Mars Pathfinder

2.1. ปัญหาที่เกิดขึ้น

The spacecraft that was used in the Mars Pathfinder mission, the machine got many system resets during the mission, resulting in losses of data but not all. The engineers needed to figure out the problem to prevent loss data from spacecraft.

2.2. สาเหตุของปัญหา

The problem causes from the mutual exclusion in concurrency approach via the semaphore mechanism. So, the problem tasks are

1. Bus scheduler task (highest priority)
    1.1. For initialize the bus for next designed clocks processes (8 Hz designed for spacecraft processor)
2. Communication and another tasks (in medium priority)
3. Bus distribution task (lowest priority)
    3.1. For process tasks related to the scientific data gathering

The spacecraft use the “information bus” to transfer data with all components. When the spacecraft try to gather the scientific data with the Bus distribution task, it uses the information bus with mutex exclusion lock to use critical region memory for preventing race condition from another process.

As the information bus task e.g. the bus scheduler task (high priority) has to schedule frequently, and it also use the critical region that already in mutex lock, so the process can’t be done and wait for release of critical region from Bus distribution task. While the process wait the CPU was assigned to the medium priority e.g. Communication process. The process preempts the CPU because it has higher priority so as this happens many time the Bus distribution didn’t complete sending the signal to the waiting process to continue schedule then the watchdog sees that within 8 Hz of CPU time designed, process not complete the tasks many times then the spacecraft reset itself for solving the problem.

When the spacecraft reset the scientific data still available for restore but the schedule for each day may need time until next day to recover schedule and ready for the next process. This causes the spacecraft lost to gathering the data.

2.3. วิธีตรวจสอบปัญหา

To check weather how to problem cause, engineers try to get the logs data from the spacecraft via reproducing the situation in the specific environment to find the factors that cause the machine reset in the lab then they found the problem that is the priority inversion problem, that is the low priority lock the resource so the high priority process can’t be process and another medium process preempt the CPU time, So in this case cause the starvation for high priority process.

2.4. วิธีแก้ปัญหา

To fix problem they change the global variable in the spacecraft to indicate that the mutual exclusion mechanism will inherit the priority from blocked process so as the highest priority were blocked then the process running in mutual exclusion will be highest priority then it is non-preemptive, the process will have CPU time until finish. So, this solves the problem of starvation waiting for entering critical region memory.