Project 4 Help

SNU Operating Systems
Dec 04, 2020
DCS Lab

Overview

- **Geo-tagged file system** (based on **ext2**)
  - Attach a GPS tag to each regular file
- **Access control** with the tags
  - Files are accessible from the location where they are recently created/modified

Key Challenges

- (1) Modify physical representation of **inode**
  - to embed GPS coordinates
- (2) Add **GPS-related inode operations** and **implement them for ext2 regular files**
  - set_gps_location
  - get_gps_location
- (3) Modify **access control mechanism** to realize location-based access control

(1) Add GPS-related fields to inode structure

- fs/ext2/ext2.h
- There are two structs for ext2 inode.
  - **inode in the memory**
  - **inode on the disk**
- Add 5 fields.
- Pay attention to endianness of the fields of the physical inode
  - You may get a hint from other fields in the structures.

```
struct gps_location {
  int lat_integer;
  int lat_fractional;
  int lng_integer;
  int lng_fractional;
  int accuracy;
};
```

(cf) Recall from Project 2 (WRR) ...

```
// kernel/sched/rt.c
const struct sched_class rt_sched_class = {
        .next                   = &fair_sched_class,
        .enqueue_task           = enqueue_task_rt,
        .dequeue_task           = dequeue_task_rt,
        .yield_task             = yield_task_rt,

        .check_preempt_curr     = check_preempt_curr_rt,

        .pick_next_task         = pick_next_task_rt,
        .put_prev_task          = put_prev_task_rt,

#ifdef CONFIG_SMP
        .select_task_rq         = select_task_rq_rt,

        .set_cpus_allowed       = set_cpus_allowed_rt,
        .rq_online              = rq_online_rt,
        .rq_offline             = rq_offline_rt,
        .pre_schedule           = pre_schedule_rt,
        .post_schedule          = post_schedule_rt,
        .task_woken             = task_woken_rt,
        .switched_from          = switched_from_rt,
#endif

        .set_curr_task          = set_curr_task_rt,
        .task_tick              = task_tick_rt,

        .get_rr_interval        = get_rr_interval_rt,

        .prio_changed           = prio_changed_rt,
        .switched_to            = switched_to_rt,
};
```

Interface

Implementation

Multiple implementation sets

```
const struct sched_class rt_sched_class = {
const struct sched_class fair_sched_class = {
const struct sched_class idle_sched_class = {
```

Pointing from each task_struct

```
struct task_struct {
        volatile long state;    /* -1 unrunnabl
        void *stack;
        atomic_t usage;
        unsigned int flags;     /* per process
        unsigned int ptrace;

#ifdef CONFIG_SMP
        struct llist_node wake_entry;
        int on_cpu;
#endif
        int on_rq;

        int prio, static_prio, normal_prio;
        unsigned int rt_priority;
        const struct sched_class *sched_class;
        struct sched_entity se;
        struct sched_rt_entity rt;
```

(cf) Similar for inode_operations

```
const struct inode_operations ext4_file_inode_operations = {
        .setattr        = ext4_setattr,
        .getattr        = ext4_getattr,
        .setxattr       = generic_setxattr,
        .getxattr       = generic_getxattr,
        .listxattr      = ext4_listxattr,
        .removexattr    = generic_removexattr,
        .get_acl        = ext4_get_acl,
        .fiemap         = ext4_fiemap,
};
```

Interface

Implementation

```
const struct inode_operations ext3_dir_inode_operations = {
const struct inode_operations ext4_file_inode_operations = {
const struct inode_operations ext4_special_inode_operations = {
```

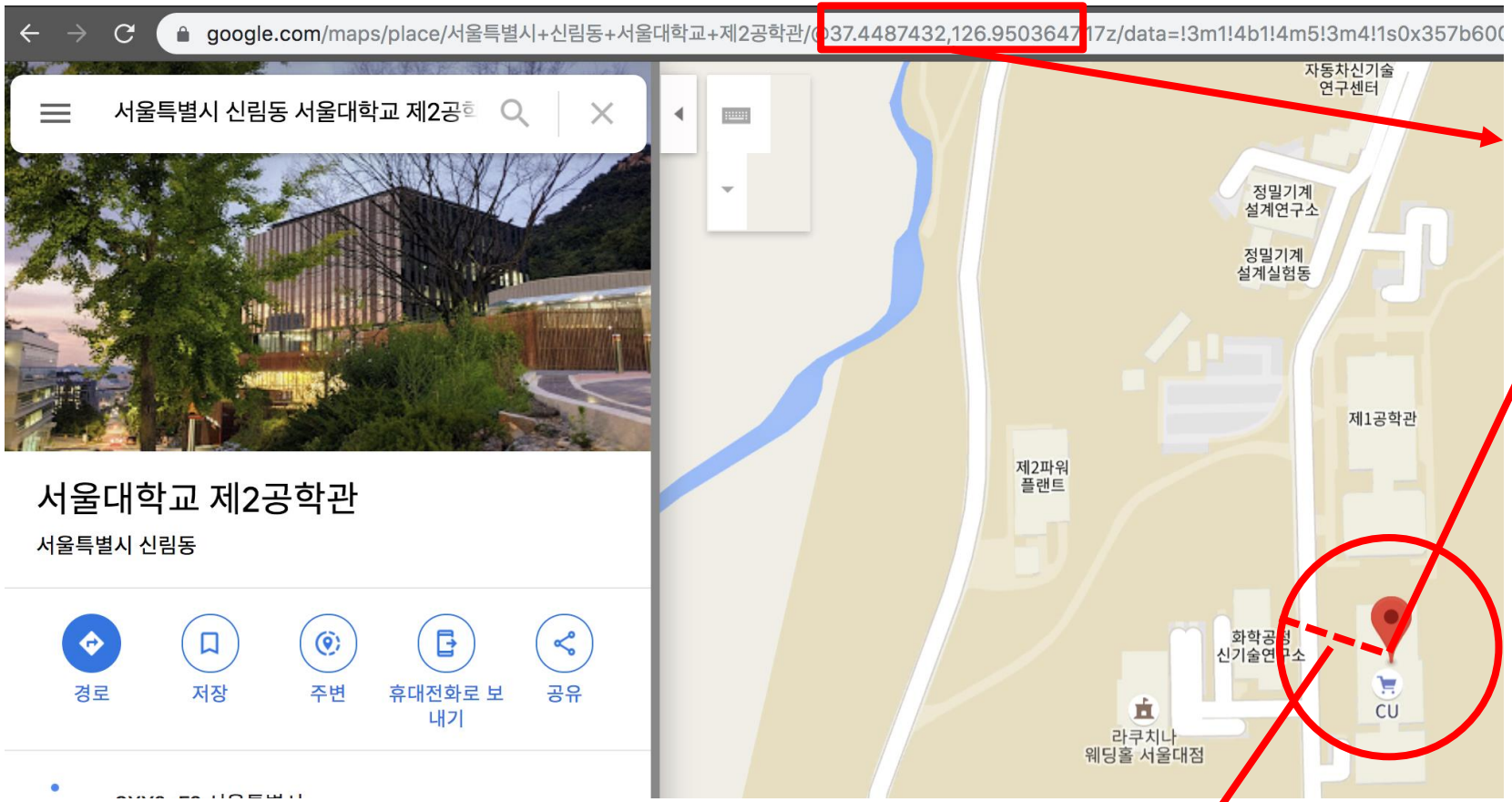
```
struct inode {
        umode_t                 i_mode;
        unsigned short          i_opflags;
        kuid_t                  i_uid;
        kgid_t                  i_gid;
        unsigned int            i_flags;

#ifdef CONFIG_FS_POSIX_ACL
        struct posix_acl        *i_acl;
        struct posix_acl        *i_default_acl;
#endif

        const struct inode_operations   *i_op;
        struct super_block      *i_sb;
```

(2) Make a new syscall

- int set_gps_location(struct gps_location___user *loc)

```
struct gps_location {
  int lat_integer;
  int lat_fractional;
  int lng_integer;
  int lng_fractional;
  int accuracy;
};
```

- Latitude = lat_integer + lat_frac*10^-6
- Longitude = lng_integer+lng_frac*10^-6
- 0 <= lat_frac, lng_frac <= 999,999
- -90 <=latitude <= 90
- -180 <= longitude <= 180
- Accuracy (meter): non-negative integer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제1공학관
제2파워 플랜트
화학공정 신기술연구소
CU
라쿠치나 웨딩홀 서울대점
(Latitude, Longitude)
Accuracy (m)

(2) Define GPS-related inode operations

- Add the following two function pointer fields to the **struct inode_operations** structure in **include/linux/fs.h**
  - int (*set_gps_location)(struct inode *);
  - int (*get_gps_location)(struct inode *, struct gps_location *);

(2) And implement them for ext2

- Implement the set/get functions for ext2.
  - set_gps_location: copy the current device location to the inode
  - get_gps_location: copy the inode location to the buffer
- Register the functions with ext2 file inode operations.

(2) Update location info

- GPS info of **regular files** should be updated whenever they are **created or modified**
  - Use set_gps_location operation
    *** You may assume that any GPS related operations are performed after properly setting the device location.

- look at
  - fs/ - for file system code
  - fs/ext2/ - for ext2 specific code

(3) Access control

- Files of the modified ext2 can be only **accessible** from the location where they are **recently created/modified**.
- There is an **inode operation related to access control**.
  You can use it.
- Compare the geo-tag and current location.
  - You cannot use float or double operations.
    *** Note that the kernel does not have any floating point or double precision support.
  - You should consider accuracy of the geo-tag
  - Compare the values with your own algorithm. Document any assumptions or approximations on README.md

Be careful!

- Current **device location** is shared mutable state,
  so you should use **proper synchronization mechanism**
  when accessing the state.

- Never access the memory by user-space addresses directly. Refer to guides and provided links in Project 1 help document(Linux Kernel Exploration Guide for OS projects).

- For parameters in struct gps_location in **set_gps_location syscall**, make sure they are in **appropriate range**.

Testing with the modified file system

- To test your code, you should create a your modified ext2 file system. You will use **mke2fs** (in e2fsprogs).

- You need to modify ext2 inode structure to make mke2fs use your modified ext2.
  - e2fsprogs/lib/ext2fs/ext2_fs.h
  - **There is a structure you should modify.**

About Submission (IMPORTANT!)

- **Due: 2020-12-15 Tuesday 24:00:00 KST**
- Make sure your branch name is *proj4*
- Don't be late!
  - We will not grade the commits after the deadline
- Slides and Demo
  - Send it to the TA (**os-tas@dcslab.snu.ac.kr**) before the deadline
  - Title: **[OS-ProjX] TeamX slides&demo submission**
  - File name: **TeamX-slides.pptx(.ppt, .pdf)**, **TeamX-demo.mp4(.avi, …)**
- Please submit only one video
- Check for format : slides title / demo name / branch name and dir ectory name