Real-Time Operating System (Day 3 Lab)

Jong-Chan Kim

Graduate School of Automotive Engineering

KMU 국민대학교 KOOKMIN UNIVERSITY

17. Loss

- 공유 자원 접근으로 인한 Data Loss 실험
- Task1: Low priority, AUTOSTART
- Task2: High priority, 1 ms 주기 실행

bsw.c

```
218 int main(void)
219 {
220     osEE_tc_stm_set_clockpersec();
221     osEE_tc_stm_set_sr0( 1000U , 1U ) ; /* 1 msec */
```

- 공유 전역 변수

Task1

```
2
3 volatile unsigned long shared = 0;
4
```

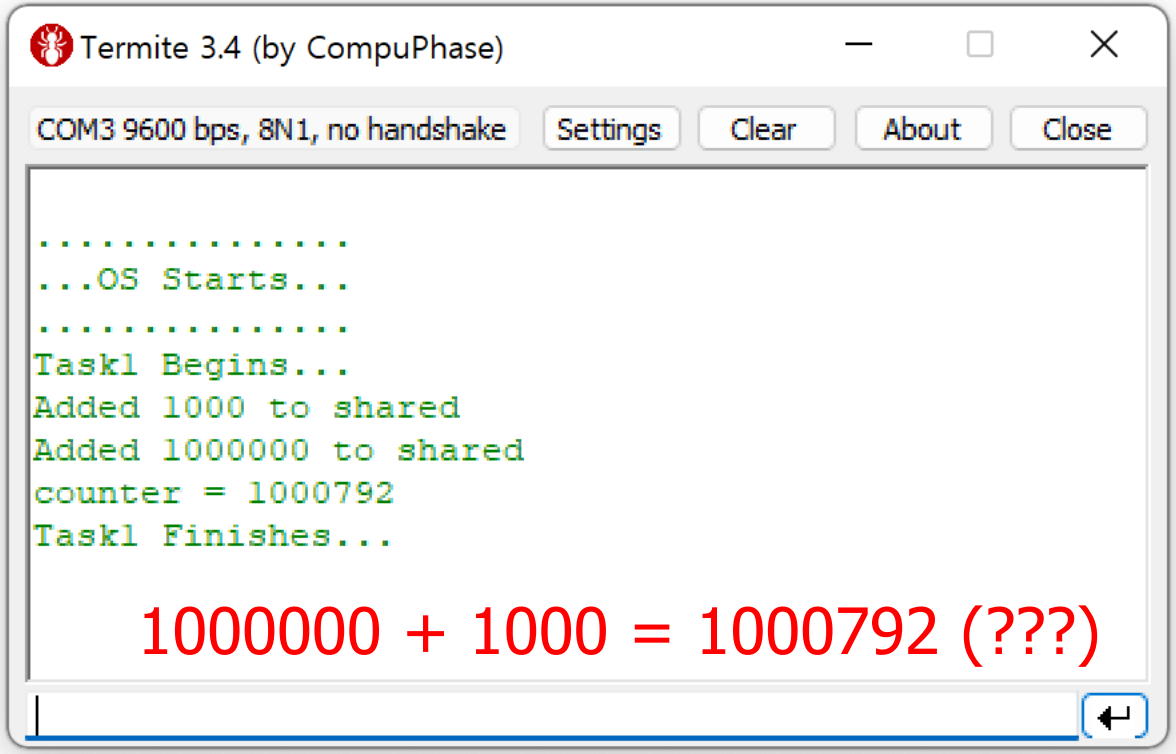
- Task1에서 100만번 shared++

```
12      unsigned long i;
13      printfSerial("Task1 Begins...\n");
14      for (i = 0; i < 1000000; i++) {
15          shared++;
16      }
```

- Task1이 한 번 실행되는 동안 Task2 반복 실행하며 shared ++
- 양 쪽 태스크에서 더한 숫자가 모두 유지가 되는지 확인

17. Loss

- Resource를 이용해서 Integrity Loss 문제 해결 필요



17. Loss

- OSEK의 RESOURCE 기능을 이용하여 Data Loss 문제 해결

```
30          GetResource(S1);
31          shared++;
32          ReleaseResource(S1);
```

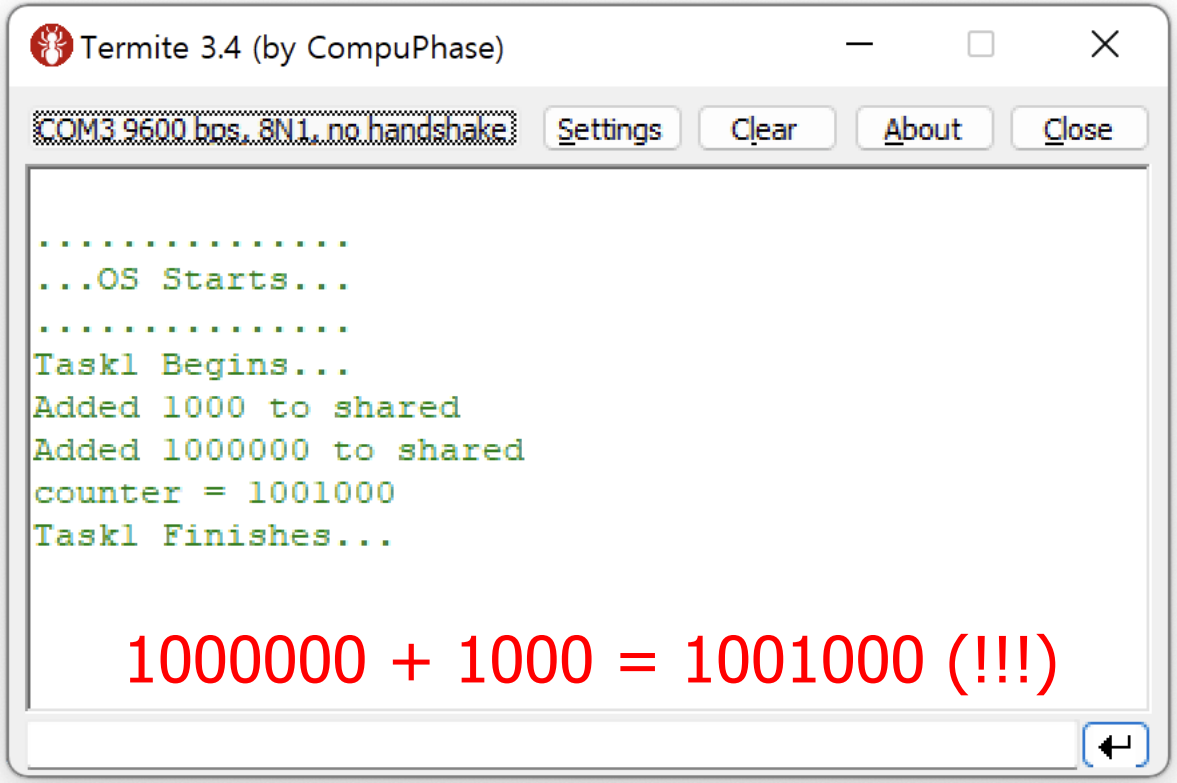
```
RESOURCE S1 {
    RESOURCEPROPERTY = STANDARD;
};

…

TASK Task1 {
    PRIORITY = 1;
    STACK = SHARED;
    SCHEDULE = FULL;
    AUTOSTART = TRUE;
    ACTIVATION = 1;
    RESOURCE = S1;
};
```

17. Loss

- Data Integrity 문제 해결



18. Mutex

Waiting/Wakeup 을 위해 Event 지정 필요

- mutex.c

```c
#include "ee.h"
#include "bsw.h"
#include "mutex.h"

void InitMutex(MutexType *mutex, EventMaskType event)
{
    mutex->flag = UNLOCKED;
    mutex->waiting_task = 0;
    mutex->event = event;
}

void GetMutex(MutexType *mutex)
{
    if (mutex->flag == LOCKED) {
        printfSerial("  -->  BLock");
        GetTaskID(&(mutex->waiting_task));
        WaitEvent(mutex->event);
    }
    mutex->flag = LOCKED;
}
```

```c
void ReleaseMutex(MutexType *mutex)
{
    if (mutex->flag == LOCKED) {
        mutex->flag = UNLOCKED;
        if (mutex->waiting_task != 0) {
            SetEvent(mutex->waiting_task, mutex->event);
        }
    }
}
```

PCP 없이 Mutex 사용할 경우 문제점을 확인하기 위한 Dummy 구현

18. Mutex

- mutex.h

```
#ifndef MUTEX_H_
#define MUTEX_H_

#define LOCKED   1
#define UNLOCKED  0

typedef struct _MutexType {
    int flag;
    EventMaskType event;
    TaskType waiting_task;
} MutexType;

void InitMutex(MutexType *mutex, EventMaskType event);

void GetMutex(MutexType *mutex);

void ReleaseMutex(MutexType *mutex);


#endif /* MUTEX_H_ */
```

18. Mutex

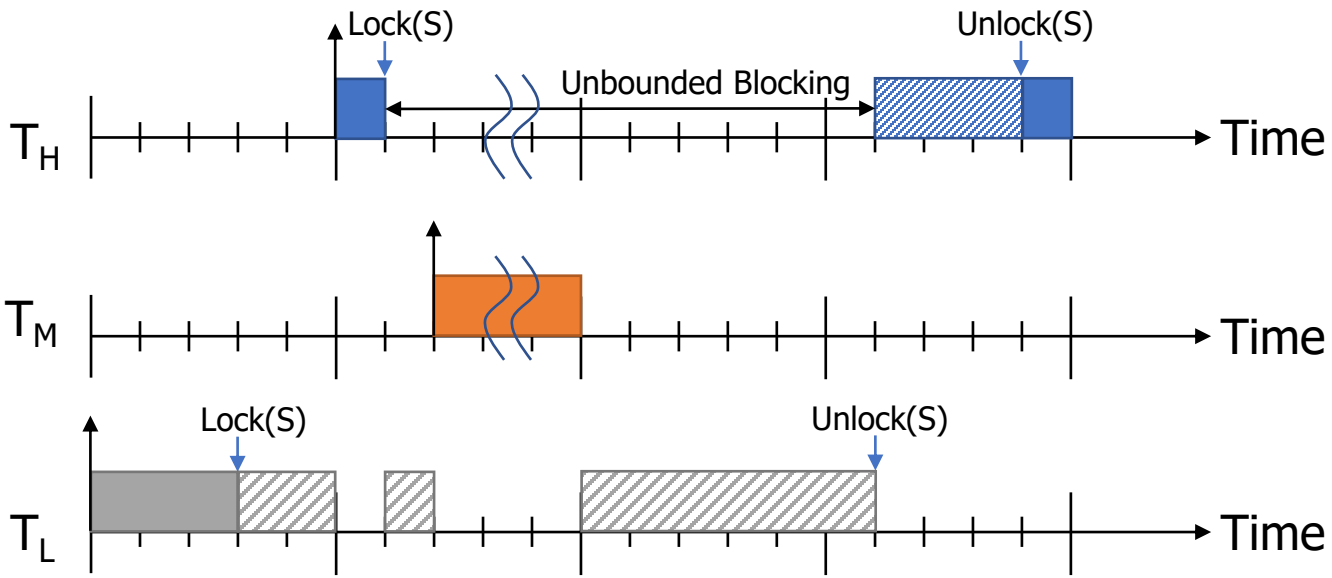
- Mutex 선언
- Timer ISR 이용
  - Mutex 초기화
  - Task Activation
- Mutex의 동작 확인

```
MutexType s1;


ISR2(TimerISR)
{
    osEE_tc_stm_set_sr0_next_match(1000000U);
    static long c = -5;
    printfSerial("\n%4ld: ", ++c);
    if(c == -4) {
        InitMutex(&s1, Event1);
    } else if (c == 0) {
        ActivateTask(TaskL);
    } else if (c == 5) {
        ActivateTask(TaskH);
    }
}
```

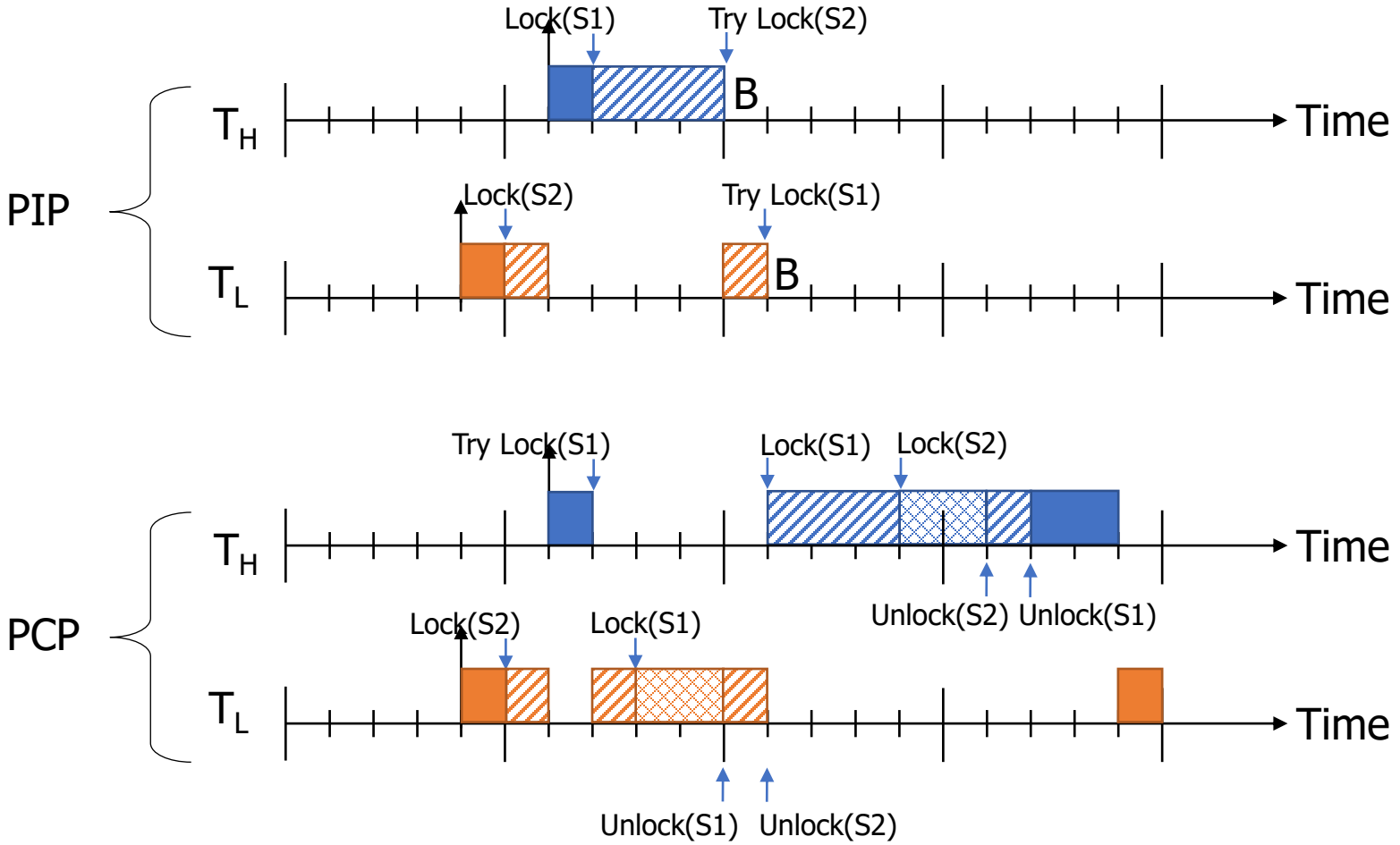
19. Priority Inversion

- 아래 스케쥴 재현하기
- PCP가 적용된 RESOURCE를 이용하여 스케쥴 변화 확인



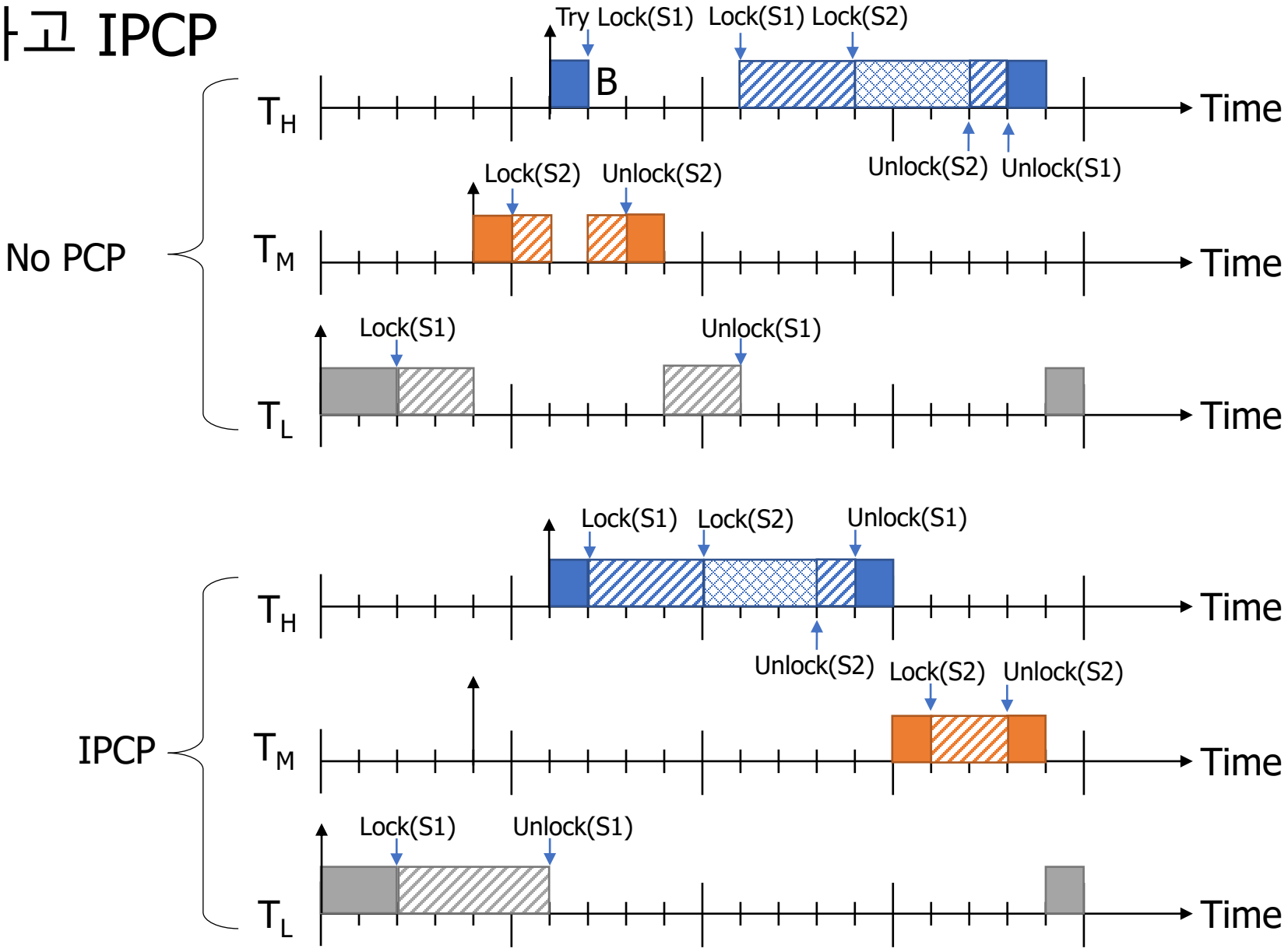
20. Deadlock

- Deadlock 재현하기
- PCP가 적용된 RESOURCE를 이용하여 Deadlock 해결



21. IPCP

- 우측 스케쥴 재현하고 IPCP 동작 확인하기



Questions