Chapter 11: Timer and Timer Services

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Where innovation starts

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ROS/Jazz applications

```
ros::rate_loop(10)
   while(ros::ok())
   {
         do your calculations
         publish results
         loop_rate.sleep();
   }
```

Introduction

- **Low level programming**
- **Scheduling future events**

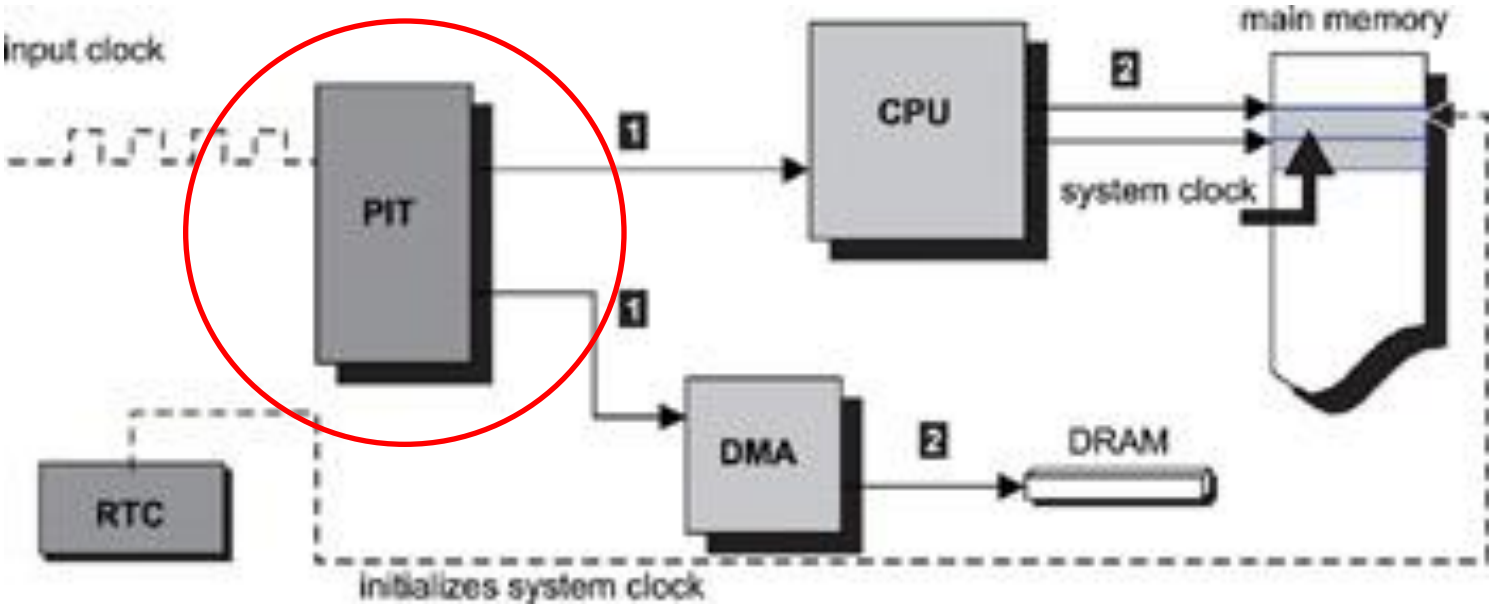
- **PIT, hard timer and soft timer**

Real-Time Clocks and System Clocks

- **Real-time clock**
  - **integrated in battery-powered DRAM**
  - **independent of CPU**

- **System clock**
  - **Retrieves its initial value from the RTC at power up**
  - **Driven by the programmable interval timer (PIT)**

Programmable interval timer



Programmable interval timer

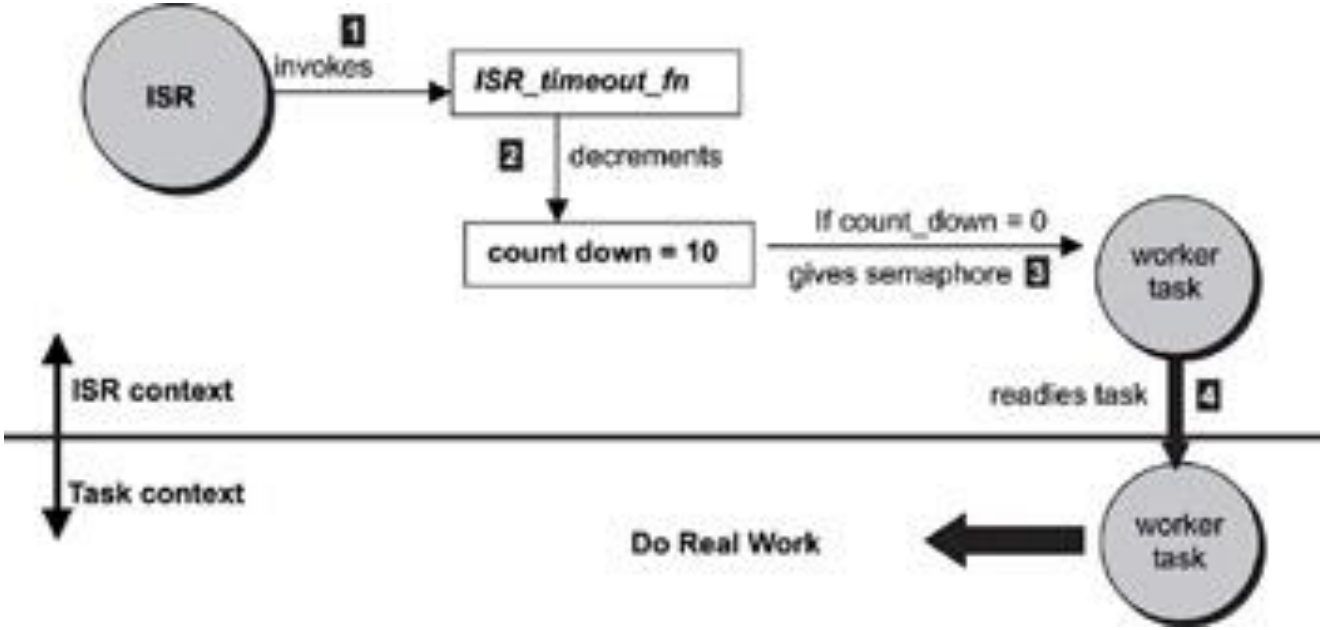
- **Input clock source with fixed frequency (timer interrupt rate).**
- **Initialization is part of the system startup.**
- **Timer interrupt rate is measured in ticks (e.g. if the timer rate is 100 ticks, one tick represents an elapsed time of 10 ms.**

Timer Interrupt Service Routines

- **Hard timer**
- **Updating the system clock**
- **Calling a registered kernel function to notify the passage of a preprogrammed period**
- **Time critical tasks**
- **Timer drift**

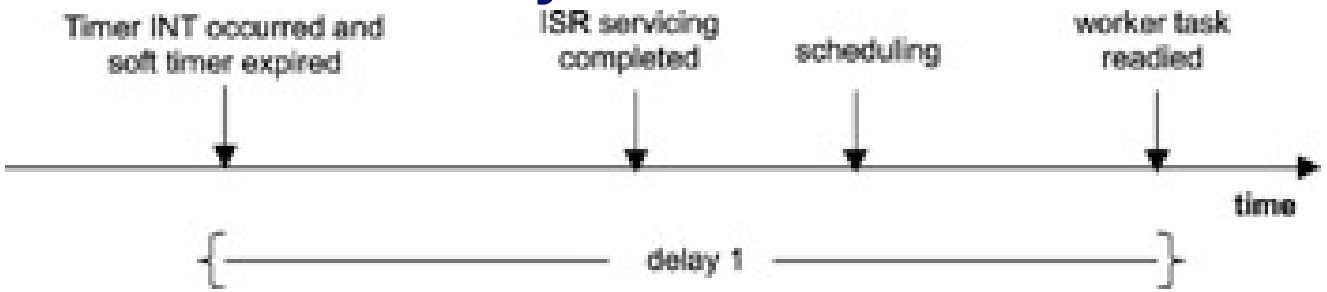
Model for Implementing the Soft Timer Handling Facility

- **Two contexts:**
  - **ISR context**
  - **Task context**

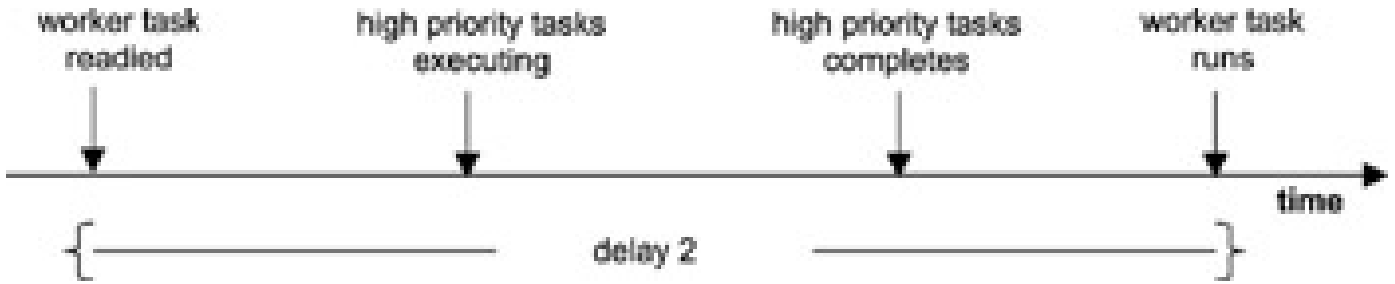


Possible processing delays

- **Event-driven delay**



- **Priority-baseddelay**

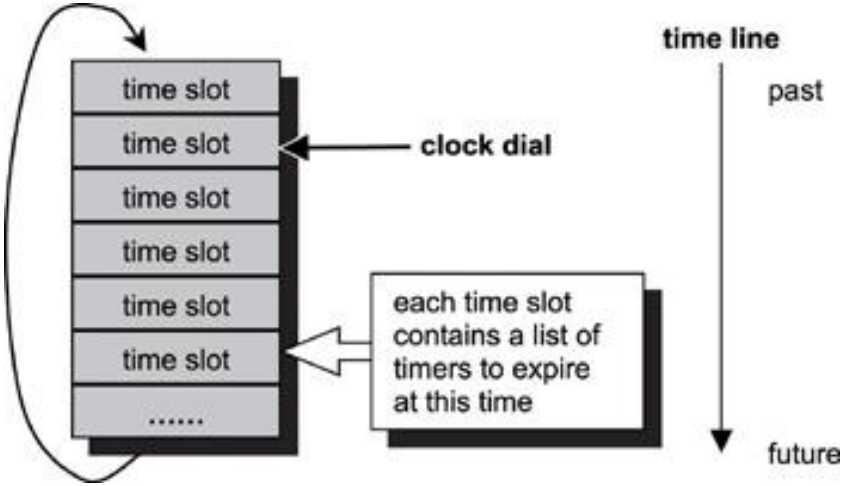


Soft timer facility implementations

- **Linked list**
  - **Unsorted, insertion at head or tail**
  - **Timer maintenance is costly**
- **Sorted list**
  - **Timers are inserted in appropriate slot**
  - **Cheaper maintenance, but more costly insertion**
- **Timing wheel**

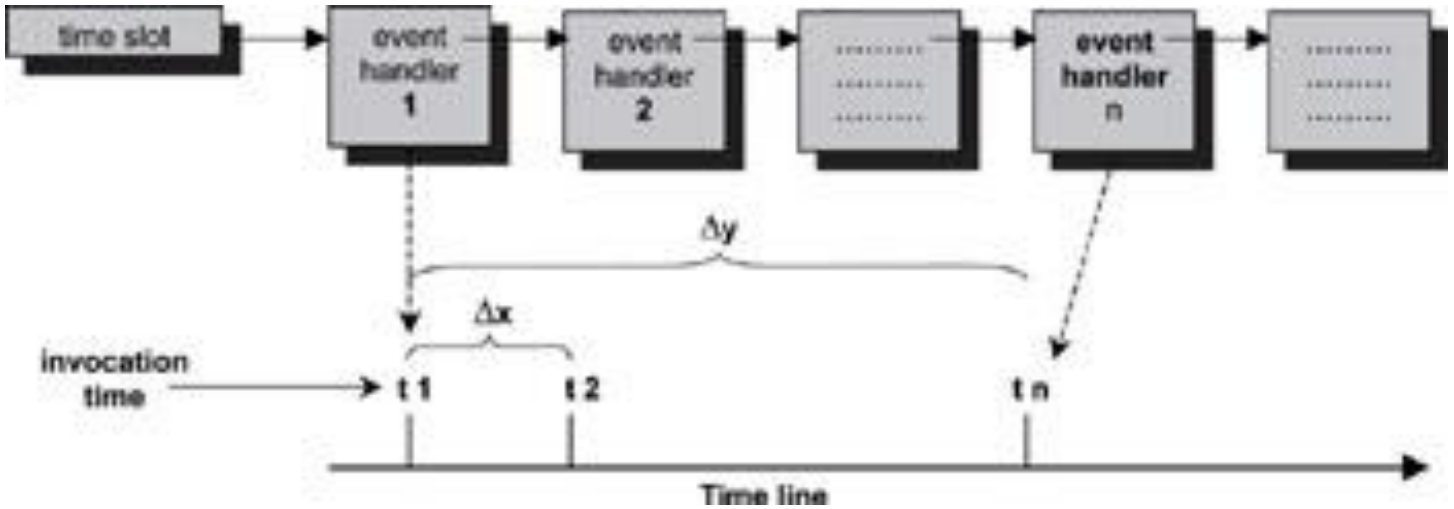
Timing wheels

- **Fixed-size array of time slots**
- **Clock dial increments to next time slot on every tick**
- **Time relative to clock dial**



Timing wheels

- **Problems:**
  - **Timer > maximum schedulable event**
  - **Timer does not exactly fit in a time slot**
  - **Callback invocation time**



Timer related operations

- **Group 1: provides low-level hardware related operations:**
  - **Timer interrupt enabling and disabling**
  - **Installation of timer interrupt service routines**
  - **Setting system clock rate (number of ticks)**

- **Group 2: provides soft-timer related services**
  - **Timer creation/deleting**
  - **Timer starting/cancelling**

- **Group 3: provides access to system clock**
  - **Getting/setting time**

ROS/Jazz applications

```
ros::Time::now(); // current time

ros::Duration five_seconds(5.0); // duration of five seconds

ros::Duration(0.5).sleep(); // sleep for half a second
```

http://www.ros.org/wiki/roscpp/Overview/Time