CONFIDENTIAL

THOUZER

サウザー

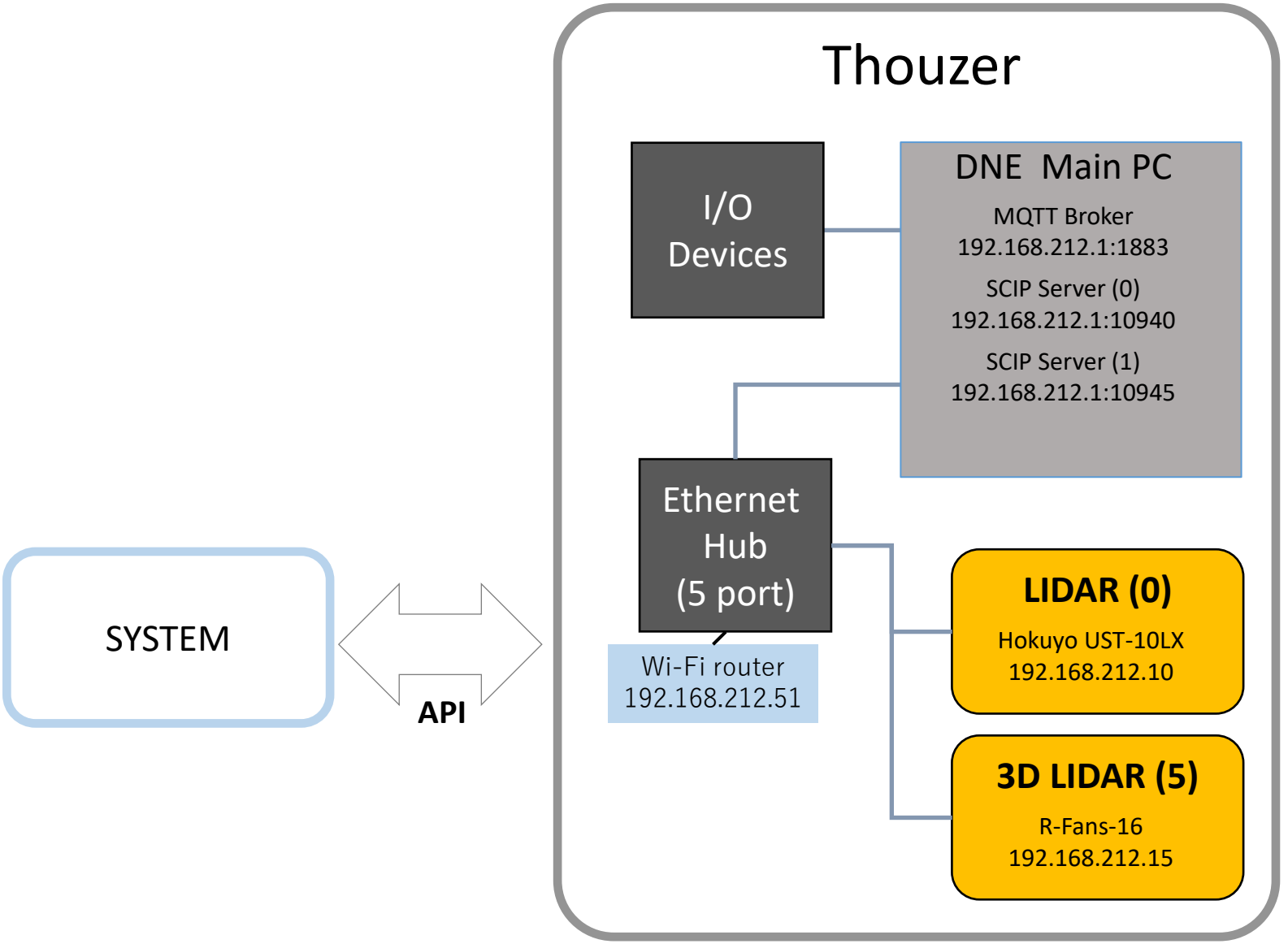
MQTT API Specifications

(2022/02/15 Version: DNE4.7.2.3.0)

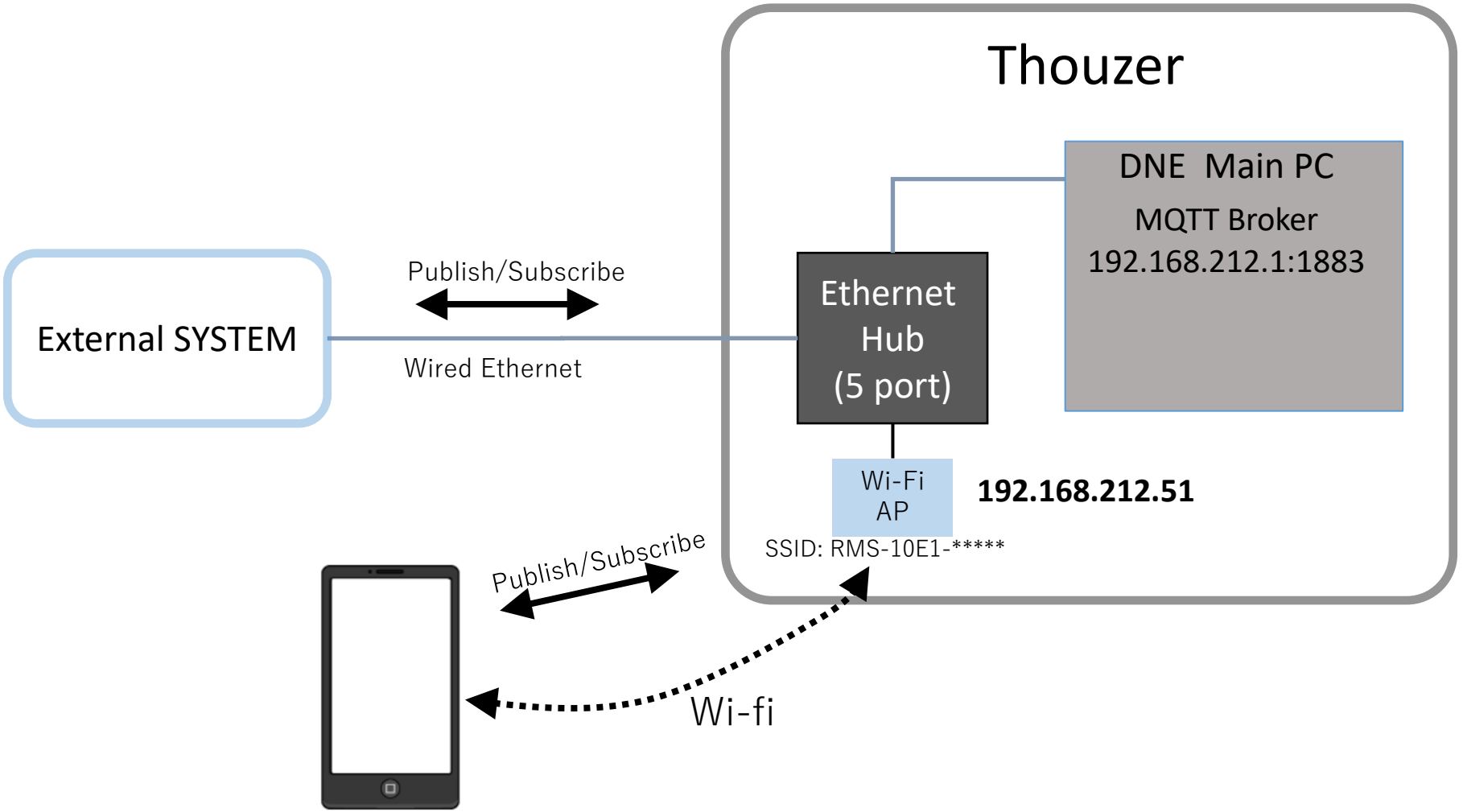
Note

- **The contents of this document are preliminary specifications and are subjected to changes in the future.**
- **Ignore MQTT messages that are not listed in this specification.**
- **Ignore JSON fields in messages that are not listed in this specification.**

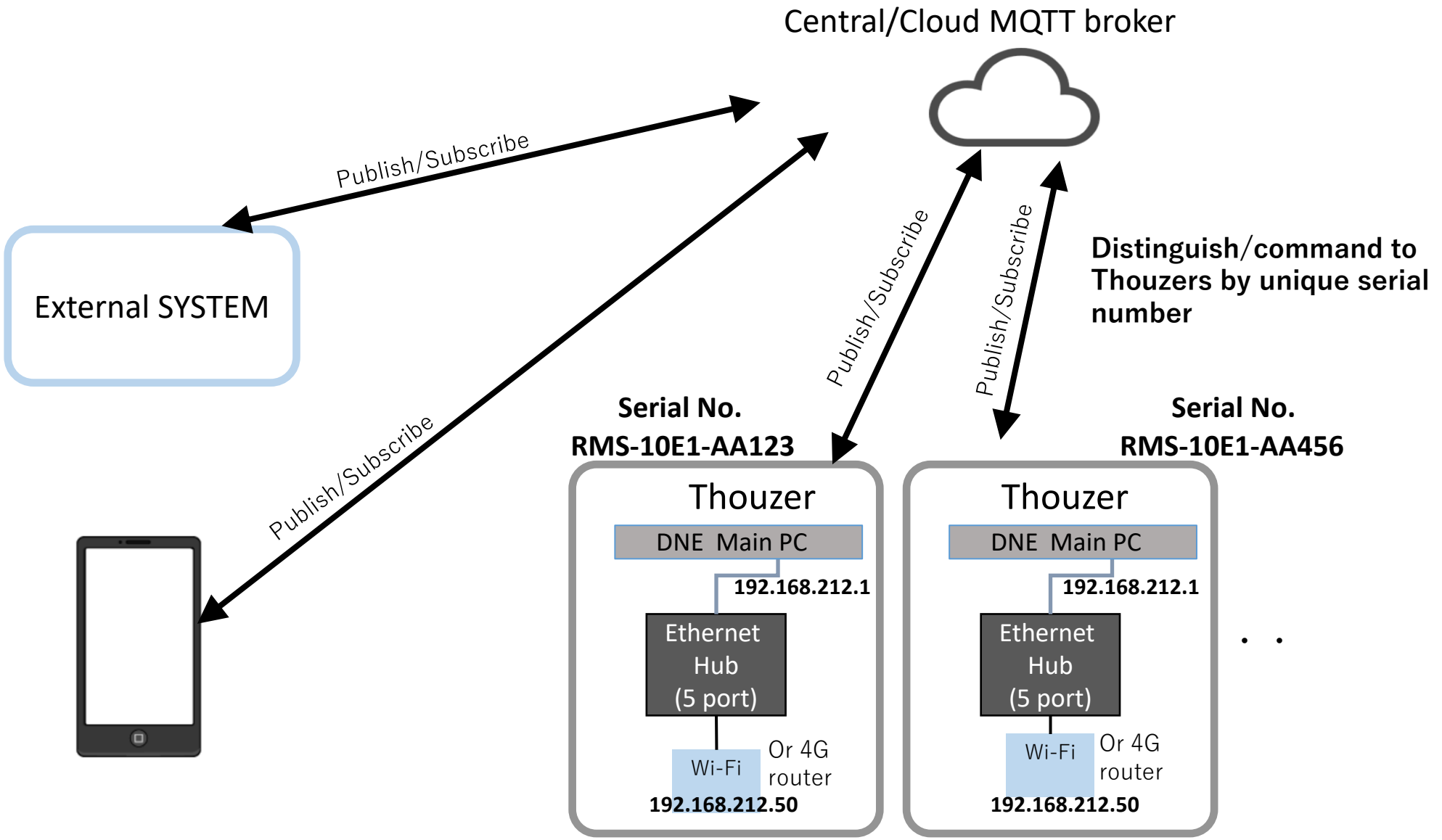
Overview - System Diagram



Overview – Local MQTT broker



Overview – Central/Cloud MQTT broker



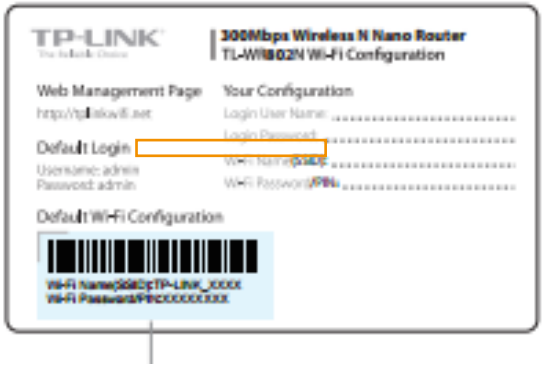
Overview - Communication

❑ Communication protocol

- Command transmission and status reception can be performed using the MQTT protocol.
- Connect to Thouzer's WLAN and MQTT broker to utilize the MQTT API

❑ Connect to Thouzer's WLAN via WiFi

- SSID is the Robot Serial Number which can be found on the sticker on the side of Thouzer
  - Example: RMS-10E2-123
- The WiFi password can be found on the TL-WR802N router of Thouzer or the router's WiFi Info card



❑ Connect to MQTT broker

- Address: 192.168.212.1 Port: 1883
- Username/Password: Indicated on the csv file provided by Doog
  - Update Thouzer with the csv file and key provided by Doog. The username and password can be changed in the csv file

❑Topic Construction

❑Hub ID/Service ID/Thouzer ID/Command Topic

❑Example: 0/THOUZER_HW/RMS-10E1-123/exec/cmd

Service ID	Command Topic	Pub/Sub Relationship	Function	
THOUZER_HW	exec/cmd	SERVER ⇒ THOUZER	Instruction command from app to Thouzer	
THOUZER_HW	ack/exec	THOUZER ⇒ SERVER	Acknowledgement from Thouzer	Not used this time
THOUZER_HW	status/app	THOUZER ⇒ SERVER	Status notification	
THOUZER_HW	event/app	THOUZER ⇒ SERVER	Event notification	
WHISPERER	pos2D_DWO	THOUZER ⇒ SERVER	Odometrical position notification	
WHISPERER	vel2D_DWO	THOUZER ⇒ SERVER	Odometrical velocity notification	
WHISPERER	battery	THOUZER ⇒ SERVER	Battery Level notification	
WHISPERER	nav	SERVER ⇒ THOUZER	Motion command	

Overview - MQTT Specifications

- Service ID
  - THOUZER_HW
    - Sends functional commands and receive functional status from Thouzer
    - exec/cmd
      - Sends commands such as Follow Me, Line Trace, Memory Trace from app to Thouzer
    - event/app
      - Receives event status from Thouzer to app, such as Memory Trace progress, Highway status
  - WHISPERER
    - Sends motion commands and receive raw data from Thouzer
    - pos2D_DWO
      - Receives estimated odometrical position data from Thouzer
    - vel2D_DWO
      - Receives estimated odometrical velocity data from Thouzer
    - Battery
      - Receive battery level from Thouzer based on the physical battery level that can be seen on Thouzer's physical controller
    - Nav
      - Sends odometrical adjustment to Thouzer to control Thouzer's motion

- Message Format
  - Send and receive JSON strings. For the contents of the format, see the following pages.

Using Mosquitto

- Subscribe to Whisperer/Event/Status Notifications
  - Format:
    - `mosquitto_sub -h <IP address> -t <topic> -u <username> -P <password> -d`
  - Example:
    - `mosquitto_sub -h 192.168.212.1 -t 0/THOUZER_HW/RMS-10E1-123/# -u doog -P abc123 -d`
- Publish commands
  - Format:
    - `mosquitto_pub -h <IP address> -m <command> -t <topic> -u <username> -P <password> -d`
  - Example:
    - `mosquitto_pub -h 192.168.212.1 -m "{ \"app\": \"app-karugamo\" }" -t 0/THOUZER_HW/RMS-10E1-123/exec/cmd -u doog -P abc123 -d`

Command: Follow-Me

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

- ❑ Sends a command from app to Thouzer to activate Follow-Me

```
{
     "app": "app-karugamo"
}
```

- ❑ Sends a command from app to Thouzer to stop Follow-Me

```
{
   "app": ""
}
```


Command: I/O Output

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

```
{
   "app": "#ext1_high"
}
```

❑ Send command to set the output port (IO1) to high level.
(The FET of the open drain output terminal turns on)

```
{
   "app": "#ext1_low"
}
```

❑ Send command to set the output port (IO1) to low level.
(The FET of the open drain output terminal turns off)

Command: I/O Output

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

```
{
   "app": "#ext0_high"
}
```

❑ Send command to set the output port (IO0) to high level.
(The FET of the open drain output terminal turns on)

```
{
   "app": "#ext0_low"
}
```

❑ Send command to set the output port (IO0) to low level.
(The FET of the open drain output terminal turns off)

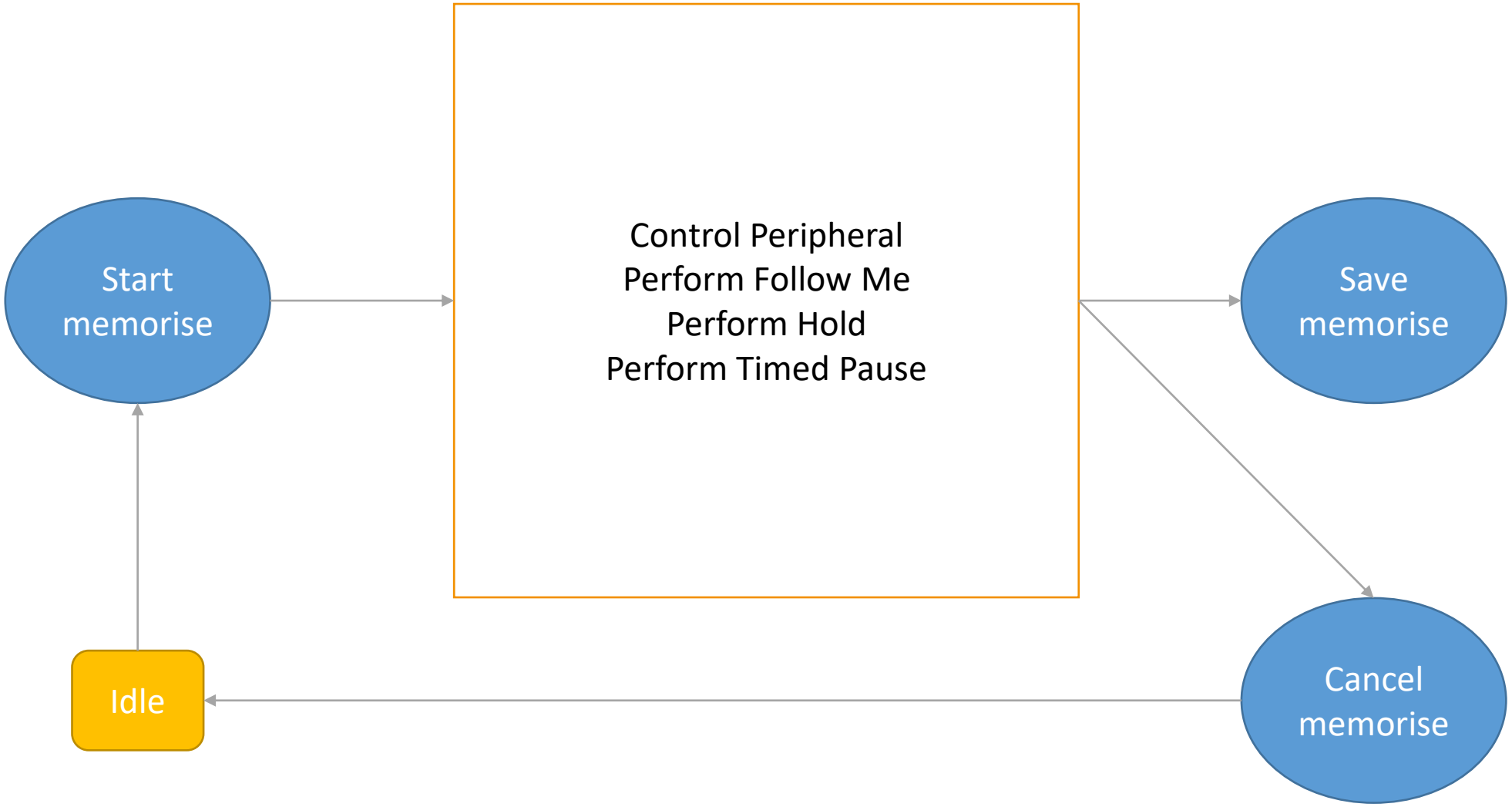
Command: I/O Output

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

```
{
   "app": "#speedmode_0"
}
```

- ❑ Send command to change speed mode as respective to the physical speed mode buttons
- ❑ #speedmode_0 to #speedmode_4

Command: Memory Trace - Memorize Mode



Command: Memory Trace - Memorize Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Start/Cancel Memorize

```
{
    "app":"memory-start-cancel",
    "params":"--nk --map mapName"
}
```

- Starts memorize function to memorize a new route of map <mapName>
- If it is in memorize mode, this command will cancel the mode
- Add --teachBack to the params to have Thouzer move in reverse (normally Thouzer cannot move backwards)

❑Cancel Memorize

```
{
    "app":"memory-cancel"
}
```

- Cancel memorize

Command: Memory Trace - Memorize Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Finish and Save Memorize

```
{
    "app":"memory-save"
}
```

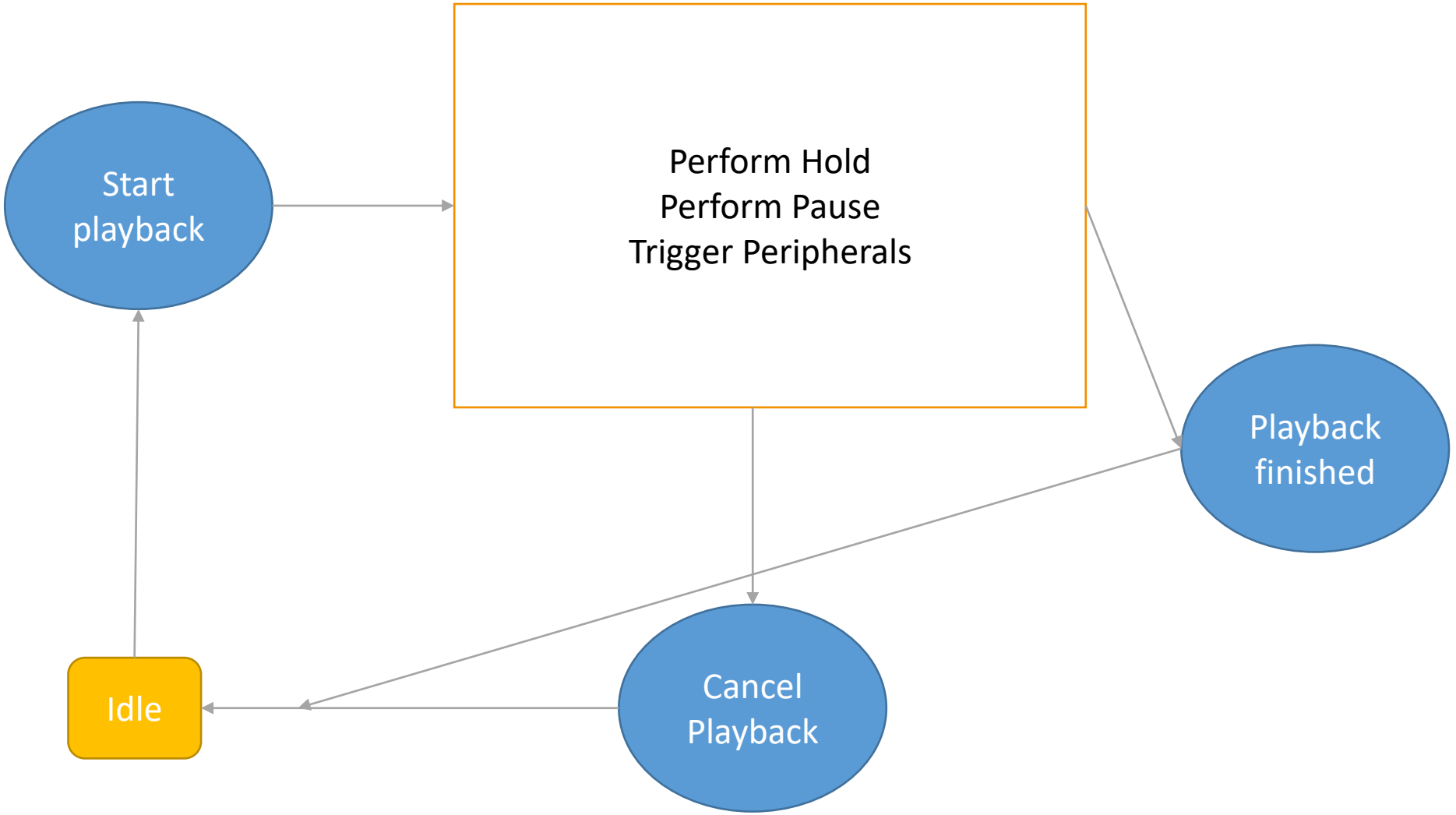
- Save the new route created

❑Hold

```
{
    "app":"# set_suspend"
}
```

- Sets hold mode in the specific position in Memorize mode

Command: Memory Trace - Playback Mode



Command: Memory Trace - Playback Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Start Playback

```
{
    "app":"app-memorytrace",
    "params":"--map mapName"
}
```

- Starts playback mode of the map <mapName>
- Add --loop to the params to have Thouzer continuously running in a loop a stop playback command is sent (the start and end point of the route must be the same point, refer to Memory Trace Manual)
- Add --reverse to the params for Thouzer to run in the reverse order of the route (Thouzer must be manually turned around first at the end of the route)

❑Cancel Playback

```
{
    "app":"memory-cancel"
}
```

- Cancel playback

Command: Memory Trace - Playback Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

- ❑Hold

```
{
    "app":"# suspend"
}
```

  - Activates hold mode in Playback mode

- ❑Resume from Hold

```
{
    "app":"app-memorytrace",
    "params":“--map <map_name> --resume"
}
```

  - End hold mode and resume playback

Command: Memory Trace - Memorize/Playback Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Pause/Timed Pause

```
{
    "app":"#pause"
}
```

- In Memorize mode, this command activates Timed Pause function. If it is activated for 10 seconds before resume received, it will pause for 10 seconds during playback
- In Playback mode, this command will pause until resume command is received

❑Resume

```
{
    "app":"#run“
}
```

- End pause mode and resume playback/memorize mode

Command: Memory Trace - Memorize/Playback Mode

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Timed Pause

```
{
    "app":"#pauseset@seconds"
}
```

- This command pause for a set amount of seconds and automatically resumes after
- Can be set for the following seconds 0, 5, 10, 15, 30, 60, 120, 180, 300, 600

Command: Highway

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Start Highway

```
{
   "app": "highway",
   "params": "--destination 101"
}
```

- Start Highway (Destination=101)

Example of Destination

101	Go to destination 101
900	Go to the first destination detected
101,201	Go to destination 201 via 101

Command: Highway - Stop

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Soft Stop

```
{
   "app": "",
   "comment": "--soft"
}
```

- Thouzer decelerates and stops.
- If Thouzer is within a stop-prohibited section (NOSTOP/I is detected), Thouzer will not stop until the stop-prohibited section is exited (NOSTOP/O is detected).

❑Immediate Stop

```
{
   "app": ""
}
```

- Thouzer stops immediately.
- Thouzer will stop even in a stop-prohibited section.

Command: Highway - Stop

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Emergency Stop

```
{
   "app": "",
   "comment": "--alert"
}
```

- Thouzer will perform an emergency stop.
- The joystick lamp on Thouzer will keep flashing until operator presses the Start Button

Command: Highway - Turn

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

❑Counter-clockwise turn

```
{
   "app": "app-turn-left"
}
```

- Turn counter-clockwise on the spot and stop when the line is detected in front

❑Clockwise turn

```
{
   "app": "app-turn-right"
}
```

- Turn Clockwise on the spot and stop when the line is detected in front.

Status Notification （Position・Velocity・Battery Level）

The following information will be sent every 0.1 seconds.

topic: **0/WHISPERER/RMS-10E1-*XXX*/pos2D_DWO**

```
{
   "x_m": "1.234", "y_m": "-5.678", "yaw_deg": "-32.4",
   "tDist_m": "3.195", "tAngle_deg": "52.4"
}
```

Estimated value (large margin of error) of the position, direction, cumulative movement distance, and cumulative rotation angle of Thouzer.

topic: **0/WHISPERER/RMS-10E1-*XXX*/vel2D_DWO**

```
{
    "v_mps": "0.345", "w_degps": "0.3"
}
```

Estimated value of Thouzer’s speed and turning speed (large margin of error)

topic: **0/WHISPERER/RMS-10E1-*XXX*/battery**

```
{
     "gauge": "10", "voltage_v": "26.0"
}
```

Estimated value of Battery level and voltage

Event/Status Notification - Memory Trace - Memorization

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

- You will be notified of events that occurred while performing Memory Trace memorization. The data/data field changes at every waypoint
- Fields other than those mentioned in the example may be included, but please ignore them.

```
{
  "serialId": "RMS-10E1-N05",
  "data": {
    "application": "memorytraceTeach",
    "status": “update",
    "map": "IO76",
    "pos": 0
  }
}
```

- "serialId": "RMS-10E1-N05", → Thouzer Serial Number
- "status": “update", → Status
- "map": "IO76", → Map Name
- "pos": 0 → Waypoint

Event/Status Notification - Memory Trace - Playback

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

- You will be notified of events that occurred while performing Memory Trace playback. The data/data field changes at every waypoint
- Fields other than those mentioned in the example may be included, but please ignore them.

```
{
  "serialId": "RMS-10E1-N05",
  "data": {
    "application": "memorytrace",
    "status": "run",
    "map": "IO76",
    "alertRatio": 0.0,
    "errorRatio": 0.0,
    "listPos": 1,
    "listLast": 97
  }
}
```

- "serialId": "RMS-10E1-N05", → Thouzer Serial Number
- "status": "run", → Status
- "map": "IO76", → Map Name
- "alertRatio": 0.0, → Alert Ratio
- "errorRatio": 0.0, → Error Ratio
- "listPos": 1, → Current Waypoint
- "listLast": 97 → Last Waypoint

Event/Status Notification - Memory Trace - Playback

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

❑Map quality (Good)


```
{
  "serialId": "RMS-10E1-N05",
  "data": {
    "application": "memorytrace",
    "status": "run",
    "map": "IO76",
    "alertRatio": 0.0,
    "errorRatio": 0.0,
    "listPos": 1,
    "listLast": 97
  }
}
```


❑alertRatio and errorRatio are indicators of the map quality ranging from 0.0 (Good) to 1.0 (Bad)

❑The above JSON shows that the map quality is good and there is no need to re-memorize the route

Event/Status Notification - Memory Trace - Playback

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

- Map quality (Bad)


```
{
  "serialId": "RMS-10E1-N05",
  "data": {
    "application": "memorytrace",
    "status": "run",
    "map": "IO76",
    "alertRatio": 0.9,
    "errorRatio": 0.7,
    "listPos": 1,
    "listLast": 97
  }
}
```


- If the indicator is near 1.0, Thouzer might not be able to continue the route
- Thus, re-memorization is required when there is a significant number of waypoints with bad map quality indication

Event/Status Notification - Highway

topic: 0/THOUZER_HW/RMS-1000-*XXX*/event/app

- You will be notified of events that occurred while driving on the highway and the current status. The data/data field changes depending on the event. If the event is associated with barcode detection, the data/data/mark fields are included.
- Fields other than those mentioned in the example may be included, but please ignore them.

```
{
  "serialId": "RMS-1000-XXX",
  "data": {
    "application": "highway",
    "status": "run",
    "event": "pass",
    "data": {
      "destination": "101B",
      "path": "102,101",
      "location": "103F(1103F)",
      "mark": { "name": "SPOT/103F(1103F)" }
    },
  },
}
```

- "serialId": "RMS-1000-XXX" → Thouzer Serial Number
- "status": "run" → Status
- "event": "pass" → Event
- "destination": "101B" → Destination or Next waypoint
- "path": "102,101" → Route
- "location": "103F(1103F)" → Current Spot
- "mark": { "name": "SPOT/103F(1103F)" } → Barcode Information of detected barcode

Event/Status Notification - Highway

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

❑Destination Barcode Detection (Match)


```
{
   "serialId": "RMS-1000-XXX",
   "data": {
      "application": "highway",
      "status": "exit",
      "event": "stop",
      "data": {
         "destination": "101B",
         "path": "102,101",
         "location": "101F(1101F)",
         "mark": { "name": "SPOT/101F(1101F)" },
      },
   },
}
```


❑Destination match ⇒ Stop

❑The above JSON shows that the destination 101 barcode is detected and Thouzer stopped

Event/Status Notification - Highway

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

❑Destination Barcode Detection (Not Match)


```
{
   "serialId": "RMS-1000-XXX",
   "data": {
      "application": "highway",
      "status": "run",
      "event": "pass",
      "data": {
         "destination": "101B",
         "path": "102,101",
         "location": "101F(1101F)",
         "mark": { "name": "SPOT/103F(1103F)" },
      },
   },
}
```


❑Destination different ⇒ pass through

❑The above JSON shows the destination 103 barcode being detected and Thouzer passed through the barcode while travelling to destination 101

Event/Status Notification - Highway

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

❑Branching Barcode Detection (Match)

```
{
   "serialId": "RMS-1000-XXX",
   "data": {
      "application": "highway",
      "status": "run",
      "event": "leftBranch",
      "data": {
         "destination": "101B",
         "path": "102,101",
         "mark": { "name": "LEFT/100F(1100F)" },
      },
   },
}
```

❑Left branch to 100 barcode is detected while travelling to destination 101. Thouzer turns at the left branch.

Event/Status Notification - Highway

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/event/app**

❑Branching Barcode Detection (Not Match)

```
{
   "serialId": "RMS-1000-XXX",
   "data": {
      "application": "highway",
      "status": "run",
      "event": "rightBranch",
      "data": {
         "destination": "101B",
         "path": "102,101",
         "mark": { "name": "LEFT/103F(1103F)" },
      },
   },
}
```

❑Left branch to 103 barcode is detected while travelling to destination 101. Thouzer turns at the right branch.

Status List - Highway

Status	Content	Occurrence Condition
start	Preparing to start	Smartphone operation, received start command
run	Travelling on route	Ready to start, cancel pause/wait
pause	Stopped for a moment	Pause barcode detected
wait	Stopped for a moment	Obstacle detected/waiting for merging
stop	Preparing to stop	Decelerate and stop command received (continue until exiting stop prohibition section)
exit	Stopped normally	Reached destination/turn and stop barcode (TURN/xxxS) and stop.
exit_suspend	Temporary interuption	Upon detection of turn and go barcode (TURN/xxxG).
exit_killed	Forced Stop	Stop operation with smartphone, button, instant stop reception
exit_error	Stopped abnormally	Line break detection/barcode reading error

Event List - Highway

Event	Content	Occurance Condition
start	Start travelling	Smartphone operation, start received
resume	Resume travelling	Resume after turning on the spot
stop	Stop on spot barcode	Destination matches spot barcode
pass	Pass through spot barcode	Destination does not match spot barcode
leftBranch	Take the left branch	Branching barcode detected. Left branch if matched, Right branch if not matched
rightBranch	Take the right branch	Branching barcode detected. Right branch if matched, left branch if not matched
forkRight	Go right at the fork	Pass the right branch point (provisionally run 2m from the branch marker)
forkLeft	Go left at the fork	Pass the left branch point (provisionally run 2m from the branch marker)
nostop	Enter stop-prohibited section	NOSTOP/I barcode detected
endNostop	Exit stop-prohibited section	NOSTOP/O barcode detected
pause	Stop for a moment	PAUSE barcode detected
endPause	Resume travelling after pause	End of pause duration
block	Stop due to obstacle	Obstacle nearby
endBlock	Resume travelling after obstacle removed	Obstacle removed

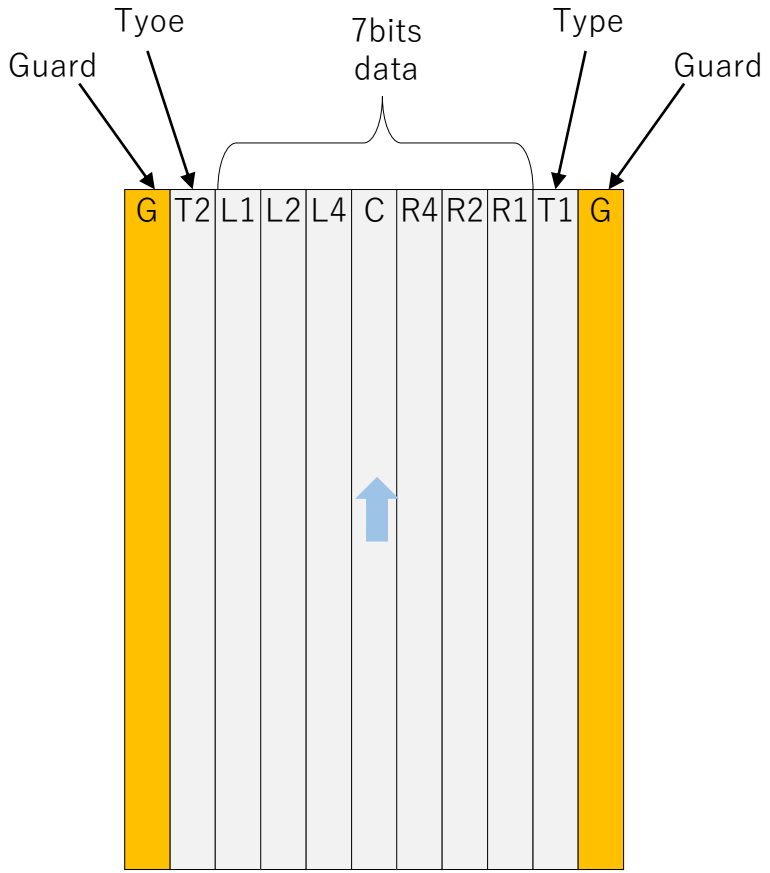
Event List - Highway

Event	Content	Occurrence Condition
priorityJoin	Enter Merge area (Priority)	Priority merging barcode(JOIN/Pxx)detected(Not used this time)
nonPriorityJoin	Enter Merge area (Non-Priority)	Non-priority merging barcode (JOIN/Nxx)detected(Not used this time)
join	Pass through merging point	Pass through merging point(run a specified distance from the merge barcode)
turn	Turn on the spot	Turn barcode(TURN) detected
speedLimit	Change maximum speed limit	Velocity change barcode (VEL) detected
lineLost	Unable to detect line	Line break detected
interrupt	Interrupted while travelling	Decelerate and stop barcode detected
null	Ignored, no event	NOP barcode detected, transition to first run
badMark	Abnormal barcode detected	Barcode reading error
undefinedMark	Undefined barcode detected	Barcode command not defined

Highway - Barcode Functionality List

Name	Function
SPOT/xxxF	Bidirectional (forward-facing) spot barcode. Stop when destination matches barcode
SPOT/xxxR	Bidirectional (reversed-facing) spot barcode. Stop when destination matches barcode
LEFT/xxxF	Take the left branch if destination matches the branching marker
LEFT/xxxR	Ignore
RIGHT/xxxF	Take the right branch if destination matches the branching marker
RIGHT/xxxR	Ignore
SPEED/xx	Change speed to xx%
TURN/L180G	Turn counter-clockwise on the spot and continue travelling upon detecting the line
TURN/L180S	Turn counter-clockwise on the spot and stop upon detecting the line
TURN/R180G	Turn clockwise on the spot and continue travelling upon detecting the line
TURN/R180S	Turn clockwise on the spot and stop upon detecting the line
PAUSE/xx	Stop for xx seconds and resume travelling
NOSTOP/I	Enter stop-prohibited zone
NOSTOP/O	Exit stop-prohibited zone
NOP	Ignore
JOIN/Pxx	Priority merge (Not used this time)
JOIN/Nxx	Non-priority merge (Not used this time)

Highway - Barcode Construction



All 11 bits of barcode, 1 bit at both ends is a fixed guard pattern
The effective code is 9 bits.
This value is expressed by 4 numbers of T / L / C / R.

$T = T1 + T2 \times 2$

$L = L1 + L2 \times 2 + L4 \times 4$

$R = R1 + R2 \times 2 + R4 \times 4$

T is the barcode type and L / C / R is the data.
Functions are assigned in advanced.

T	Tyoe	(L/C/R) Defination
0	Stop	Destination
1	Right branch	Branch address
2	Left branch	Branch address
3	Command	Function number

If you read the marker in the opposite direction,
the left and right of the branch will be reversed and L and R will be replaced

Highway - Assigned Barcode List

T=0 C=0		R							
		0	1	2	3	4	5	6	7
L	0	SPOT/800B	SPOT/000R	SPOT/100R	SPOT/200R	SPOT/300R	SPOT/400R	SPOT/500R	SPOT/600R
	1	SPOT/000F	SPOT/801B	SPOT/001R	SPOT/101R	SPOT/201R	SPOT/301R	SPOT/401R	SPOT/501R
	2	SPOT/100F	SPOT/001F	SPOT/802B	SPOT/002R	SPOT/102R	SPOT/202R	SPOT/302R	SPOT/402R
	3	SPOT/200F	SPOT/101F	SPOT/002F	SPOT/803B	SPOT/003R	SPOT/103R	SPOT/203R	SPOT/303R
	4	SPOT/300F	SPOT/201F	SPOT/102F	SPOT/003F	SPOT/804B	SPOT/004R	SPOT/104R	SPOT/204R
	5	SPOT/400F	SPOT/301F	SPOT/202F	SPOT/103F	SPOT/004F	SPOT/805B	SPOT/005R	SPOT/105R
	6	SPOT/500F	SPOT/401F	SPOT/302F	SPOT/203F	SPOT/104F	SPOT/005F	SPOT/806B	SPOT/006R
	7	SPOT/600F	SPOT/501F	SPOT/402F	SPOT/303F	SPOT/204F	SPOT/105F	SPOT/006F	SPOT/807B

T=1 C=0		R							
		0	1	2	3	4	5	6	7
L	0	RIGHT/800B	RIGHT/000R	RIGHT/100R	RIGHT/200R	RIGHT/300R	RIGHT/400R	RIGHT/500R	RIGHT/600R
	1	RIGHT/000F	RIGHT/801B	RIGHT/001R	RIGHT/101R	RIGHT/201R	RIGHT/301R	RIGHT/401R	RIGHT/501R
	2	RIGHT/100F	RIGHT/001F	RIGHT/802B	RIGHT/002R	RIGHT/102R	RIGHT/202R	RIGHT/302R	RIGHT/402R
	3	RIGHT/200F	RIGHT/101F	RIGHT/002F	RIGHT/803B	RIGHT/003R	RIGHT/103R	RIGHT/203R	RIGHT/303R
	4	RIGHT/300F	RIGHT/201F	RIGHT/102F	RIGHT/003F	RIGHT/804B	RIGHT/004R	RIGHT/104R	RIGHT/204R
	5	RIGHT/400F	RIGHT/301F	RIGHT/202F	RIGHT/103F	RIGHT/004F	RIGHT/805B	RIGHT/005R	RIGHT/105R
	6	RIGHT/500F	RIGHT/401F	RIGHT/302F	RIGHT/203F	RIGHT/104F	RIGHT/005F	RIGHT/806B	RIGHT/006R
	7	RIGHT/600F	RIGHT/501F	RIGHT/402F	RIGHT/303F	RIGHT/204F	RIGHT/105F	RIGHT/006F	RIGHT/807B

T=0 C=1		R							
		0	1	2	3	4	5	6	7
L	0	SPOT/700B	SPOT/601F	SPOT/502F	SPOT/403F	SPOT/304F	SPOT/205F	SPOT/106F	SPOT/007F
	1	SPOT/601R	SPOT/701B	SPOT/602F	SPOT/503F	SPOT/404F	SPOT/305F	SPOT/206F	SPOT/107F
	2	SPOT/502R	SPOT/602R	SPOT/702B	SPOT/603F	SPOT/504F	SPOT/405F	SPOT/306F	SPOT/207F
	3	SPOT/403R	SPOT/503R	SPOT/603R	SPOT/703B	SPOT/604F	SPOT/505F	SPOT/406F	SPOT/307F
	4	SPOT/304R	SPOT/404R	SPOT/504R	SPOT/604R	SPOT/704B	SPOT/605F	SPOT/506F	SPOT/407F
	5	SPOT/205R	SPOT/305R	SPOT/405R	SPOT/505R	SPOT/605R	SPOT/705B	SPOT/606F	SPOT/507F
	6	SPOT/106R	SPOT/206R	SPOT/306R	SPOT/406R	SPOT/506R	SPOT/606R	SPOT/706B	SPOT/607F
	7	SPOT/007R	SPOT/107R	SPOT/207R	SPOT/307R	SPOT/407R	SPOT/507R	SPOT/607R	SPOT/707B

T=1 C=1		R							
		0	1	2	3	4	5	6	7
L	0	RIGHT/700B	RIGHT/601F	RIGHT/502F	RIGHT/403F	RIGHT/304F	RIGHT/205F	RIGHT/106F	RIGHT/007F
	1	RIGHT/601R	RIGHT/701B	RIGHT/602F	RIGHT/503F	RIGHT/404F	RIGHT/305F	RIGHT/206F	RIGHT/107F
	2	RIGHT/502R	RIGHT/602R	RIGHT/702B	RIGHT/603F	RIGHT/504F	RIGHT/405F	RIGHT/306F	RIGHT/207F
	3	RIGHT/403R	RIGHT/503R	RIGHT/603R	RIGHT/703B	RIGHT/604F	RIGHT/505F	RIGHT/406F	RIGHT/307F
	4	RIGHT/304R	RIGHT/404R	RIGHT/504R	RIGHT/604R	RIGHT/704B	RIGHT/605F	RIGHT/506F	RIGHT/407F
	5	RIGHT/205R	RIGHT/305R	RIGHT/405R	RIGHT/505R	RIGHT/605R	RIGHT/705B	RIGHT/606F	RIGHT/507F
	6	RIGHT/106R	RIGHT/206R	RIGHT/306R	RIGHT/406R	RIGHT/506R	RIGHT/606R	RIGHT/706B	RIGHT/607F
	7	RIGHT/007R	RIGHT/107R	RIGHT/207R	RIGHT/307R	RIGHT/407R	RIGHT/507R	RIGHT/607R	RIGHT/707B

When the marker is read backward, the direction display (F / R) at the end of the address is replaced.
Normally, there are 49 street numbers from 001 to 607.
Addresses ending in 00 are special addresses that match all destinations on the same line number (hundreds digit).
The addresses assigned to symmetrical codes (700B-707B, 800B-807B) are not used this time)

Highway - Assigned Barcode List

T=2 C=0	R							
	0	1	2	3	4	5	6	7
L 0	LEFT/800B	LEFT/000R	LEFT/100R	LEFT/200R	LEFT/300R	LEFT/400R	LEFT/500R	LEFT/600R
1	LEFT/000F	LEFT/801B	LEFT/001R	LEFT/101R	LEFT/201R	LEFT/301R	LEFT/401R	LEFT/501R
2	LEFT/100F	LEFT/001F	LEFT/802B	LEFT/002R	LEFT/102R	LEFT/202R	LEFT/302R	LEFT/402R
3	LEFT/200F	LEFT/101F	LEFT/002F	LEFT/803B	LEFT/003R	LEFT/103R	LEFT/203R	LEFT/303R
4	LEFT/300F	LEFT/201F	LEFT/102F	LEFT/003F	LEFT/804B	LEFT/004R	LEFT/104R	LEFT/204R
5	LEFT/400F	LEFT/301F	LEFT/202F	LEFT/103F	LEFT/004F	LEFT/805B	LEFT/005R	LEFT/105R
6	LEFT/500F	LEFT/401F	LEFT/302F	LEFT/203F	LEFT/104F	LEFT/005F	LEFT/806B	LEFT/006R
7	LEFT/600F	LEFT/501F	LEFT/402F	LEFT/303F	LEFT/204F	LEFT/105F	LEFT/006F	LEFT/807B

T=3 C=0	R							
	0	1	2	3	4	5	6	7
L 0	SPEED/0 (VEL/0/0)	SPEED/25 (VEL/25/0)	SPEED/50 (VEL/50/0)	SPEED/100 (VEL/100/0)	JOIN/P0	JOIN/P1	JOIN/P2	JOIN/P3
1	SPEED/0 (VEL/0/25)	SPEED/25 (VEL/25/25)	SPEED/50 (VEL/50/25)	SPEED/100 (VEL/100/25)	JOIN/P4	JOIN/P5	JOIN/P6	JOIN/P7
2	SPEED/0 (VEL/0/50)	SPEED/25 (VEL/25/50)	SPEED/50 (VEL/50/50)	SPEED/100 (VEL/100/50)	JOIN/N0	JOIN/N1	JOIN/N2	JOIN/N3
3	SPEED/0 (VEL/0/100)	SPEED/25 (VEL/25/100)	SPEED/50 (VEL/50/100)	SPEED/100 (VEL/100/100)	JOIN/N4	JOIN/N5	JOIN/N6	JOIN/N7
4	JOIN/P8	JOIN/P12	JOIN/N8	JOIN/N12	-	-	-	-
5	JOIN/P9	JOIN/P13	JOIN/N9	JOIN/N13	-	-	-	-
6	JOIN/P10	JOIN/P14	JOIN/N10	JOIN/N14	-	-	-	-
7	JOIN/P11	JOIN/P15	JOIN/N11	JOIN/N15	-	-	-	-

T=2 C=1	R							
	0	1	2	3	4	5	6	7
L 0	LEFT/700B	LEFT/601F	LEFT/502F	LEFT/403F	LEFT/304F	LEFT/205F	LEFT/106F	LEFT/007F
1	LEFT/601R	LEFT/701B	LEFT/602F	LEFT/503F	LEFT/404F	LEFT/305F	LEFT/206F	LEFT/107F
2	LEFT/502R	LEFT/602R	LEFT/702B	LEFT/603F	LEFT/504F	LEFT/405F	LEFT/306F	LEFT/207F
3	LEFT/403R	LEFT/503R	LEFT/603R	LEFT/703B	LEFT/604F	LEFT/505F	LEFT/406F	LEFT/307F
4	LEFT/304R	LEFT/404R	LEFT/504R	LEFT/604R	LEFT/704B	LEFT/605F	LEFT/506F	LEFT/407F
5	LEFT/205R	LEFT/305R	LEFT/405R	LEFT/505R	LEFT/605R	LEFT/705B	LEFT/606F	LEFT/507F
6	LEFT/106R	LEFT/206R	LEFT/306R	LEFT/406R	LEFT/506R	LEFT/606R	LEFT/706B	LEFT/607F
7	LEFT/007R	LEFT/107R	LEFT/207R	LEFT/307R	LEFT/407R	LEFT/507R	LEFT/607R	LEFT/707B

T=3 C=1	R							
	0	1	2	3	4	5	6	7
L 0	-	RIGHT/900	TURN/R180S	TURN/L180S	-	-	-	-
1	LEFT/900	-	TURN/R180G	TURN/L180G	-	-	-	-
2	NOP	NOP	PAUSE/10	NOSTOP/1	-	-	-	-
3	NOP	NOP	NOSTOP/0	PAUSE/30	-	-	-	-
4	-	-	-	-	-	SPOT/9001	SPOT/9002	-
5	-	-	-	-	SPOT/9014	-	-	-
6	-	-	-	-	SPOT/9013	-	-	-
7	-	-	-	-	-	-	-	-

The SPEED function is assigned to the markers of T = 3, C = 0, L, R = 0 to 3, and the speed value changes depending on the reading direction.
The label on the marker says VEL / xx / yy, where xx is the forward speed value and yy is the reverse speed value.

Command: Motion

topic: **0/WHISPERER/ RMS-10E1-*XXX* /exec/cmd**

- ❑Controls Thouzer motion remotely
- ❑3 Types of motion controls
  - Destination Speed Running
  - Arc Curve Running
  - Obstacle Avoidance Running
- ❑Recommended transmission interval 0.02 seconds. If there is no transmission for more than 1 second, it stops. The maximum speed / acceleration varies depending on the speed mode (selected by button operation).

Speed Mode	Speed (m/s)	Acc (m/s^2)	Turning (deg/s)	Turning Acc (deg/s^2)
Low	0.5	0.4 / 0.5	67	121 / 135
High	1.0	0.5 / 1.0	112	202 / 225

acceleration / deceleration. acceleration / deceleration.

Command: Motion

topic: **0/THOUZER_HW/RMS-10E1-*XXX*/exec/cmd**

- ❑Start Motion Control Command

```
{
    "app":"app-whisperer"
}
```

- ❑Stop Motion Control Command

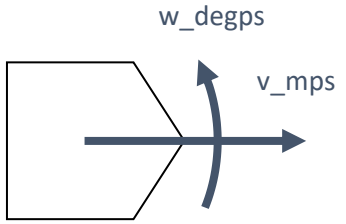
```
{
    "app":""
}
```

Command: Motion

topic: 0/WHISPERER/RMS-10E1-*XXX*/nav

❑Designated speed running

```
{
    "v_mps": "<Speed(m/s)>",
    "w_degps": "<Turning(deg/s)>"
}
```



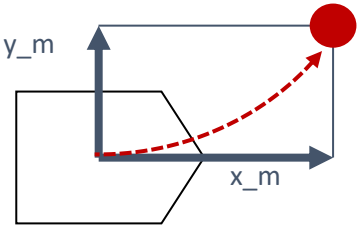
- Runs at the specified speed and turning speed
- No obstacles detection

Command: Motion

topic: 0/WHISPERER/RMS-10E1-*XXX*/nav

❑Arc curve running

```
{
      " x_m " : " < Reference pointX (m)>",
      "y_m": "< Reference pointY(m)>"
}
```



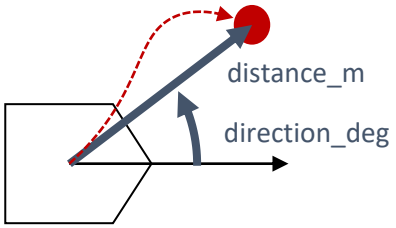
- The robot travels along a circular path to the specified reference point (relative coordinates).
- Stops when an obstacle is detected.
- The speed changes according to the remaining distance.

Command: Motion

topic: 0/WHISPERER/RMS-10E1-*XXX*/nav

❑Obstacle avoiding running

```
{
    "distance_m": "<Target distance(m)>",
    "direction_deg": "<direction(deg)>"
}
```



- Drive around the obstacles and stop at the reference point.
- The speed changes according to the remaining distance.