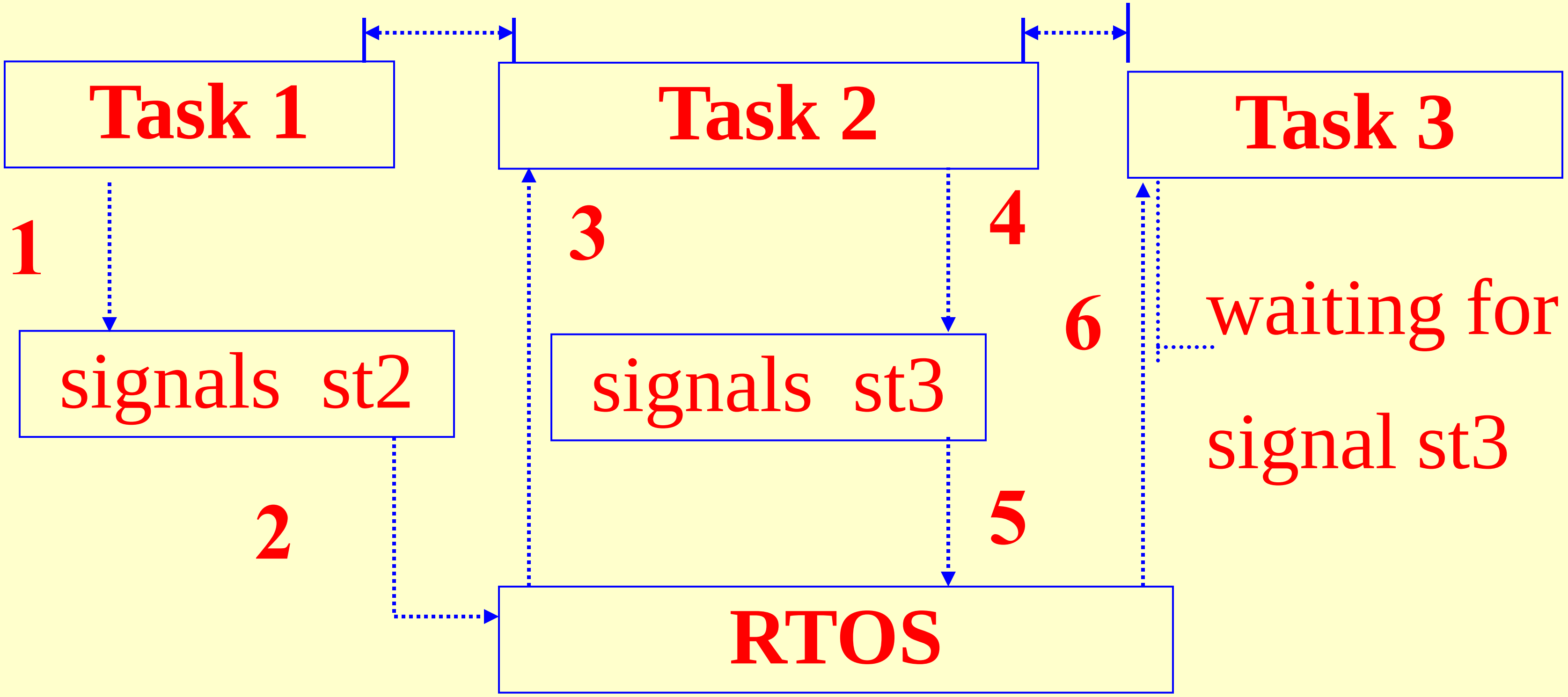
Four tasks of Example for the digital camera

- All tasks run in four different time slots
- First task executes when system sends it a signal *sw1*, for example, from the interrupt service routine
- The routine executes on the user pressing a switch to start taking the picture

The digital camera first three tasks

- Must execute in sequence one after one
- Second starts when first task sends signal *st2*
- Third task executes when second task sends it a signal *st3*
- Fourth task executes when system sends it a message *md4* to start or the task 3 sends signal *st4*

Task Synchronisation in a sequence among three tasks



Example- Three Task Synchronisation in a digital camera

Semaphore— A token for an IPC

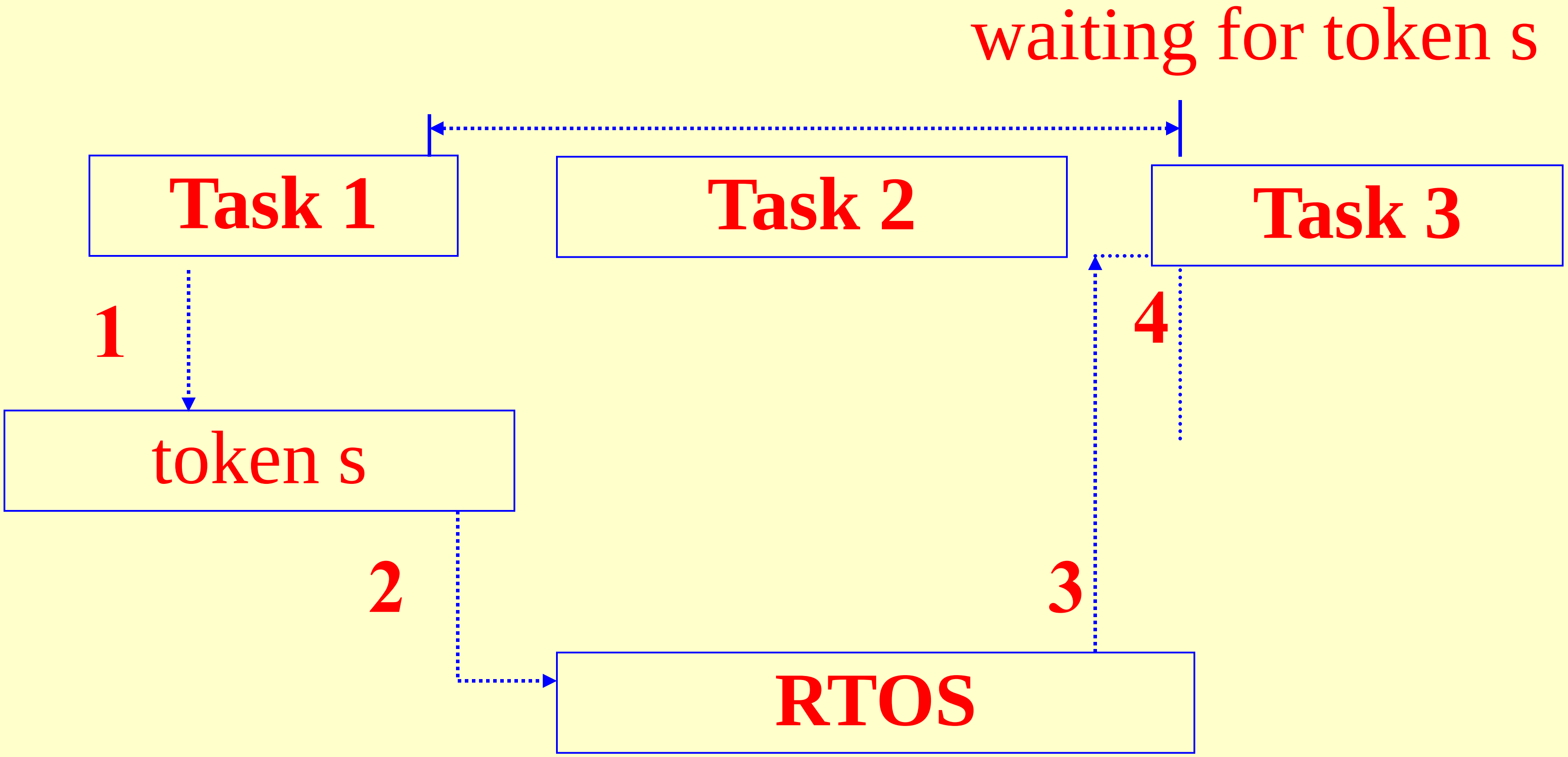
A task executes a function ‘send-token’

Another task blocked at certain point, waits for the token and is started (unblocks) by OS on execution of the send-token function

Example- A function os_send_token (K_SEM) executes at task 1

so that a task 2 with at a function os_wait (K_SEM,0, 0) starts after OS gets token‘K_SEM’

Task Synchronisation namong three tasks



waiting for token s

Task 1

Task 2

Task 3

1

token s

2

3

4

RTOS

Example- Two Tasks 1 and 3 Synchronisation

Critical Section

- Section of codes which have some action or variable, which must complete before other section of the codes run
- For example, a section updating time in hrs. min. sec. and date is a critical section. Unless all five parameters update, the other section for display should not update

Wait for an event-flag

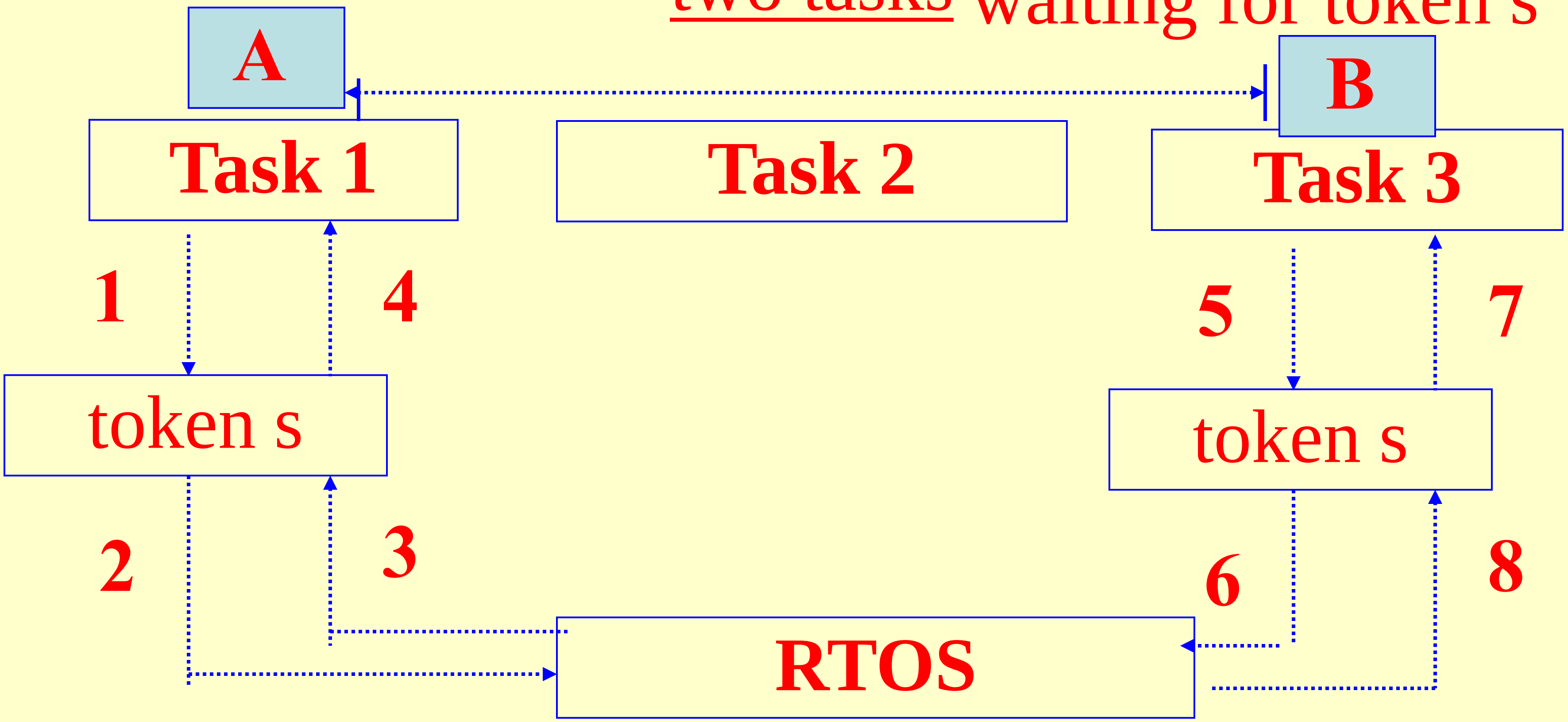
A task section *B* waits for an event to occur at task section *A* and unblocks and runs after that event

Example– Time-date display section waiting for update for new time-date

Two Critical sections A and B

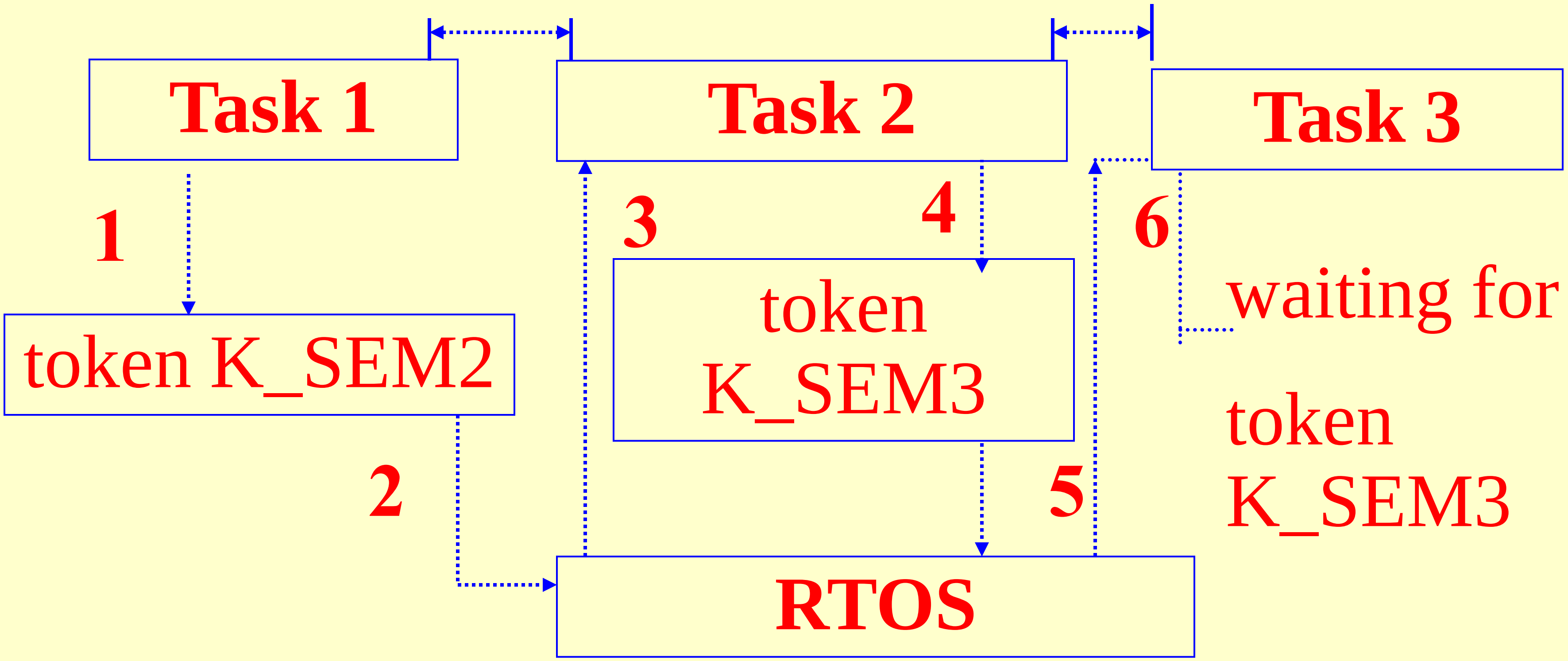
- Section *A* having a set of codes that should run un-interrupted, such that other section(s) *B should block during A's run*

Task critical sections Synchronisation among two tasks waiting for token s



▨ Example- Two Tasks 1 and 3 critical sections Synchronisation

Task Synchronisation in a sequence among three tasks



Task 1

Task 2

Task 3

1

token K_SEM2

2

3

4

token K_SEM3

5

6

waiting for

token K_SEM3

RTOS

Example- Three Task Synchronisation in a digital camera

Wait for a message

A task section *B* section waits for a message from at task section *A* and unblocks and runs after that message

Example- Time-date display section waiting for updated new time-date

Message— A string or pointer address for an IPC

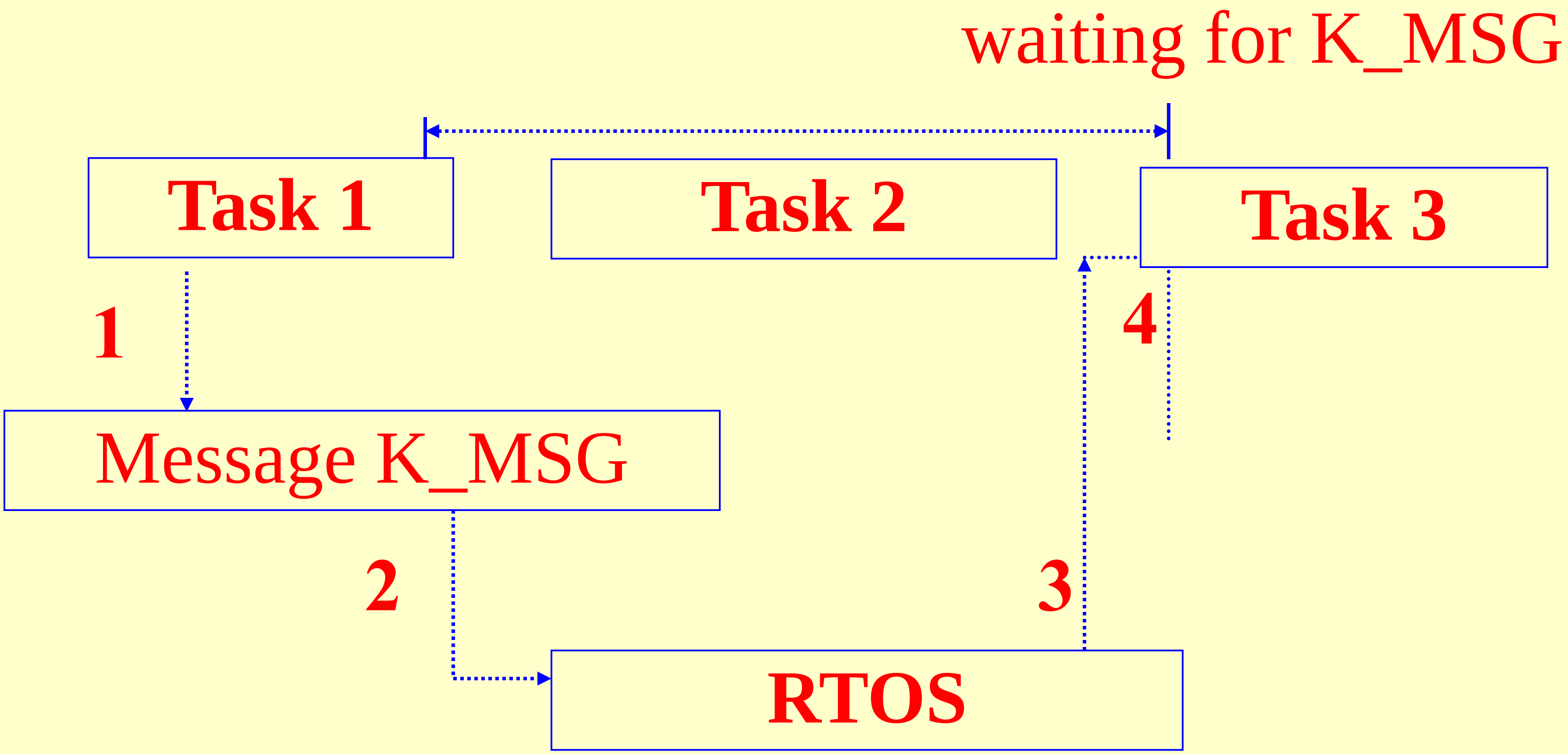
A task executes a function ‘send-message’

Another task blocked at certain point, waits for the message K_MSG and is started (unblocks) by OS on execution of the send-message function

Example- A function os_send_msg (K_MSG) executes at task 1

so that a task 2 with at a function os_wait (K_MSG,0, 0) starts after OS gets message ‘K_MSG’

Task Synchronisation among three tasks



waiting for K_MSG

Task 1

Task 2

Task 3

1

Message K_MSG

2

RTOS

3

4

Example- Two Tasks 1 and 3 Synchronisation

Wait for an *exception* (condition) message

An exception handling task section *B* section waits for an error message (exception) from task section *A* and unblocks and runs after that message

Example- handling of exceptions thrown by a task

A hypothetical example of a toffee vending machine system (ITMS)

- Inter process Communication among four tasks
- Task, *taskkeyparsing* parses the action needed from the keys entered by the customer

A hypothetical example of a toffee vending machine system (ITMS)

- Task, *taskdsply* displays the idle time message(s) and the messages during response to customer queries and customer selection of a specific toffee and to facilitate the graphic user interactions (GUIs)

A hypothetical example of a toffee vending machine system (ITMS)

- Task, *taskmoney* collects the cost of toffee in terms of coins (or debit card) from a customer

A hypothetical example of a toffee vending machine system (ITMS)

- Task, *tasktoffee* delivers the selected toffee, whether chocolate or almond or mango flavoured toffee

Summary

We learnt

- A *signal* permits a task or ISR program run after a certain task signals and notifies to OS that signal

We learnt

- A *semaphore* permits unblocking of a task section after a certain task sends and RTOS notifies that *semaphore*

We learnt

- A *message* passes and unblocks a task section after a certain task sends the message and RTOS notifies that *message*

End of Lesson 03 on

Inter process Communication (IPC)