

A self-driving delivery simulation with the vehicle monitoring and dispatching system in the urban city with SUMO simulator

2019-06-16



Outline

1. Introduction
2. Related Work
3. System Overview
4. Traffic Control Interface
5. Dispatching Mechanism & User Scenario
6. Simulation Setup & Result
7. Conclusion & Future Work

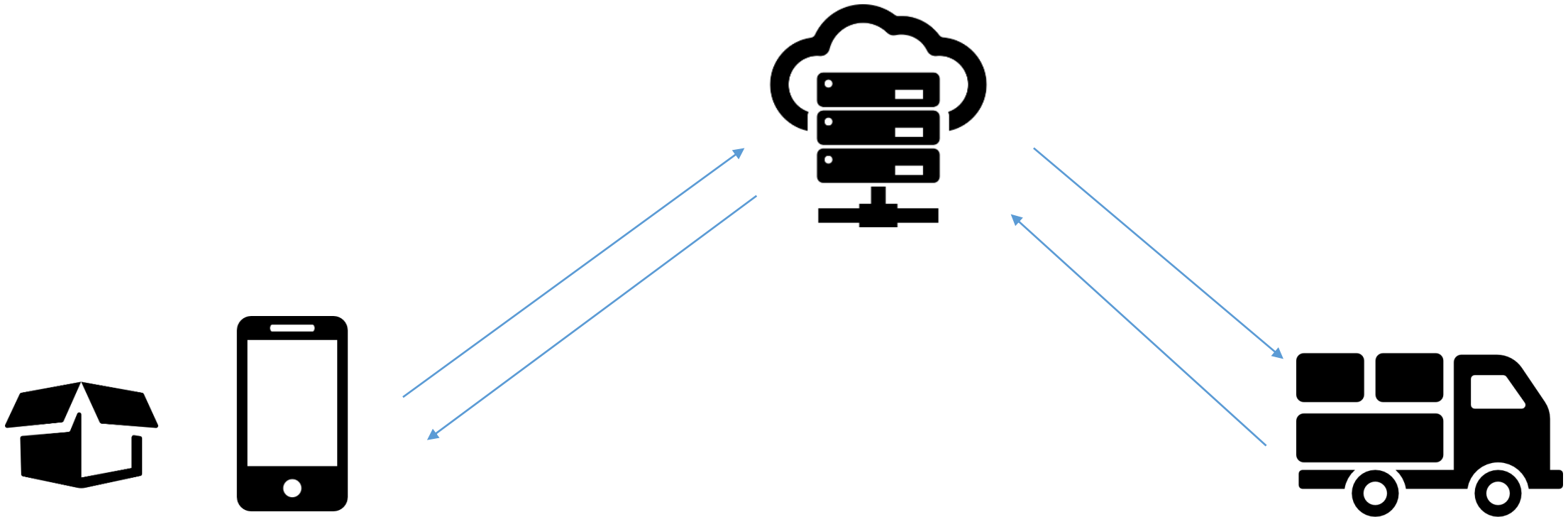
Introduction

1. Introduction

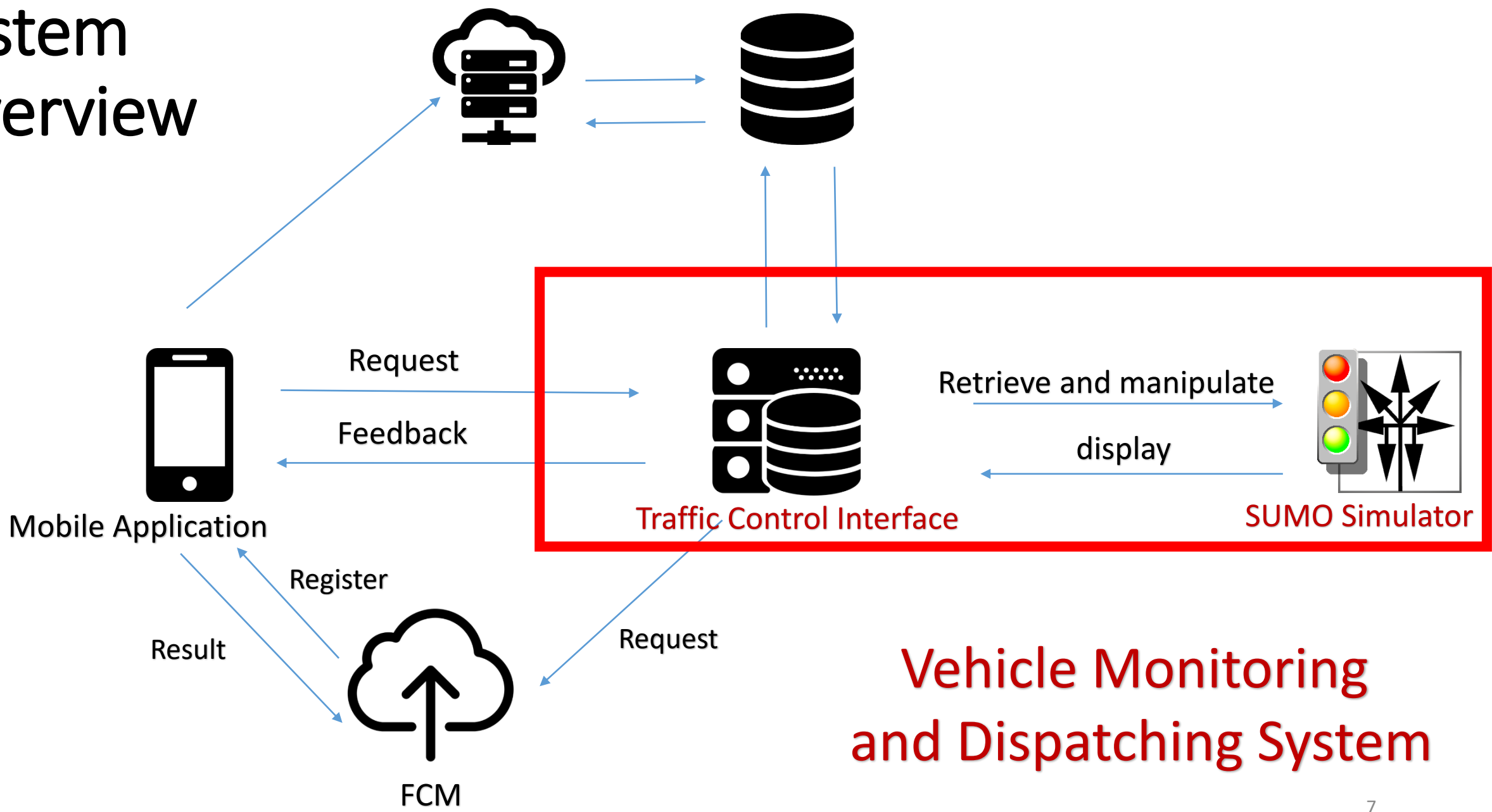
Related work

[1] Sumo as a Service – Building a Web Service to Interact with SUMO

System Architecture with Self-driving Truck

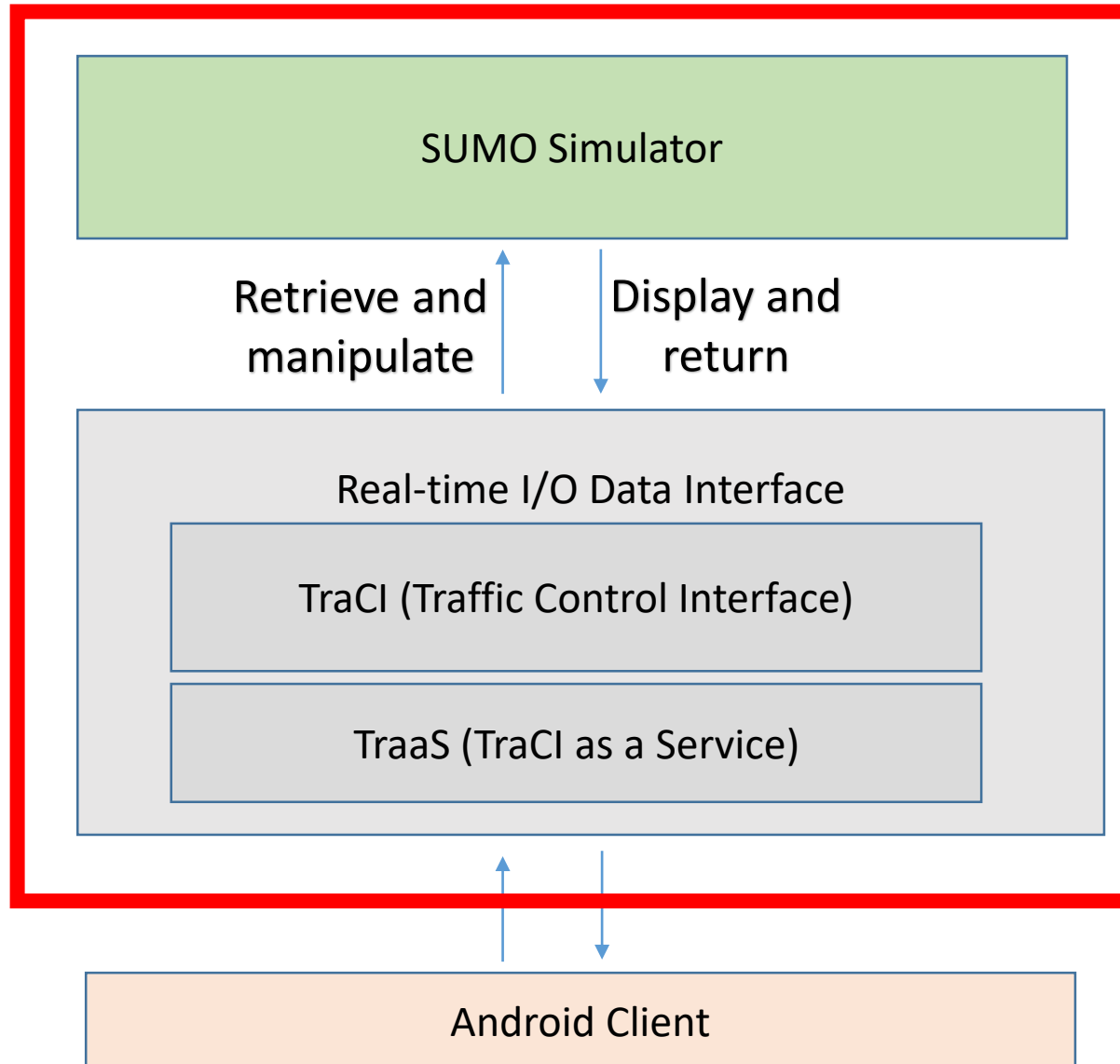


System Overview



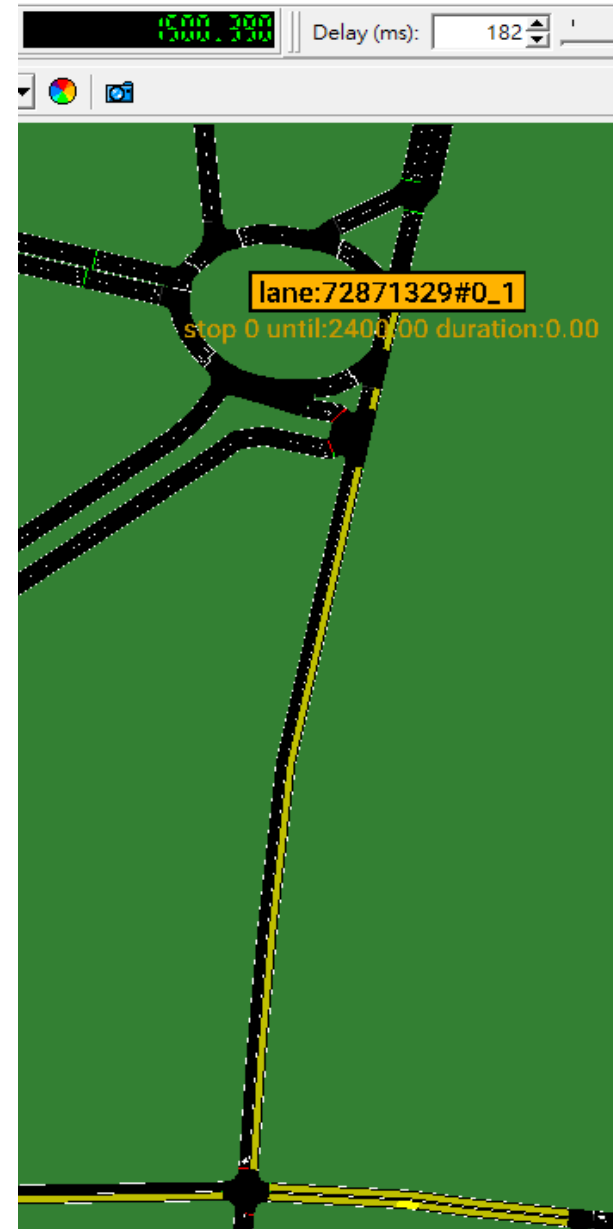
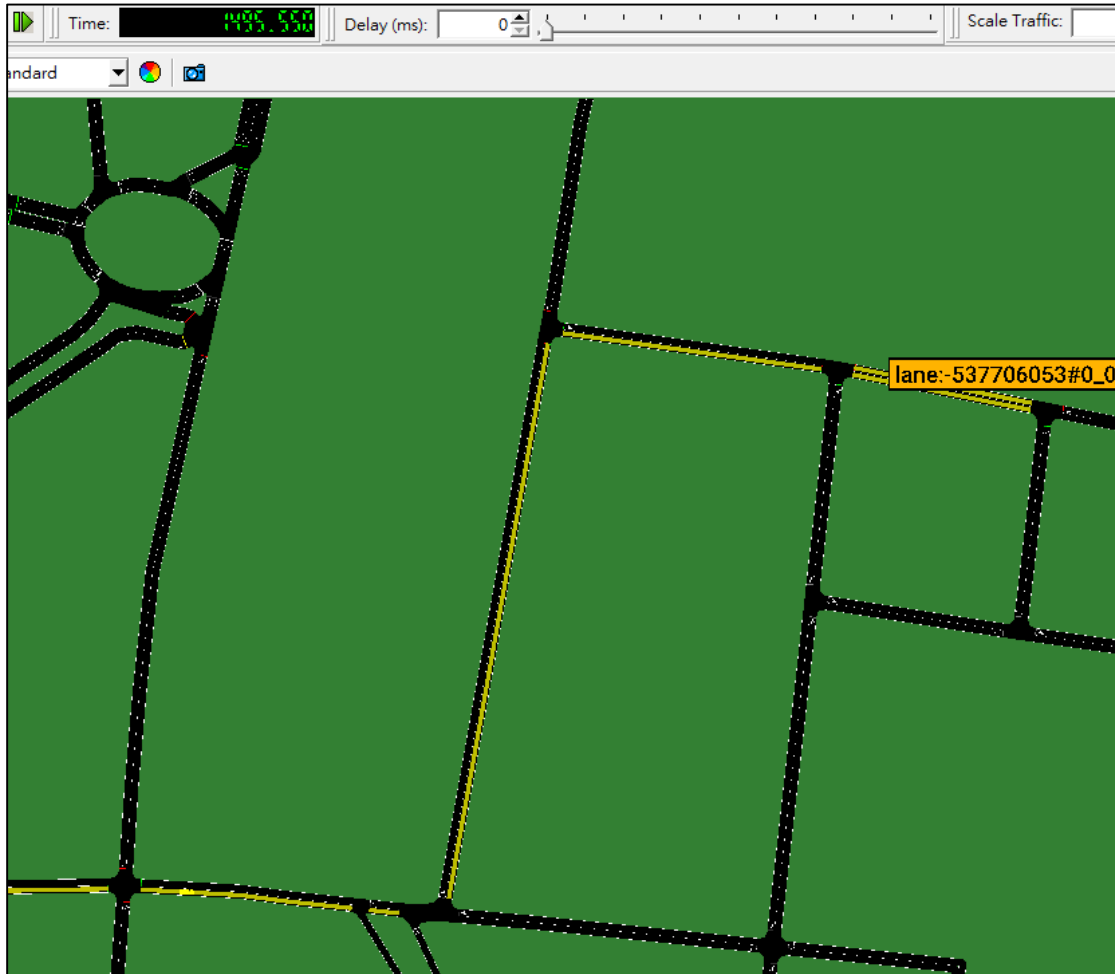
Building TraaS

Vehicle Monitoring and Dispatching System



- The service binds on a specific IP address and on a specific port.
- TraCI can retrieve values of simulated objects (vehicle) and manipulate their behavior "on-line".
- TraaS can communicate with the Android Client.

Vehicle Routing Parameter



- setRoute:
 - vehID
 - edgeList
- setStop:
 - VehID
 - edgeID
 - pos
 - laneIndex
 - duration
 - sf
 - startPos
 - until

Address
conversion

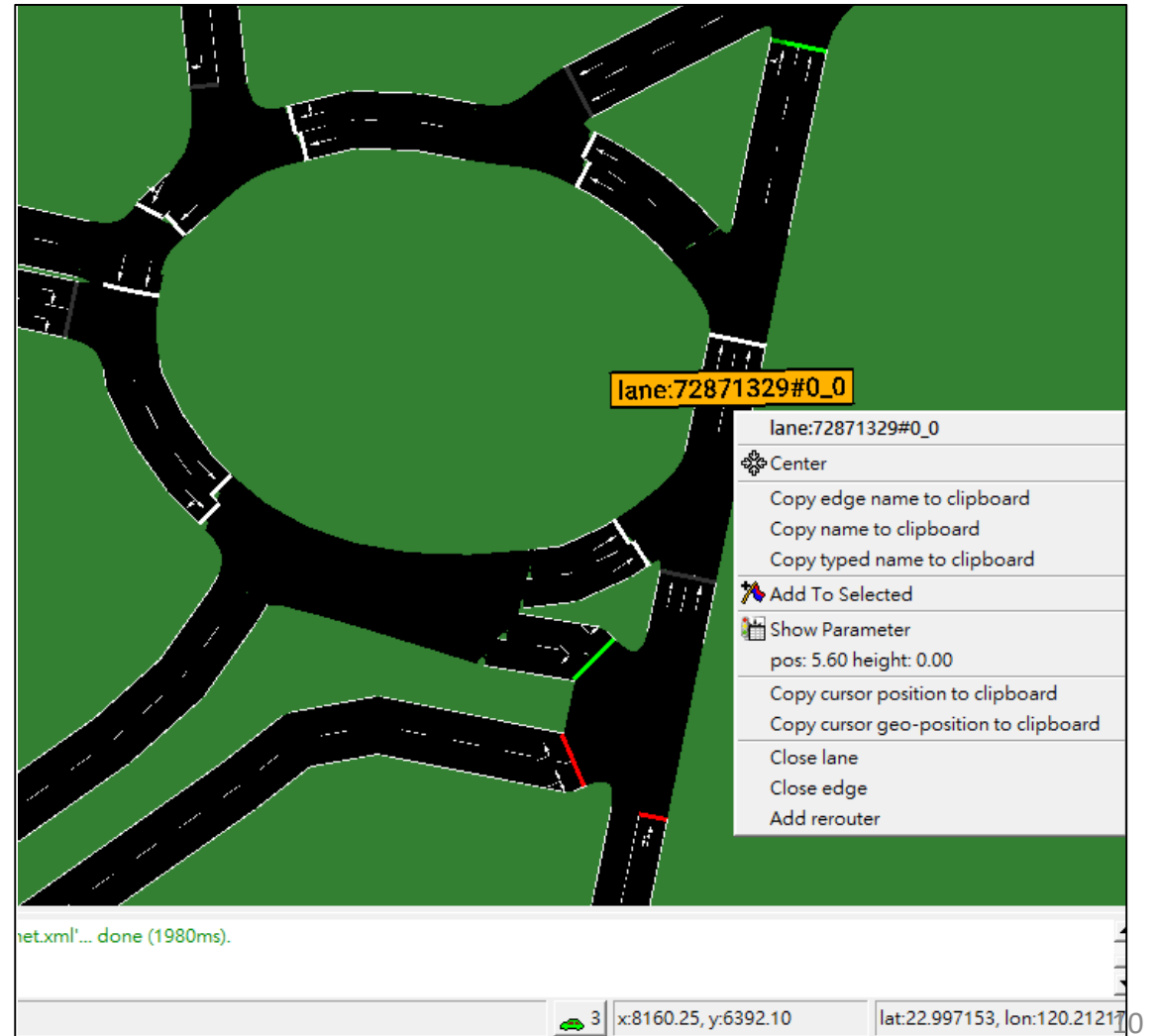
Sender
address

Google Map API

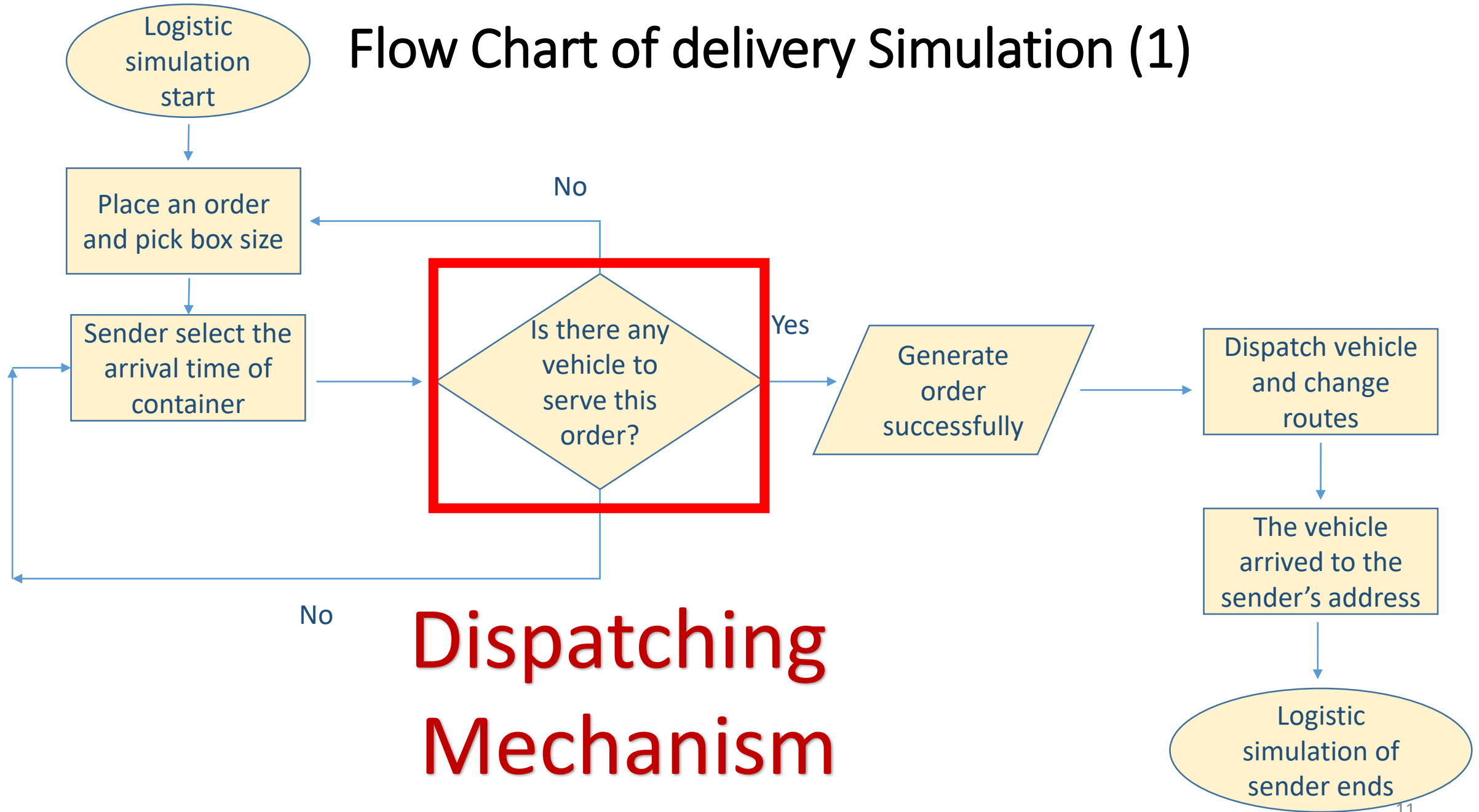
longitude,
latitude

convertRoad function
in SUMO API

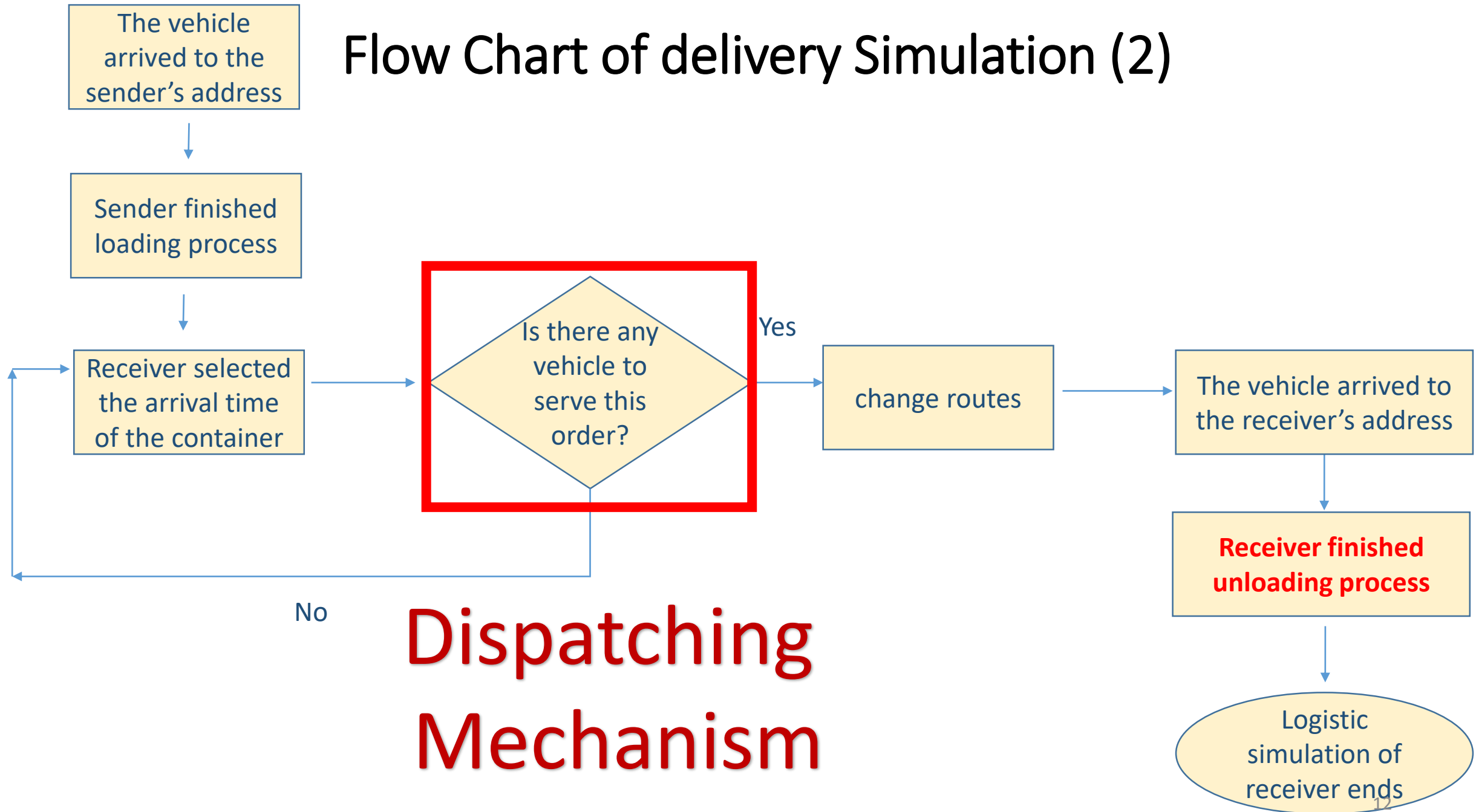
Road ID
of SUMO



Flow Chart of delivery Simulation (1)

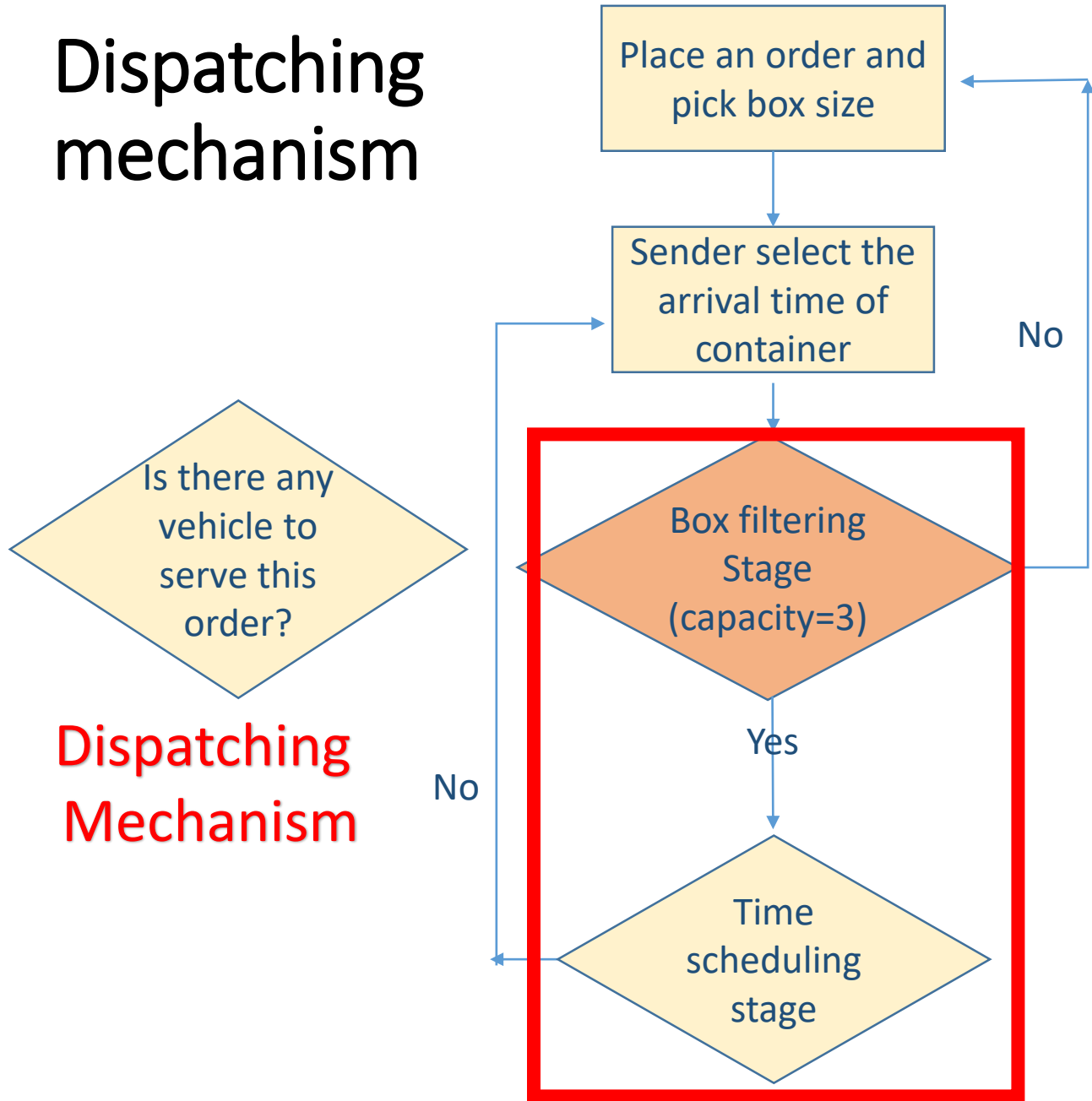


Flow Chart of delivery Simulation (2)



Dispatching mechanism

Dispatching Mechanism



	V1	V2	V3
small	111 112		
medium		221	
large			

Insert Box size=small,
there are v1,v2,v3 after box filtering stage

	V1	V2	V3	V4	V5
small	111				
medium	121 122 123	221	321 322 323	421 422	
large					

Insert Box size=medium,
there are v2,v4,v5 after box filtering stage

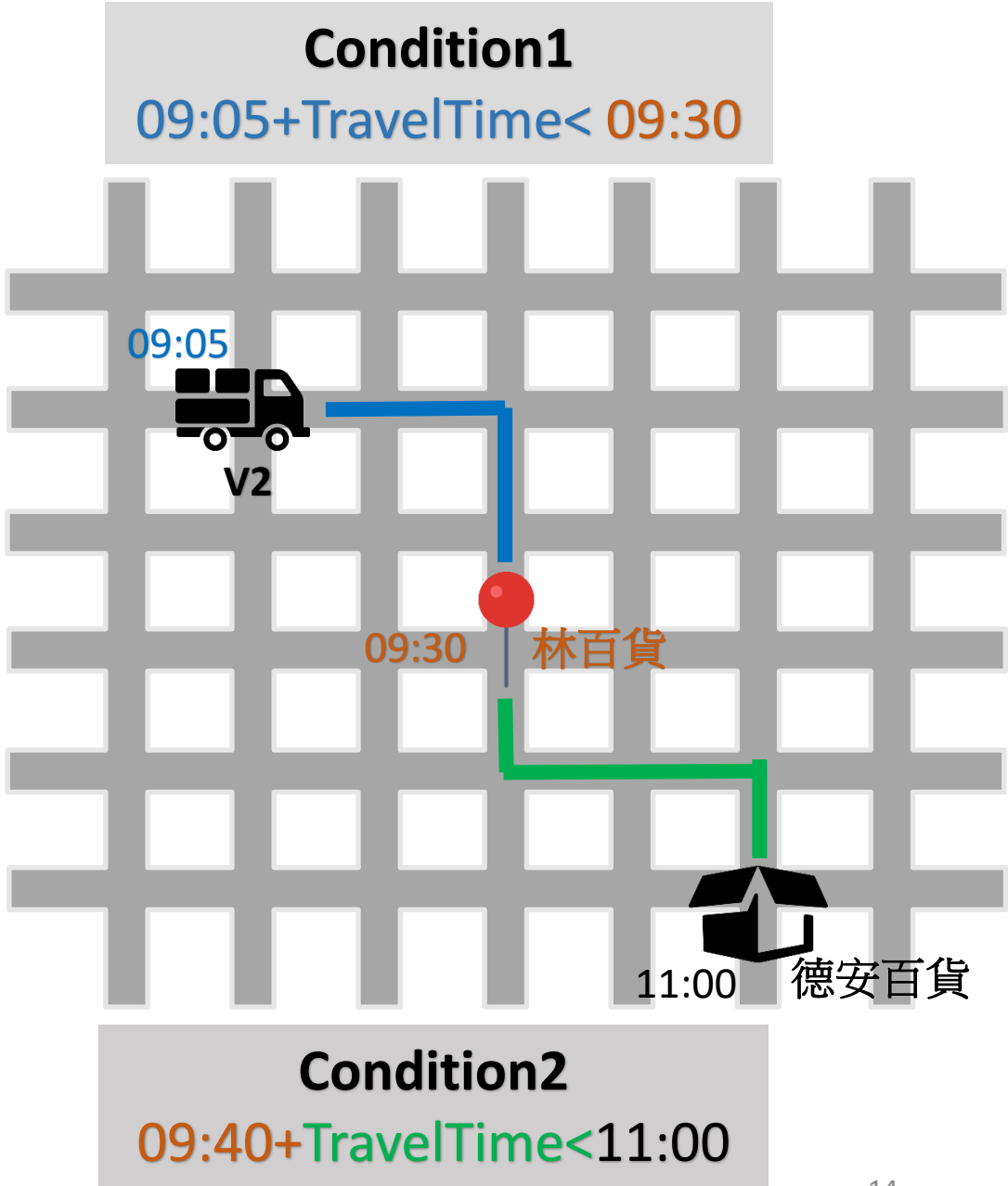
Time Scheduling stage (1)

Current Time:09:05

	V1	V2	V3
09:30	S1:台南地方法院 small(111)	S4:林百貨 small (211)	
10:00			
10:30			
11:00	S2:安平古堡 small(112)	S3:德安百貨 medium (221)	
11:30			

Insert Box
size=small
Insert
time=09:30

Sender4
address:林百貨



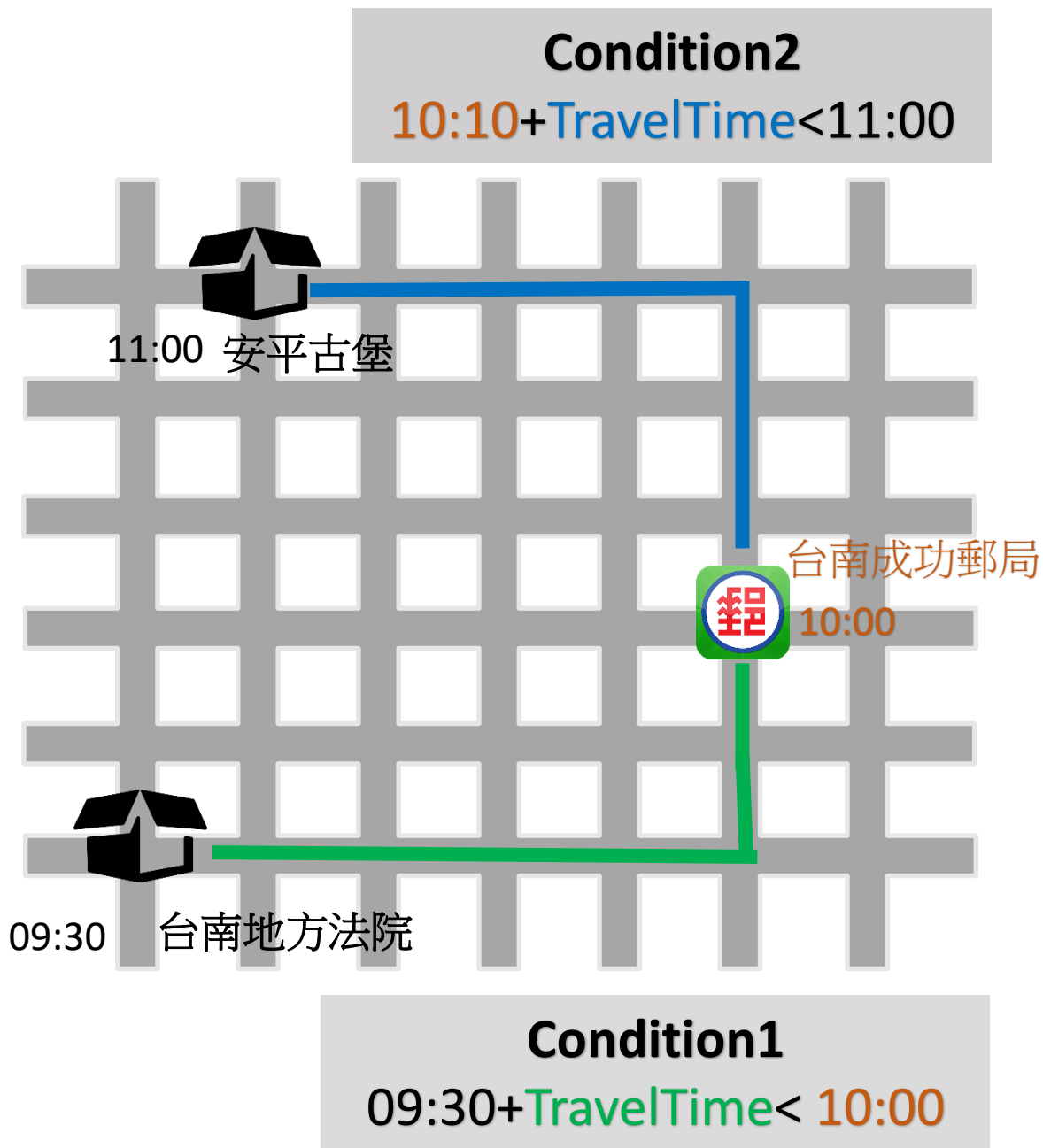
Time Scheduling stage (2)

Current Time:09:15

	V1	V2	V3
09:30	S1:台南地方法院 small(111)	S4:林百貨 small (211)	
10:00			
10:30			
11:00	S2:安平古堡 small(112)	S3:德安百貨 medium (221)	
11:30			

Insert Box
size=medium
Insert
time=10:00

Sender5 address:
台南成功郵局

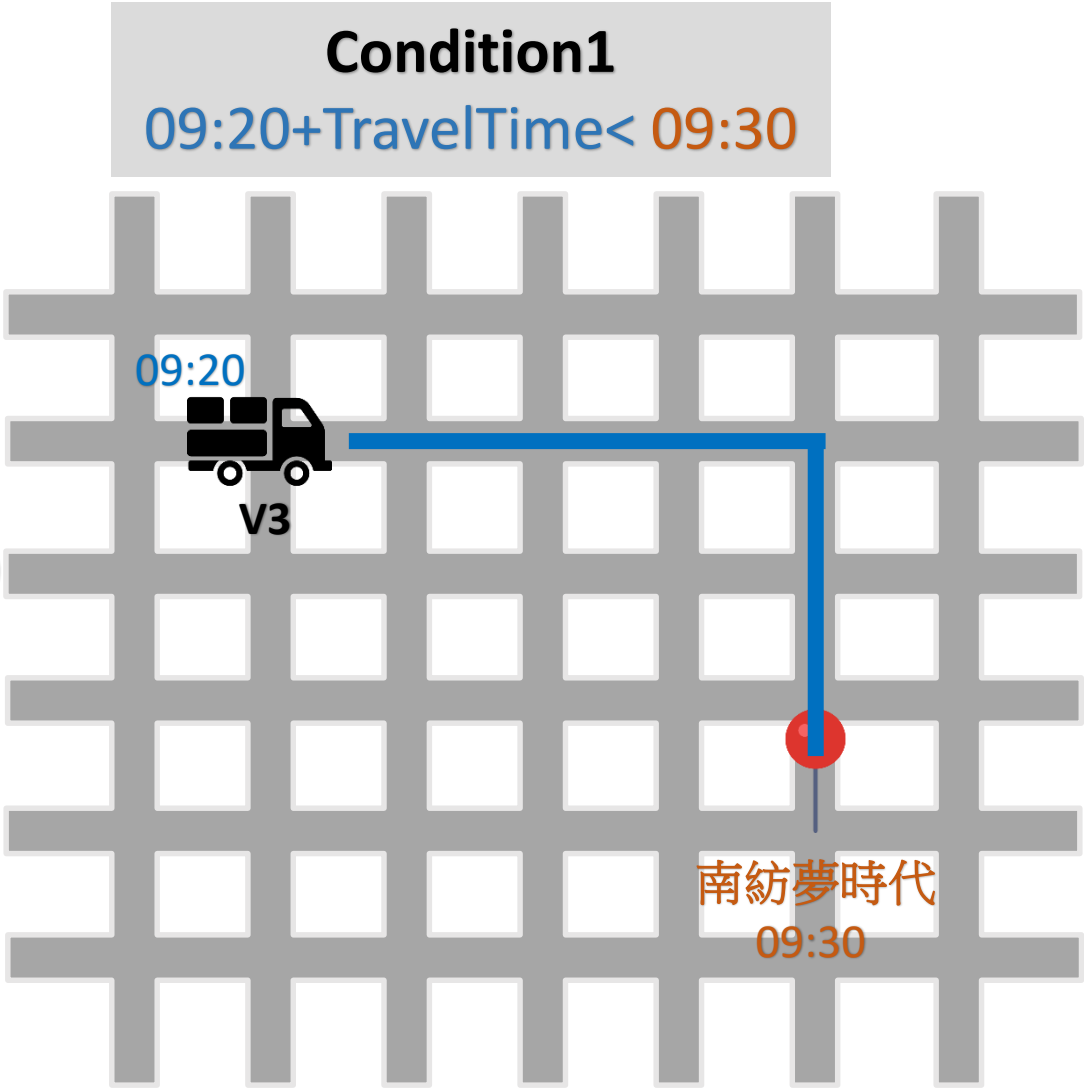


Time Scheduling stage (3)

Current Time:09:20

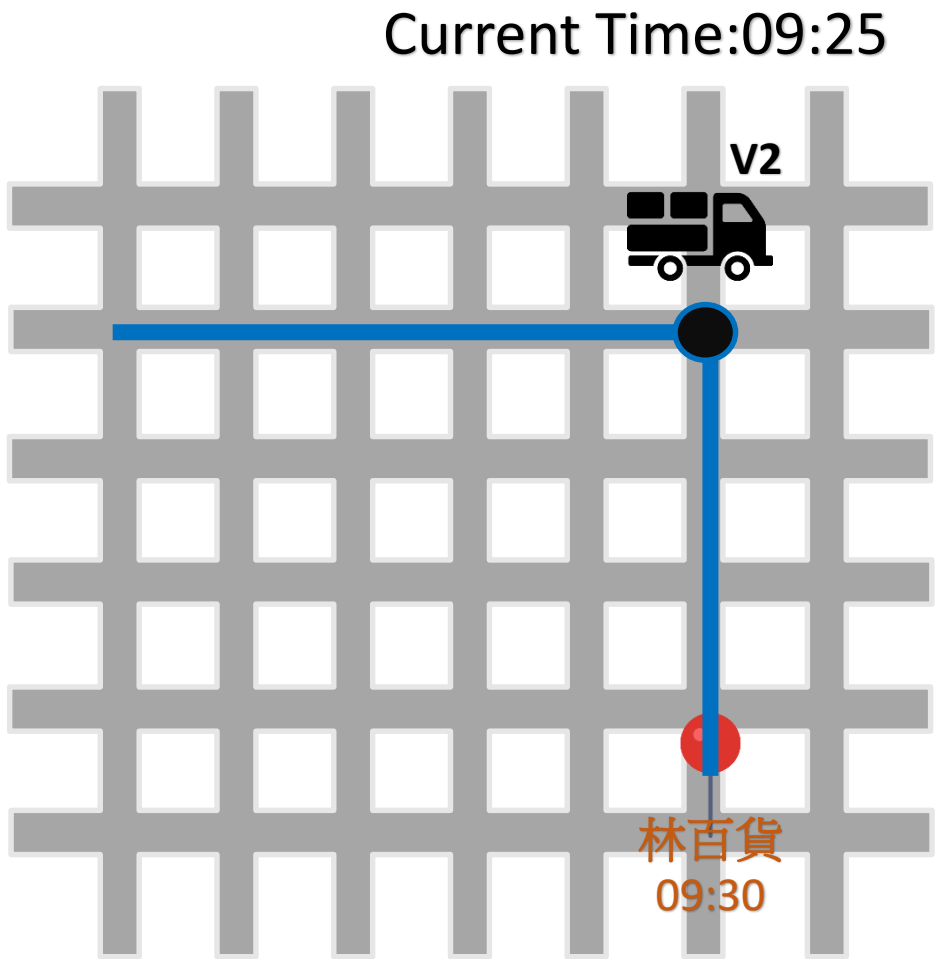
	V1	V2	V3
09:30	S1:台南地方 法院 small(111)	S4:林百貨 small (211)	
10:00	S5:台南成功 郵局 medium(121)		
10:30			
11:00	S2:安平古堡 small(112)	S3:德安百 貨 medium (221)	
11:30			

Insert Box
size=large
Insert time=09:30
Sender6 address:
南紡夢時代



Sender Scenario

	V2
09:30	S4:林百貨 small (211)
10:00	
10:30	
11:00	S3:德安百貨 medium (221)
11:30	



At 09:25, the sumo server would use FCM to notify sender4 that the vehicle2 is coming.

At 09:30, the sumo server would notify sender4 that the vehicle2 arrived to the destination.

At 09:35, the vehicle2 has finished the loading process and notify reciver4 to pick the receiver's arrival time.

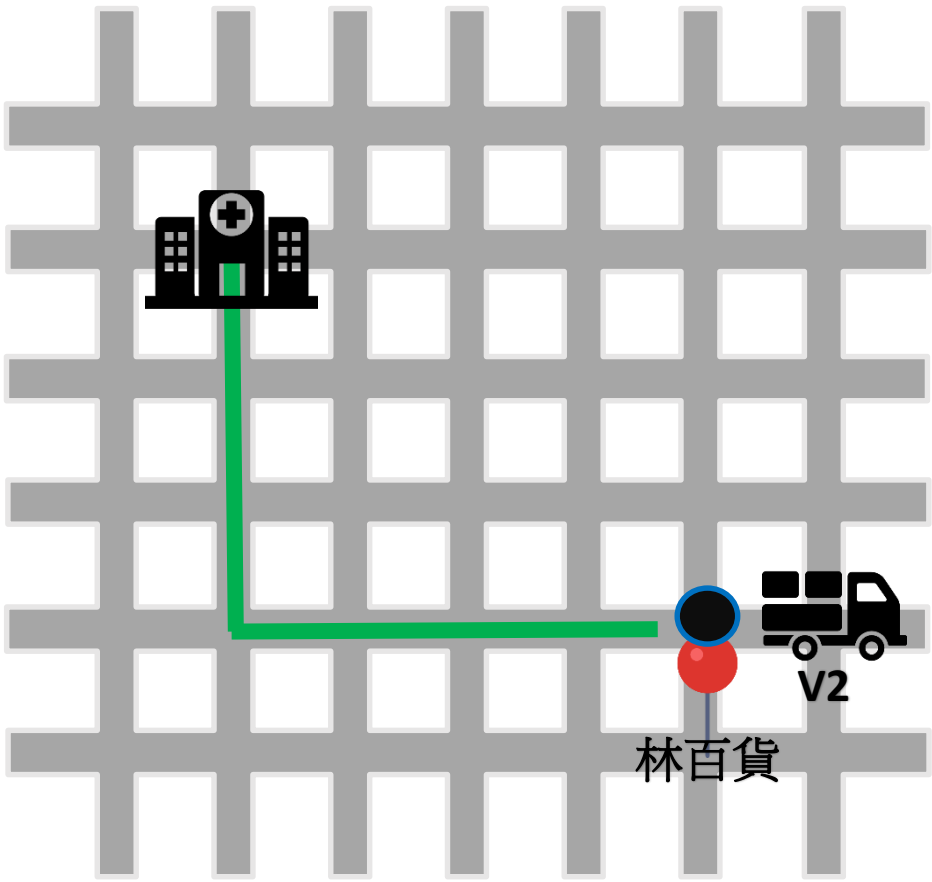
Receiver Scenario (1)

At 09:37, reciver4 picked the arrival time of 10:00 and the receiver's request was accepted by the vehicle2

At 09:40, the vehicle2 would end the stopping stage of sender4 and go to the NCKU Hospital in the green route.

At 09:55, the sumo server would use FCM to notify receiver4 that the vehicle2 is coming.

	V2
09:30	S4:林百貨 small (211)
10:00	R4:成大醫院 (211)
10:30	
11:00	S3:德安百貨 medium (221)
11:30	

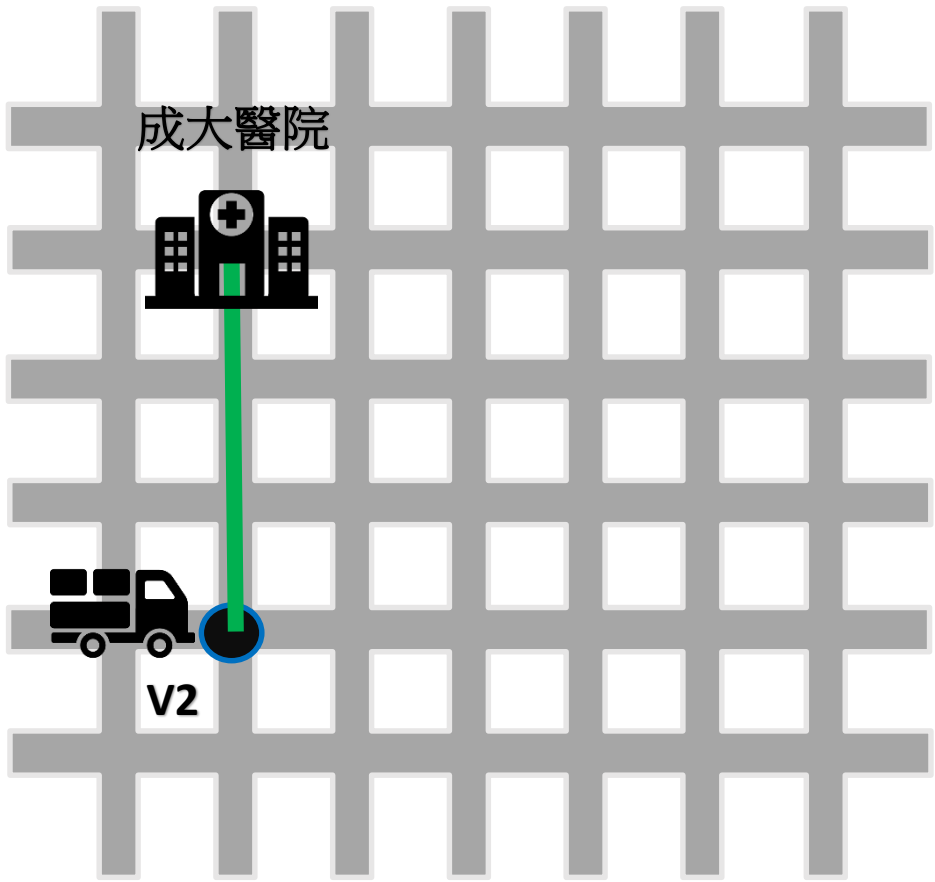


Current Time:09:37

Receiver Scenario (2)

At 09:55, the sumo server would use FCM to notify receiver4 that the vehicle2 is coming.

	V2
09:30	S4:林百貨 small (211)
10:00	R4:成大醫院 (211)
10:30	
11:00	S3:德安百貨 medium (221)
11:30	



Current Time:09:55

At 10:00, the sumo would use notify receiver4 that the vehicle2 arrived to the destination.

At 10:05, the vehicle2 has finished the **unloading** process.

At 10:10, the vehicle2 would end the stopping stage of receiver4 and go to the next destination.

測量距離
在地圖上按一下即可新增路徑

總面積：50.07 平方公里 (19.33 平方英里)
總距離：31.50 公里 (19.57 英里)



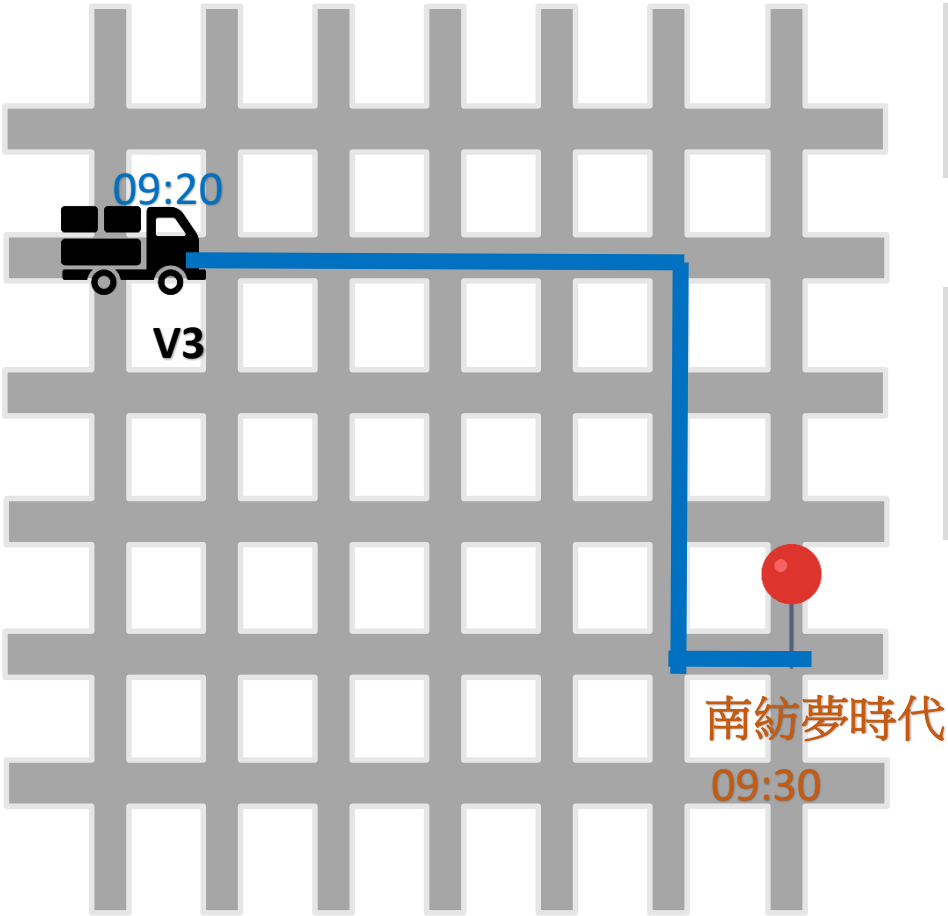
Simulation Setup (2)



Attribute	Value
Simulation area	Tainan downtown area 50.07 km ²
The number of junctions	6785
The number of roads	25069
The number of trucks	3
V _{max}	5.0 [m/s]
Average speed of truck	4.0 [m/s]
Simulation time	09:00-15:00 (6 hours=21600 seconds)

Simulation Setup (3)

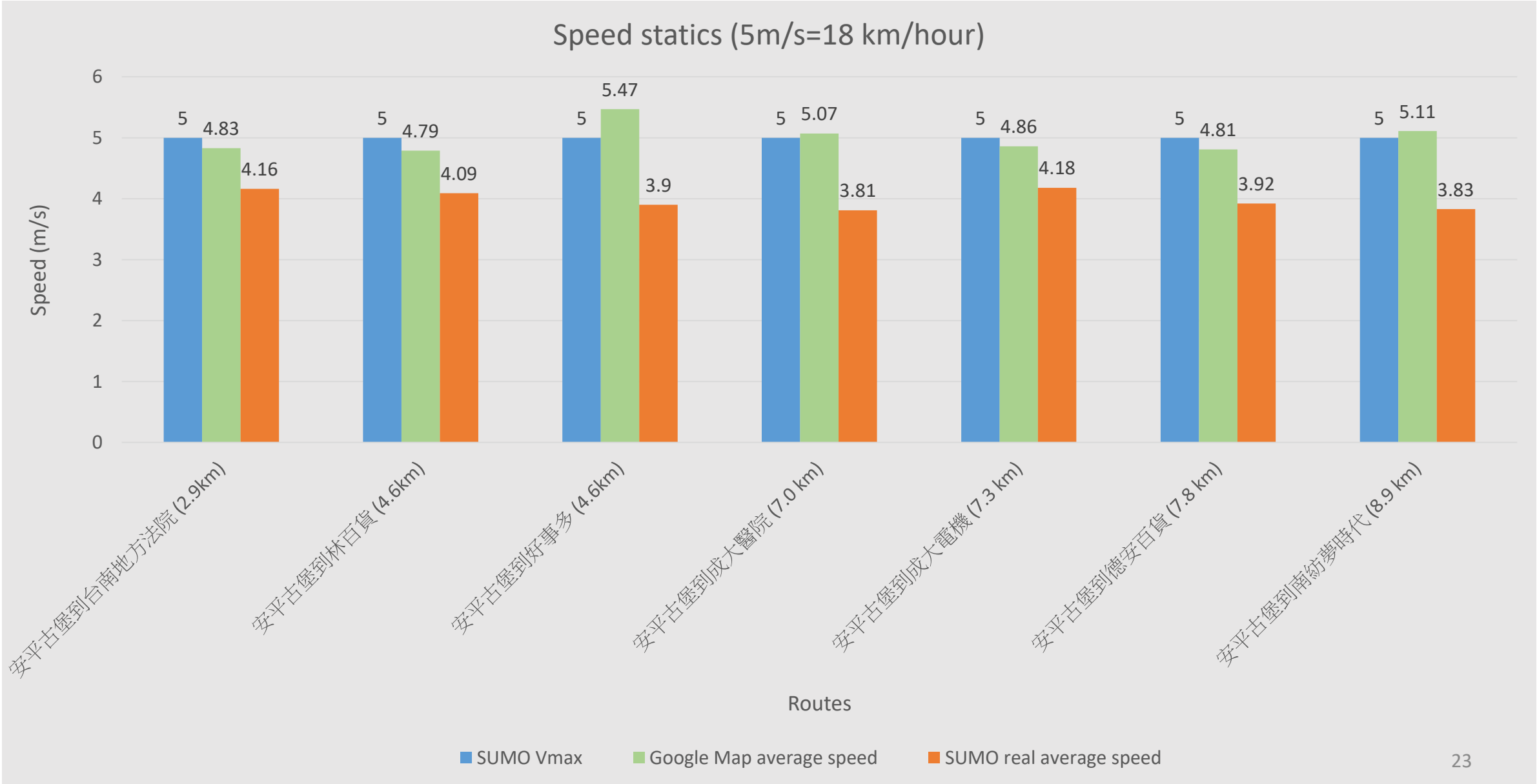
Simulation area	Tainan downtown area (50.07 km2)
The number of junctions	6785
The number of roads	25069
The number of trucks	3
Vmax	5.0 [m/s]
Average speed of truck	4.0 [m/s]
Simulation time	09:00-15:00 (6 hours=21600 seconds)



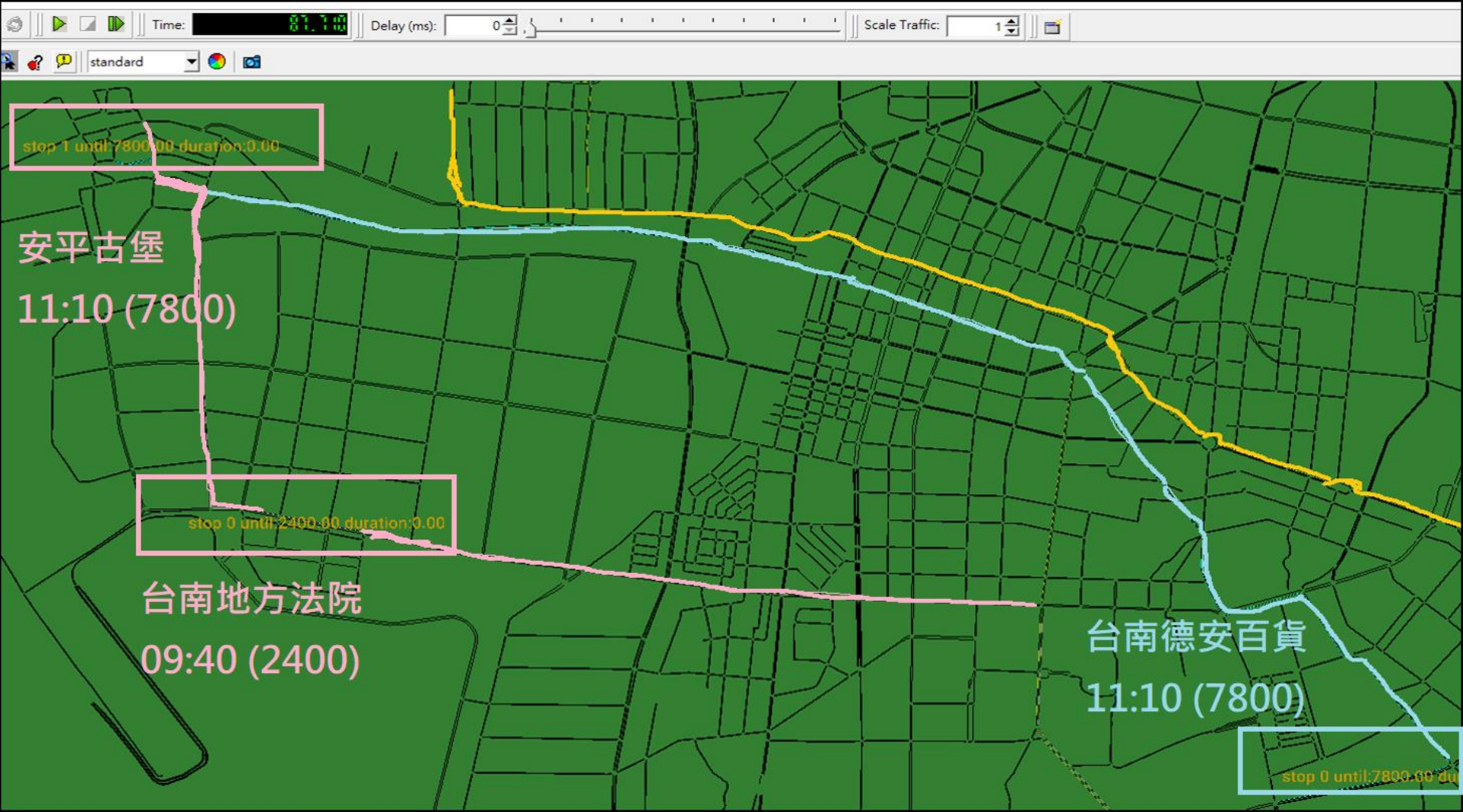
Condition1
09:20+TravelTime< 09:30

TravelTime=
DrivingDistance/
Average_speed (4.0)

Speed Statics



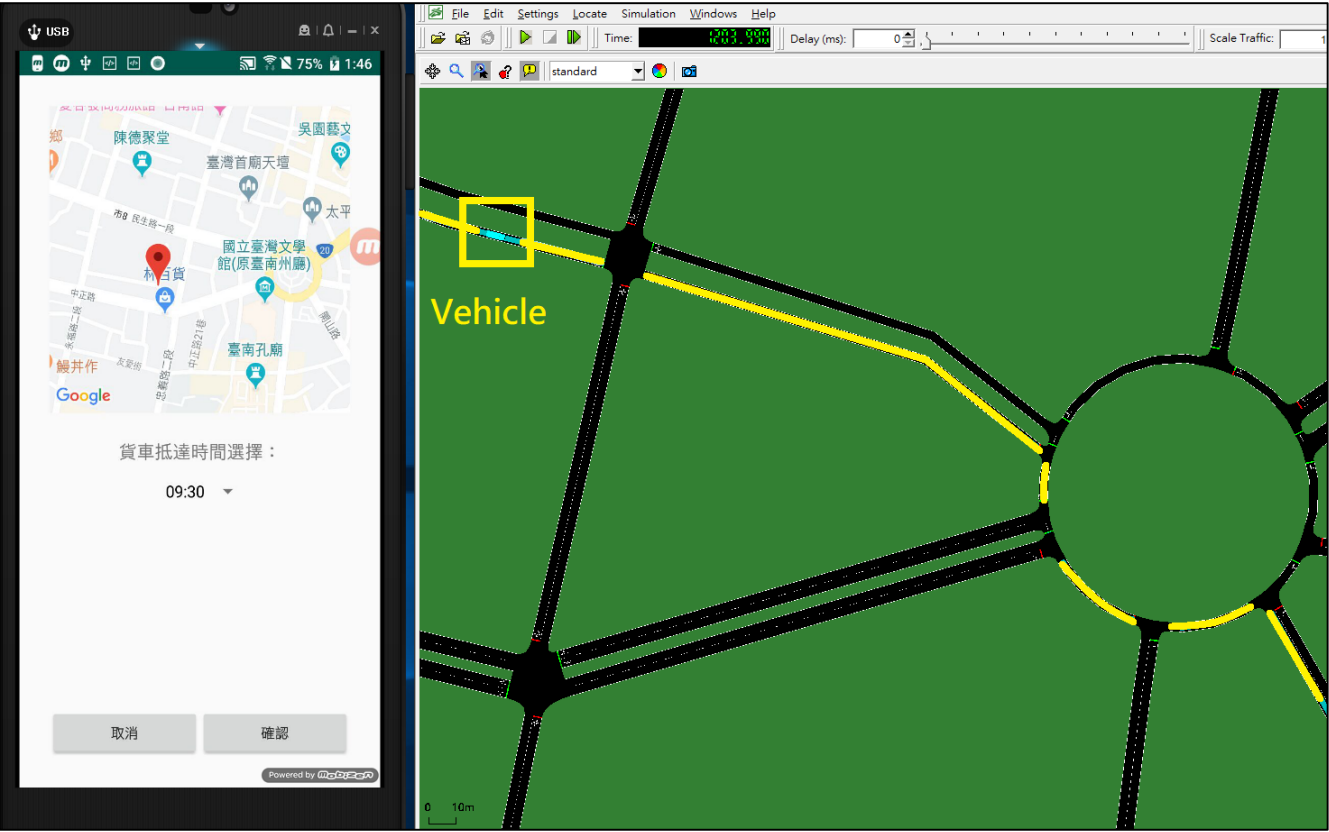
Simulation Result-Initialization



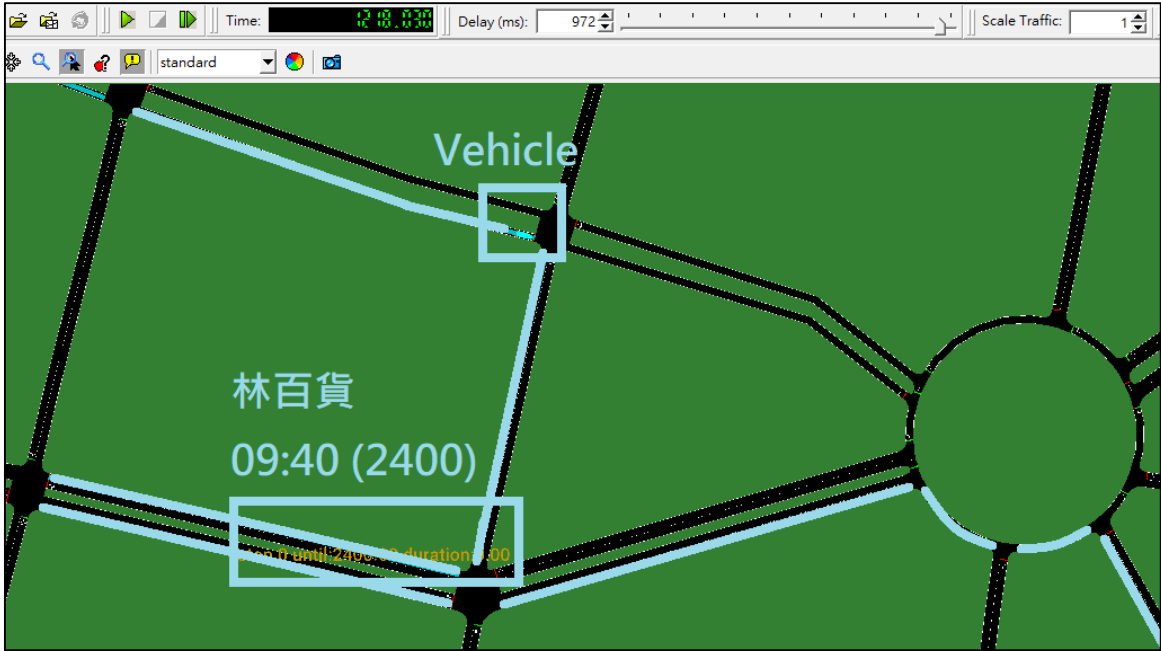
	V1	V2	V3
09:30	S1: 台南地方法院		
10:00			
10:30			
11:00	S2: 安平古堡	S3: 德安百貨	
11:30			

Simulation Result- sender request insertion

Current Timeseconds:1203 (09:20:03)

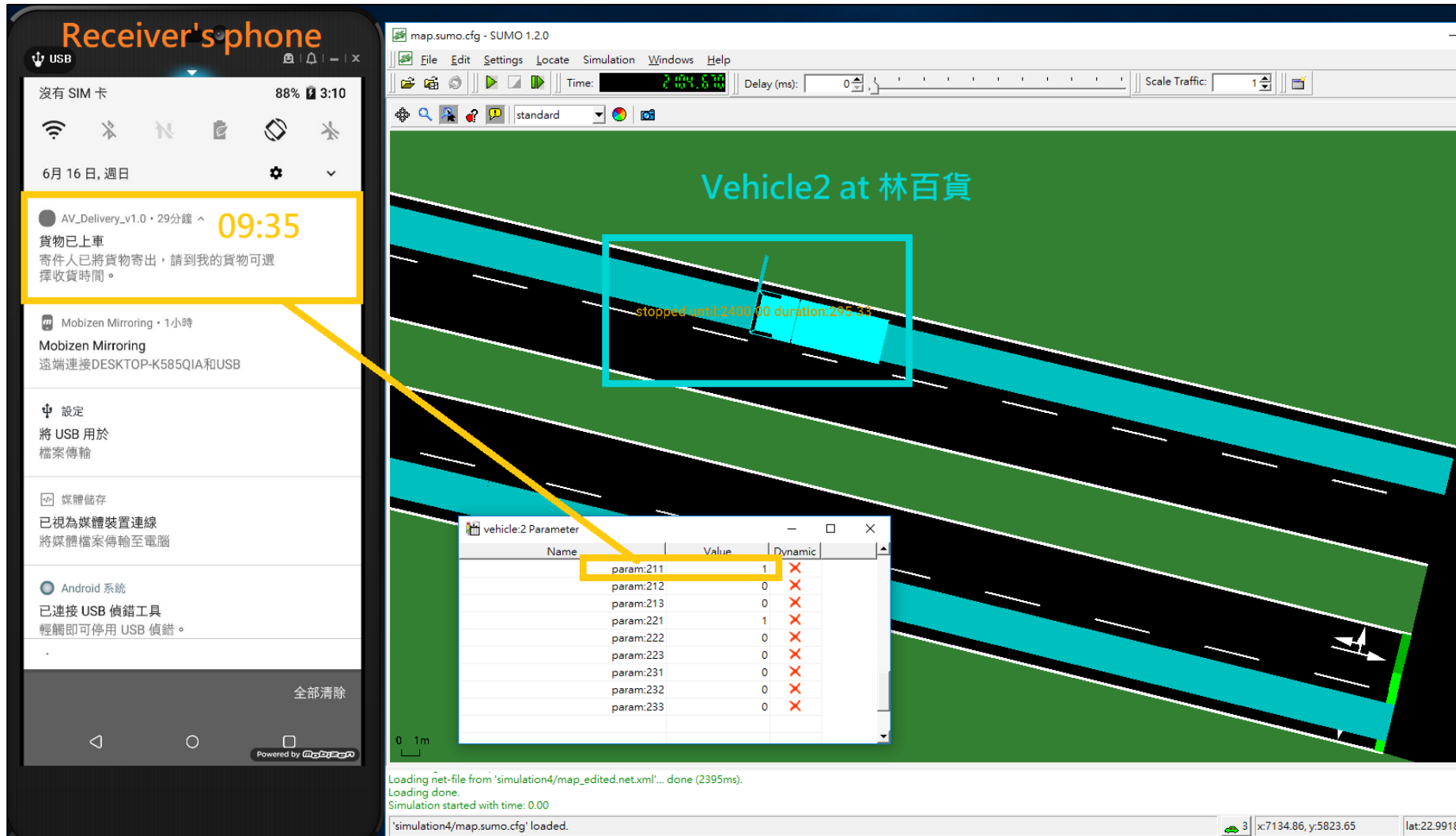


Current Timeseconds:1218 (09:20:18)



Simulation Result- finish loading process in sender address

Current Timesecods:2104 (09:35)



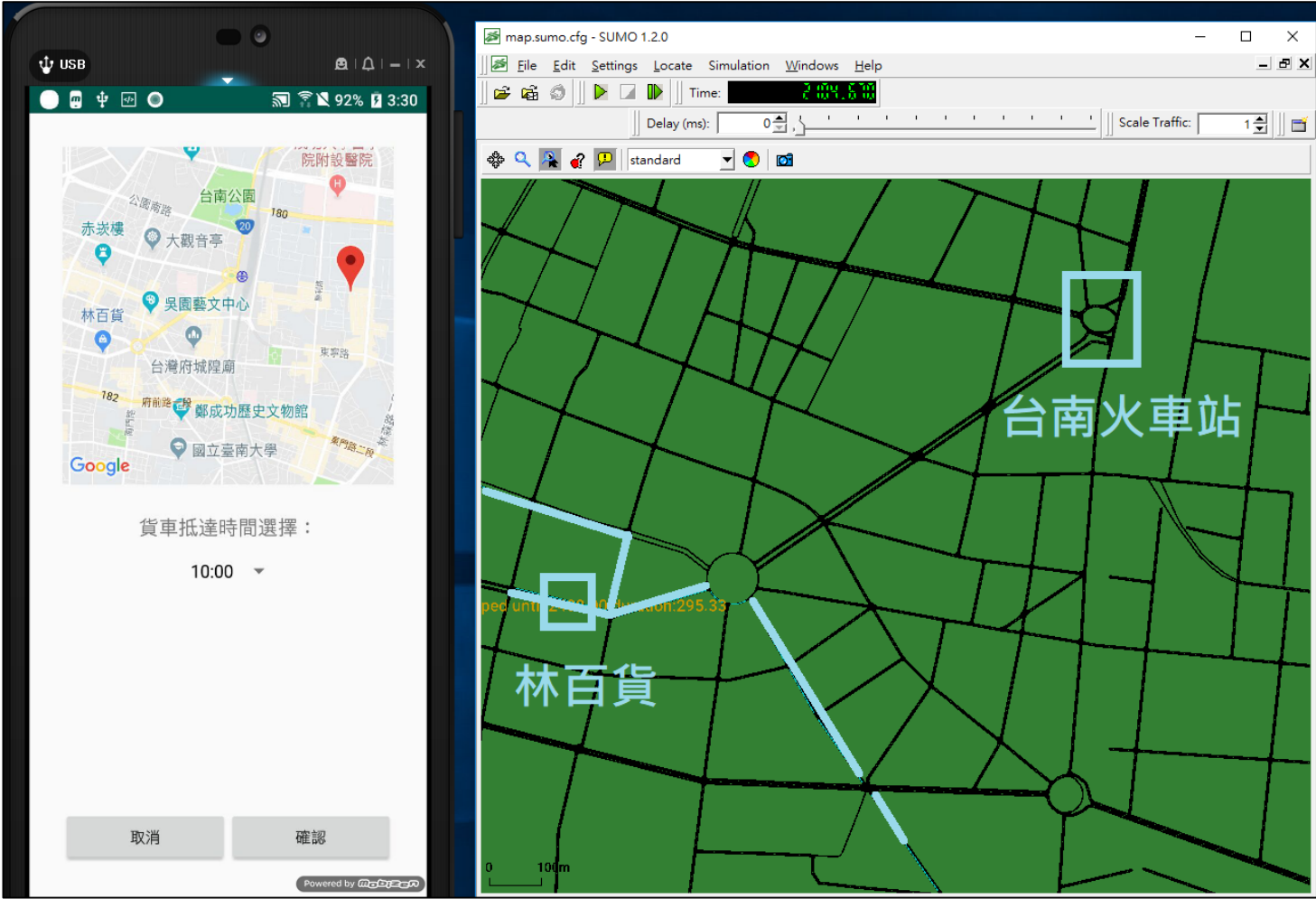
1.The receiver would get the notification at 09:35 that the loading process finished.

2.The parameters of vehicle2 show that the “box211” has the container.

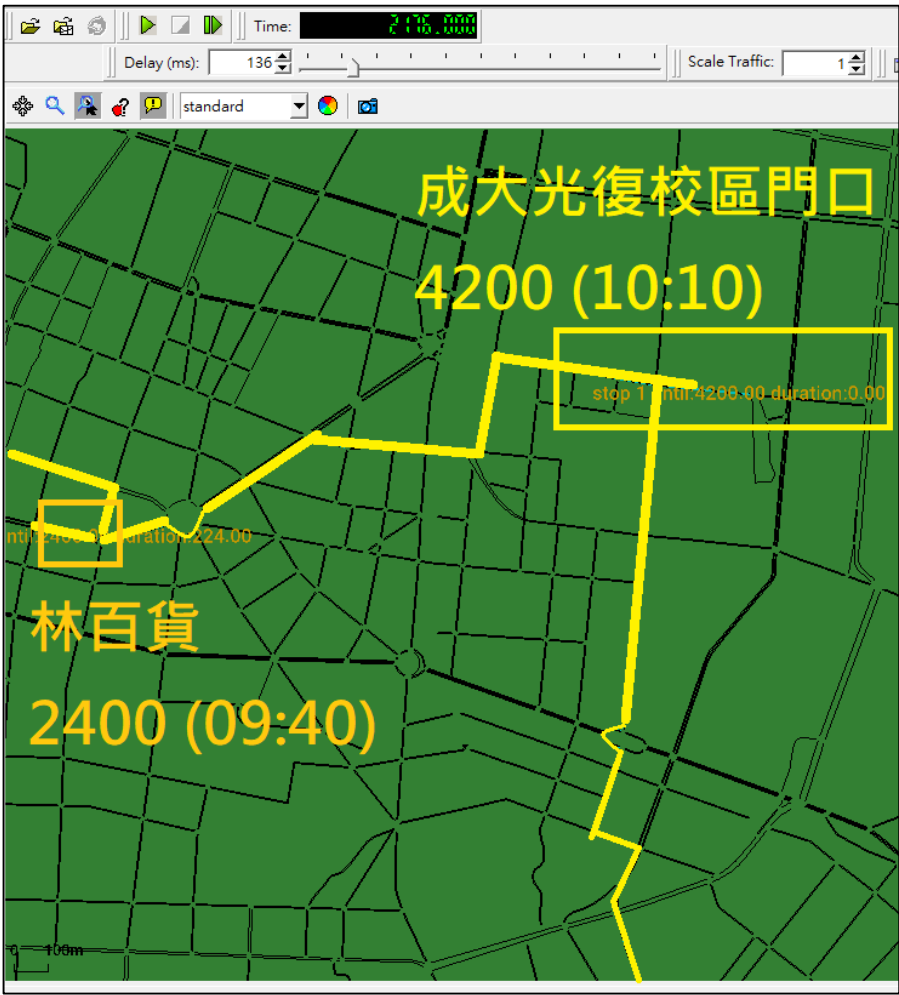
3.The vehicle2 cannot leave until 2400 (09:40).

Simulation Result- receiver request insertion

Current Timeseconds:2104 (09:35:04)



Current Timeseconds:2176 (09:36:16)



Simulation Result- finish unloading process in receiver address

Current Timeseconds:4059 (10:07:29)

沒有 SIM 卡

100% 4:06

6月 16日, 週日

● AV_Delivery_v1.0 • 2分鐘

貨車已到達

貨物已送達，請準備簽收。

● AV_Delivery_v1.0 • 2分鐘

貨車即將到達

貨車將於約5分後到達。

Mobizen Mirroring • 2小時

Mobizen Mirroring

遠端連接DESKTOP-K585QIA和USB

設定

將 USB 用於

檔案傳輸

媒體儲存

已視為媒體裝置連線

將媒體檔案傳輸至電腦

10:00

map.sumo.cfg - SUMO 1.2.0

File Edit Settings Locate Simulation Windows Help

Time: 4059.340 Delay (ms): 0 Scale Traffic: 1

standard

The vehicle2 would not leave
成大光口 until 4200 (10:10)

stopped until 4200.00 duration:130.66

貨物已卸貨

Name	Value	Dynamic
param:211	0	×
param:212	0	×
param:213	0	×
param:221	1	×
param:222	0	×
param:223	0	×
param:231	0	×
param:232	0	×
param:233	0	×

0 10m

Conclusion

Future work