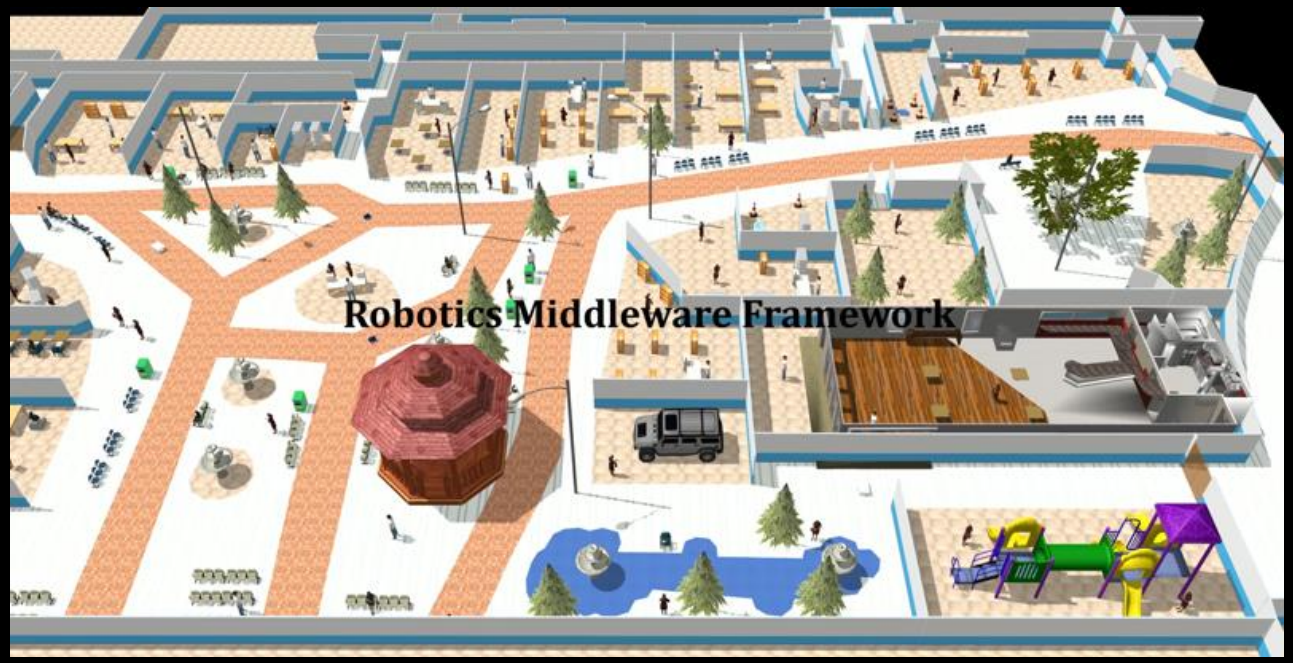
Open-RMF

A Common Language for Robot Interoperability



Lecture 2

정은빈

Contents

RMF Demo 소개

RMF Demos worlds

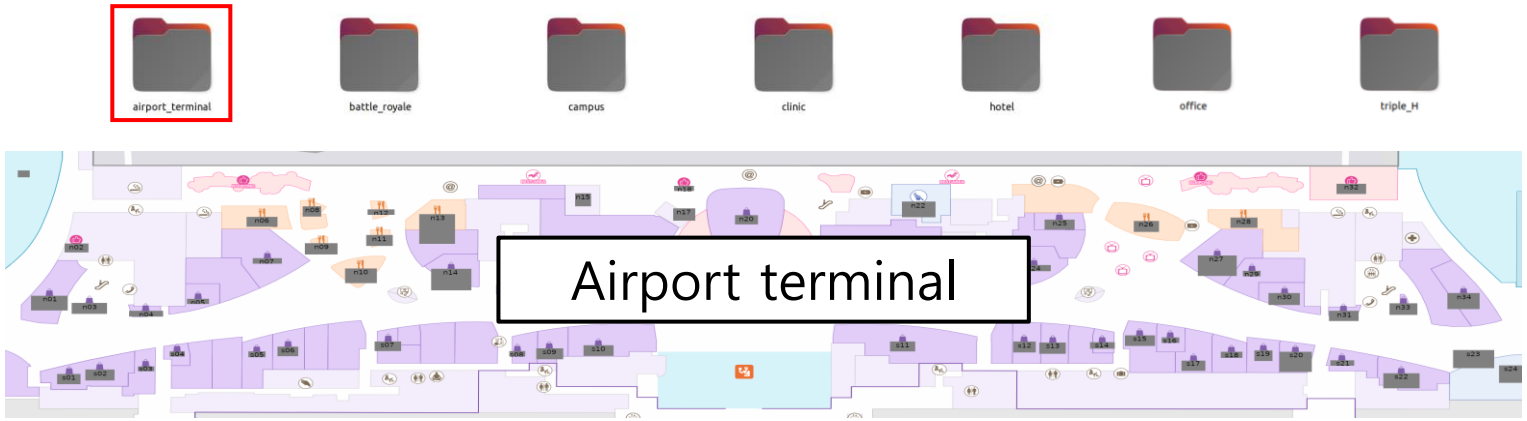
- Demos Worlds

```
cd ~/rmf_ws/src/rmf_demos/rmf_demos_maps/maps
```

RMF Demos worlds

- Demos Worlds

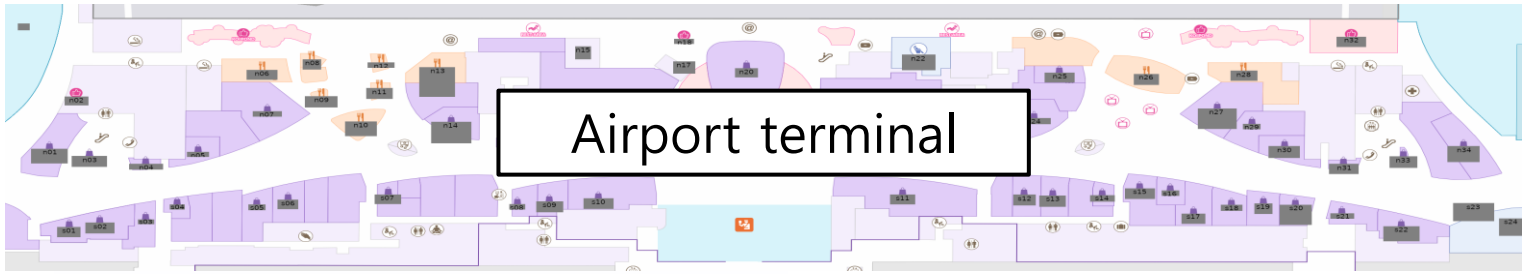
```
cd ~/rmf_ws/src/rmf_demos/rmf_demos_maps/maps
```



RMF Demos worlds

- Demos Worlds

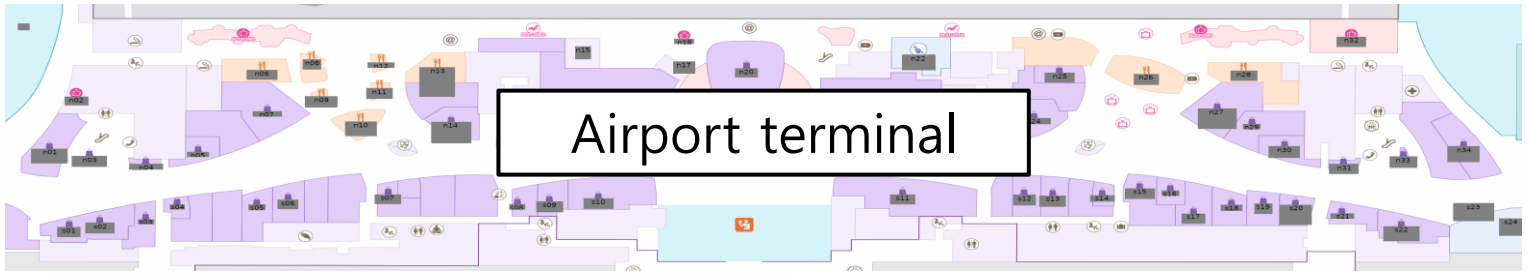
```
cd ~/rmf_ws/src/rmf_demos/rmf_demos_maps/maps
```



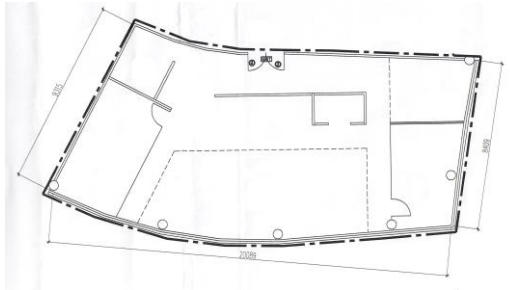
RMF Demos worlds

- Demos Worlds

```
cd ~/rmf_ws/src/rmf_demos/rmf_demos_maps/maps
```



Hotel



Office

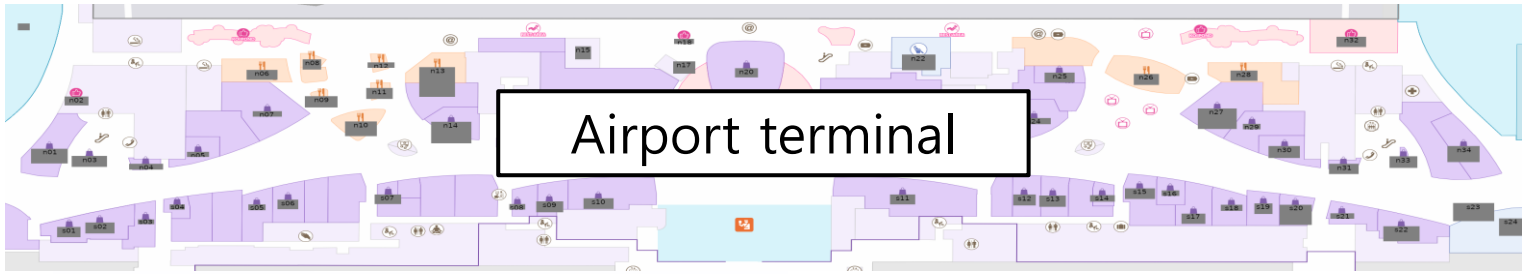
RMF Demos worlds

Demos Task

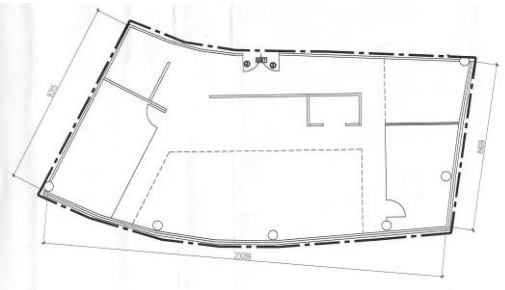
Task: World 내에서 로봇이 수행하는 업무

Task 종류

- Delivery
- Patrol
- Clean



Hotel



Office

Office World Demo

Office World Demo

Office world 실행

환경 불러오기

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

Classic Gazebo로 office world 실행

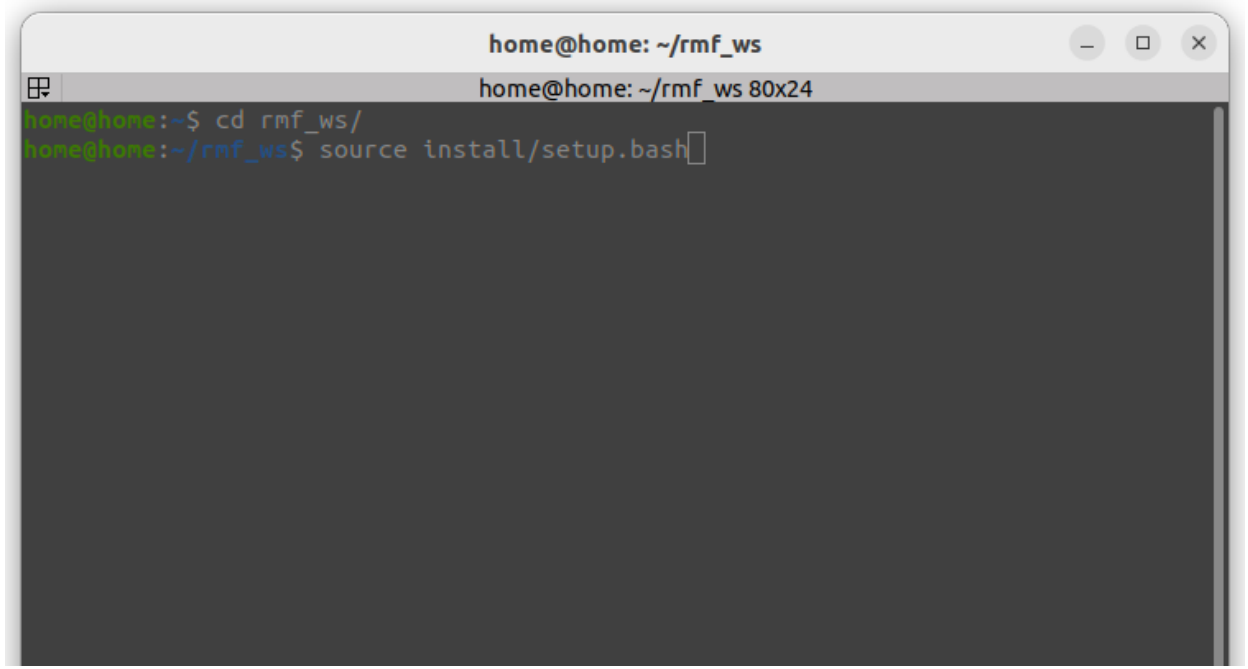
```
ros2 launch rmf_demos_gz_classic office.launch.xml
```

Office World Demo

Office world 실행

환경 불러오기

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

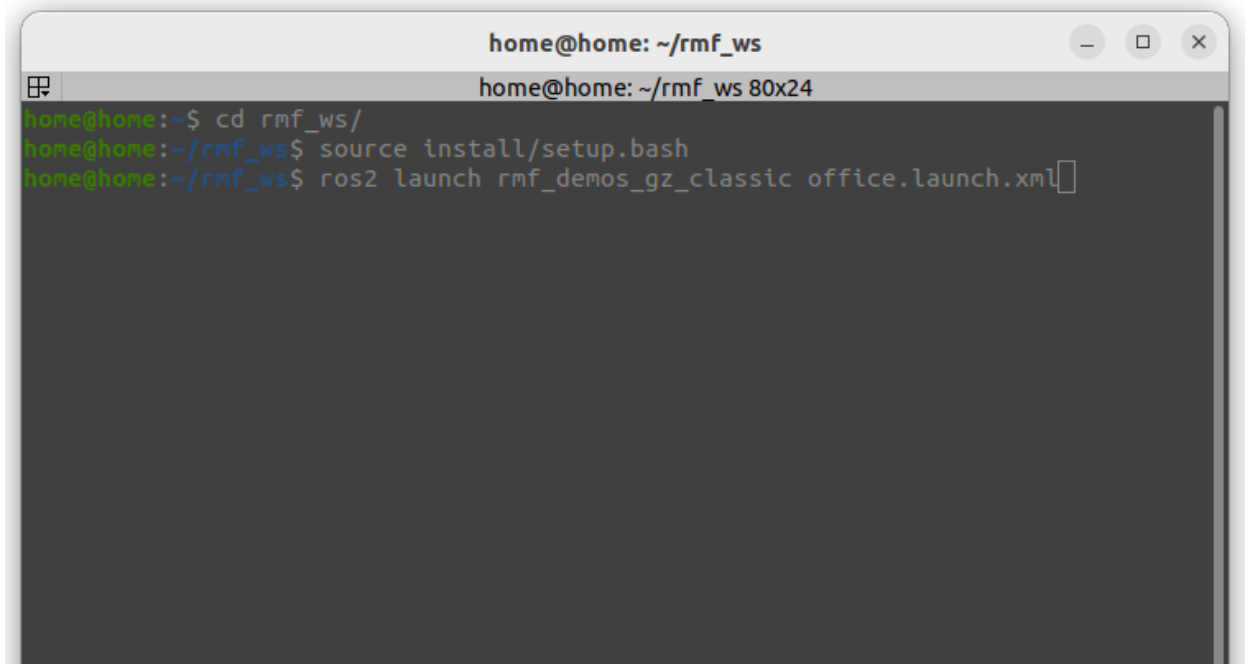


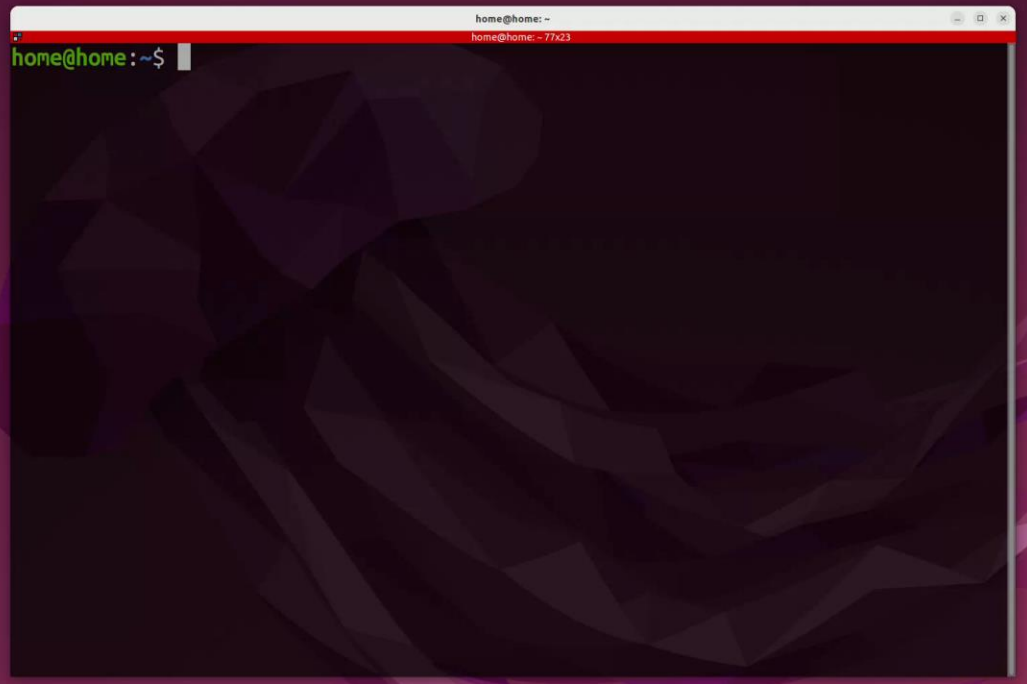
Office World Demo

Office world 실행

Classic Gazebo로 office world 실행

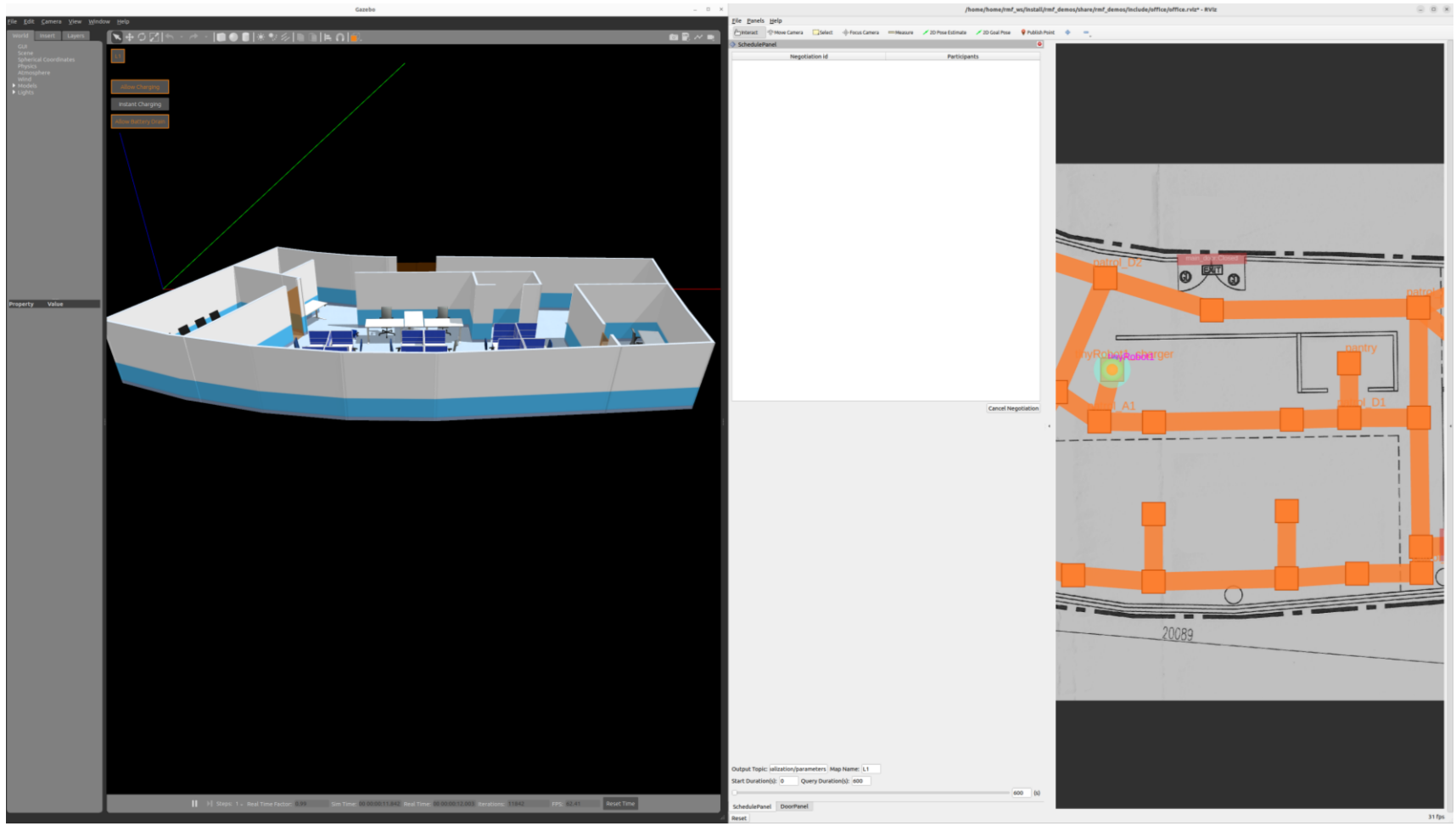
```
ros2 launch rmf_demos_gz_classic office.launch.xml
```




home@home: ~
home@home: ~ 77x23
home@home:~$

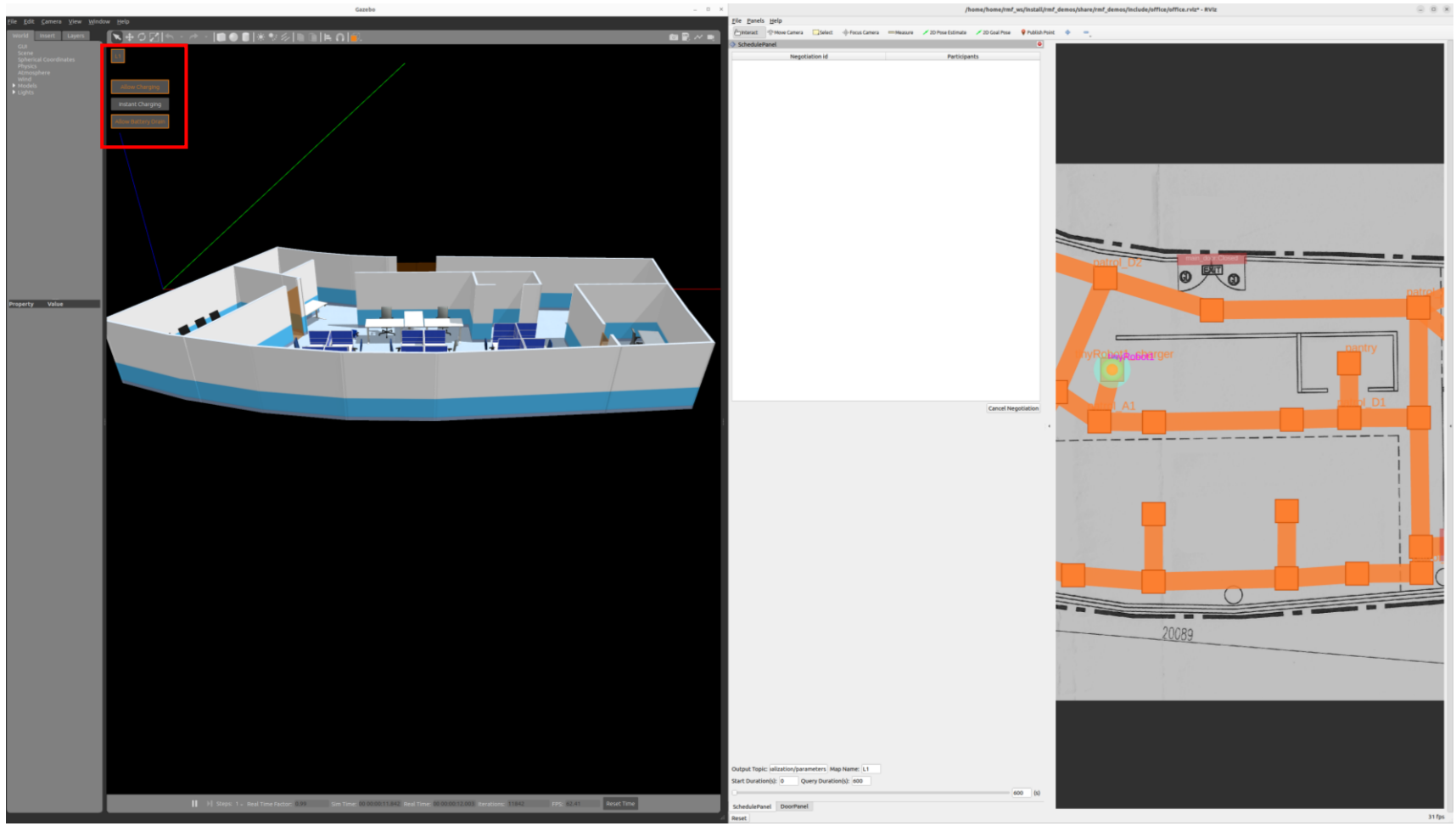
Office World Demo

- Office world 실행
  - Classic Gazebo로 office world 실행



Office World Demo

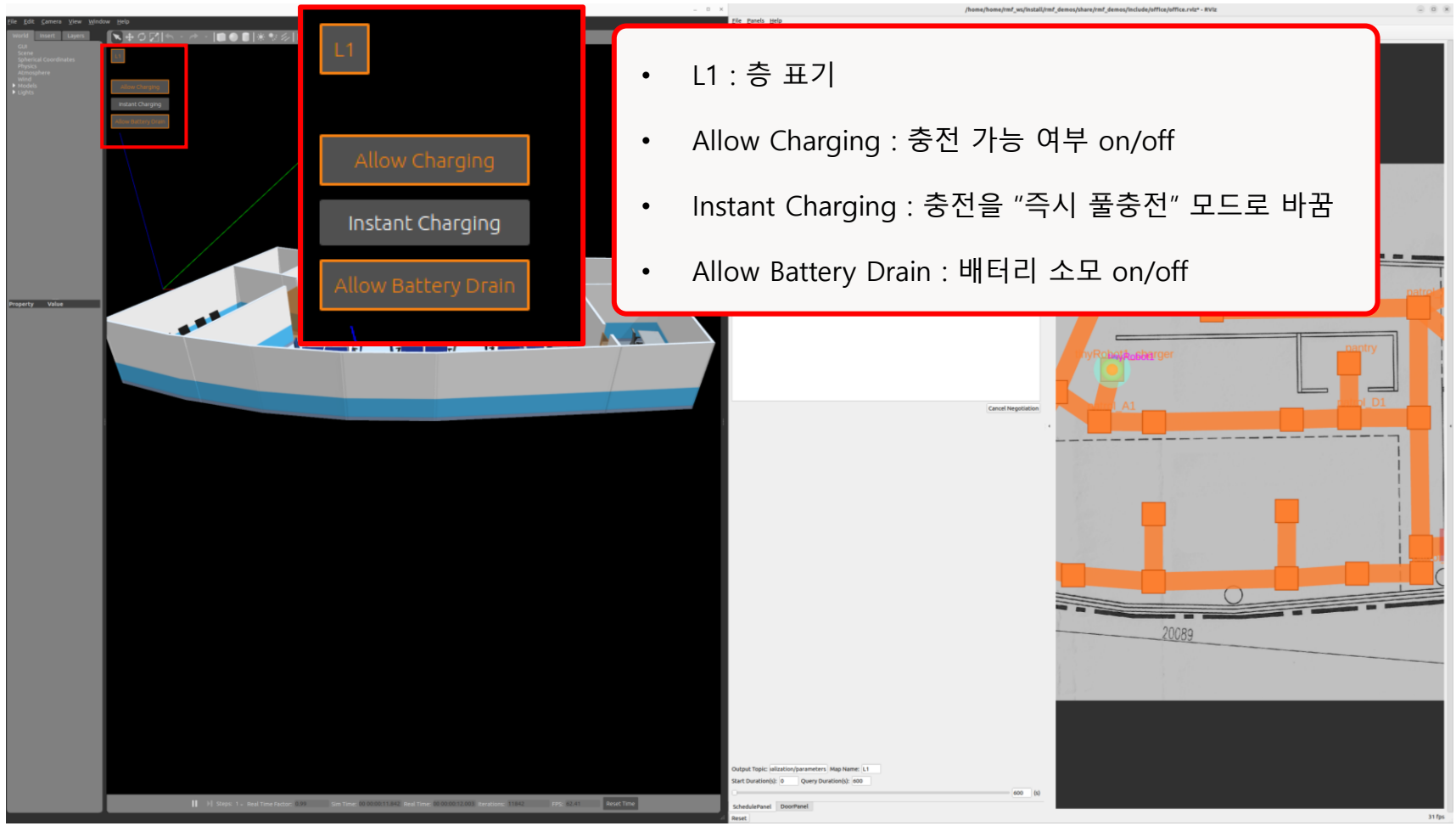
- Office world 실행
  - Classic Gazebo로 office world 실행



Office World Demo

Office world 실행

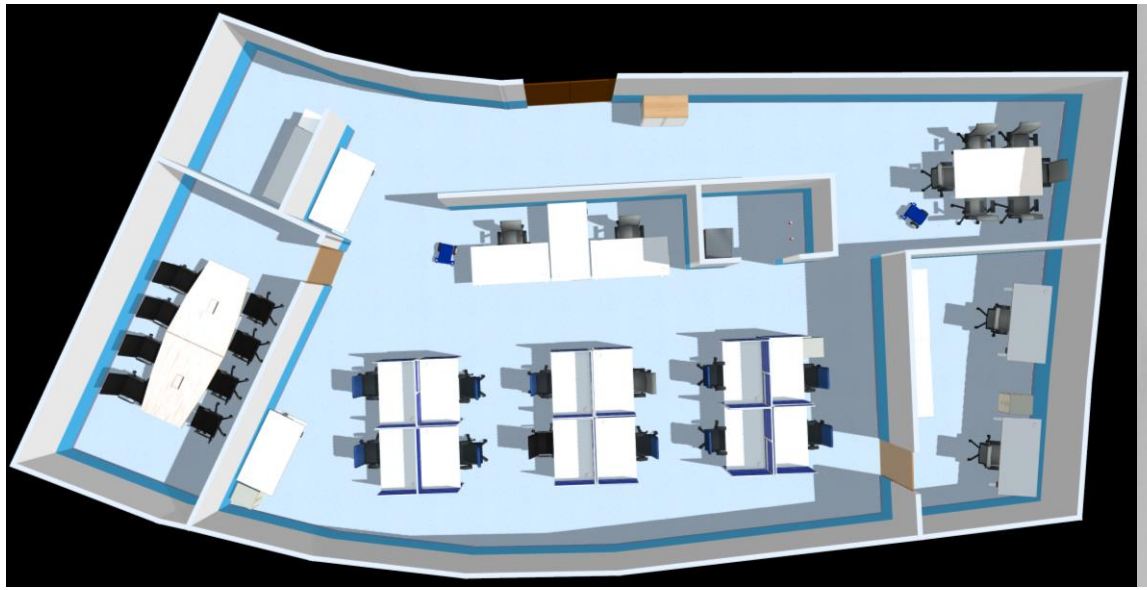
Classic Gazebo로 office world 실행



Office World Demo

Office world 실행

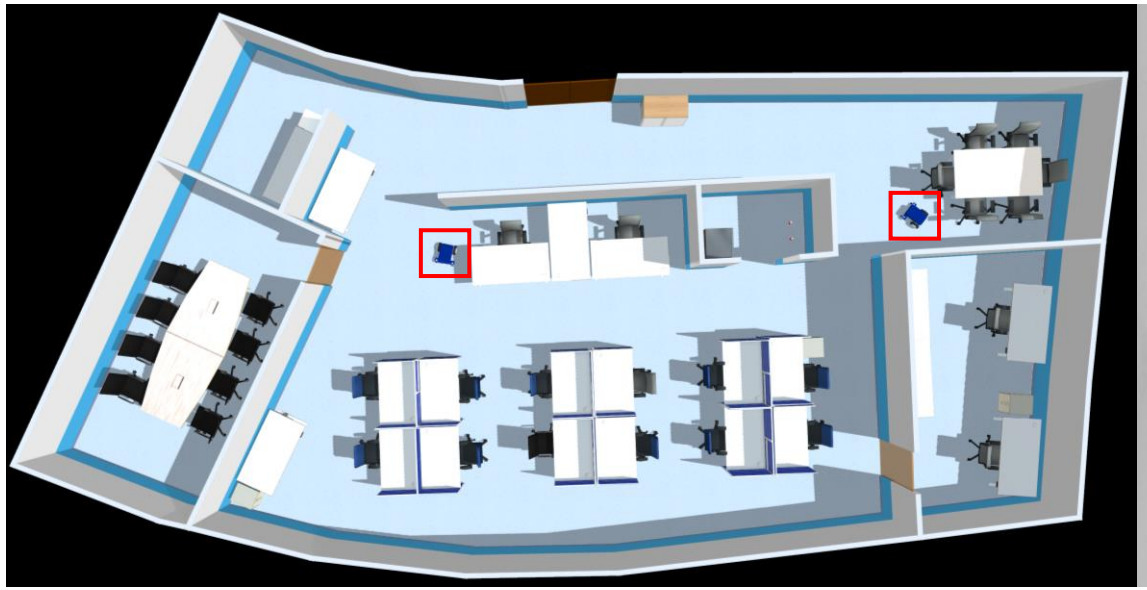
Office world 설명



Office World Demo

Office world 실행

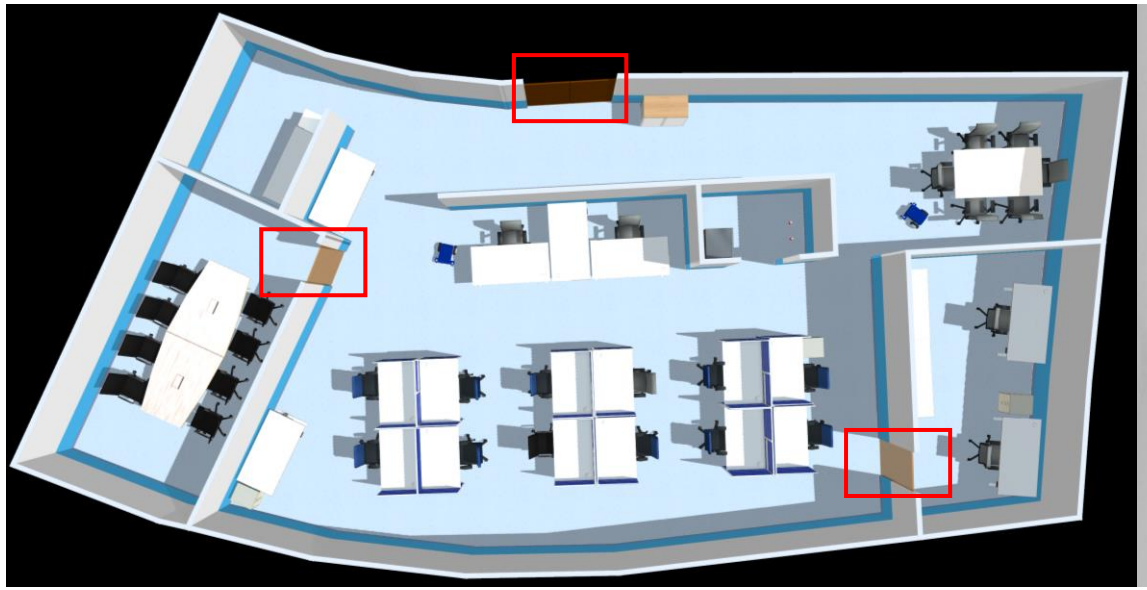
Office world 설명

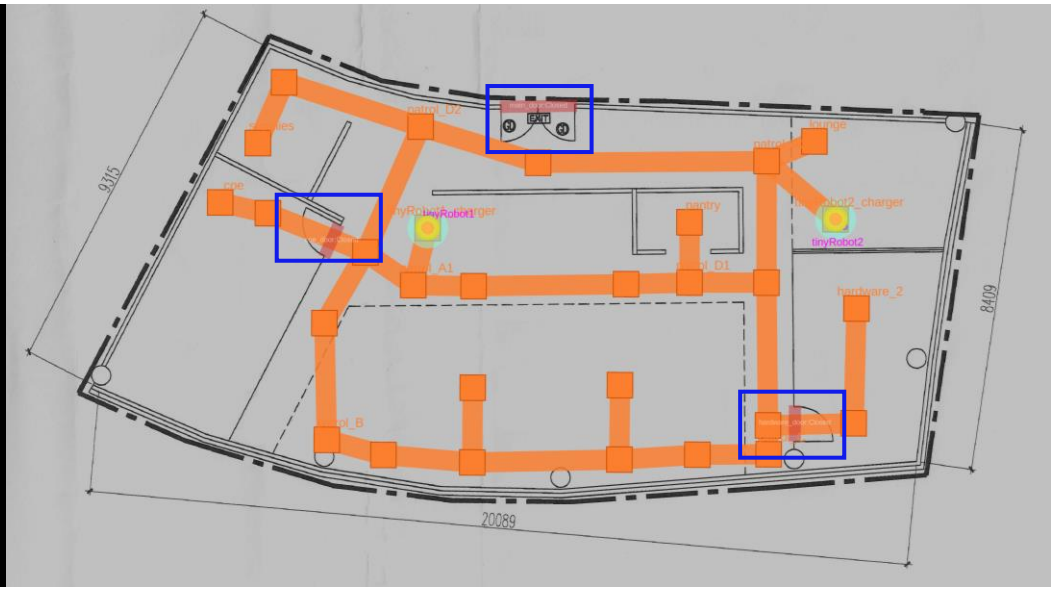


Office World Demo

Office world 실행

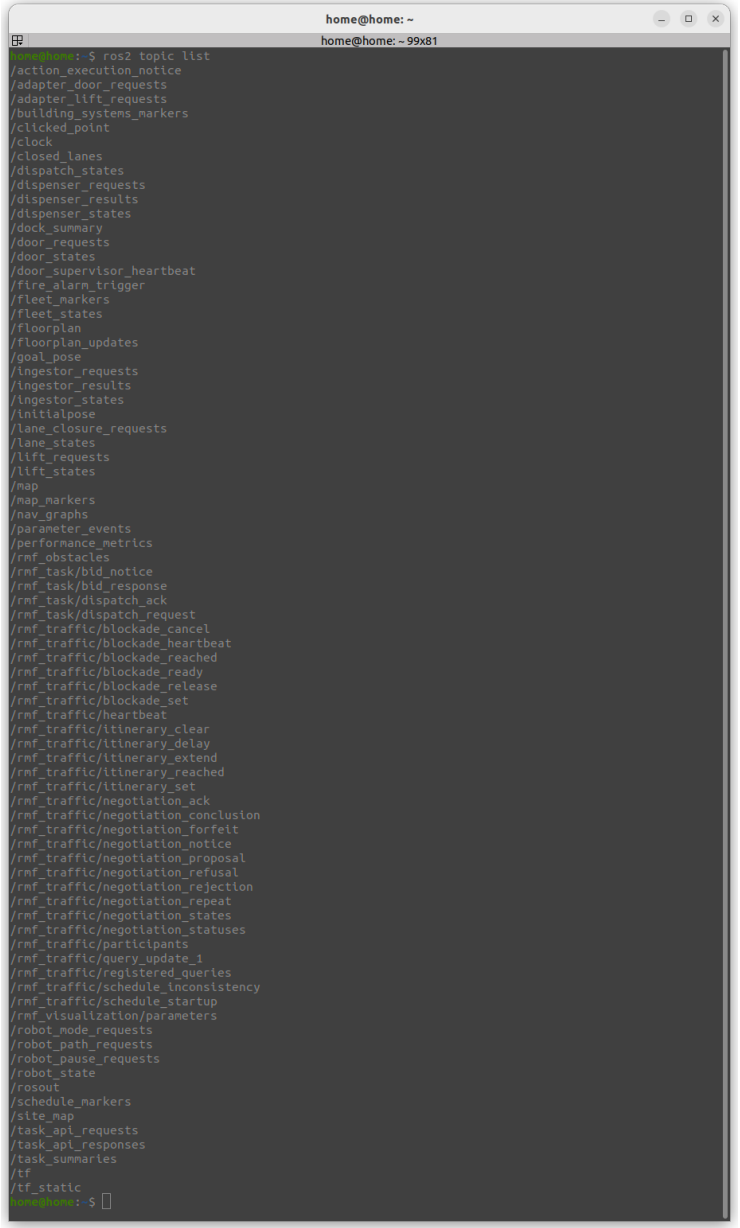
Office world 설명





Office World Demo

- Topics
  - Robot: 로봇의 위치, 배터리 상태, 작업 진행 상태
    - Topics: /fleets_states
  - Environment:
    - Door: /door_requests, /door_states, /door_supervisor_heartbeat
    - Lift: /lift_requests, /lift_states
  - RMF Task: RMF 시스템 관련 작업 관리
    - Topics: /rmf_task/bid_notice, /rmf_task/dispatch_request
  - RMF Traffic: 로봇들 사이의 원활한 트래픽 흐름과 경로 계획 관리
    - Topics: /rmf_traffic/blockade_, /rmf_traffic/itinerary_, /rmf_traffic/negotiation_



Office World Demo

Delivery Task 실행

환경 불러오기

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

Delivery Task 명령

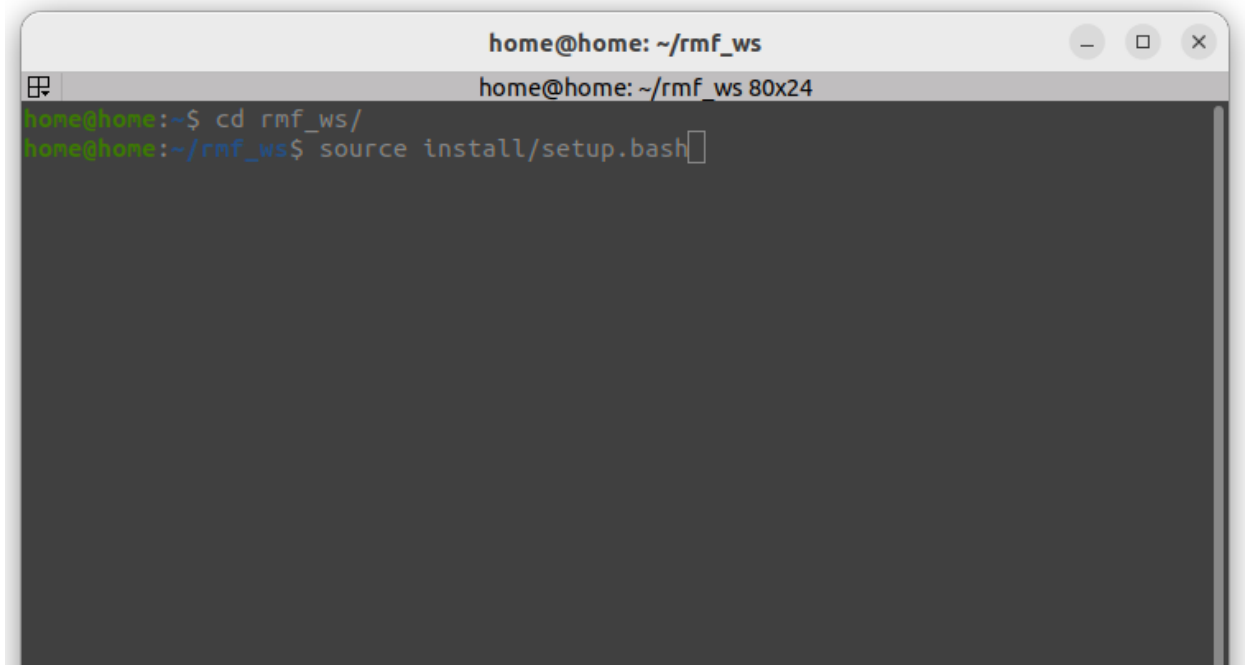
```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
```

Office World Demo

Delivery Task 실행

환경 불러오기

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

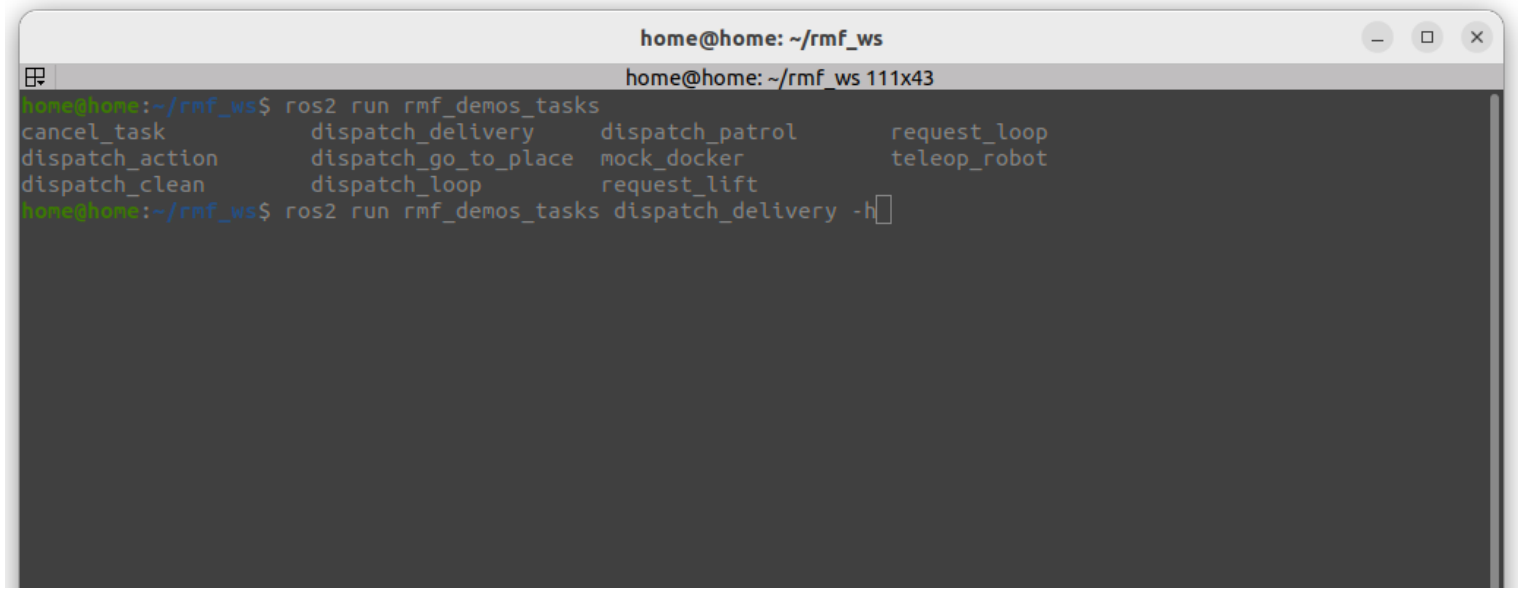


Office World Demo

Delivery Task 실행

Delivery Task 명령

```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
```

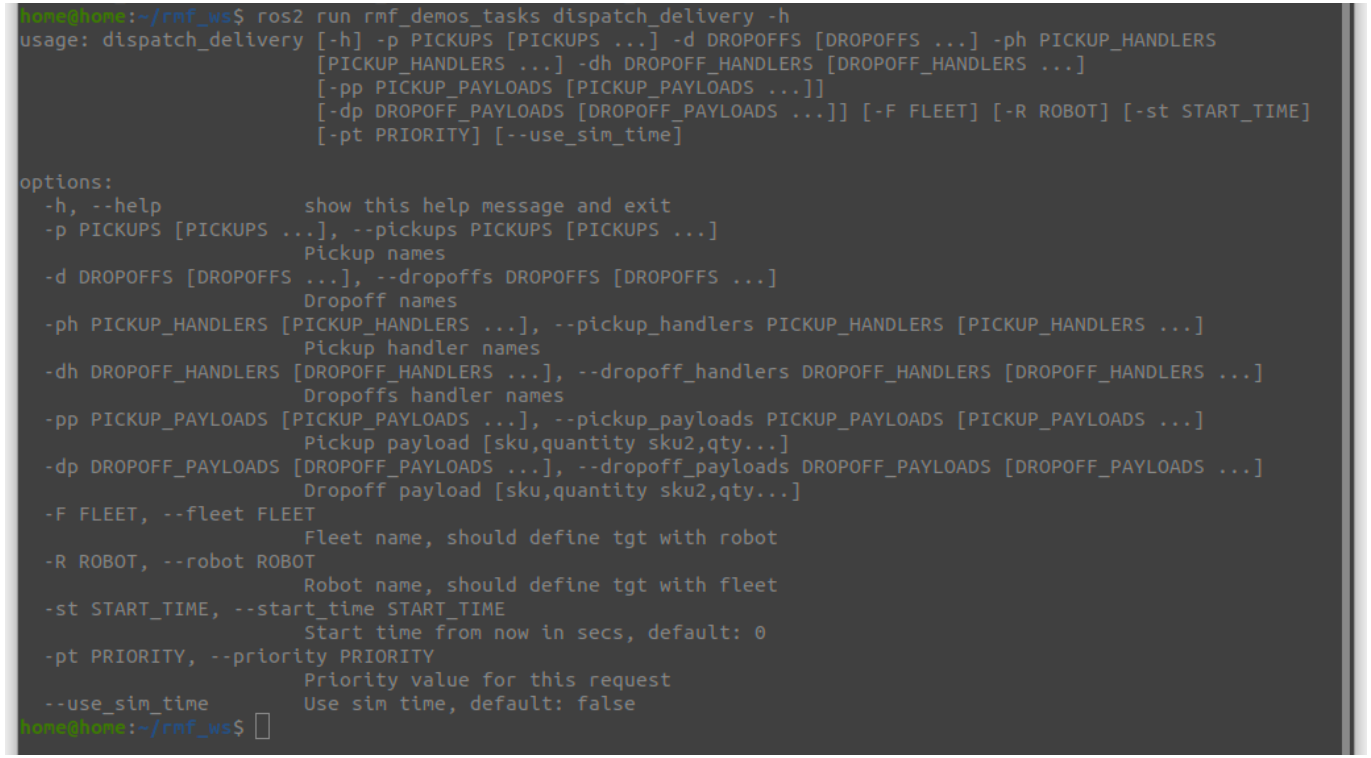


Office World Demo

Delivery Task 실행

Delivery Task 명령

```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
```

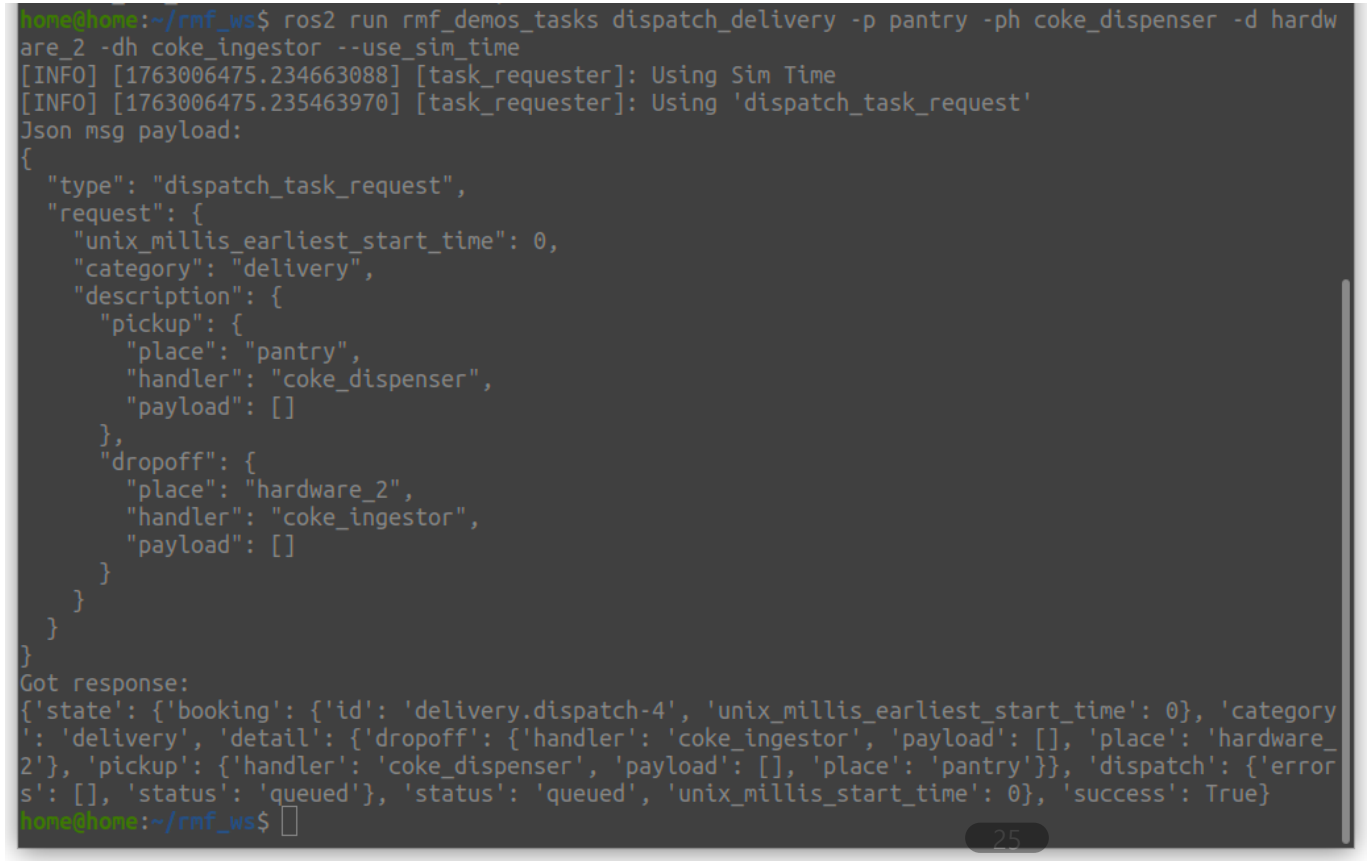


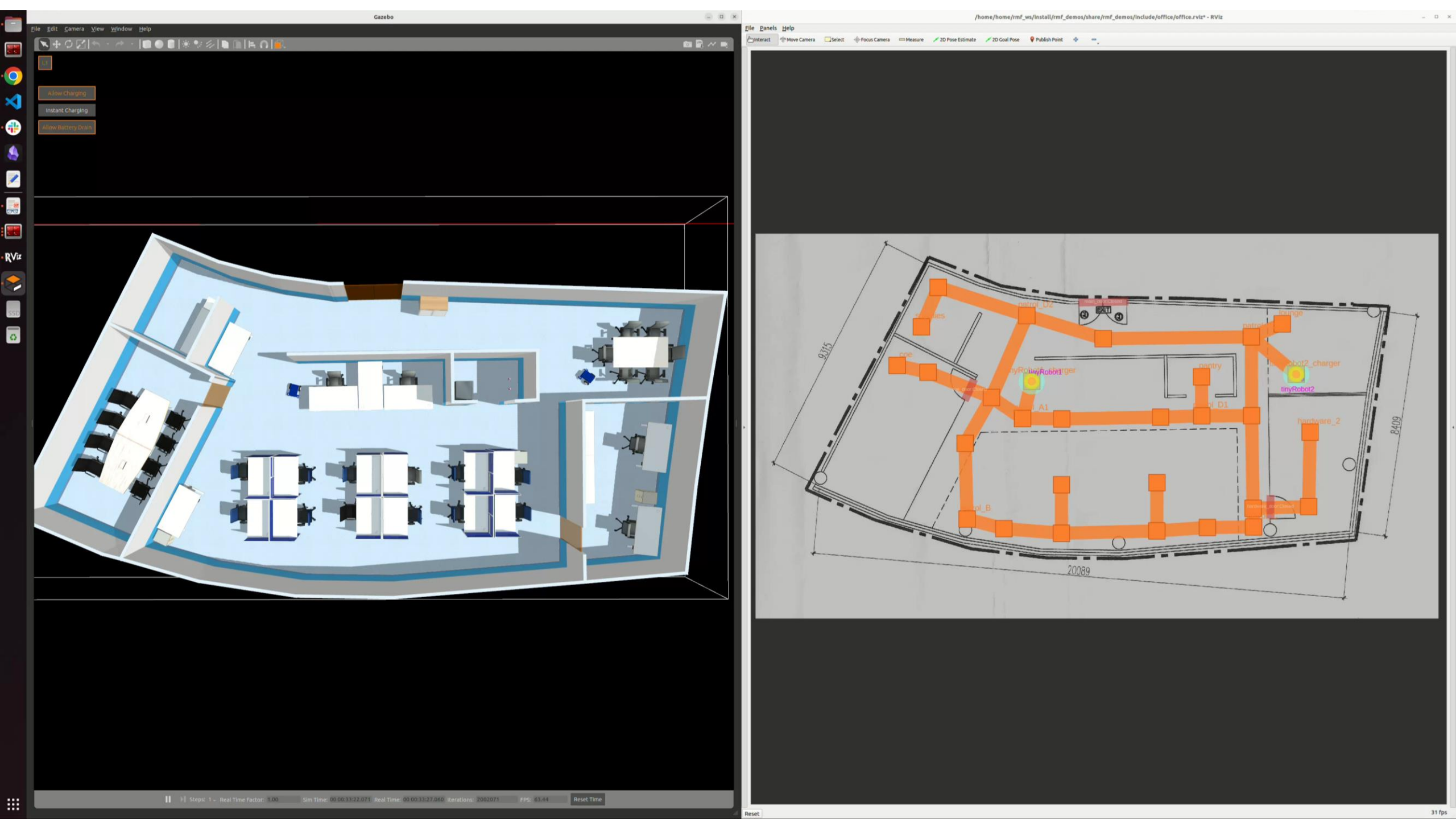
Office World Demo

Delivery Task 실행

Delivery Task 명령

```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
```




Gazebo
File Edit Camera View Window Help
Allow Charging
Instant Charging
Allow Battery Drain
/home/home/rmf_ws/install/rmf_demos/share/rmf_demos/include/office/office.rviz* - RViz
File Panels Help
Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Goal Pose Publish Point
lounge
tinyRobot1
tinyRobot2
tinyRobot2_charger
hardware_2
9315
8409
20089
Reset
31 fps

Office World Demo

Delivery Task 실행 log 확인

Task 할당 log

```
[fleet_adapter-16] [INFO] [1763010267.371189441] [tinyRobot_command_handle]: Robot tinyRobot2 has successfully navigated along requested path.
[fleet_adapter-16] [INFO] [1763010267.834962847] [tinyRobot_command_handle]: Robot [tinyRobot1] has reached the destination for cmd_id 156
[fleet_adapter-16] [INFO] [1763010267.848651099] [tinyRobot_command_handle]: Robot tinyRobot1 has successfully navigated along requested path.
[rmf_task_dispatcher-13] [INFO] [1763010273.742820221] [rmf_dispatcher_node]: Add Task [delivery.dispatch-0] to a bidding queue
[rmf_task_dispatcher-13] [INFO] [1763010273.821562558] [rmf_dispatcher_node]:  - Start new bidding task: delivery.dispatch-0
[fleet_adapter-16] [INFO] [1763010273.822128310] [tinyRobot_fleet_adapter]: [Bidder] Received Bidding notice for task_id [delivery.dispatch-0]
[fleet_adapter-16] [INFO] [1763010273.822634538] [tinyRobot_fleet_adapter]: Planning for [2] robot(s) and [1] request(s)
[fleet_adapter-16] [INFO] [1763010273.827292464] [tinyRobot_fleet_adapter]: Submitted BidProposal to accommodate task [delivery.dispatch-0] by robot [tinyRobot2] with new cost [2445.315016]
[rmf_task_dispatcher-13] [INFO] [1763010275.821638018] [rmf_dispatcher_node]: Determined winning Fleet Adapter: [tinyRobot], from 1 responses
[rmf_task_dispatcher-13] [INFO] [1763010275.821727887] [rmf_dispatcher_node]: Dispatcher Bidding Result: task [delivery.dispatch-0] is awarded to fleet adapter [tinyRobot], with expected robot [tinyRobot2].
[fleet_adapter-16] [INFO] [1763010275.822171381] [tinyRobot_fleet_adapter]: Bid for task_id [delivery.dispatch-0] awarded to fleet [tinyRobot]. Processing request...
[fleet_adapter-16] [INFO] [1763010275.825748707] [tinyRobot_fleet_adapter]: Assignments updated for robots in fleet [tinyRobot] to accommodate task_id [delivery.dispatch-0]
[fleet_adapter-16] [INFO] [1763010275.826474474] [tinyRobot_fleet_adapter]: Beginning new task [delivery.dispatch-0] for [tinyRobot/tinyRobot2]. Remaining queue size: 1
[fleet_adapter-16] [INFO] [1763010275.826924106] [tinyRobot_command_handle]: Requesting tinyRobot2 to stop...
[fleet_adapter-16] [INFO] [1763010275.840819137] [tinyRobot_command_handle]: Received new path for tinyRobot2
```

경로 추종 및 Task 수행 log

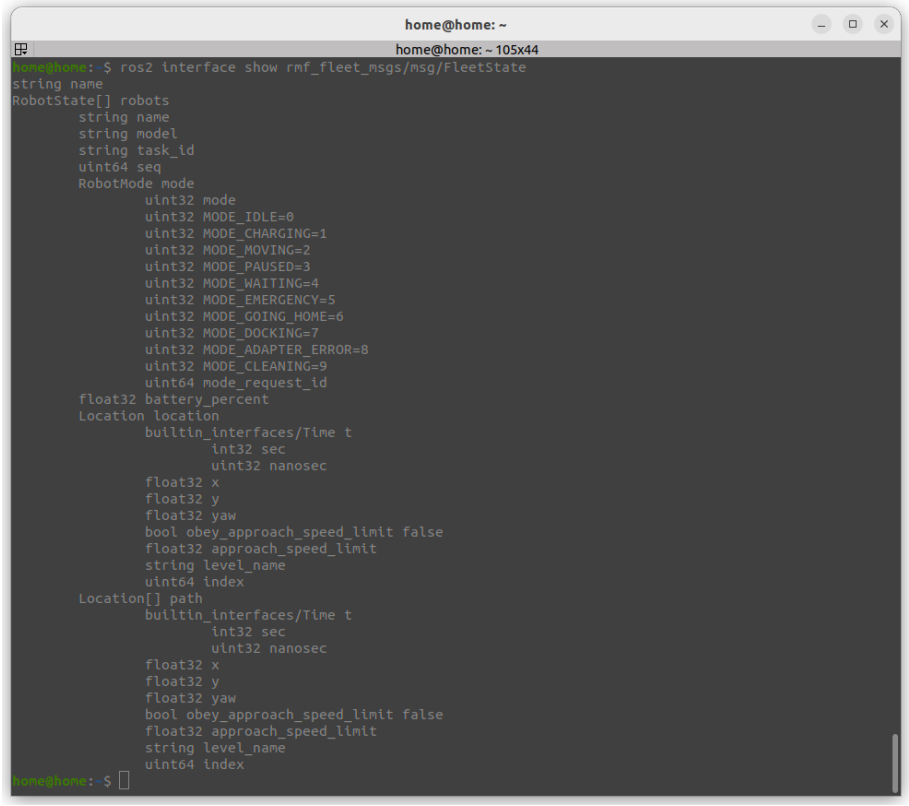
```
[fleet_adapter-16] [INFO] [1763010354.579464275] [tinyRobot_command_handle]: Received new path for tinyRobot1
[fleet_adapter-16] [INFO] [1763010355.143711315] [tinyRobot_command_handle]: Robot [tinyRobot1] has reached the destination for cmd_id 172
[fleet_adapter-16] [INFO] [1763010356.118913877] [tinyRobot_command_handle]: Robot [tinyRobot2] has reached the destination for cmd_id 173
[fleet_adapter-16] [INFO] [1763010356.124192956] [tinyRobot_command_handle]: Robot tinyRobot2 has successfully navigated along requested path.
[fleet_adapter-16] [INFO] [1763010356.125844110] [tinyRobot_command_handle]: Received new path for tinyRobot2
[fleet_adapter-16] [INFO] [1763010359.630450838] [tinyRobot_command_handle]: Robot [tinyRobot2] has reached the destination for cmd_id 174
[fleet_adapter-16] [INFO] [1763010360.103722353] [tinyRobot_command_handle]: Robot [tinyRobot1] has reached the destination for cmd_id 173
[gzserver-17] [WARN] [1763010360.110072947] [coke_dispenser]: No item to dispense: [delivery.dispatch-1]
[fleet_adapter-16] [INFO] [1763010360.111275200] [tinyRobot_command_handle]: Robot tinyRobot1 has successfully navigated along requested path.
[gzserver-17] [WARN] [1763010361.109841109] [coke_dispenser]: Request already failed: [delivery.dispatch-1]
[fleet_adapter-16] [INFO] [1763010361.117741141] [tinyRobot_command_handle]: Received new path for tinyRobot1
[fleet_adapter-16] [INFO] [1763010366.162596753] [tinyRobot_command_handle]: Robot [tinyRobot1] has reached the destination for cmd_id 174
[fleet_adapter-16] [INFO] [1763010367.110456160] [tinyRobot_command_handle]: Robot [tinyRobot2] has reached the destination for cmd_id 175
[gzserver-17] [INFO] [1763010367.116557690] [coke_ingestor_node]: Ingesting item
[gzserver-17] [INFO] [1763010367.116762904] [coke_ingestor_node]: Success
[fleet_adapter-16] [INFO] [1763010367.117269296] [tinyRobot_command_handle]: Robot tinyRobot2 has successfully navigated along requested path.
[fleet_adapter-16] [INFO] [1763010369.120825201] [tinyRobot_fleet_adapter]: Beginning new task [ParkRobotcfc9b5] for [tinyRobot/tinyRobot2]. Remaining queue size: 0
[fleet_adapter-16] [INFO] [1763010369.144763890] [tinyRobot_command_handle]: Received new path for tinyRobot2
```

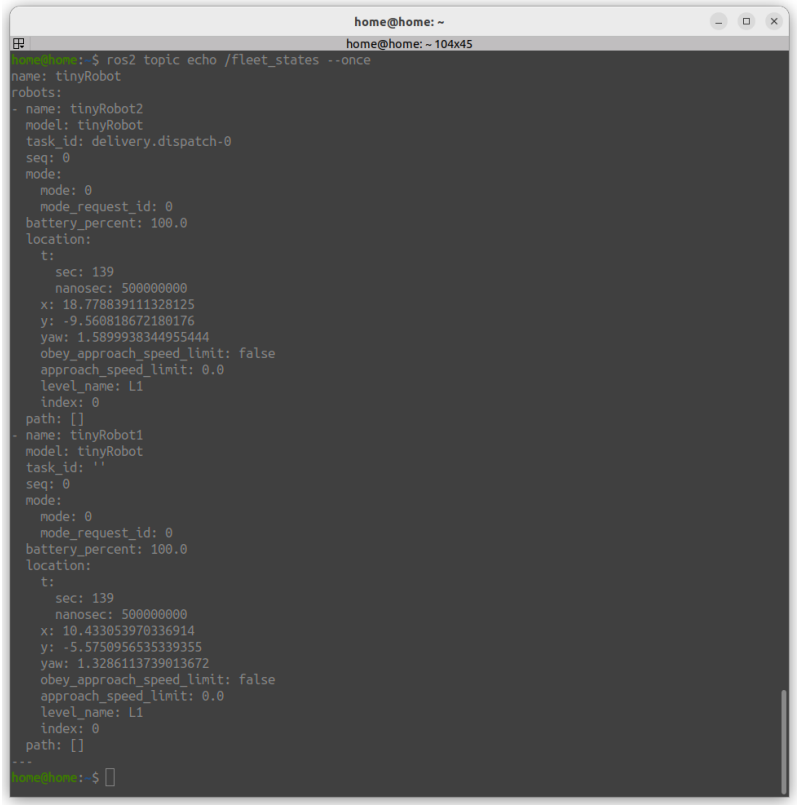
Office World Demo

Delivery Task 실행 후 주요 Topic 확인

Robot: /fleet_states

```
ros2 topic echo /fleet_states
```



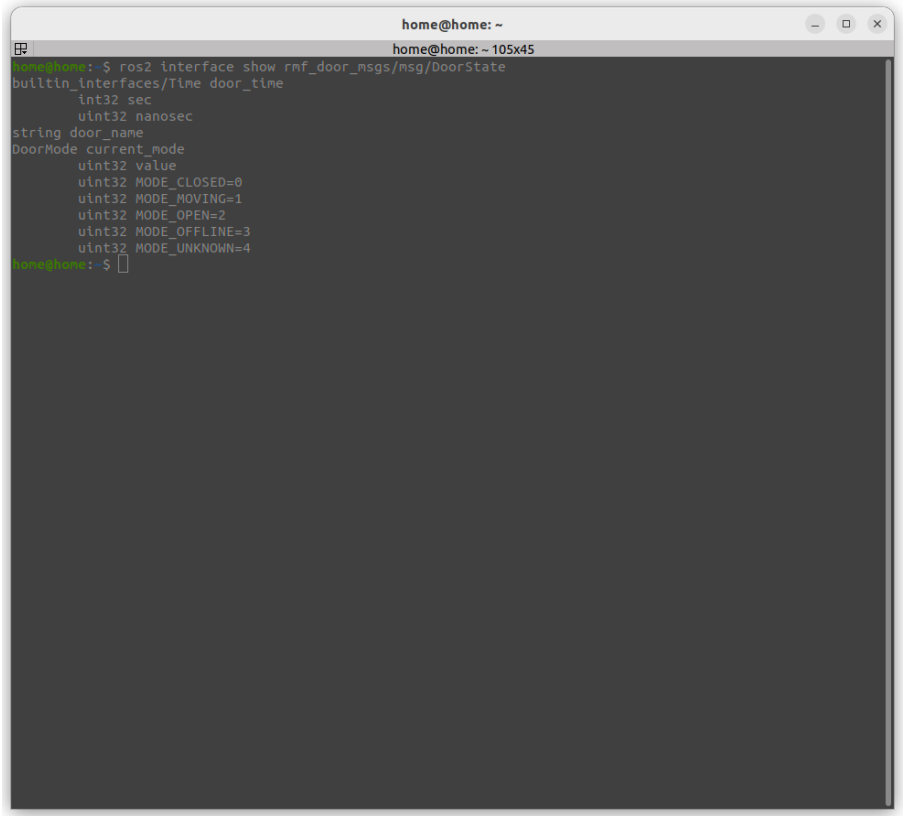


Office World Demo

- Delivery Task 실행 후 주요 Topic 확인

  - Door: /door_states

```
ros2 topic echo /door_states
```



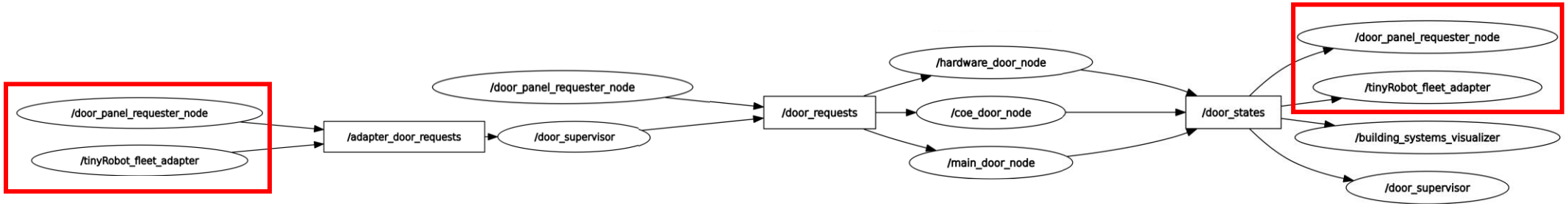

```
---
door_time:
  sec: 978
  nanosec: 802000000
door_name: hardware_door
current_mode:
  value: 0
---
```

```
---
door_time:
  sec: 986
  nanosec: 802000000
door_name: hardware_door
current_mode:
  value: 1
---
```

```
---
door_time:
  sec: 988
  nanosec: 802000000
door_name: hardware_door
current_mode:
  value: 2
---
```

Office World Demo

- Delivery Task 실행 후 Door 관련 rosgraph 확인
  - Door 관련 rosgraph



Office World Demo

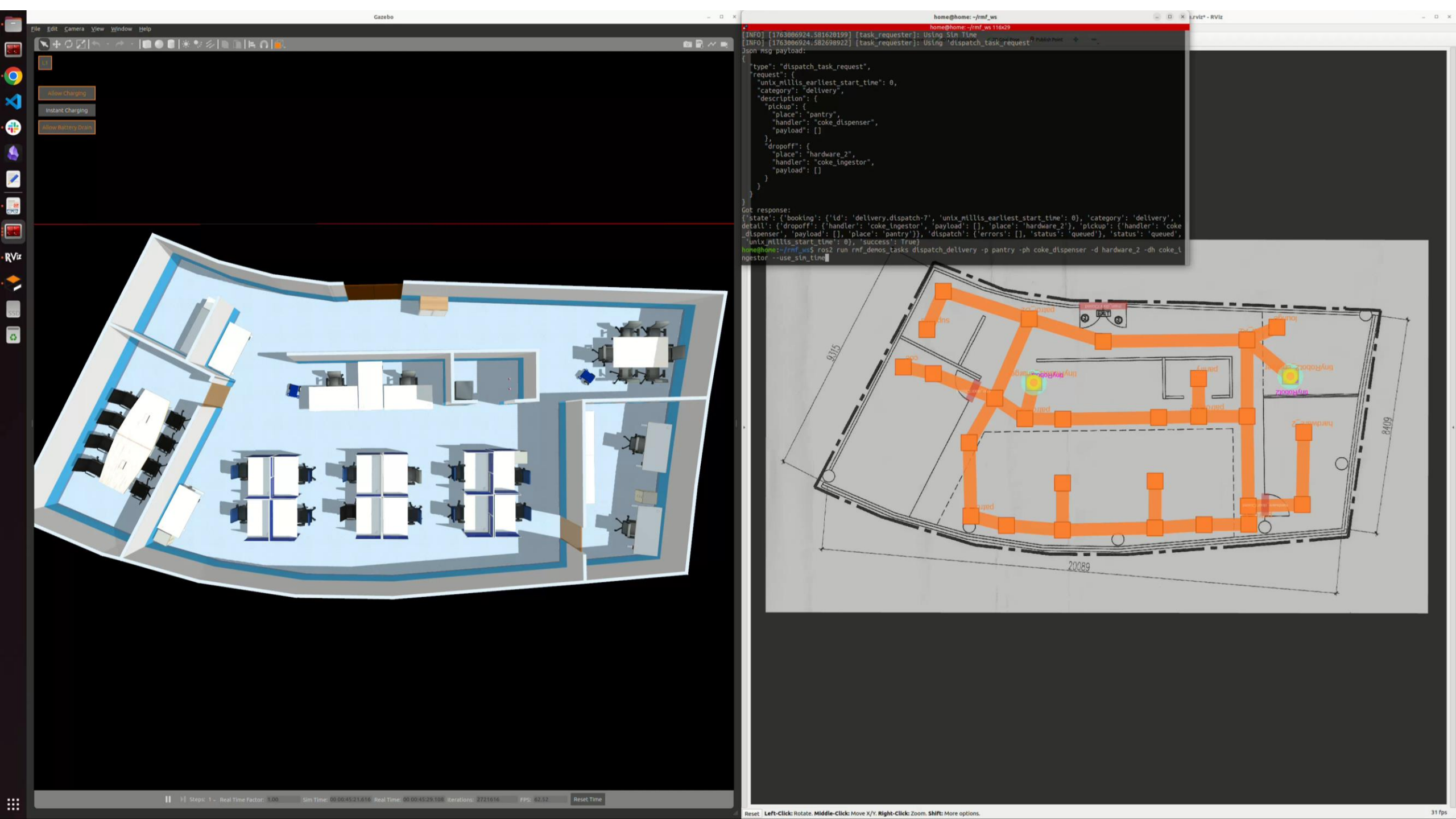
Delivery Task 명령으로 로봇 2대 운용

Delivery Task 명령 실행 / 로봇 지정 X

```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
```

Delivery Task 명령 실행 / 로봇 지정 O (tinyRobot1)

```
ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor –R tinyRobot1 --use_sim_time
```


Gazebo
File Edit Camera View Window Help
Allow Charging
Instant Charging
Allow Battery Drain
home@home: ~/rmf_ws
home@home: ~/rmf_ws 116x29
[INFO] [1763006924.581620199] [task_requester]: Using Sim Time
[INFO] [1763006924.582698922] [task_requester]: Using 'dispatch_task_request'
Json msg payload:
{
"type": "dispatch_task_request",
"request": {
"unix_millis_earliest_start_time": 0,
"category": "delivery",
"description": {
"pickup": {
"place": "pantry",
"handler": "coke_dispenser",
"payload": []
},
"dropoff": {
"place": "hardware_2",
"handler": "coke_ingestor",
"payload": []
}
}
}
}
Got response:
{'state': {'booking': {'id': 'delivery.dispatch-7', 'unix_millis_earliest_start_time': 0}, 'category': 'delivery', 'detail': {'dropoff': {'handler': 'coke_ingestor', 'payload': [], 'place': 'hardware_2'}, 'pickup': {'handler': 'coke_dispenser', 'payload': [], 'place': 'pantry'}}, 'dispatch': {'errors': [], 'status': 'queued'}, 'status': 'queued', 'unix_millis_start_time': 0}, 'success': True}
home@home:~/rmf_ws$ ros2 run rmf_demos_tasks dispatch_delivery -p pantry -ph coke_dispenser -d hardware_2 -dh coke_ingestor --use_sim_time
9315
8409
20089
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click: Zoom. Shift: More options.
31 fps

Office World Demo

- Delivery Task 명령으로 로봇 2대 운용 log 확인

  - Traffic Negotiation

log

```
[gzserver-17] [INFO] [1763010311.456589757] [coke_dispenser]: Dispensing item
[gzserver-17] [INFO] [1763010311.456861253] [coke_dispenser]: Success
[fleet_adapter-16] [INFO] [1763010311.458254632] [tinyRobot_command_handle]: Received new path for tinyRobot1
[fleet_adapter-16] [INFO] [1763010311.915147380] [tinyRobot_command_handle]: Robot [tinyRobot1] has reached the destination for cmd_id 164
[gzserver-17] [WARN] [1763010312.456250615] [coke_dispenser]: Request already succeeded: [delivery.dispatch-0]
[fleet_adapter-16] [INFO] [1763010312.460333781] [tinyRobot_command_handle]: Received new path for tinyRobot2
[rmf_traffic_schedule-1] Require negotiation for: 5 4
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1] [0] Active negotiation: 5 4
[rmf_traffic_schedule-1]     Current negotiation state
[rmf_traffic_schedule-1]  -- 4:1 [5:0]
[rmf_traffic_schedule-1]  -- [5:0]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1] [0] Active negotiation: 5 4
[rmf_traffic_schedule-1]     Current negotiation state
[rmf_traffic_schedule-1]  -- {4:1}
[rmf_traffic_schedule-1]  -- [5:0]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1] [0] Active negotiation: 5 4
[rmf_traffic_schedule-1]     Current negotiation state
[rmf_traffic_schedule-1]  -- {4:1}
[rmf_traffic_schedule-1]  -- 5:1 [4:0]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1] [0] Active negotiation: 5 4
[rmf_traffic_schedule-1]     Current negotiation state
[rmf_traffic_schedule-1]  -- {4:1}
[rmf_traffic_schedule-1]  -- 5:1 >4:1<
[rmf_traffic_schedule-1]
[rmf_traffic_schedule-1] [INFO] [1763010312.481019046] [rmf_traffic_schedule_primary]: Resolved negotiation [0]: 5:1 4:1
[fleet_adapter-16] [INFO] [1763010312.484005250] [tinyRobot_command_handle]: Received new path for tinyRobot2
[fleet_adapter-16] [INFO] [1763010312.486447055] [tinyRobot_command_handle]: Received new path for tinyRobot1
```

RMF Panel

RMF Panel

RMF Panel

→ RMF 시스템의 건물·로봇·태스크 상태를 브라우저에서 모니터링·제어할 수 있는 웹 기반 대시보드/관리 도구

RMF Panel으로 Delivery Task 명령 내리기

환경 불러오기

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

Classic Gazebo로 office world 실행

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

RMF Panel 접속

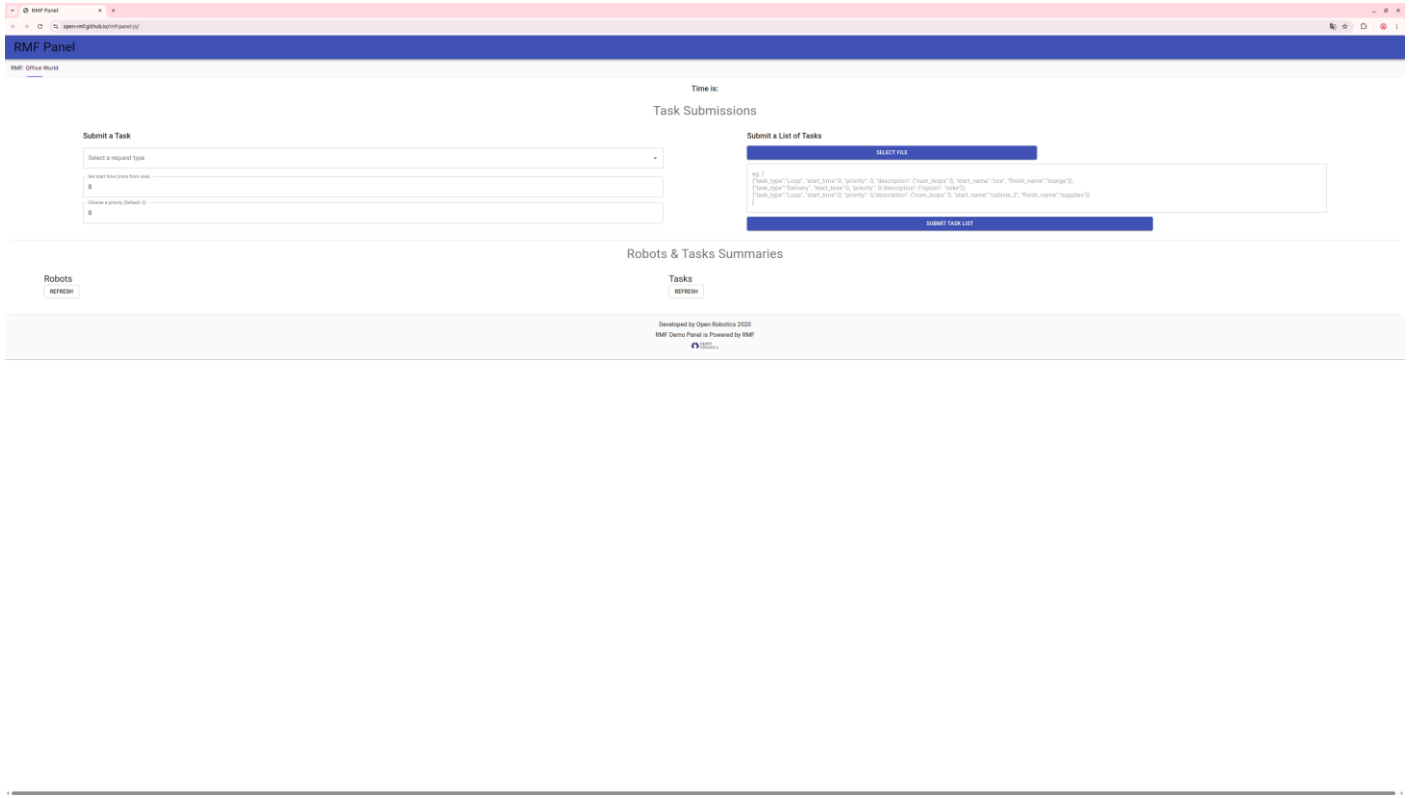
https://open-rmf.github.io/rmf-panel-js/

RMF Panel

RMF Panel으로 Delivery Task 명령 내리기

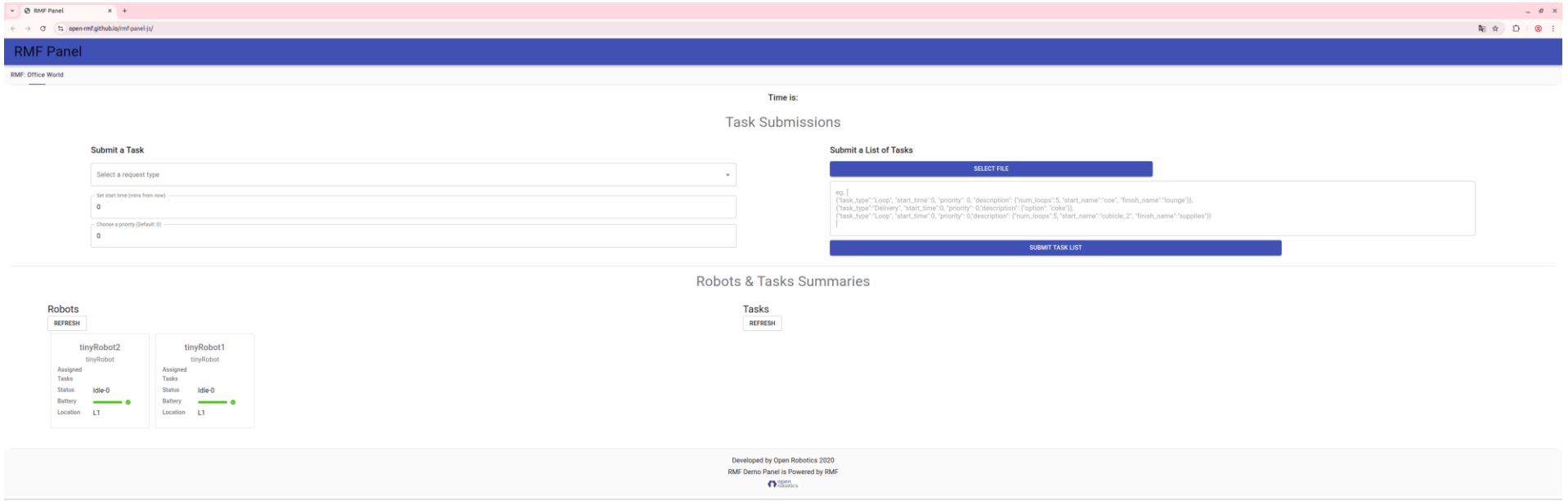
RMF Panel 접속

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



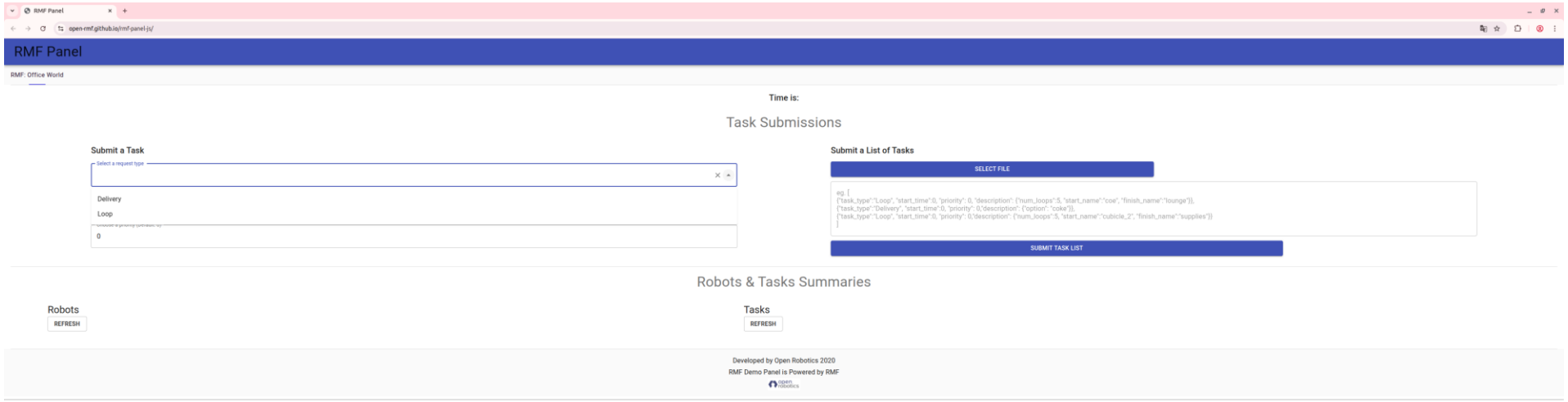
RMF Panel

- **RMF Panel**으로 Delivery Task 명령 내리기



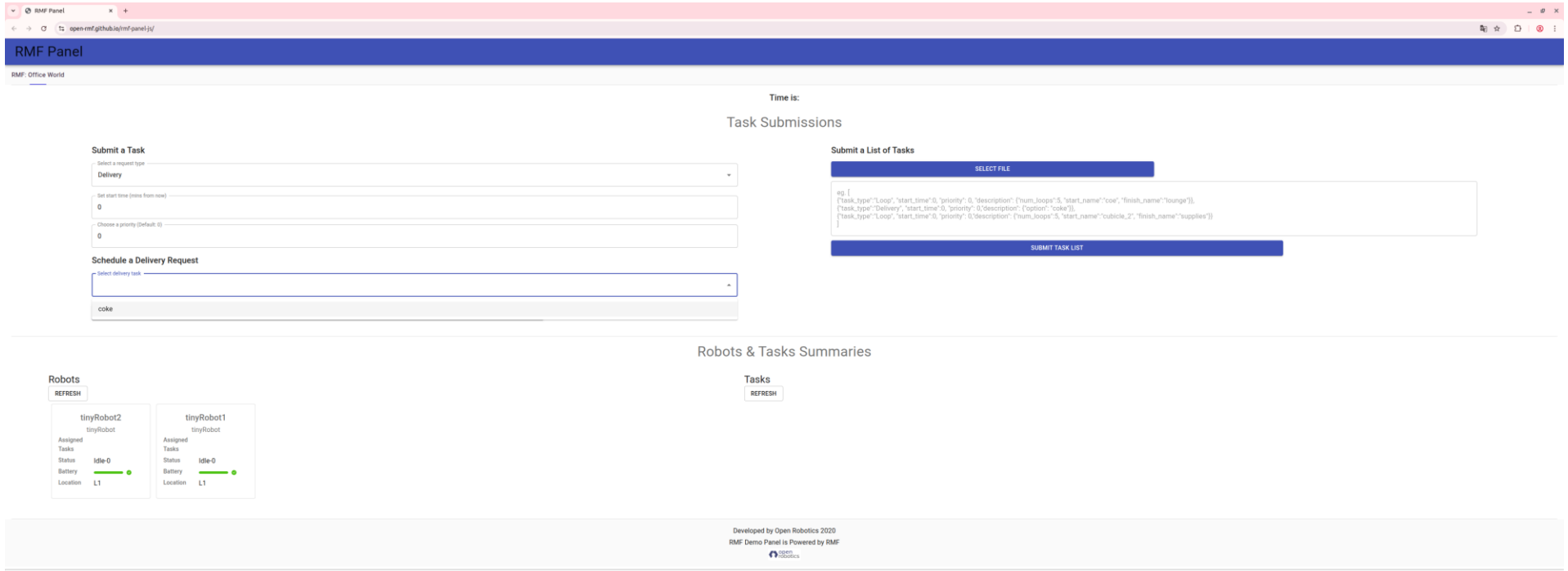
RMF Panel

- **RMF Panel**으로 Delivery Task 명령 내리기



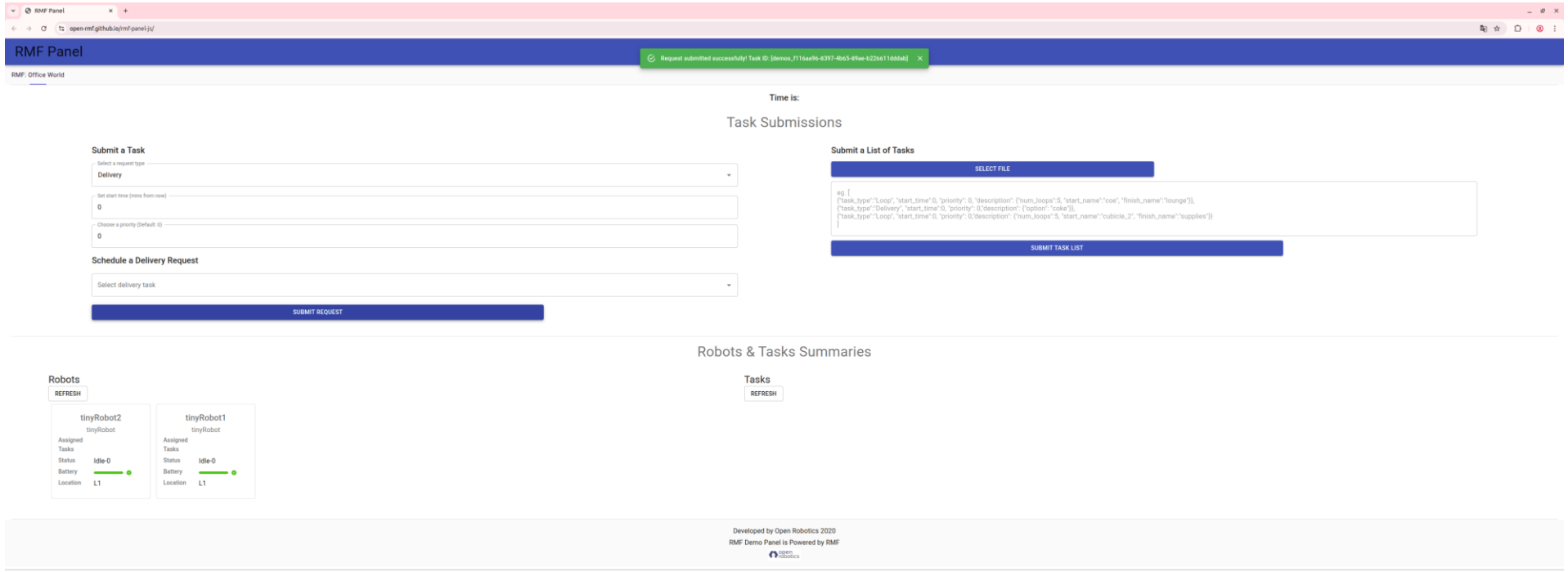
RMF Panel

- **RMF Panel**으로 Delivery Task 명령 내리기



RMF Panel

- **RMF Panel**으로 Delivery Task 명령 내리기

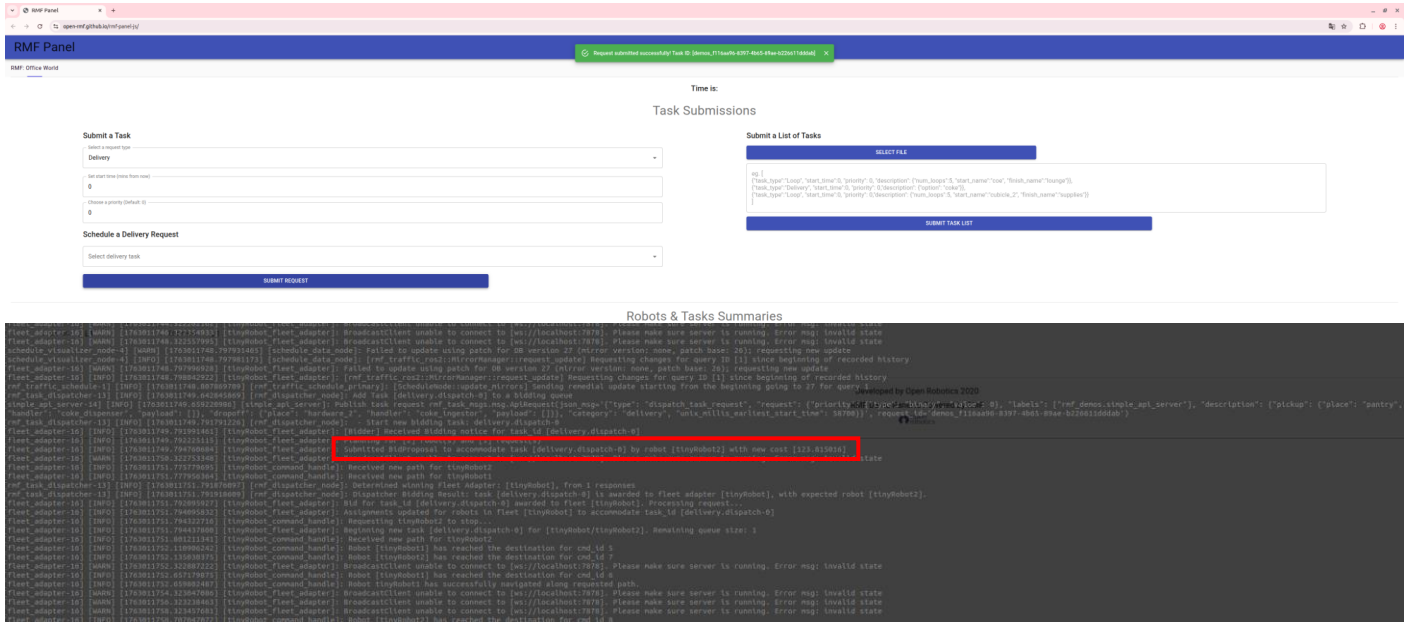


RMF Panel

RMF Panel으로 Delivery Task 명령 내리기

RMF Panel 접속

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



감사합니다