

## VERGILIUS and QualNet Tutorial

This tutorial shows all the steps that need to be taken to generate a scenario with VERGILIUS using SUMO and then simulate it with QualNet

### Acquiring Tiger Maps

The first step is to decide in which geographical region we want to run the simulations. In this tutorial we chose to simulate a residential area of Los Angeles, California. VERGILIUS uses the TIGER Line files that can be downloaded at:

<http://www.census.gov/geo/www/tiger/tiger2006se/tgr2006se.html>

The files are divided by state and each of them represents a county. For the correspondence between counties and their file code please see the TIGER user manual.

Download the file related to the county you want to simulate and unzip it. VERGILIUS only need the .RT1 and .RT2 files.

### Generating a Scenario for SUMO

Now that we have the TIGER maps we can generate a scenario for SUMO. In order to do this we need to run VMF in mode 1. The sample configuration file (mode1\_sumo.config) is reported below.

```
MODE 1
ORIGIN      34056000    -118434000
WIDTH 500
HEIGHT      500
RT1  "TIGER_FILES_PATH/TGR06037.RT1"
RT2  "TIGER_FILES_PATH/TGR06037.RT2"

BUILD_SUMO_OUTPUT YES
SUMO_SIMULATION_TIME 600
SUMO_NODES_FILE      SUMOnodes.xml
SUMO_EDGES_FILE      SUMOedges.xml
SUMO_TURNS_FILE      SUMOturns.xml
SUMO_FLOWS_FILE      SUMOfloows.xml

SCENARIO      RANDOM
SCENARIO_DIJKSTRA_WEIGHT      TIME
RANDOM_SCENARIO_DESTINATION_TYPE      RANDOM      0
AVERAGE_ARRIVALS 200
```

Please the user manual for the meaning of all the options.

To run VMF type:

```
mono VMF.exe mode1_sumo.config
```

VMF will generate the following files:

- Data.txt contains info related to the geographical area extracted from TIGER.
- links and nodes files are (paired as .data.txt and out\_data) descriptions of the map in terms of links and nodes (vertices and edges of a graph) in different formats.

- TGR06037.RT1.cut is a reduced version of the TIGER file that contains only the roads related to the area of interest. (it can be reused in further simulations to speed up the process).
- output.bmp is a graphical representation of the road network.
- The SUMO\* files are the description of the network required by SUMO, we will see how to use them in the following paragraph.

### Running SUMO from the VERGILIUS output

First we need to generate the net file for SUMO. Run the following command:

```
sumo-netconvert -n SUMOnodes.xml -e SUMOedges.xml -o SUMOnet.xml
```

Then we need to generate the routes:

```
sumo-jtrrouter -n SUMOnet.xml -f SUMOfloWS.xml -t SUMOturns.xml -o SUMOroutes.xml
```

Now we can modify the SUMO\_Config.cfg file specifying the two newly generated files. Modify the 2 configuration lines as follows:

```
net-file="SUMOnet.xml"
route-files="SUMOroutes.xml"
```

We are now ready to run SUMO:

```
sumo -c SUMO_Config.cfg --netstate-dump sumoOutput.xml
```

### Generate QualNet input

To generate the input for QualNet we need to run VMF in mode 7. Here is the related config file (mode7.conf):

```
MODE      7

SUMO_INPUT_NODES_FILE    "SUMO_PATH/SUMOnodes.xml"
SUMO_INPUT_EDGES_FILE    "SUMO_PATH/SUMOedges.xml"
SUMO_INPUT_NETWORK_FILE  "SUMO_PATH/SUMOnet.xml"
SUMO_INPUT_TRACE_FILE    "SUMO_PATH/sumoOutput.xml"
```

Launch VMF as follows:

```
mono VMF.exe mode7.conf
```

VMF will generate the input files for QualNet:

- out.mobility is the mobility file.
- out3.app is a sample application file.
- outLinks.data and outNodes.data are a description of the road topology to be used by CORNER in QualNet.
- out.fault is the fault file required by QualNet.
- statistics.data contains useful information to create th config file for QualNet.

## Running the QualNet Simulation

To run QualNet simulation using this scenario we have to create a configuration file (corner.config)

```
VERSION 4.5
EXPERIMENT-NAME corner
SIMULATION-TIME 600S
SEED 1
COORDINATE-SYSTEM CARTESIAN
TERRAIN-DIMENSIONS (200, 200)
SUBNET N24-192.0.0.0 192.0.0.0 255.0.0.0 10/8 { 1 thru 199}
FAULT-CONFIG-FILE out.fault
NODE-PLACEMENT FILE
NODE-POSITION-FILE out.mobility
MOBILITY FILE
MOBILITY-POSITION-GRANULARITY 1.0
MOBILITY-GROUND-NODE NO
PROPAGATION-CHANNEL-FREQUENCY 2.4e9
PROPAGATION-LIMIT -111.0
PROPAGATION-PATHLOSS-MODEL CORNER
PROPAGATION-CORNER-LINKS-FILE outLinks.data
PROPAGATION-CORNER-NODES-FILE outNodes.data
PROPAGATION-SHADOWING-MODEL CONSTANT
PROPAGATION-SHADOWING-MEAN 4.0
PROPAGATION-FADING-MODEL NONE
PHY-MODEL PHY802.11b
PHY-RX-MODEL PHY802.11b
PHY-LISTENABLE-CHANNEL-MASK 1
PHY-LISTENING-CHANNEL-MASK 1
PHY-TEMPERATURE 290
PHY-NOISE-FACTOR 7.0
PHY802.11-AUTO-RATE-FALLBACK NO
PHY802.11-DATA-RATE 2000000
PHY802.11-DATA-RATE-FOR-BROADCAST 2000000
PHY802.11b-TX-POWER--1MBPS 8.5
PHY802.11b-TX-POWER--2MBPS 8.5
PHY802.11b-TX-POWER--6MBPS 8.5
PHY802.11b-TX-POWER-11MBPS 8.5
PHY802.11b-RX-SENSITIVITY--1MBPS -93.0
PHY802.11b-RX-SENSITIVITY--2MBPS -89.0
PHY802.11b-RX-SENSITIVITY--6MBPS -87.0
PHY802.11b-RX-SENSITIVITY-11MBPS -83.0
ANTENNA-GAIN 0.0
ANTENNA-EFFICIENCY 0.8
ANTENNA-MISMATCH-LOSS 0.3
ANTENNA-CABLE-LOSS 0.0
ANTENNA-CONNECTION-LOSS 0.2
ANTENNA-HEIGHT 1.5
ANTENNA-MODEL OMNIDIRECTIONAL
MAC-PROTOCOL MACDOT11
PROMISCUOUS-MODE NO
NETWORK-PROTOCOL IP
IP-QUEUE-NUM-PRIORITIES 3
IP-QUEUE-PRIORITY-QUEUE-SIZE 50000
IP-QUEUE-TYPE FIFO
IP-QUEUE-SCHEDULER STRICT-PRIORITY
IP-FORWARDING YES
ROUTING-PROTOCOL AODV
```

APP-CONFIG-FILE	out3.app	
SCHEDULER-QUEUE-TYPE		SPLAYTREE
HOST-STATISTICS		YES
APPLICATION-STATISTICS		YES
TCP-STATISTICS		YES
UDP-STATISTICS		YES
RSVP-STATISTICS		NO
ROUTING-STATISTICS		YES
ACCESS-LIST-STATISTICS		NO
ROUTE-REDISTRIBUTION-STATISTICS		NO
IGMP-STATISTICS		NO
EXTERIOR-GATEWAY-PROTOCOL-STATISTICS		YES
NETWORK-LAYER-STATISTICS		YES
DIFFSERV-EDGE-ROUTER-STATISTICS		NO
QUEUE-STATISTICS		YES
MAC-LAYER-STATISTICS		YES
PHY-LAYER-STATISTICS		YES
MOBILITY-STATISTICS		NO

The main features that need to be changed are highlighted. We need to change all the filenames according to the names of our scenario. In addition we need to set the simulation time, the number of nodes and the size of the map according to the information provided by `statistics.data`.

To run QualNet run the following

```
qualnet corner.config
```

QualNet will generate a statistics file called `corner.stat` (same name as the `EXPERIMENT-NAME` specified in the config file). This file contains all the network statistics. It can be processed using scripts (preferred) or through the QualNet GUI (Windows only).