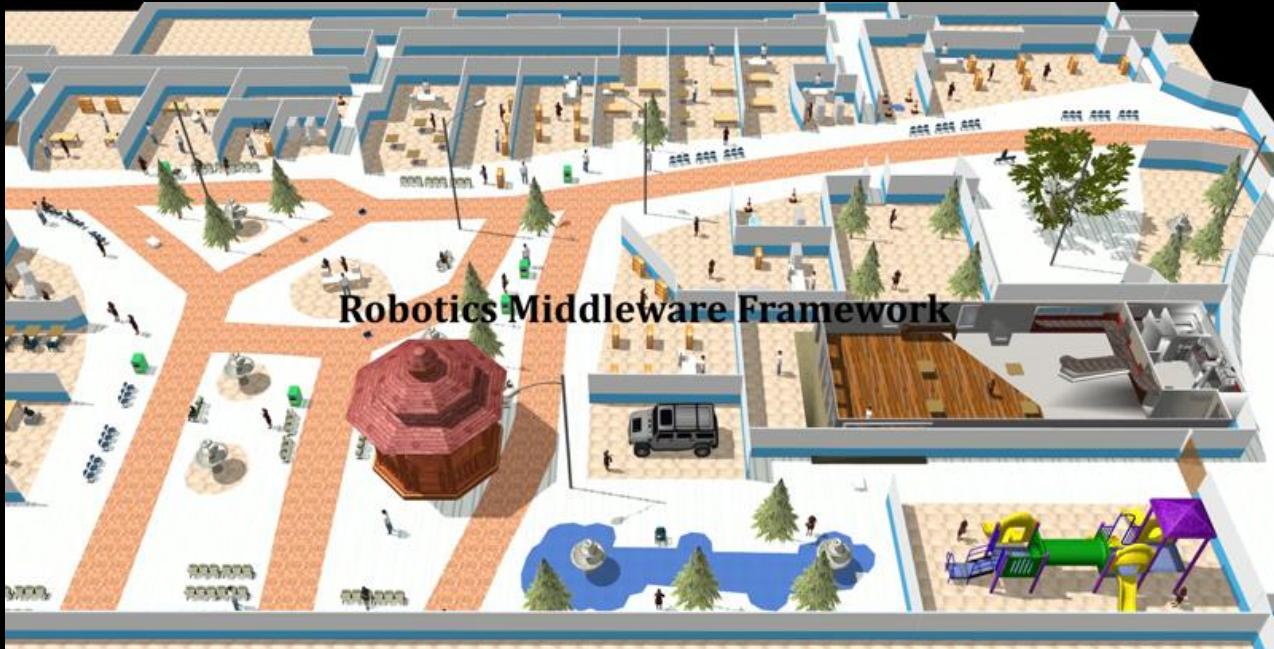




A Common Language for Robot Interoperability



Lecture 4

정은빈

Contents

01 **Airport Terminal
world Demo**

02 **RMF Panel**

Airport Terminal world Demo

Airport Terminal world Demo

⦿ Airport Terminal world 실행

| 환경 불러오기

```
cd ~/rmf_ws && source install/setup.bash
```

| Classic Gazebo로 Airport Terminal world 실행

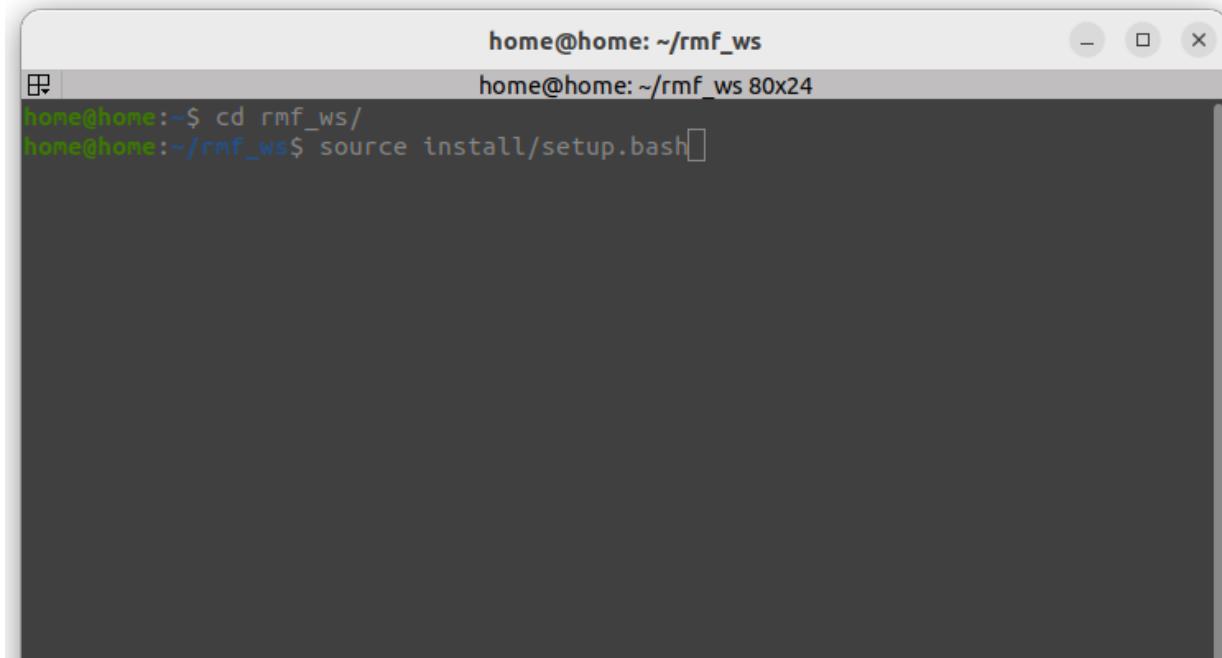
```
ros2 launch rmf_demos_gz_classic airport_terminal.launch.xml
```

Airport Terminal world Demo

⦿ Airport Terminal world 실행

| 환경 불러오기

```
cd ~/rmf_ws && source install/setup.bash
```

A screenshot of a terminal window titled "home@home: ~/rmf_ws". The window shows the command "cd ~/rmf_ws && source install/setup.bash" being typed at the prompt. The terminal has a dark background with light-colored text. The window has a standard OS X style with a close button in the top right corner.

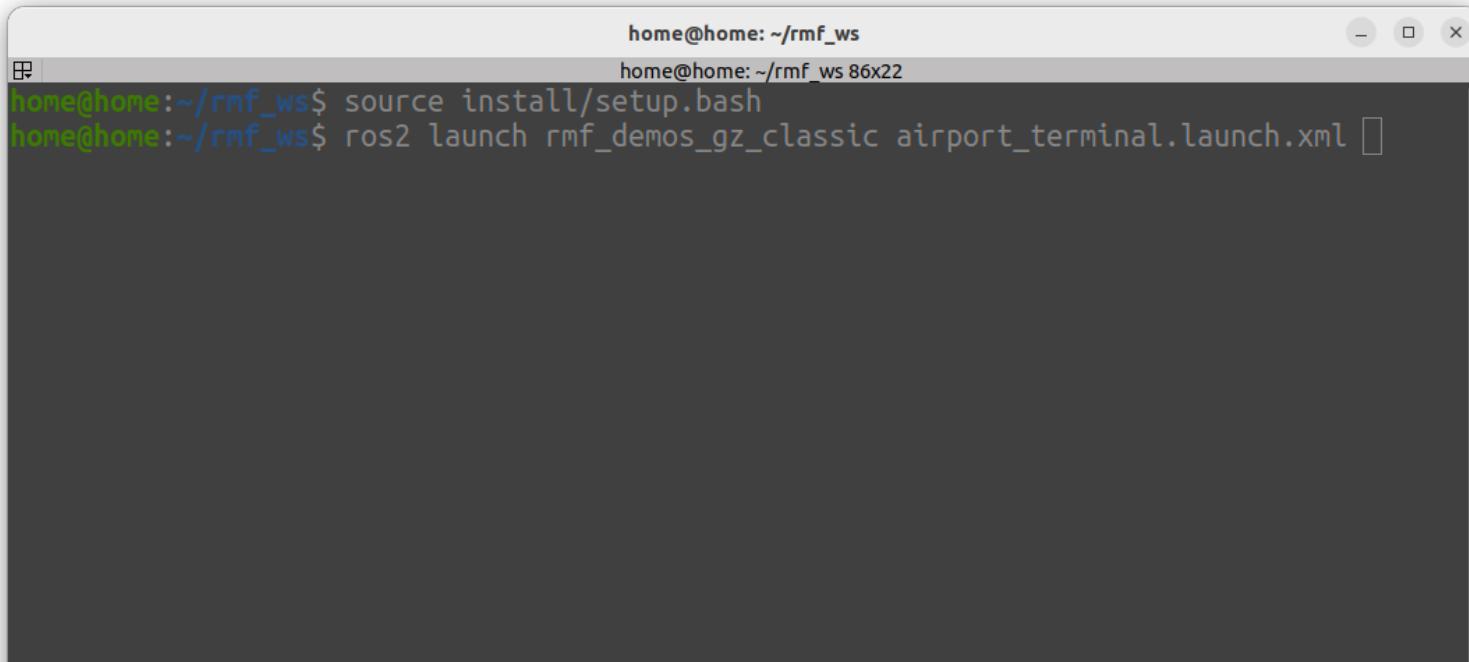
```
home@home: ~/rmf_ws
home@home: ~/rmf_ws 80x24
home@home:~$ cd rmf_ws/
home@home:~/rmf_ws$ source install/setup.bash
```

Airport Terminal world Demo

⦿ Airport Terminal world 실행

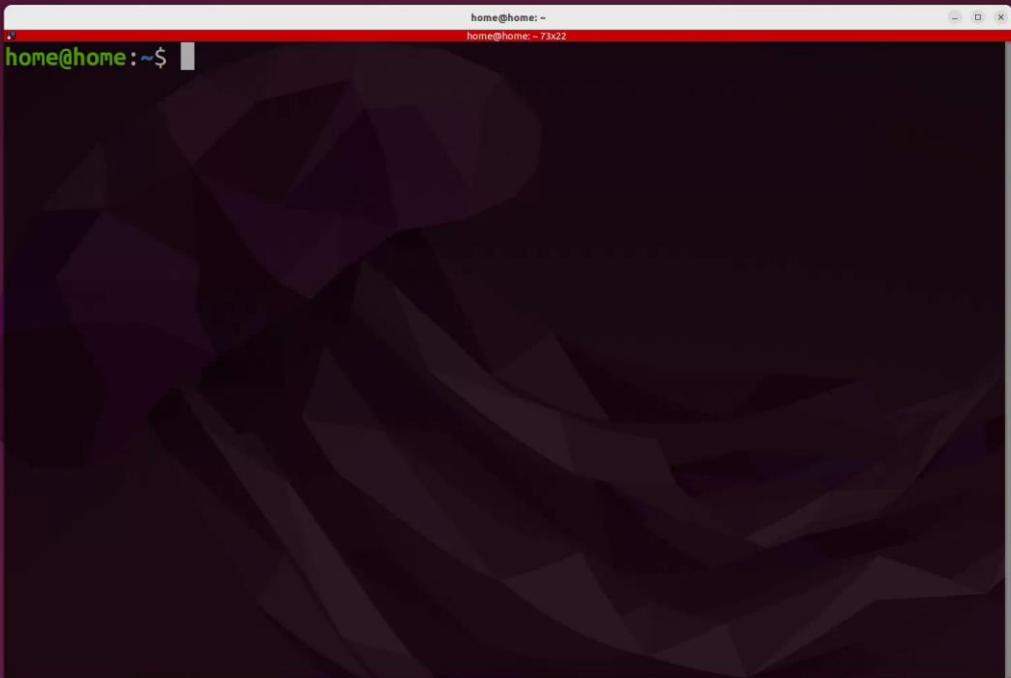
| Classic Gazebo로 Airport Terminal world 실행

```
ros2 launch rmf_demos_gz_classic airport_terminal.launch.xml
```

A screenshot of a terminal window titled "home@home: ~/rmf_ws". The window shows two lines of command-line text:

```
home@home:~/rmf_ws$ source install/setup.bash
home@home:~/rmf_ws$ ros2 launch rmf_demos_gz_classic airport_terminal.launch.xml
```

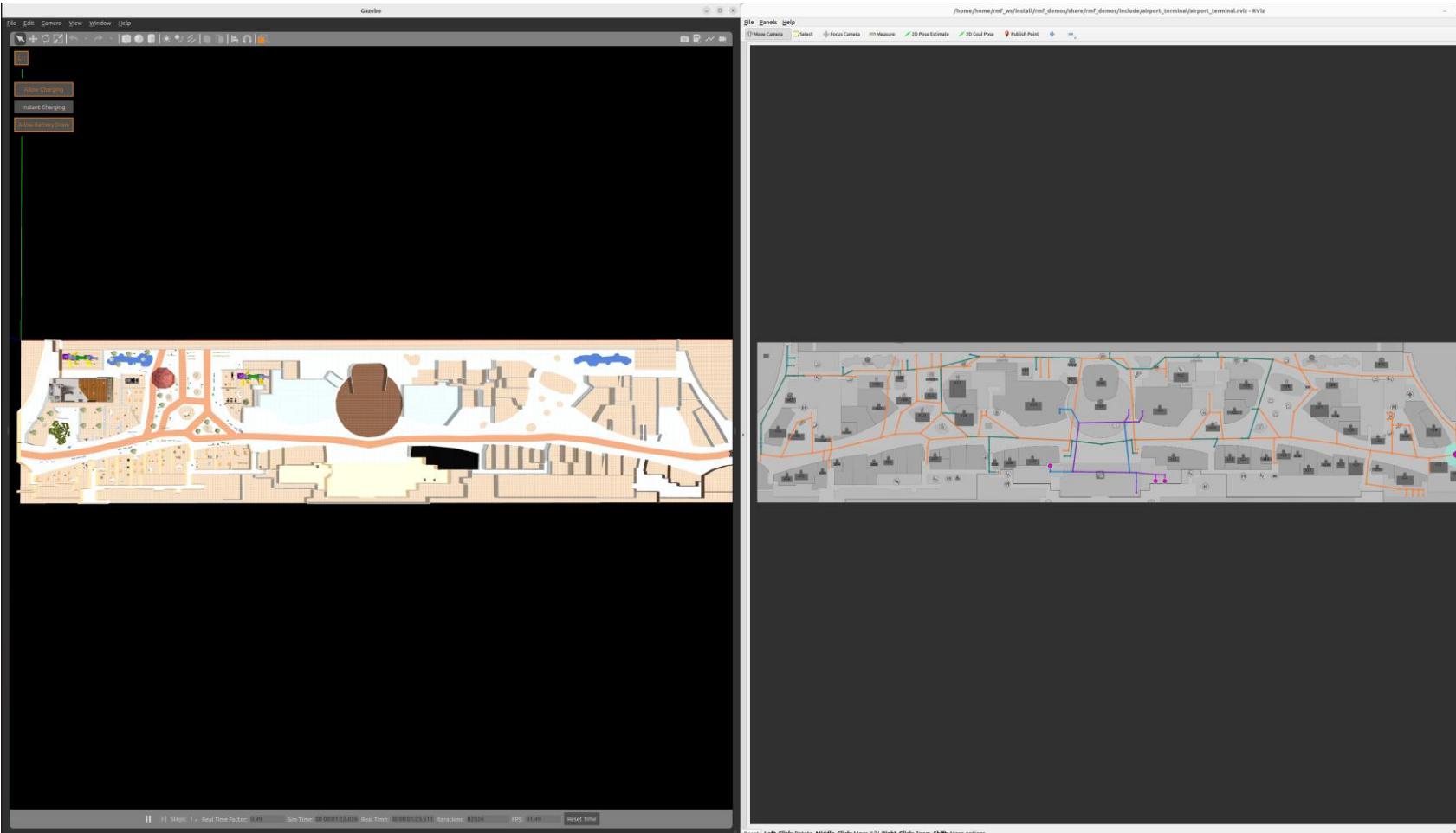
The terminal has a light gray background and white text. The window title bar is dark gray with white text.



Airport Terminal world Demo

⦿ Airport Terminal world 실행

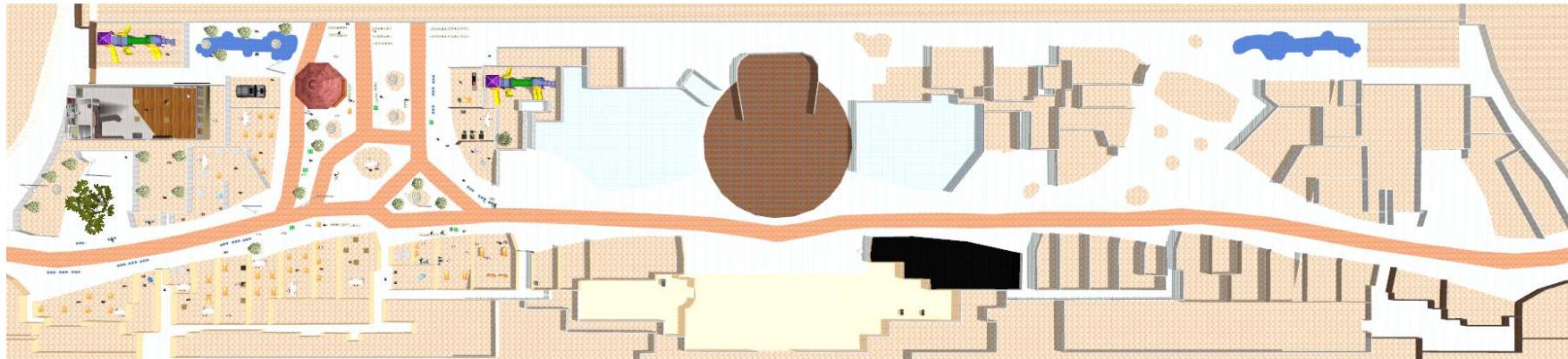
| Classic Gazebo로 Airport Terminal world 실행



Airport Terminal world Demo

▶ Airport Terminal world 실행

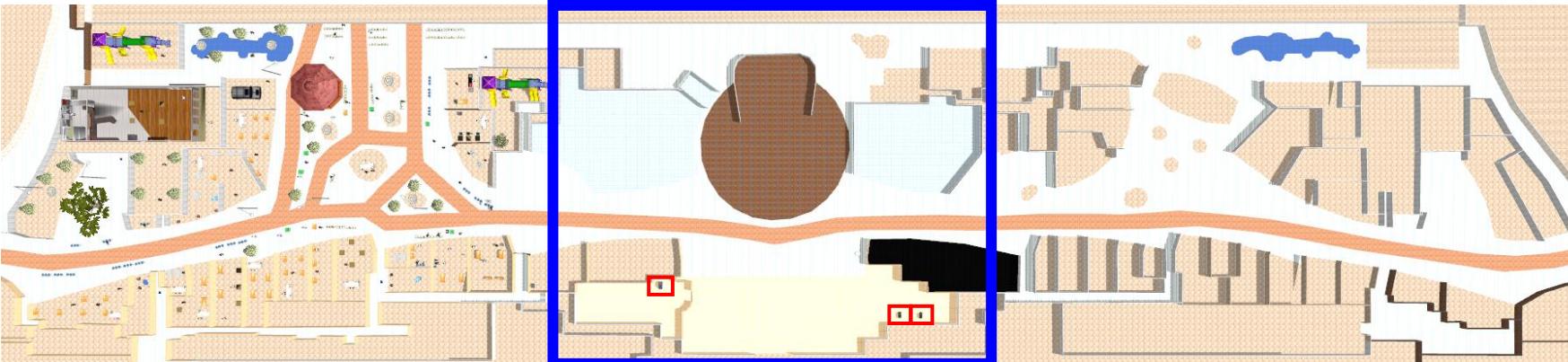
| Airport Terminal world 설명



Airport Terminal world Demo

⦿ Airport Terminal world 실행

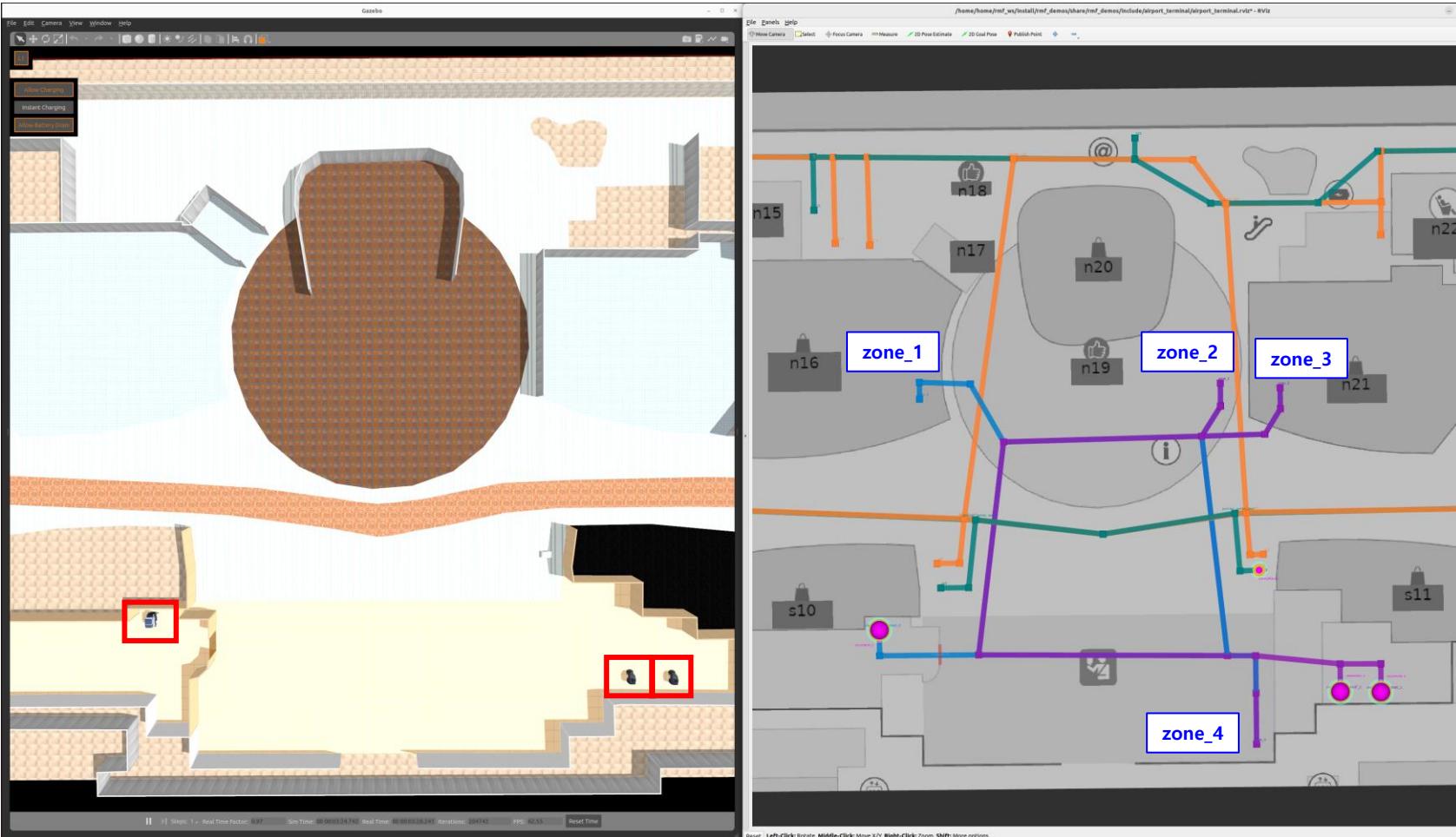
| Airport Terminal world 설명



Airport Terminal world Demo

⦿ Airport Terminal world 실행

I Airport Terminal world 설명



Airport Terminal world Demo

⦿ Clean Task 실행

| 환경 불러오기

```
cd ~/rmf_ws && source install/setup.bash
```

| Clean Task 명령

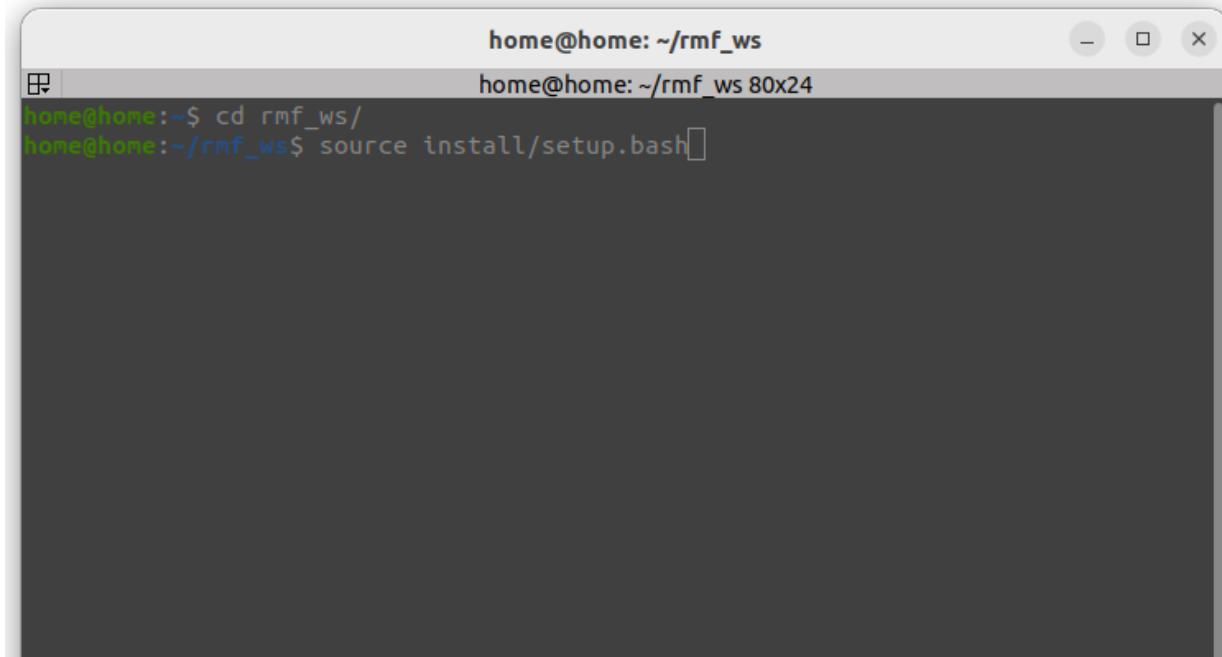
```
ros2 run rmf_demos_tasks dispatch_clean -cs zone_3 --use_sim_time
```

Airport Terminal world Demo

⦿ Clean Task 실행

| 환경 불러오기

```
cd ~/rmf_ws && source install/setup.bash
```



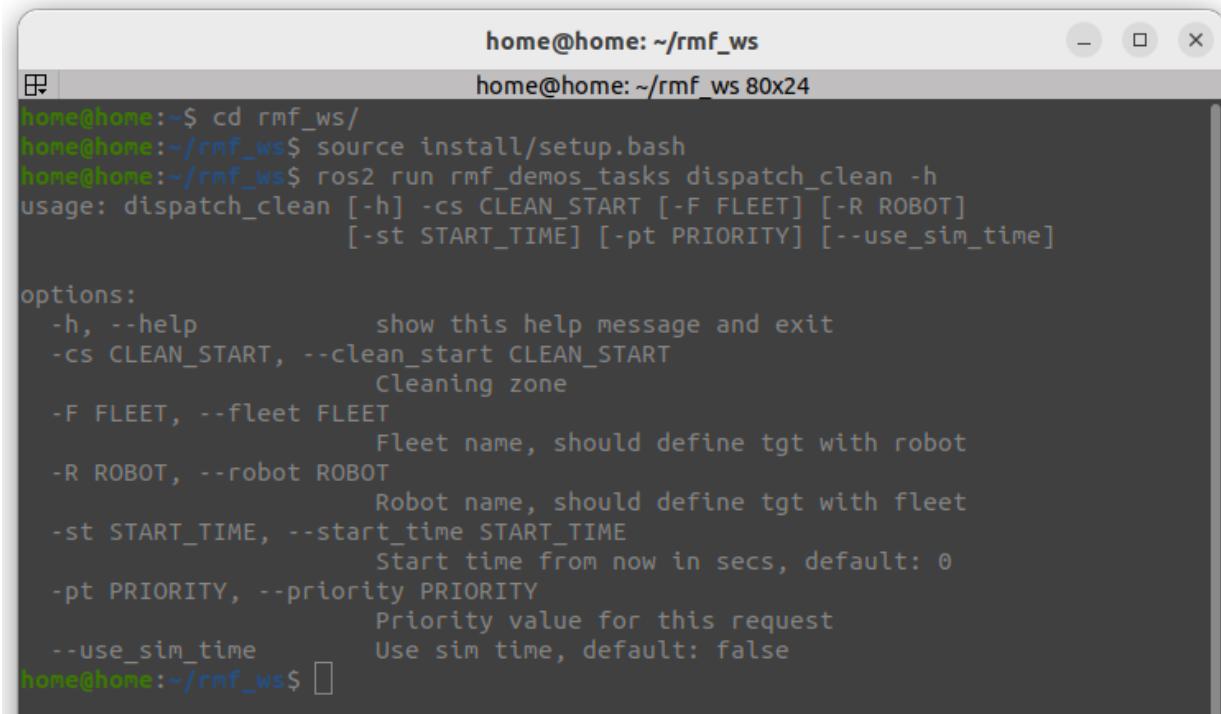
The screenshot shows a terminal window titled "home@home: ~/rmf_ws". The window has a white header bar with the title and a dark gray body. In the body, there is a command-line interface. The first line shows the user's prompt: "home@home: ~/rmf_ws". The second line shows the command being typed: "cd ~/rmf_ws/". The third line shows the command being completed: "home@home: ~/rmf_ws\$ source install/setup.bash". The cursor is visible at the end of the third line.

Airport Terminal world Demo

⦿ Clean Task 실행

| Clean Task 명령

```
ros2 run rmf_demos_tasks dispatch_clean -cs zone_3 --use_sim_time
```



The image shows a terminal window titled "home@home: ~/rmf_ws". The terminal displays the following command and its usage:

```
home@home:~$ cd rmf_ws/
home@home:~/rmf_ws$ source install/setup.bash
home@home:~/rmf_ws$ ros2 run rmf_demos_tasks dispatch_clean -h
usage: dispatch_clean [-h] -cs CLEAN_START [-F FLEET] [-R ROBOT]
                      [-st START_TIME] [-pt PRIORITY] [--use_sim_time]

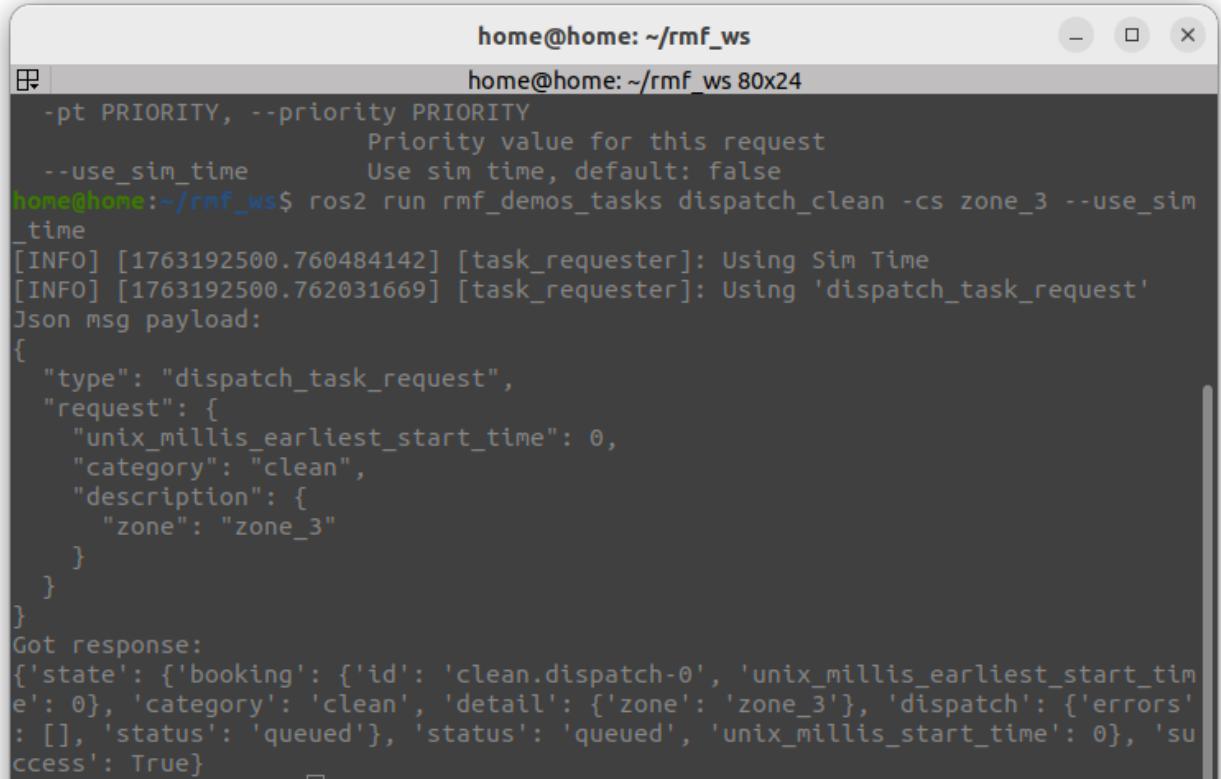
options:
  -h, --help            show this help message and exit
  -cs CLEAN_START, --clean_start CLEAN_START
                        Cleaning zone
  -F FLEET, --fleet FLEET
                        Fleet name, should define tgt with robot
  -R ROBOT, --robot ROBOT
                        Robot name, should define tgt with fleet
  -st START_TIME, --start_time START_TIME
                        Start time from now in secs, default: 0
  -pt PRIORITY, --priority PRIORITY
                        Priority value for this request
  --use_sim_time        Use sim time, default: false
home@home:~/rmf_ws$
```

Airport Terminal world Demo

⦿ Clean Task 실행

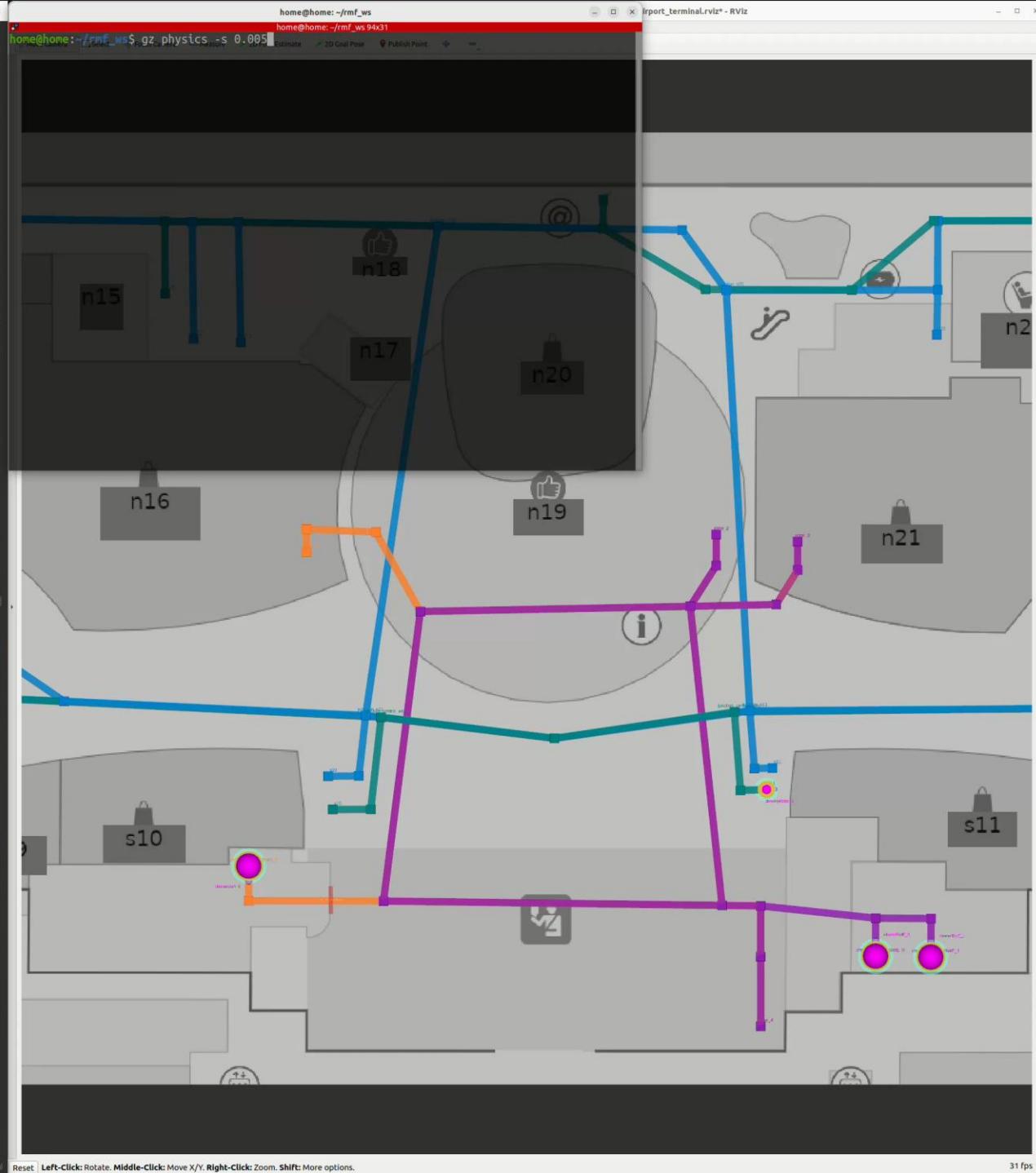
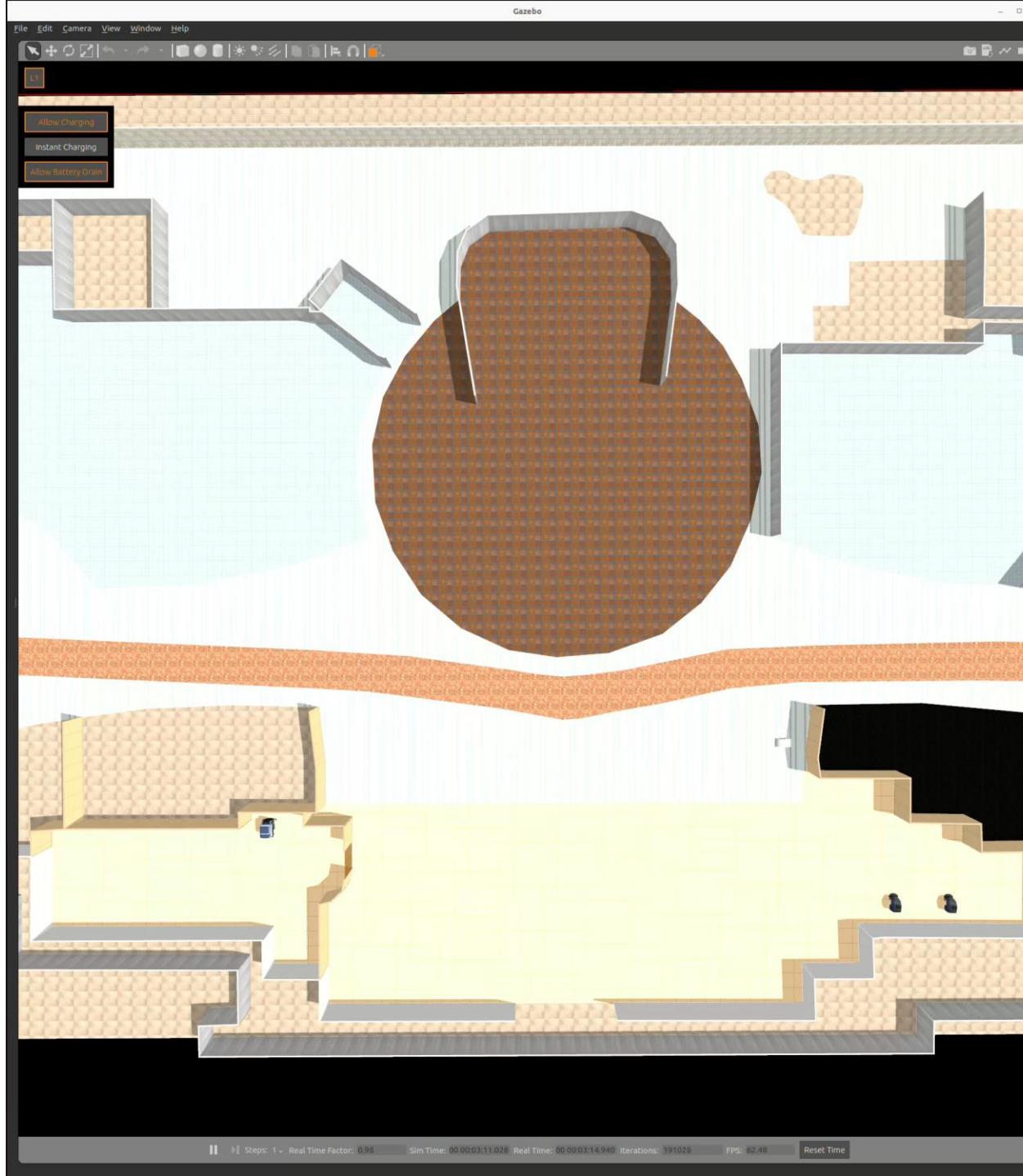
| Clean Task 명령

```
ros2 run rmf_demos_tasks dispatch_clean -cs zone_3 --use_sim_time
```



The terminal window shows the command being run and its output:

```
home@home: ~/rmf_ws
home@home: ~/rmf_ws 80x24
-pt PRIORITY, --priority PRIORITY
          Priority value for this request
--use_sim_time      Use sim time, default: false
home@home:~/rmf_ws$ ros2 run rmf_demos_tasks dispatch_clean -cs zone_3 --use_sim_time
[INFO] [1763192500.760484142] [task_requester]: Using Sim Time
[INFO] [1763192500.762031669] [task_requester]: Using 'dispatch_task_request'
Json msg payload:
{
  "type": "dispatch_task_request",
  "request": {
    "unix_millis_earliest_start_time": 0,
    "category": "clean",
    "description": {
      "zone": "zone_3"
    }
  }
}
Got response:
{'state': {'booking': {'id': 'clean.dispatch-0', 'unix_millis_earliest_start_time': 0}, 'category': 'clean', 'detail': {'zone': 'zone_3'}, 'dispatch': {'errors': [], 'status': 'queued'}, 'status': 'queued', 'unix_millis_start_time': 0}, 'success': True}
```



Airport Terminal world Demo

⦿ Clean Task log 확인

| Task 할당 log

```
[fleet_adapter-10] [INFO] [1763192511.870197685] [tinyRobot_command_handle]: Robot tinyRobot_3 has successfully navigated along requested path.  
[rmf_task_dispatcher-13] [INFO] [1763192515.792854841] [rmf_dispatcher_node]: Add Task [clean.dispatch-1] to a bidding queue  
[rmf_task_dispatcher-13] [INFO] [1763192515.905785550] [rmf_dispatcher_node]: - Start new bidding task: clean.dispatch-1  
[fleet_adapter-24] [INFO] [1763192515.905906995] [cleanerBotE_fleet_adapter]: [Bidder] Received Bidding notice for task_id [clean.dispatch-1]  
[fleet_adapter-24] [INFO] [1763192515.906017515] [cleanerBotE_fleet_adapter]: Planning for [2] robot(s) and [1] request(s)  
[fleet_adapter-22] [INFO] [1763192515.905908902] [cleanerBotA_fleet_adapter]: [Bidder] Received Bidding notice for task_id [clean.dispatch-1]  
[fleet_adapter-22] [INFO] [1763192515.906008485] [cleanerBotA_fleet_adapter]: Planning for [1] robot(s) and [1] request(s)  
[fleet_adapter-16] [INFO] [1763192515.905909001] [tinyRobot_fleet_adapter]: [Bidder] Received Bidding notice for task_id [clean.dispatch-1]  
[fleet_adapter-18] [INFO] [1763192515.905909434] [deliveryRobot_fleet_adapter]: [Bidder] Received Bidding notice for task_id [clean.dispatch-1]  
[fleet_adapter-22] [INFO] [1763192515.906462323] [cleanerBotA_fleet_adapter]: Submitted BidProposal to accommodate task [clean.dispatch-1] by robot [cleanerBotA_0] with new cost [747.538261]  
[fleet_adapter-24] [INFO] [1763192515.906923407] [cleanerBotE_fleet_adapter]: Submitted BidProposal to accommodate task [clean.dispatch-1] by robot [cleanerBotE_1] with new cost [692.147233]  
[fleet_adapter-24] [INFO] [1763192516.048701963] [cleanerBotE_command_handle]: Robot [cleanerBotE_0] has reached the destination for cmd_id 32  
[rmf_task_dispatcher-13] [INFO] [1763192517.905844985] [rmf_dispatcher_node]: Determined winning Fleet Adapter: [cleanerBotE], from 4 responses  
[rmf_task_dispatcher-13] [INFO] [1763192517.905911742] [rmf_dispatcher_node]: Dispatcher Bidding Result: task [clean.dispatch-1] is awarded to fleet adapter [cleanerBotE], with expected robot [cleanerBotE_1].  
[fleet_adapter-24] [INFO] [1763192517.906115879] [cleanerBotE_fleet_adapter]: Bid for task_id [clean.dispatch-1] awarded to fleet [cleanerBotE]. Processing request...  
[fleet_adapter-24] [INFO] [1763192517.906440128] [cleanerBotE_fleet_adapter]: Assignments updated for robots in fleet [cleanerBotE] to accommodate task_id [clean.dispatch-1]  
[fleet_adapter-24] [INFO] [1763192517.906654403] [cleanerBotE_fleet_adapter]: Beginning new task [clean.dispatch-1] for [cleanerBotE/cleanerBotE_1]. Remaining queue size: 1  
[fleet_adapter-24] [INFO] [1763192517.906724823] [cleanerBotE_command_handle]: Requesting cleanerBotE_1 to stop...
```

RMF Panel

RMF Panel

⦿ RMF Panel으로 Clean Task 명령 내리기

| 환경 불러오기

```
cd ~/rmf_ws && source install/setup.bash
```

| Classic Gazebo로 airport_terminal world 실행

```
ros2 launch rmf_demos_gz_classic airport_terminal.launch.xml server_uri="ws://localhost:7878"
```

| RMF Panel 접속

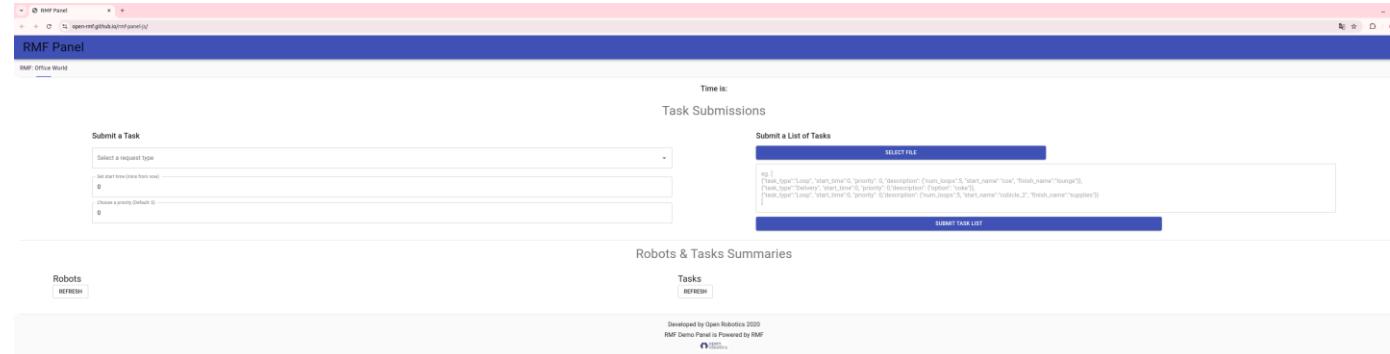
<https://open-rmf.github.io/rmf-panel-js/>

RMF Panel

⦿ RMF Panel으로 Clean Task 명령 내리기

| RMF Panel 접속

<https://open-rmf.github.io/rmf-panel-js/>



RMF Panel

⦿ RMF Panel으로 Clean Task 명령 내리기

The screenshot shows the RMF Panel web application interface. At the top, there's a header bar with the title "RMF Panel" and a sub-header "RMF - Airport Terminal World". Below the header, there are two main sections: "Task Submissions" and "Robots & Tasks Summaries".

Task Submissions: This section contains two forms. The left form is for "Submit a Task" and includes fields for "Select a request type" (set to "0"), "Set start time (from now)" (set to "0"), and "Choose a priority (Default: 0)". The right form is for "Submit a List of Tasks" and has a "SELECT FILE" button and a text area containing JSON task definitions. An example of the JSON is provided:

```
eg [ { "task_type": "Loop", "start_time": 0, "priority": 0, "description": "(num_loops:5, "start_name": "co", "finish_name": "lounge")}, { "task_type": "Delivery", "start_time": 0, "priority": 0, "description": "(option: "coffee")}, { "task_type": "Loop", "start_time": 0, "priority": 0, "description": "(num_loops:5, "start_name": "cubicle_2", "finish_name": "supplies")}]
```

Robots & Tasks Summaries: This section displays a grid of robot status cards. Each card provides information about a robot's assigned tasks, current status, battery level, and location. The robots listed are:

- cleanerBotE_1: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- cleanerBotE_0: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- deliveryRobot_2: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- deliveryRobot_1: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- deliveryRobot_0: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- caddy: Assigned Tasks 0, Status Moving, Battery 90%, Location L1
- tinyRobot_3: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- tinyRobot_2: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- tinyRobot_1: Assigned Tasks 0, Status Idle, Battery 100%, Location L1
- tinyRobot_0: Assigned Tasks 0, Status Idle, Battery 100%, Location L1

At the bottom of the page, there's a footer note: "Developed by Open Robotics 2020" and "RMF Demo Panel is Powered by RMF".

RMF Panel

⦿ RMF Panel으로 Clean Task 명령 내리기

The screenshot shows the RMF Panel web application. At the top, there's a navigation bar with tabs like 'RMF', 'Airport Terminal World', and 'Time is:'. Below the navigation is a section for 'Task Submissions' with two main options: 'Submit a Task' (a form with dropdowns for 'Select a request type' like 'Delivery', 'Clean', or 'Loop') and 'Submit a List of Tasks' (a file input field with a 'SELECT FILE' button). In the center, there's a summary section titled 'Robots & Tasks Summaries' containing six cards for different robots: 'cleanerBotE_1', 'cleanerBotE_0', 'deliveryRobot_2', 'deliveryRobot_1', 'deliveryRobot_0', and 'caddy'. Each card displays the robot's name, type, assigned tasks (e.g., 'Idle-0'), battery level (e.g., 100%), and location (e.g., L1). Below the robot summary is a footer with the text 'Developed by Open Robotics 2020' and 'RMF Demo Panel is Powered by RMF'.

RMF Panel

☞ RMF Panel으로 Clean Task 명령 내리기

The screenshot shows the RMF Panel interface for managing robots and tasks. The top navigation bar includes tabs for 'Task Submissions' and 'Robots & Tasks Summaries'. The 'Task Submissions' section contains two forms: 'Submit a Task' (for a single task like 'Clean') and 'Submit a List of Tasks' (for multiple tasks via a file). The 'Robots & Tasks Summaries' section displays a grid of robot status cards. Each card provides details such as robot name, type, assigned tasks, status (e.g., 'Idle-0'), battery level, and location (e.g., L1). A summary at the bottom indicates 'Moving 2' robots.

Time is: [REDACTED]

Task Submissions

Submit a Task

Select a request type: Clean

Set start time (move from now): 0

Choose a priority (Default: 0): 0

Schedule a Clean Request

Pick a zone: zone_2

SUBMIT REQUEST

Submit a List of Tasks

SELECT FILE

[REDACTED]

SUBMIT TASK LIST

Robots & Tasks Summaries

REFRESH

REFRESH

Robot Name	Type	Assigned Tasks	Status	Battery	Location
cleanerBot_E_1	cleanerBotE	Idle-0	Green	L1	
cleanerBot_E_0	cleanerBotE	Idle-0	Green	L1	
deliveryRobot_2	deliveryRobot	Idle-0	Green	L1	
deliveryRobot_1	deliveryRobot	Idle-0	Green	L1	
deliveryRobot_0	deliveryRobot	Idle-0	Green	L1	
caddy	caddy	Moving-2	Blue	L1	
tinyRobot_3	tinyRobot	Idle-0	Green	L1	
tinyRobot_2	tinyRobot	Idle-0	Green	L1	
tinyRobot_1	tinyRobot	Idle-0	Green	L1	
tinyRobot_0	tinyRobot	Idle-0	Green	L1	

Developed by Open Robotics 2020
RMF Demo Panel is Powered by RMF

Open Robotics

RMF Panel

☞ RMF Panel으로 loop, delivery Task 명령 내리기

The screenshot shows the RMF Panel interface for the "Airport Terminal World".

Task Submissions: A red box highlights the "Submit a List of Tasks" section. It contains a "SELECT FILE" button and a text area with the following JSON code:

```
eg. [ { "task_type": "Loop", "start_time": 0, "priority": 0, "description": { "num_loops": 5, "start_name": "cow", "finish_name": "lounge" }}, { "task_type": "Delivery", "start_time": 0, "priority": 0, "description": { "option": "coke" }}, { "task_type": "Loop", "start_time": 0, "priority": 0, "description": { "num_loops": 5, "start_name": "cubicle_2", "finish_name": "supplies" }}, ]
```

Robots & Tasks Summaries: This section displays status for various robots:

- cleanerBot_E_1: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- cleanerBot_E_0: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- deliveryRobot_2: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- deliveryRobot_1: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- deliveryRobot_0: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- caddy: Assigned Tasks 0, Status Moving-2, Battery 100%, Location L1
- tinyRobot_3: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- tinyRobot_2: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- tinyRobot_1: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1
- tinyRobot_0: Assigned Tasks 0, Status Idle-0, Battery 100%, Location L1

Bottom Footer: Developed by Open Robotics 2020
RMF Demo Panel is Powered by RMF

RMF Panel

RMF: Airport Terminal World

Submit a Task

Select a request type
Loop

Set start time (mins from now)
0

Choose a priority (Default: 0)
0

Schedule a Loop Request

Select start location
koi_pond

Select end location
west_koi_pond

Number of Loops
1

SUBMIT REQUEST

Submit a List of Tasks

SELECT FILE

```
{ "task_type": "Delivery", "start_time": "0", "priority": "0", "description": { "option": "mop" } },  
{ "task_type": "Loop", "start_time": "0", "priority": "0", "description": { "num_loops": "1", "start_name": "koi_pond", "finish_name": "west_koi_pond" } }
```

SUBMIT TASK LIST

Robots & Tasks Summaries

Robot	REFRESH
deliveryRobot_2 deliveryRobot	
deliveryRobot_1 deliveryRobot	
deliveryRobot_0 deliveryRobot	
cleanerBotE_1 cleanerBotE	
cleanerBotE_0 cleanerBotE	
cleanerBotA_0 cleanerBotA	
caddy caddy	
tinyRobot_3 tinyRobot	
tinyRobot_2 tinyRobot	
tinyRobot_1 tinyRobot	
tinyRobot_0 tinyRobot	

Developed by Open Robotics 2020
RMF Demo Panel is Powered by RMF

감사합니다