

Real-time traffic forecast by means of macroscopic models for Dynamic Traffic Assignment: theory and practice

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Summary

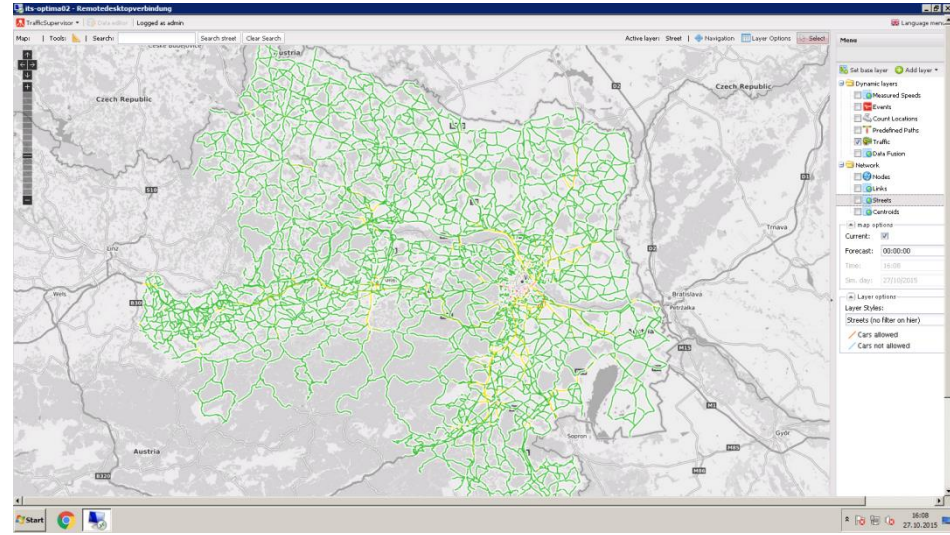
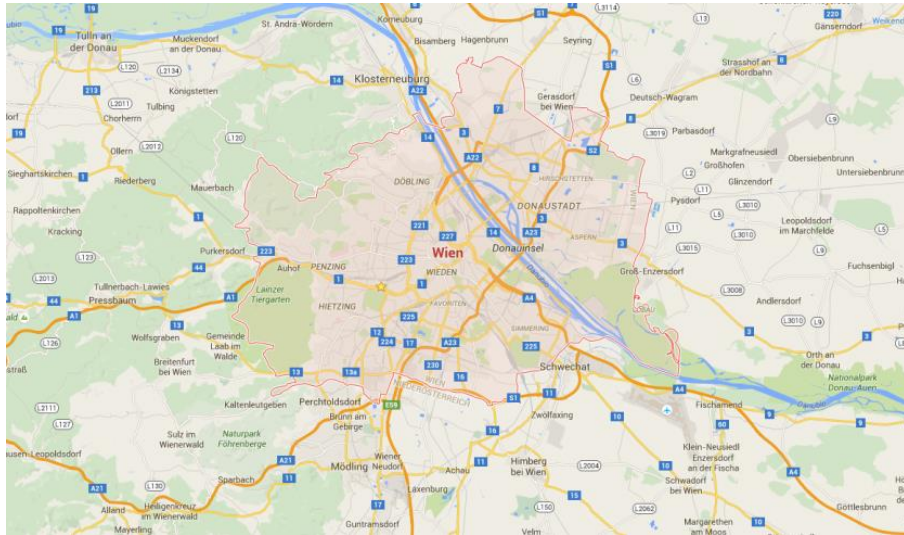
- Let's start with the use case: requirements and delivery
- Use of Dynamic Traffic Assignment models in mobility management centres
- Formulation and solution of Dynamic User Equilibrium to obtain route choice probabilities
- Dynamic Network Loading via General Link Transmission Model for Rolling Horizon simulation in real-time
- Towards more data and model integration
- Some real world application
- Open issues



A USE CASE: REQUIREMENTS AND DELIVERY



Optima and HyperPath for the Wien Region



	Regional Supervisor
Extension	27,000 square km
Demand zones	1096
Demand matrices	Hourly O/D matrices, 3 day types
Network model	50,000 link > 70,000 km
Assignment model	Dynamic Network Loading 5 min Dynamic User Equilibrium 20 min

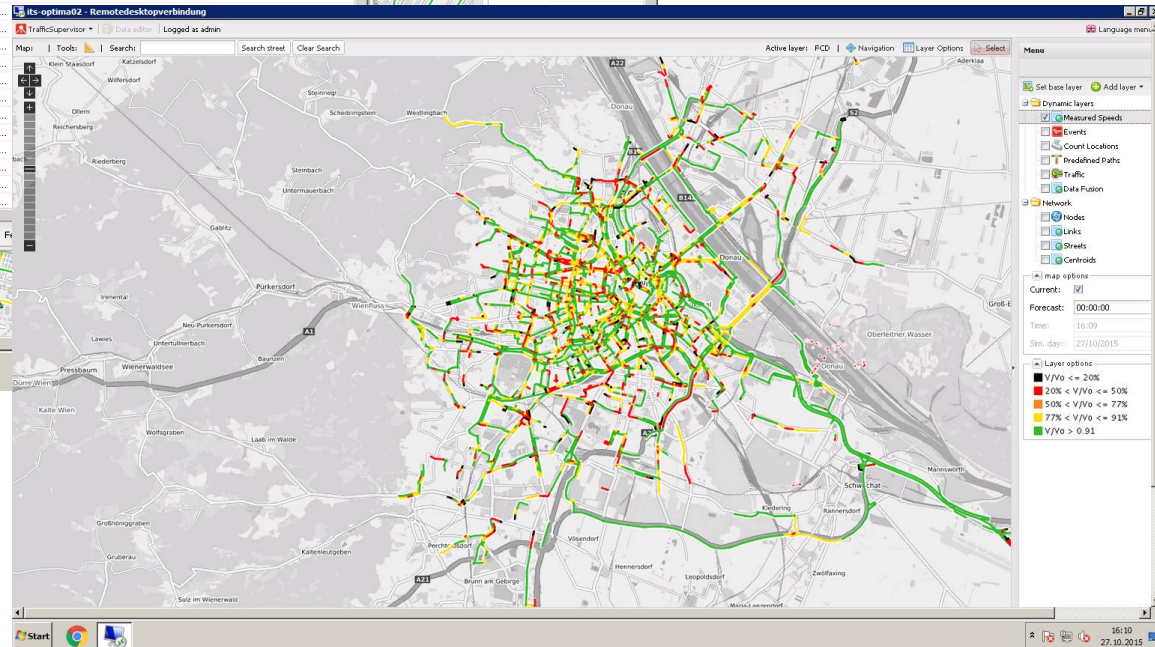
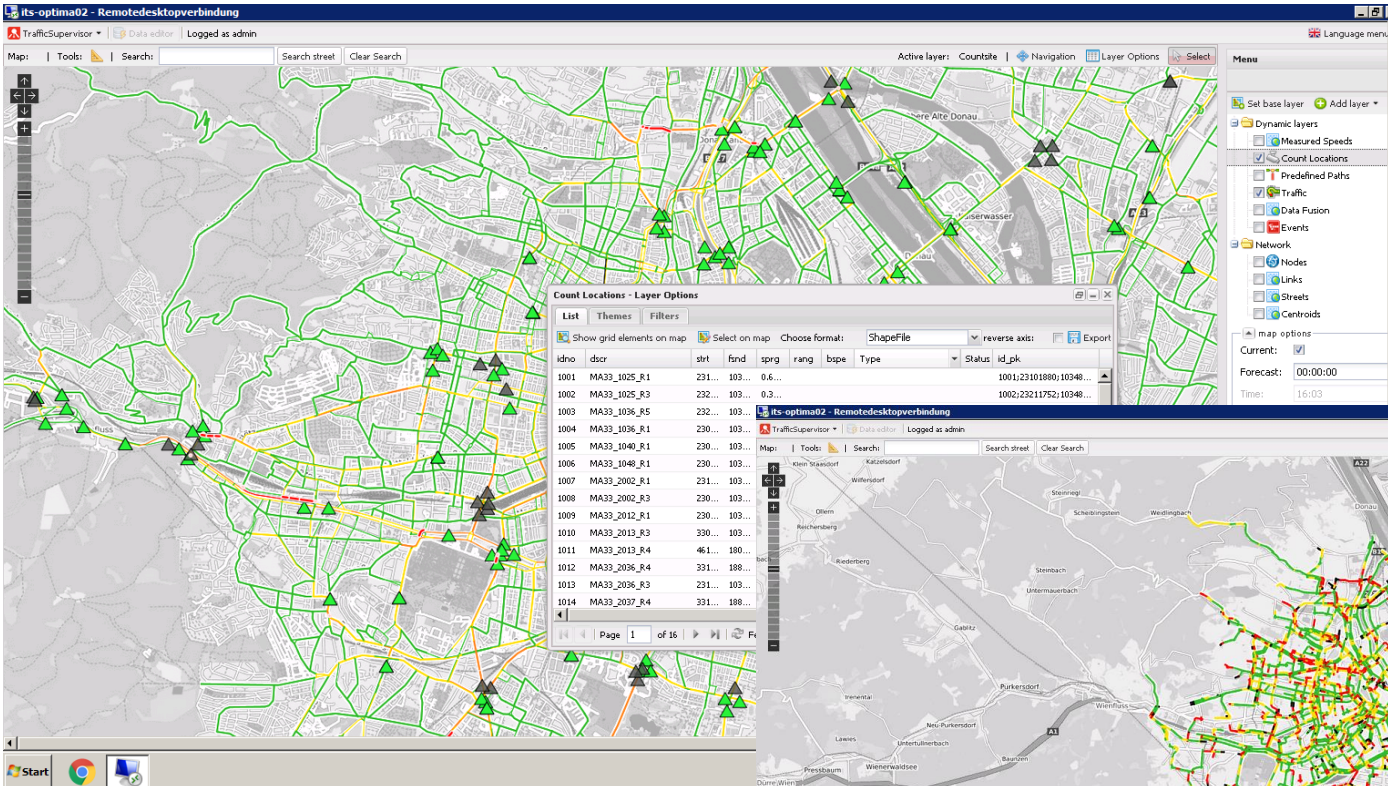


Goal of the project traffic prediction and infomobility

- Real time traffic monitoring of flow and speed
- Real time traffic forecast
- Simulation of events
- Parallel simulation of interventions
- Provide current and forecasted speeds to the national journey planner of the VAO project -> HyperPath

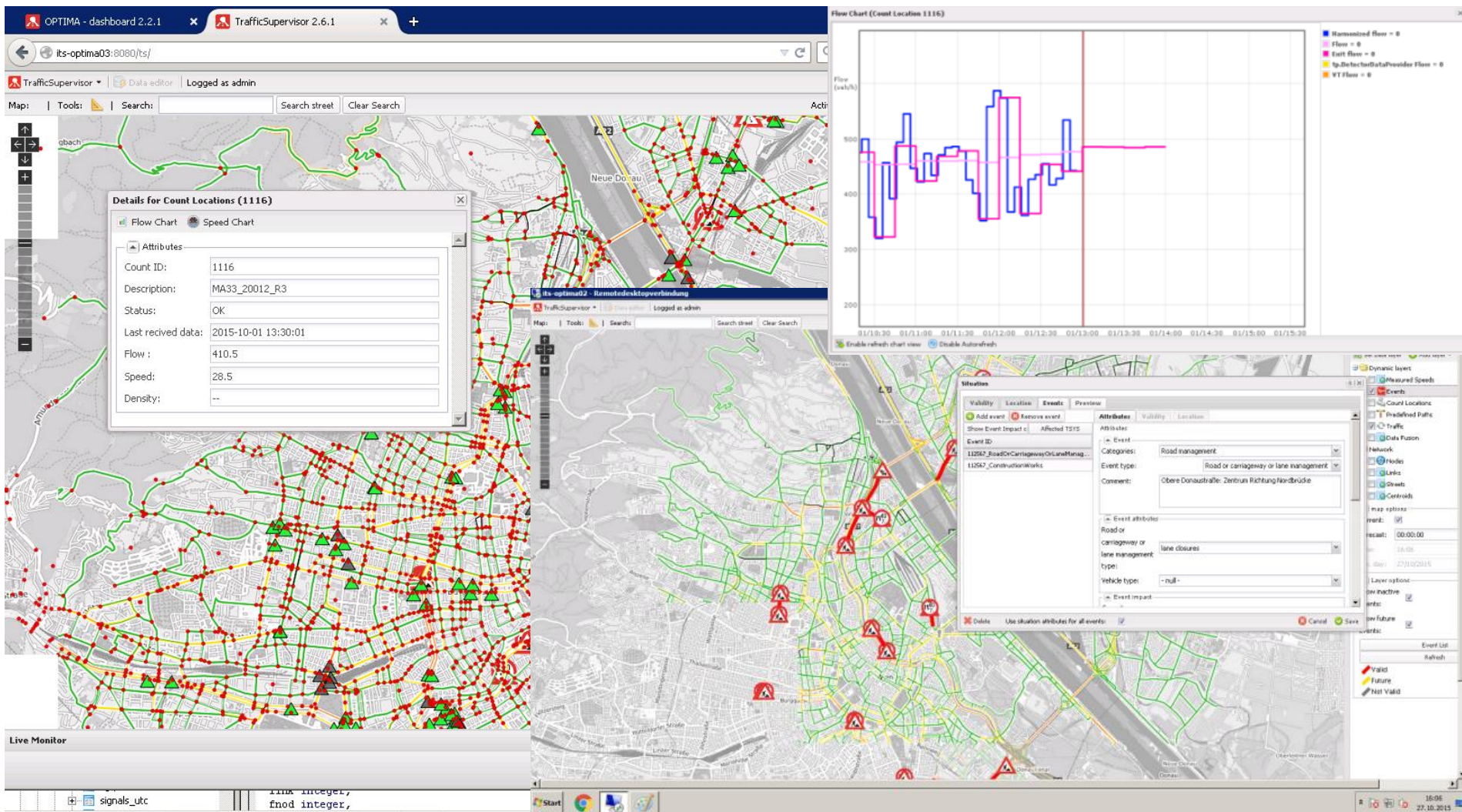


Real-time feeds FCD and loop detectors





Real time monitoring and event management



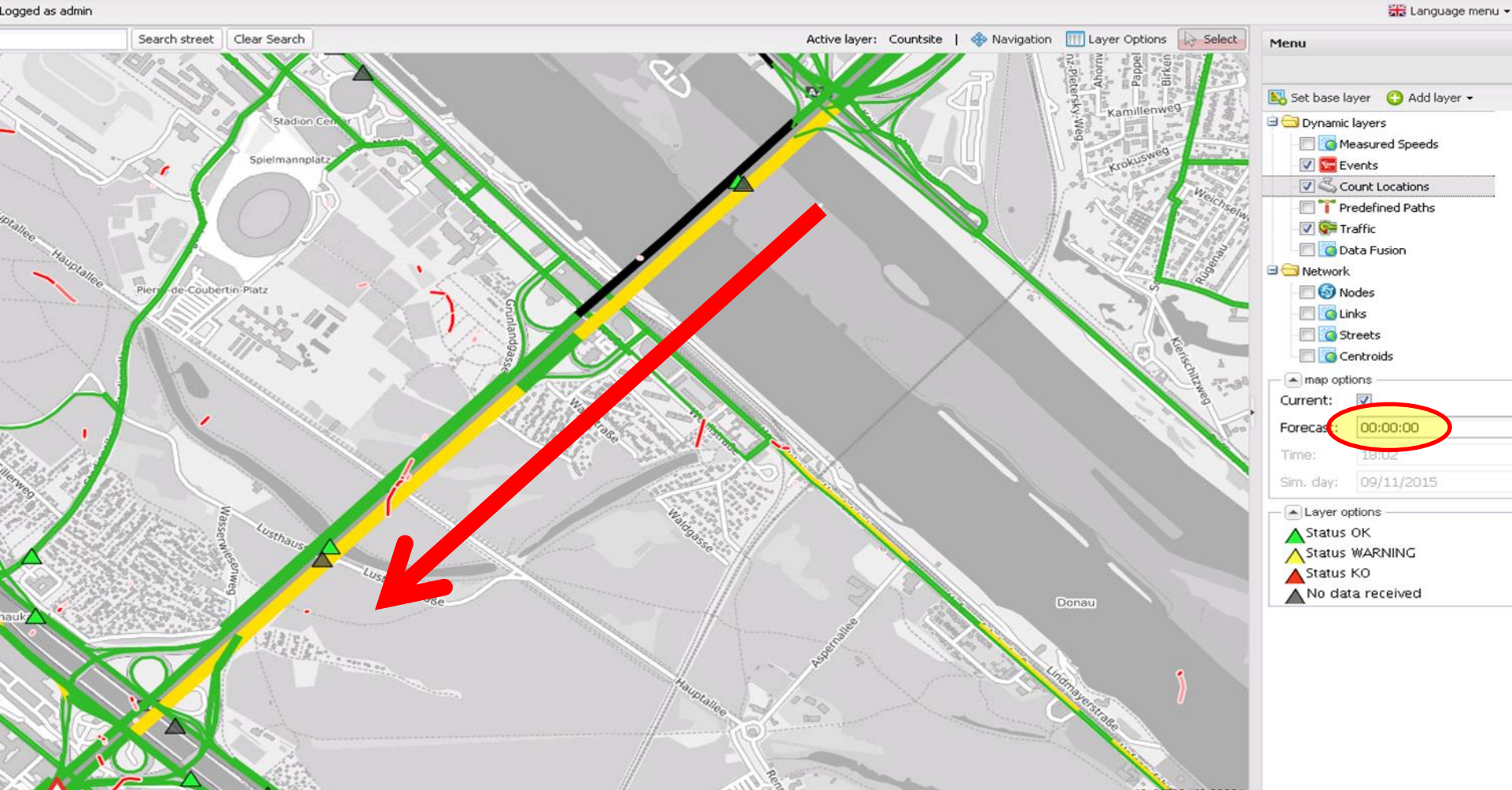


Challenges and solutions

- Very large network
 - ◆ Half-automatic methods to build, update, simplify and calibrate
 - ◆ The DNL in 1 minute on the “assignment” network
- Traffic events received in standard EU format (DATEX2) and geo-referentiated to the national graph called GIP
 - ◆ Automatic calculation of event impacts starting from the type of the event and its standardized description
- Data fusion of FCD coming from city cabs (about 3000) and loop detectors (about 1000)

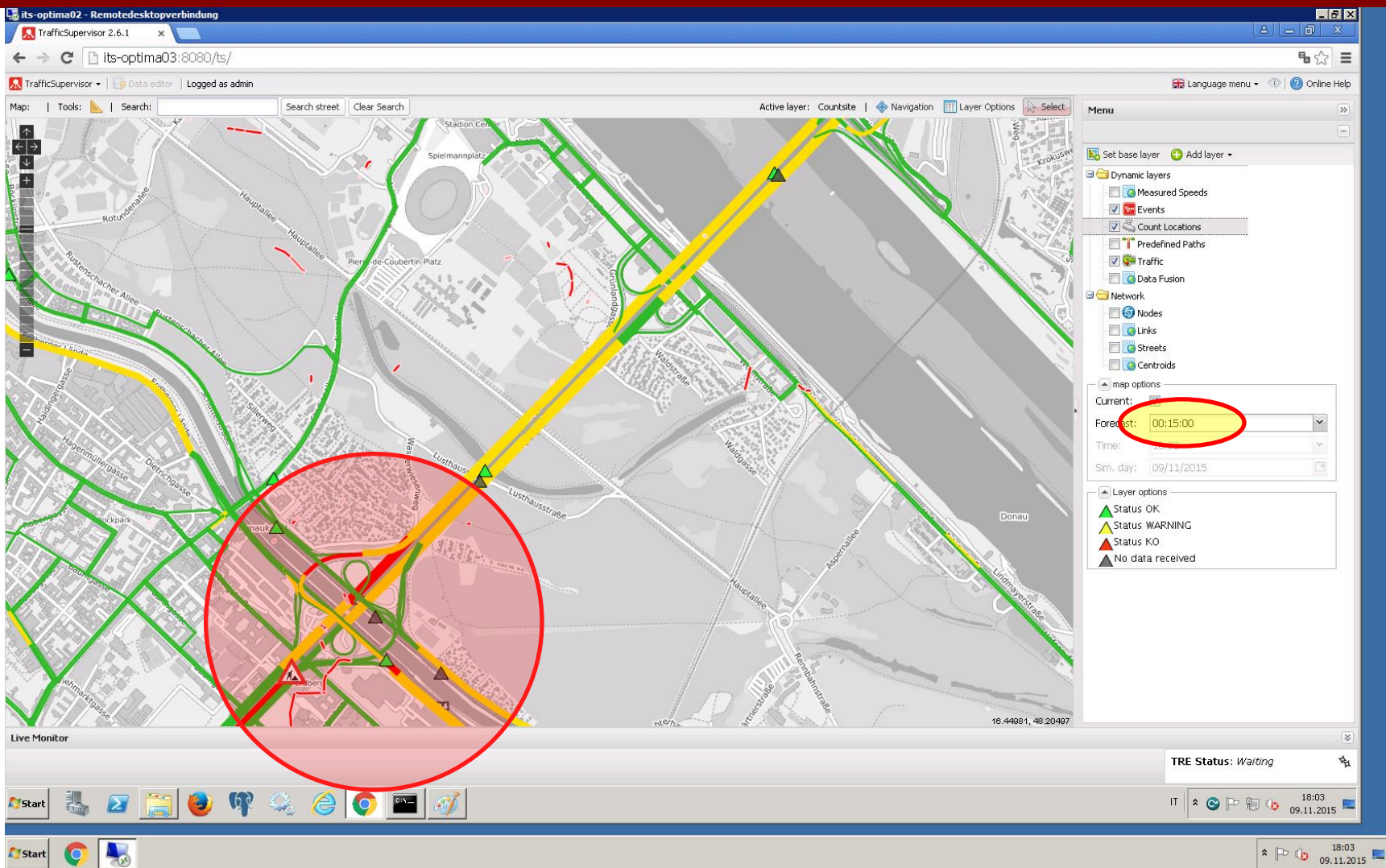


Unexpected congestion detected on the bridge



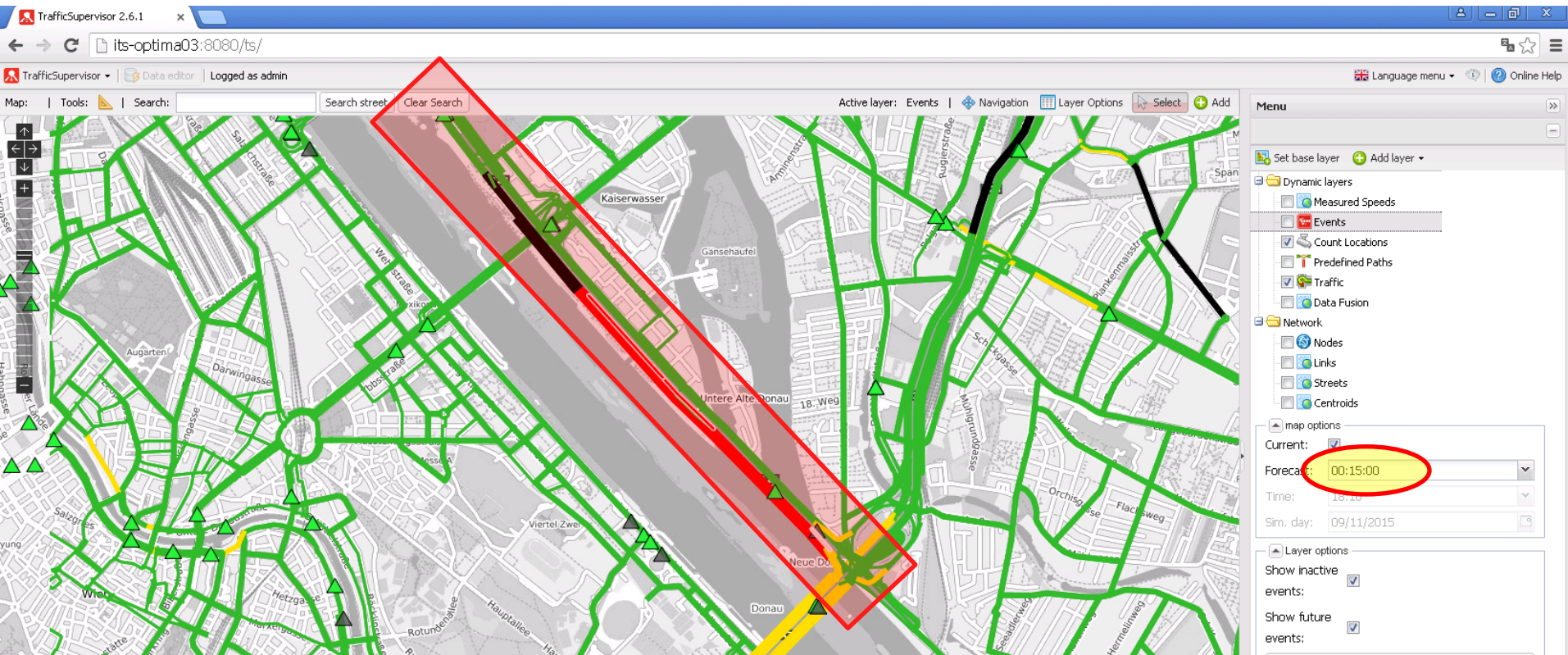


Congestion downstream 15 min forecast



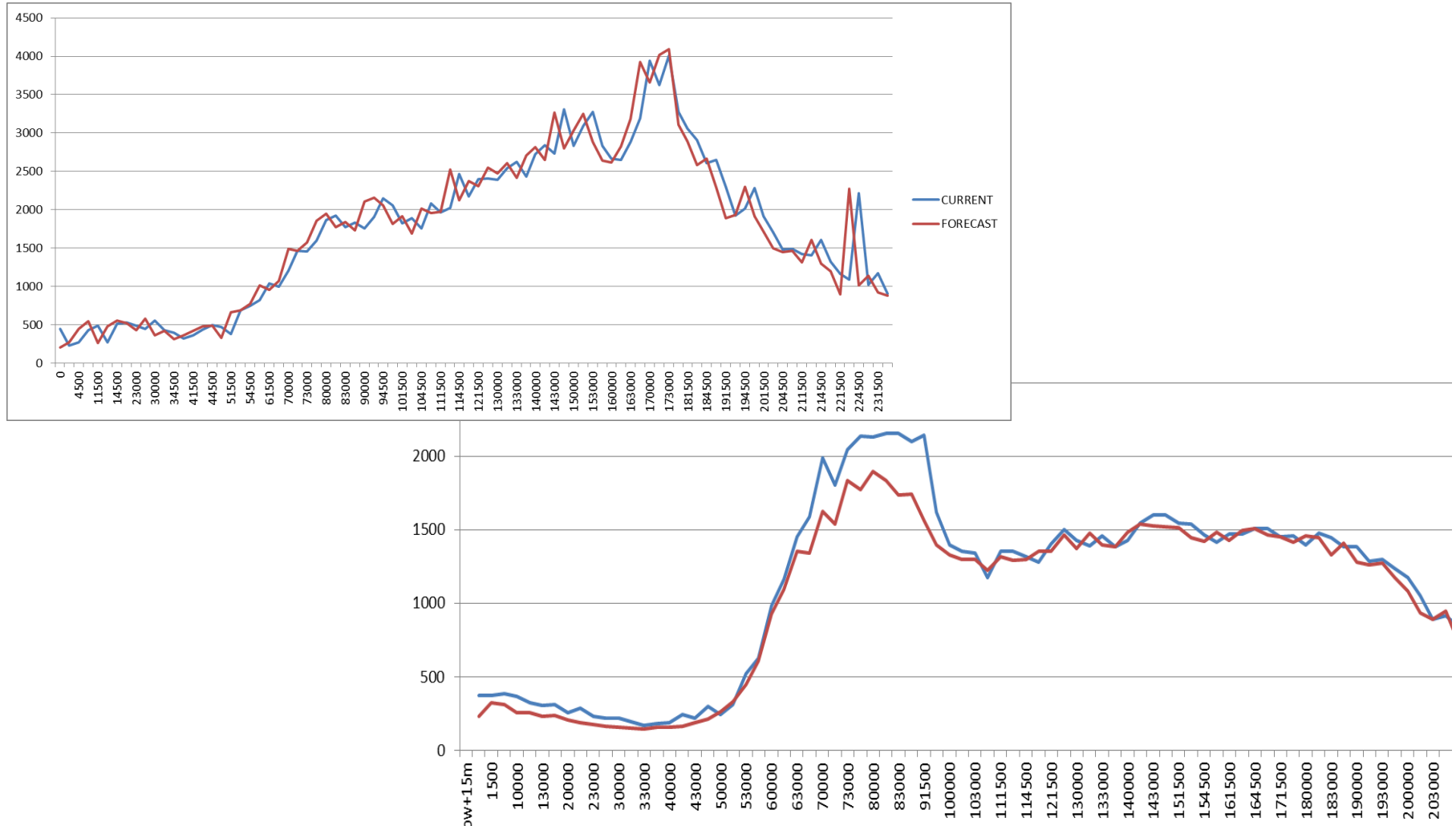


Congestion upstream 15 min forecast





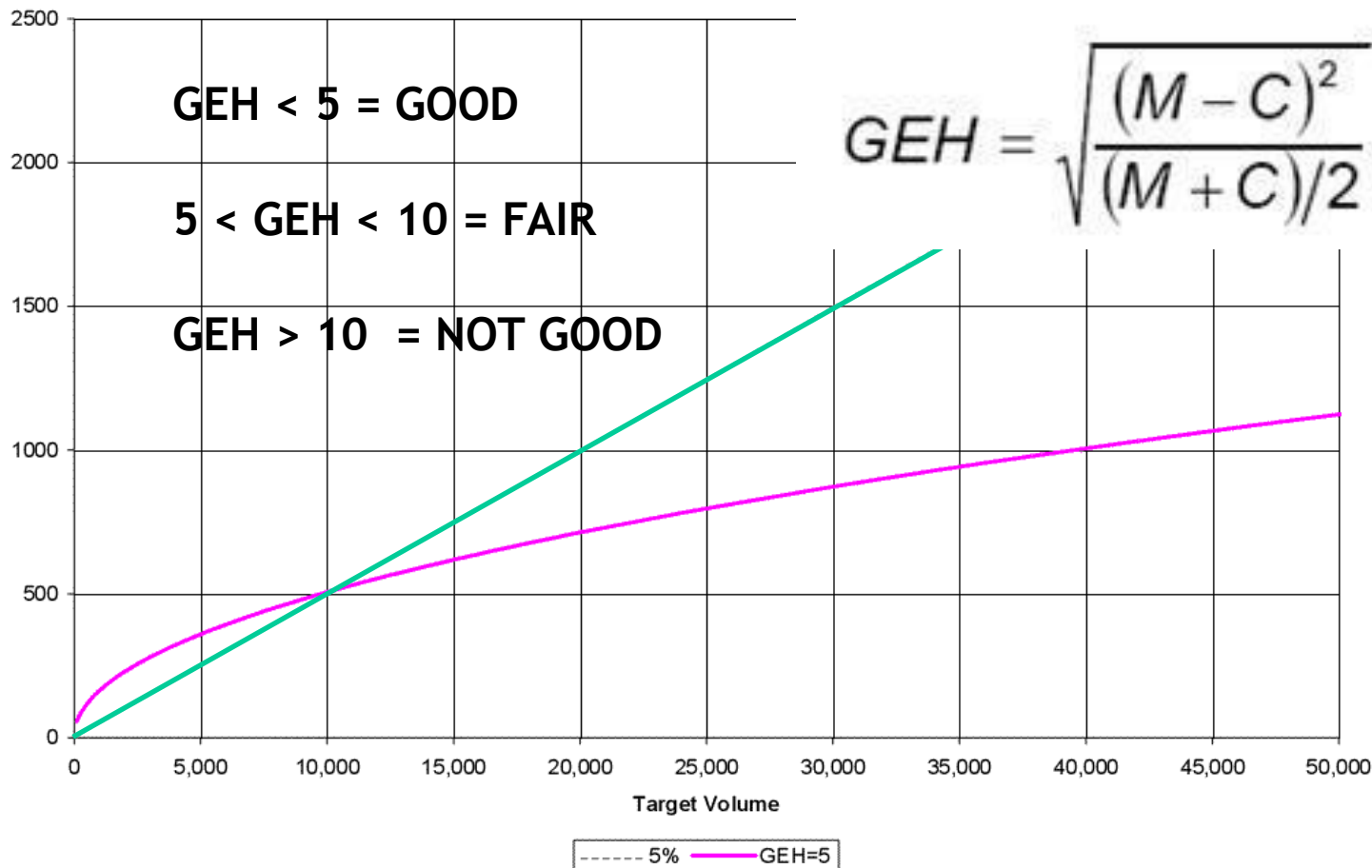
Validation through comparison of detector measure and forecast 15m





GEH statistics to monitor and evaluate the prediction

Maximum Allowable Variation: 5% vs GEH=5

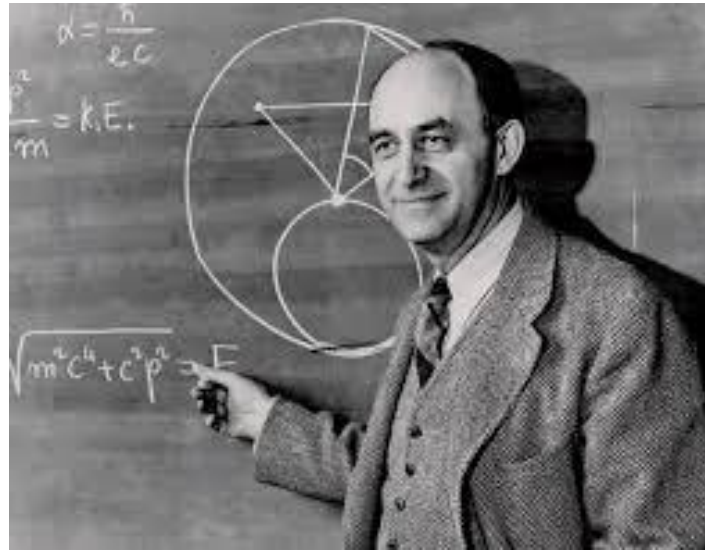




Forecast used by HyperPath in VAO to improve journey planning

The screenshot displays the AnachB routing application interface. The main window shows a journey from 2331 Vösendorf, Schönbrunner Allee 42 to Praterkai, Wien, departing on Tuesday, 27.10.2015 at 16:27. The interface is divided into several sections:

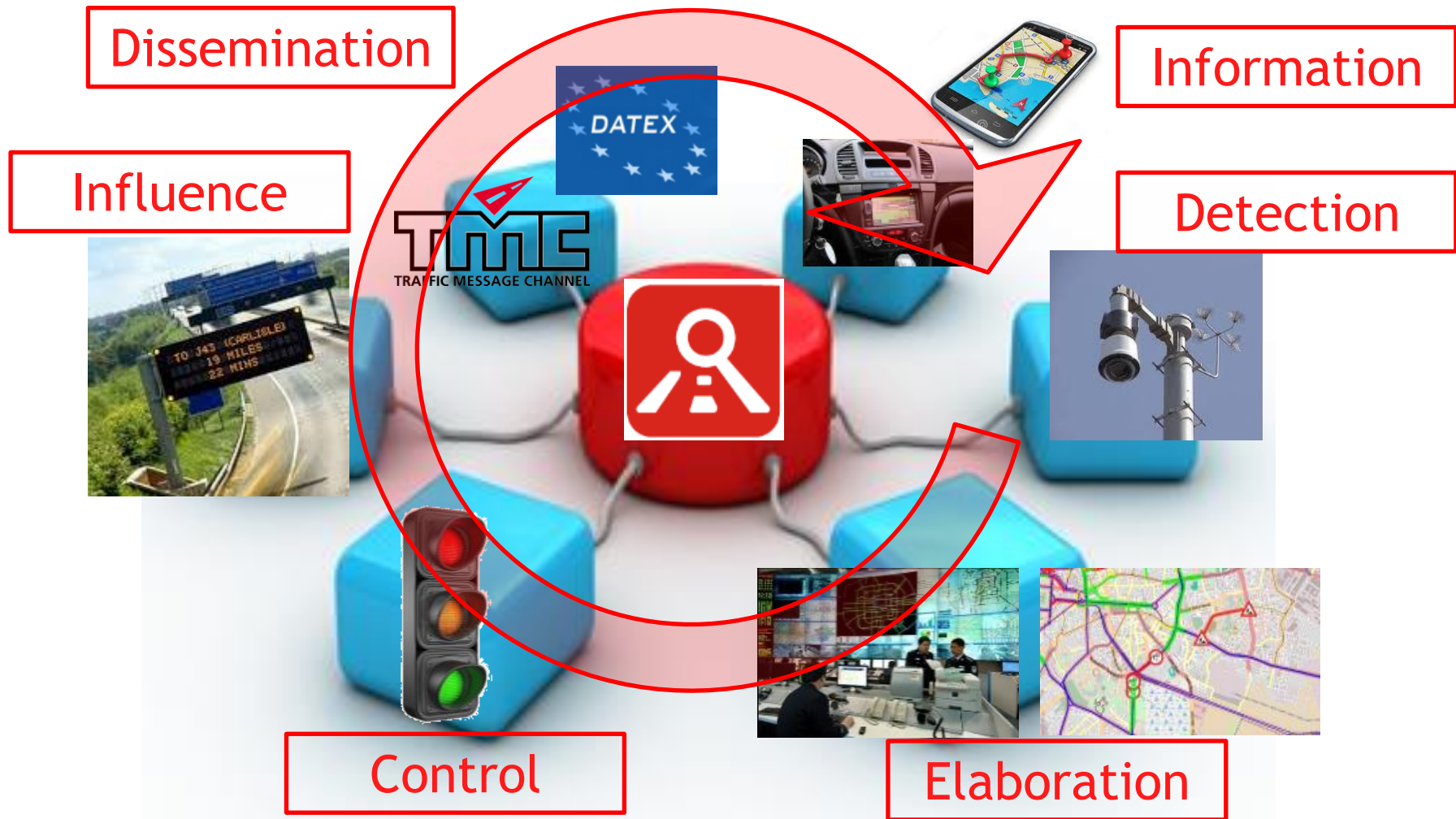
- Left Panel (JOURNEY RESULTS):** Lists various transport modes:
 - Public transport:** Shows several options with departure times, charges, and durations. For example, a departure at 16:53 for 2x chg. (4,40 €) with a 44-minute duration.
 - Bike:** Shows a route from 16:27 to 17:44, 17,8 km, 1h 17min.
 - Foot, Bike & Ride, Bike Carriage:** Other transport options are listed at the bottom.
- Center Panel (Car):** Displays details for the selected car route:
 - Departure: 27.10.2015, 16:27
 - Route: 2331 Vösendorf, Schönbrunner Allee 42 (A) to Praterkai, Wien (B)
 - Mode: Car | 15,2 km | 0h 26min
 - Distance: 15,2 km
 - Seeking for parking space: approx. 1 min
 - Walk to destination: approx. 1 min
 - Arrival: 16:53 Praterkai, Wien
- Map:** A detailed map of the Vienna region showing the route from Vösendorf to Praterkai, Wien. The route is highlighted in red and blue. A traffic forecast overlay is visible, showing a red line indicating a delay or congestion. A legend for the traffic forecast is open, listing options like 'Traffic now', 'Traffic Cameras', 'Traffic news', 'Carsharing', etc.
- Bottom Panel:** Windows taskbar showing the system time as 16:30 on 27/10/2015.



USE OF DTA MODELS FOR TRAFFIC MANAGEMENT



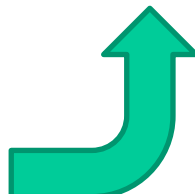
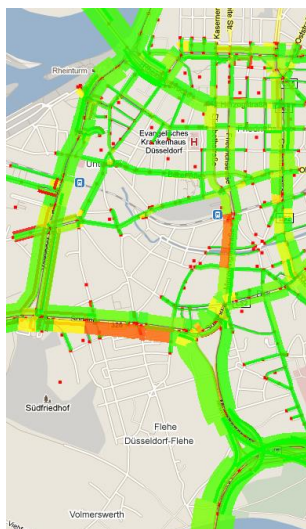
An operative system for mobility management and traffic control





Why models in a control room: from data to information

- Traffic data Amplifier



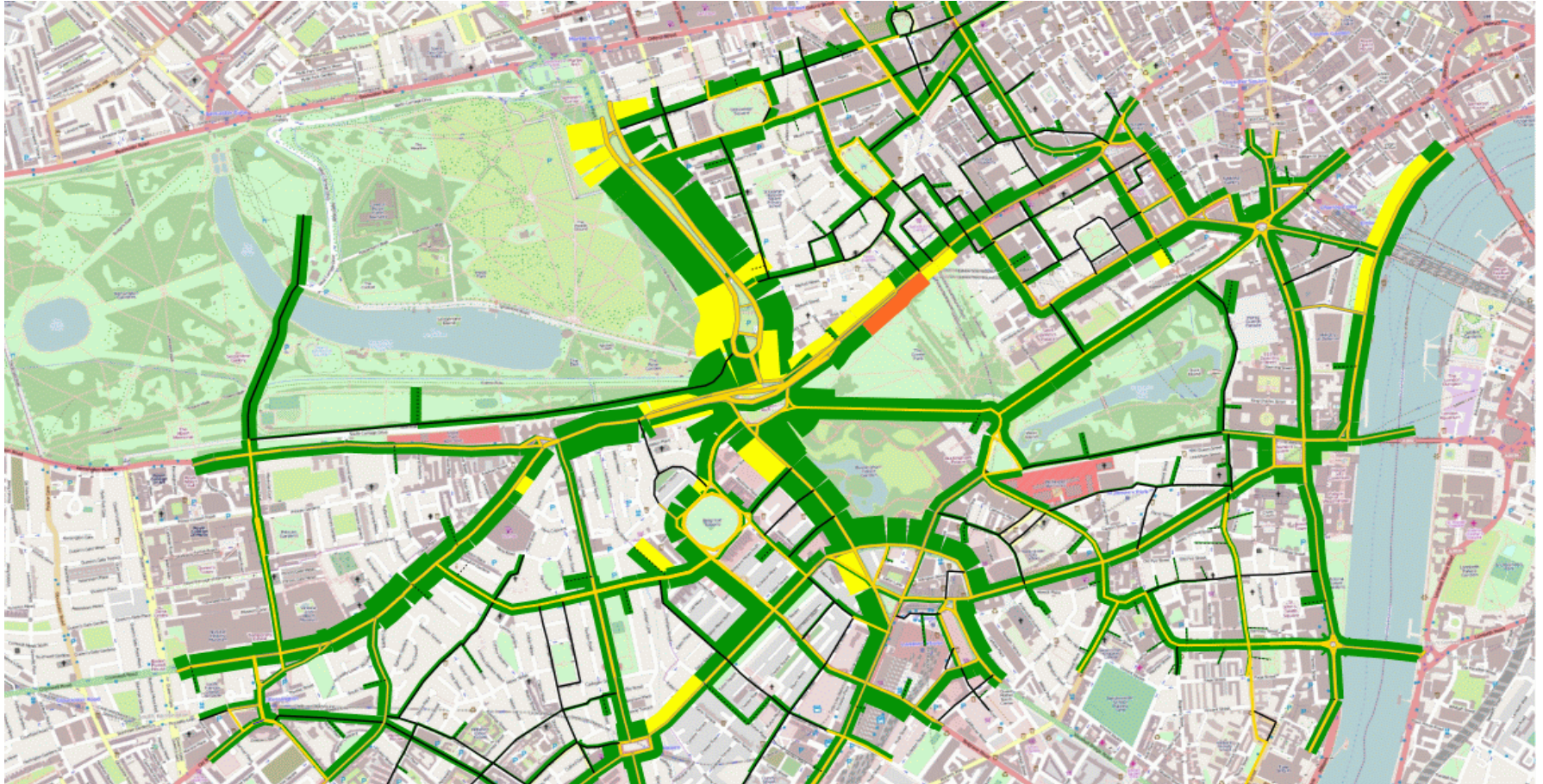
- Real time Decision Support





Augmented infomobility in space and time

FORECASTING FOR 7:30 AM FROM DTA MODEL



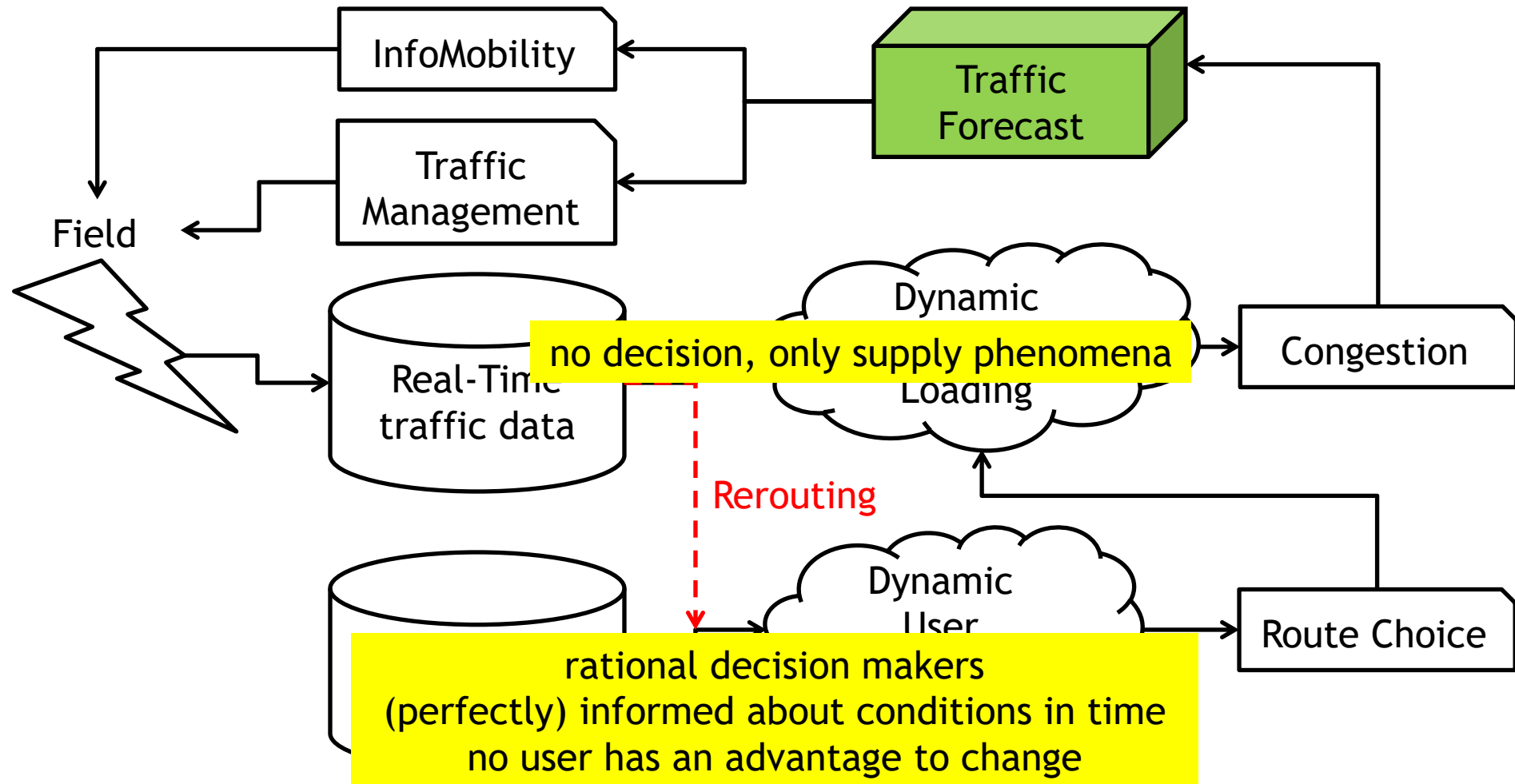


Dynamic Traffic Assignment to road networks

- Use cases of DTA models
 - ◆ transport planning and management through off-line equilibrium
 - ◆ traffic monitoring and control through real-time network loading
- Main advantage
 - ◆ explicitly reproduce vehicle queues along links and their spillback at intersections
 - thus overcoming the weak representation of congestion by volume delay functions in static assignment models
 - ◆ react to unpredicted events (accidents, road works) and control countermeasures (vms, traffic lights)
 - thus overcoming the weak sensitivity of pattern recognition models



DTA models for traffic forecast: DNL and DUE

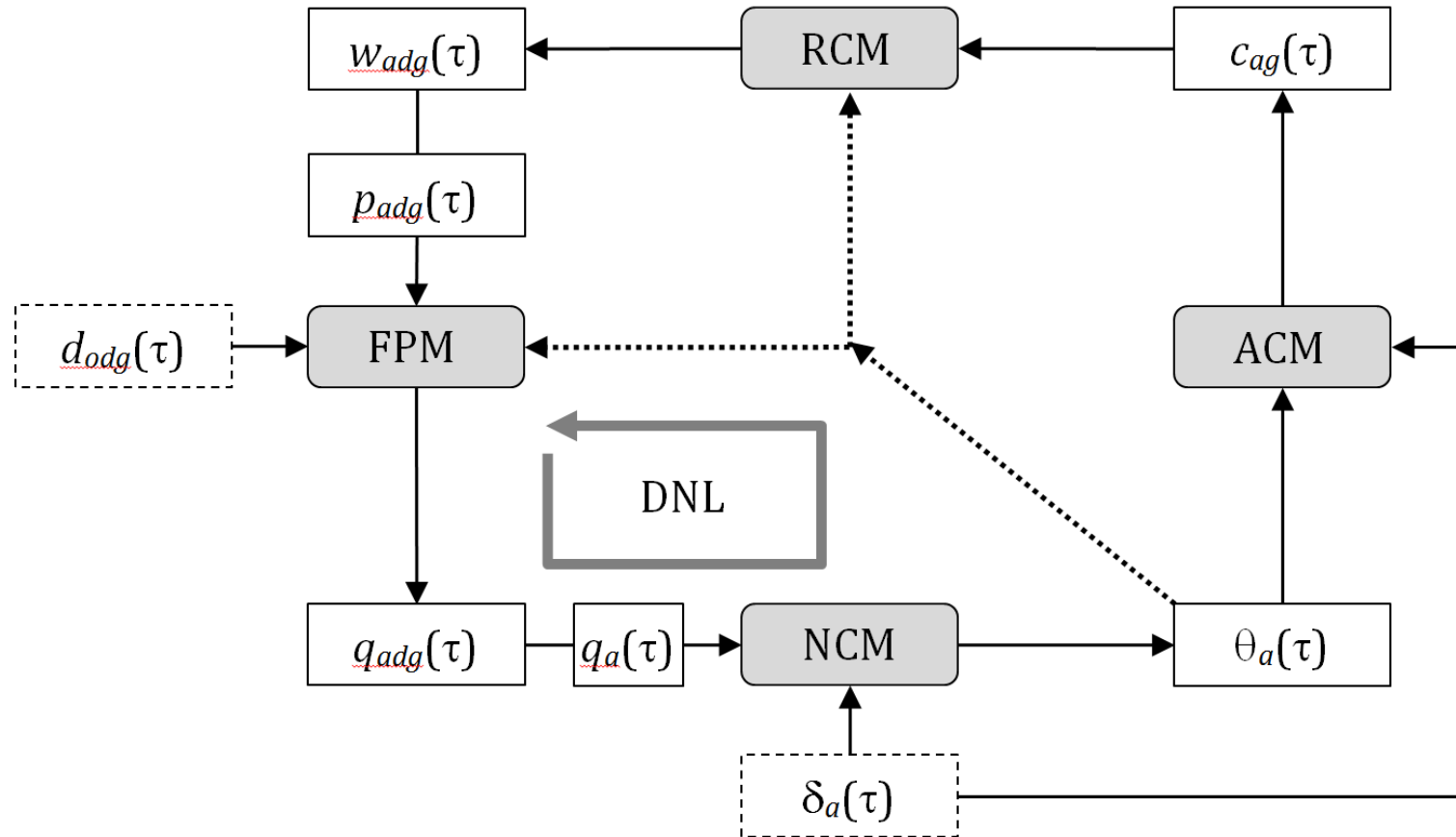




FORMULATION AND SOLUTION OF DUE BASED ON ARC PROBABILITIES



Fixed-Point schema of DTA model with implicit path enumeration



DUE = NCM → ACM → RCM → FPM → [MSA] → NCM

DNL = NCM → FPM → [MSA] → NCM



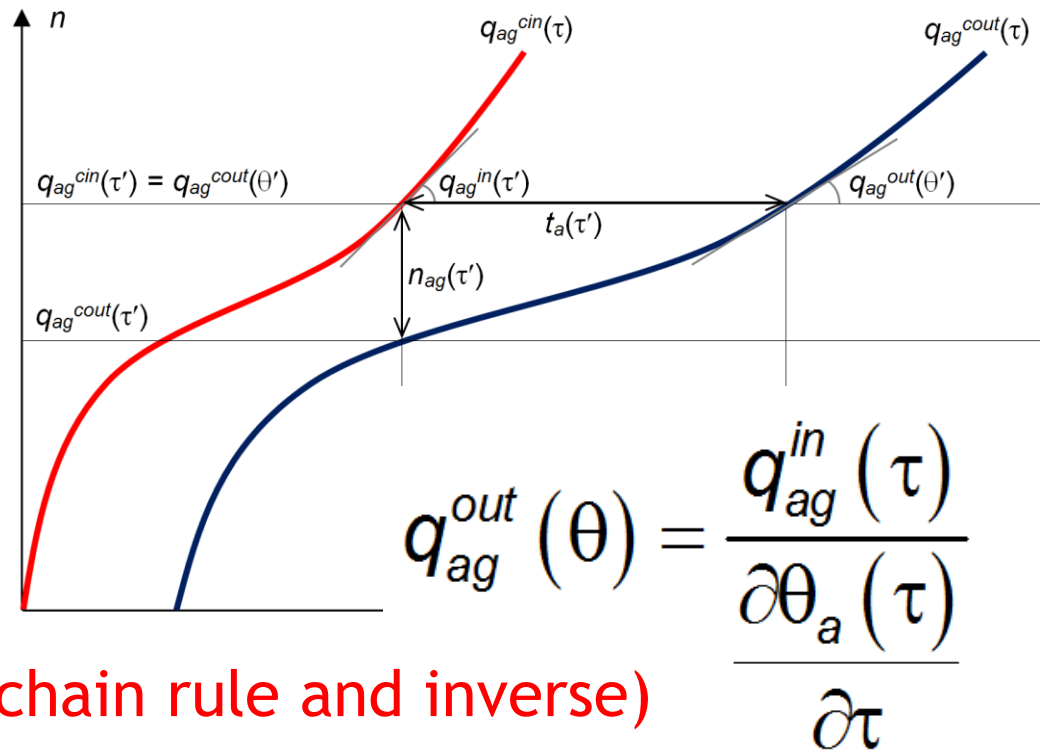
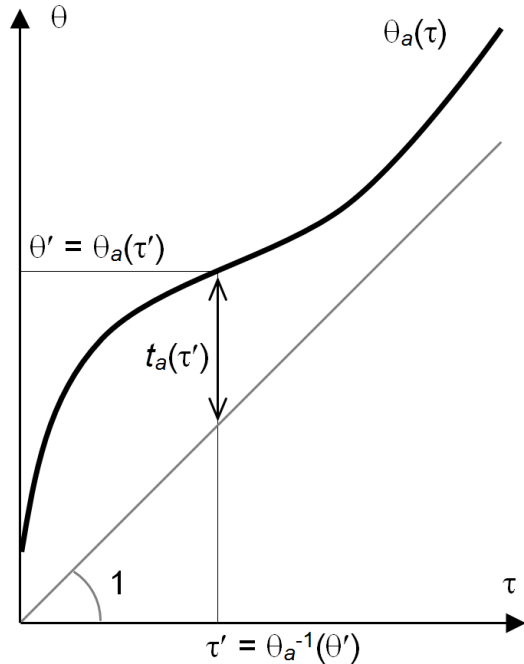
Variables: functions of time

- $p_{agd}(\tau)$ **probability** that, at time $\tau \in T$, users of class $g \in G$ directed toward $d \in Z$ choose to enter arc $a \in A$ conditional on being at its tail
- $d_{odg}(\tau)$ **demand** flow of class $g \in G$ travelling from origin $o \in Z$ to destination $d \in Z$ and departing at time $\tau \in T$
- $\delta_a(\tau)$ **characteristic** vector of arc $a \in A$ at time $\tau \in T$
- $q_{agd}(\tau)$ **flow** of class $g \in G$ users entering arc $a \in A$ at time $\tau \in T$ directed to destination $d \in Z$
- $q_a(\tau)$ **volume** entering arc $a \in A$ at time $\tau \in T$
- $\theta_a(\tau)$ **exit time** of arc $a \in A$ for users entering at time $\tau \in T$
- $c_{ag}(\tau)$ **cost** of arc $a \in A$ perceived by class $g \in G$ users entering at $\tau \in T$
- $w_{agd}(\tau)$ expected **disutility** perceived by users of class $g \in G$ entering arc $a \in A$ at time $\tau \in T$ and directed toward destination $d \in Z$



Travel times and vehicle flows in dynamic macroscopic models

$$t_a(\tau) = \theta_a(\tau) - \tau \quad \text{FIFO} \quad q_{ag}^{cout}(\theta) = q_{ag}^{cin}(\tau) \quad , \quad \tau = \theta_a^{-1}(\theta)$$

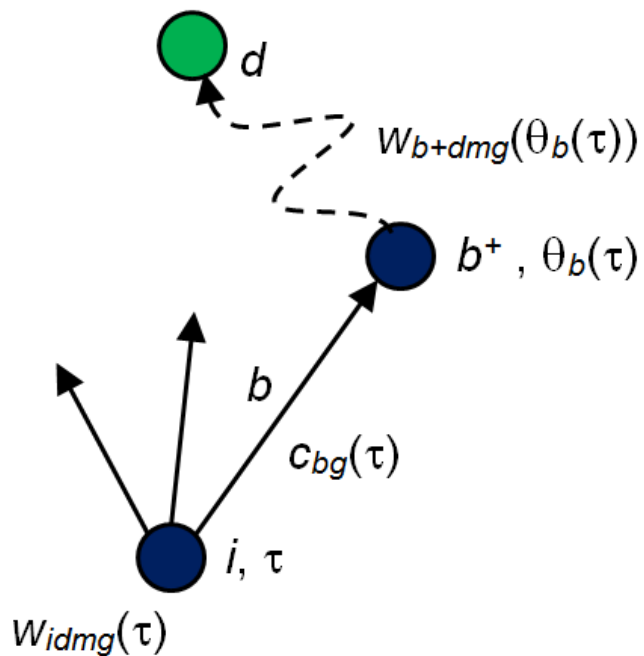


derivatives (chain rule and inverse)



Sequential Route Choice Model based on random utility e.g. DSP

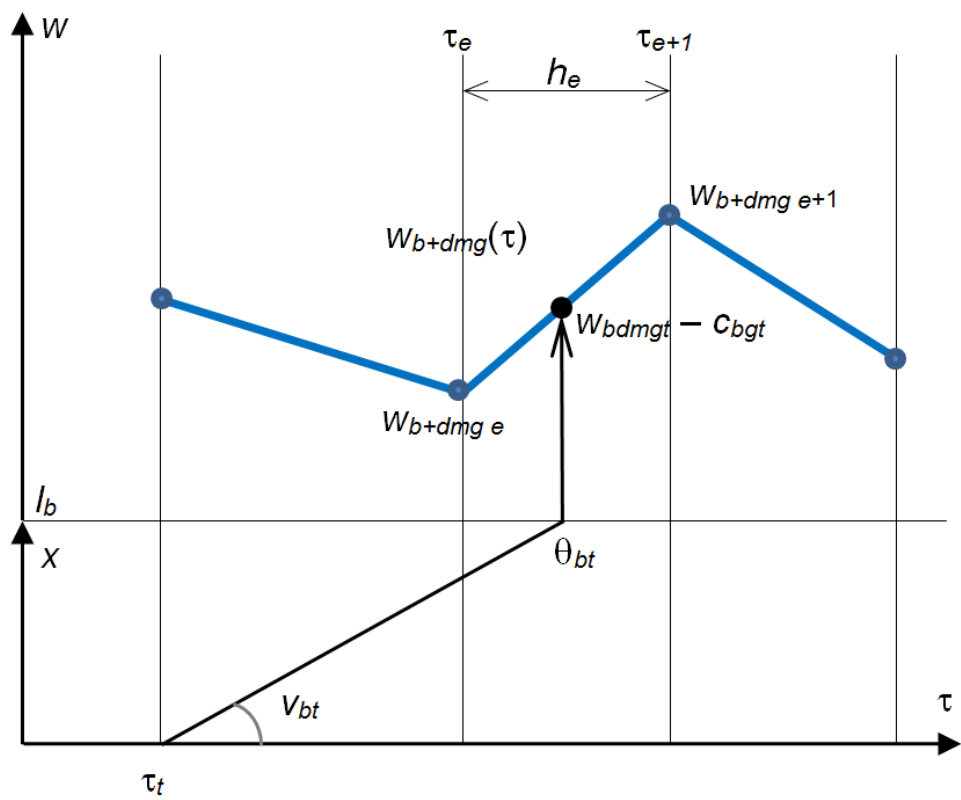
$$W_{b+dmg}(\tau) = c_{bg}(\tau) + W_{b^+dmg}(\theta_b(\tau))$$



$$p_{admg} = \begin{cases} p_{admg}(W_{b+dmg}, \forall b \in i^+ \cap A_m), & \text{if } a \in A_m \\ 0, & \text{otherwise} \end{cases}$$

$$W_{idmg} = W_{idmg}(W_{b+dmg}, \forall b \in i^+ \cap A_m) \text{ solve system in reverse chronological order}$$

$$W_{b+dmge} = c_{bgt} + W_{b^+dmge} + (\theta_{bt} - \tau_e) \cdot \frac{W_{b^+dmge+1} - W_{b^+dmge}}{h_e}$$



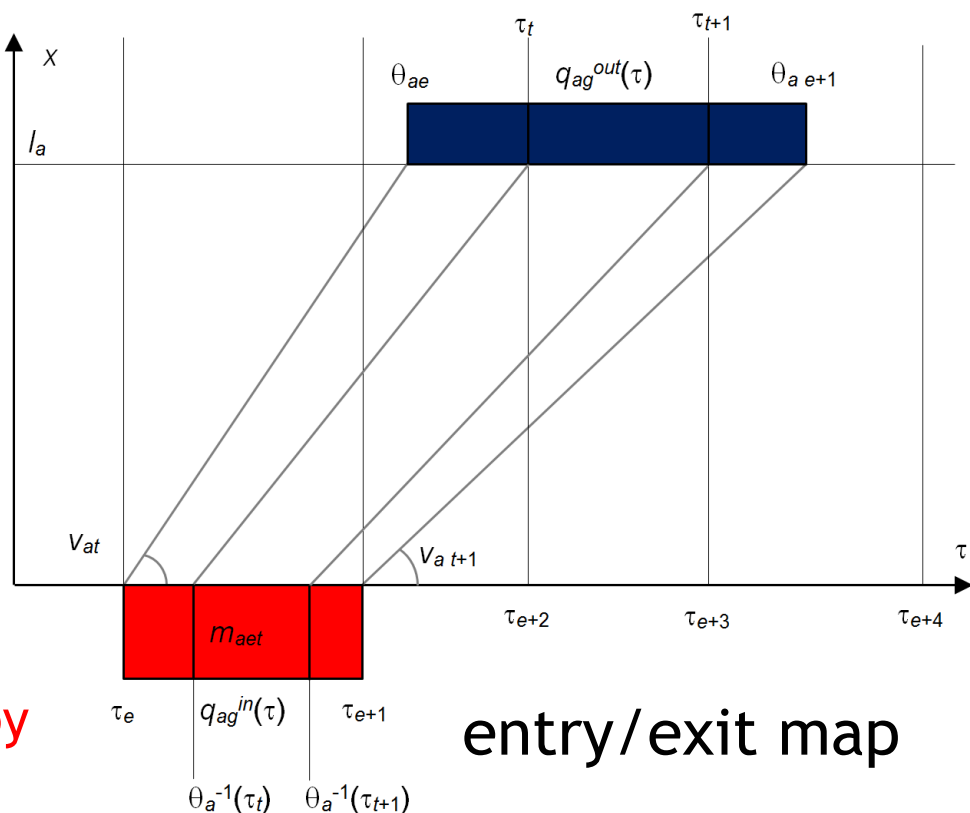
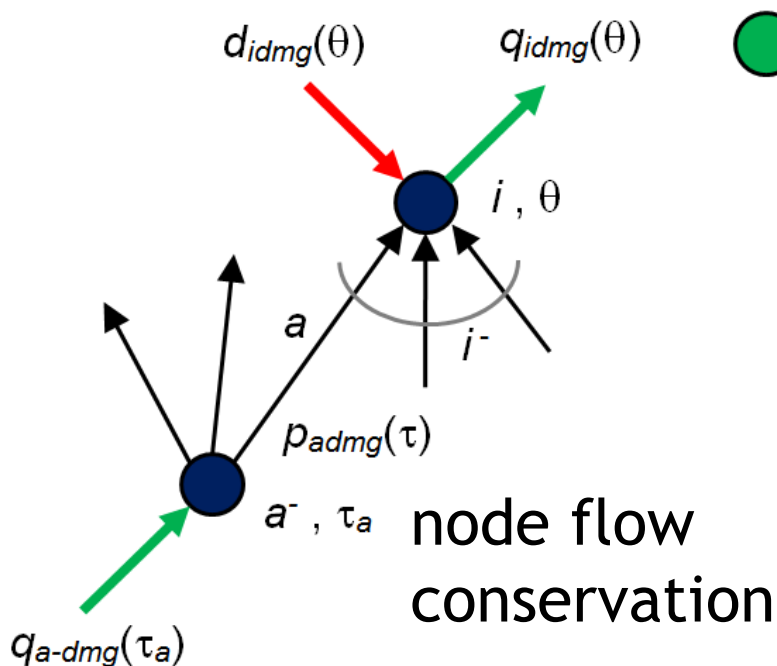


Flow Propagation Model based on arc probabilities

$$q_{idmg}(\theta) = d_{idmg}(\theta) + \sum_{a \in i^-} \frac{q_{a-dmg}(\tau_a)}{\frac{\partial \theta_a(\tau_a)}{\partial \tau}} \cdot p_{admge}(\tau_a) \quad q_{idmgt} = d_{idmgt} + \sum_{a \in i^-} \sum_{e < t} q_{a-dmge} \cdot \frac{h_e}{h_t} \cdot m_{aet} \cdot p_{admge} + \sum_{a \in i^-} q_{a-dmgt} \cdot m_{att} \cdot p_{admgt}$$

$$\tau_a = \theta_a^{-1}(\theta), \forall a \in i^-$$

$$m_{aet} = \frac{\text{Min}(\text{Min}(\theta_a^{-1}(\tau_{t+1}), \tau_{e+1}) - \text{Max}(\theta_a^{-1}(\tau_t), \tau_e), 0)}{\tau_{e+1} - \tau_e}$$



BiCGstab with preconditioning by
efficient triangularized solution



Functionals of the fixed point problems

- ACM – Arc Cost Model

- RCM – Route Choice Model

$$w_{idg}(\tau) = \text{Min}(w_{adg}(\tau), \forall a \in i[+])$$

$$w_{adg}(\tau) = c_{ag}(\tau) + w_{a[+]dg}(\theta_a(\tau))$$

$$c_{ag}(\tau) = c_{ag}^{toll}(\tau) + \beta_g^{voft} \cdot (\theta_a(\tau) - \tau)$$

$$(w_{adg}(\tau) - w_{idg}(\tau)) \cdot p_{adg}(\tau) = 0$$

- FPM – Flow Propagation Model

$$q_{idg}(\tau) = d_{idg}(\tau) + \sum_{a \in i[-]} q_{adg}(\theta_a^{-1}(\tau)) \cdot \frac{\partial \theta_a^{-1}(\tau)}{\partial \tau}$$

$$q_{adg}(\tau) = p_{adg}(\tau) \cdot q_{idg}(\tau)$$

- NCM – Network Congestion Model

$$\theta_a(\tau) = \theta_a(\mathbf{q}_A(\tau))$$



Variational Inequality problem for deterministic route choices

- Focus on local choices at each node $i \in N$ among its forward star made by users of class $g \in G$ directed toward each destination $d \in Z$
- VI problem defined on probabilities
- Feasible set is a simple polytope
- Cost functional does includes the solution of DNL

$$\sum_{d \in Z} \sum_{g \in G} \sum_{i \in N-d} \sum_{a \in i^+} \int_{\tau \in T} w_{adg}(\mathbf{p}_{ADGT}^*, \tau) \cdot (p_{adg}^*(\tau) - p_{adg}(\tau)) \cdot d\tau \leq 0, \forall \mathbf{p}_{ADGT} \in S_p^{ADGT}$$

$$S_p^{ADGT} = \left\{ \begin{array}{l} \mathbf{p}_{ADGT} \in \mathfrak{R}^{ADGT} : p_{adg}(\tau) \geq 0, \forall a \in A, \forall d \in Z, \forall g \in G ; \\ \sum_{a \in i^+} p_{adg}(\tau) = 1, \forall i \in N-d, \forall d \in Z, \forall g \in G \end{array} \right\}$$

$$\sum_{k \in K} \sum_{g \in G} \int_{\tau \in T} c_{kg}(\mathbf{p}_{KGT}^*, \tau) \cdot (p_{kg}^*(\tau) - p_{kg}(\tau)) \cdot d\tau \leq 0, \forall \mathbf{p}_{KGT} \in S_p^{KGT}$$

$$S_p^{KGT} = \left\{ \begin{array}{l} \mathbf{p}_{KGT} \in \mathfrak{R}^{KGT} : p_{kg}(\tau) \geq 0, \forall k \in K, \forall g \in G ; \\ \sum_{k \in K_{od}} p_{kg}(\tau) = 1, \forall od \in Z \times Z, \forall g \in G \end{array} \right\}$$

proved to be equivalent to path
based formulation of DUE



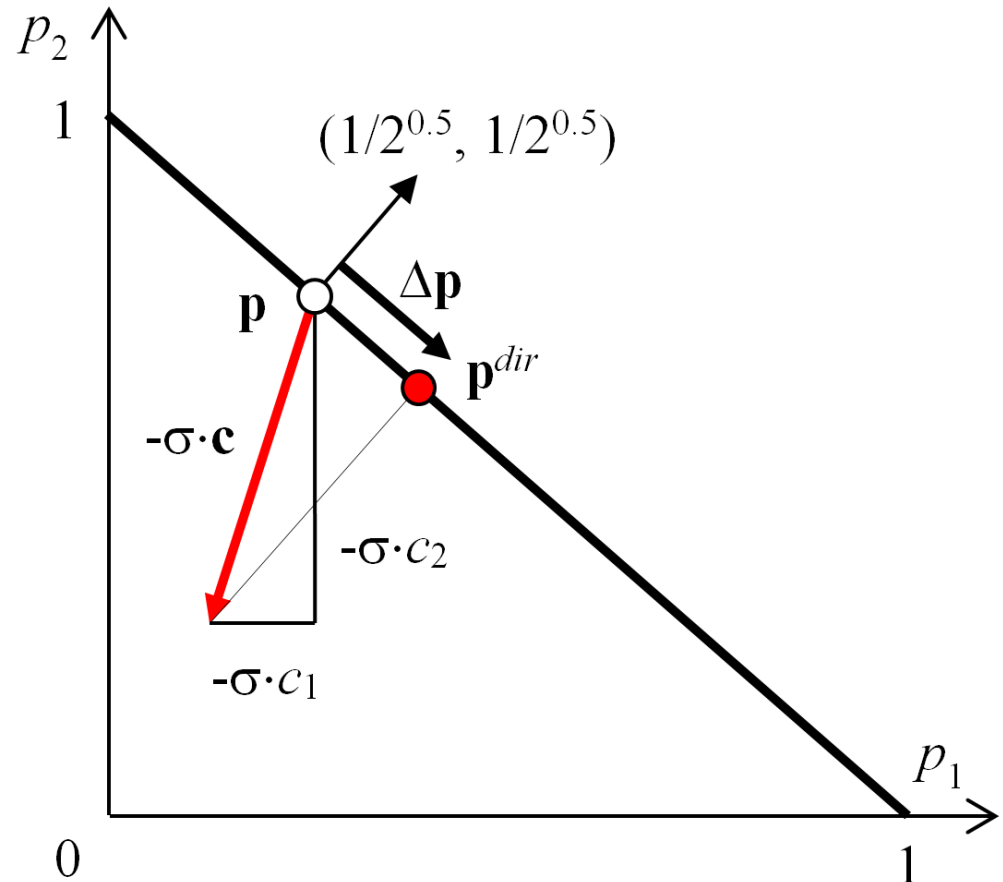
Gap function: revisit the classical convergence

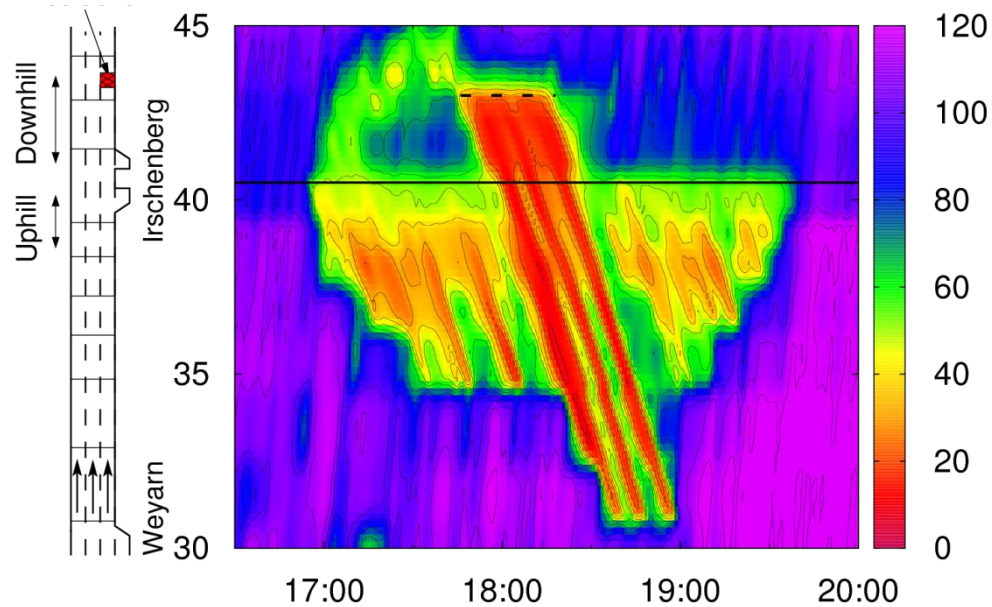
- Measures how close we are from a dynamic user equilibrium
- Ranges from 1 to 0 (equilibrium)
- How much better users can do if they could choose again their local route without changing costs
- Small cost variations can imply large flow variations
- Local equilibrium implies global equilibrium

$$\gamma(\mathbf{p}_{ADGT}^*) = 1 - \frac{\sum_{d \in Z} \sum_{g \in G} \sum_{i \in N - \{d\}} \int_{\tau \in T} w_{idg}(\mathbf{p}_{ADGT}^*, \tau) \cdot d\tau}{\sum_{d \in Z} \sum_{g \in G} \sum_{i \in N - \{d\}} \sum_{a \in i^+} \int_{\tau \in T} w_{adg}(\mathbf{p}_{ADGT}^*, \tau) \cdot p_{adg}^*(\tau) \cdot d\tau}$$

Search probability direction with Gradient Projection

- If c_1 and c_2 are equal, then we have equilibrium and the search direction is null
- When heading towards the equilibrium we do smaller moves
- Proper scaling e.g. with $\sigma = 1/c_{\min}$
- No derivatives available for Quasi-Newton
- The cost operator is a (macroscopic) simulator





GENERAL LINK TRANSMISSION MODEL FOR DNL



Critical modelling choice: supply

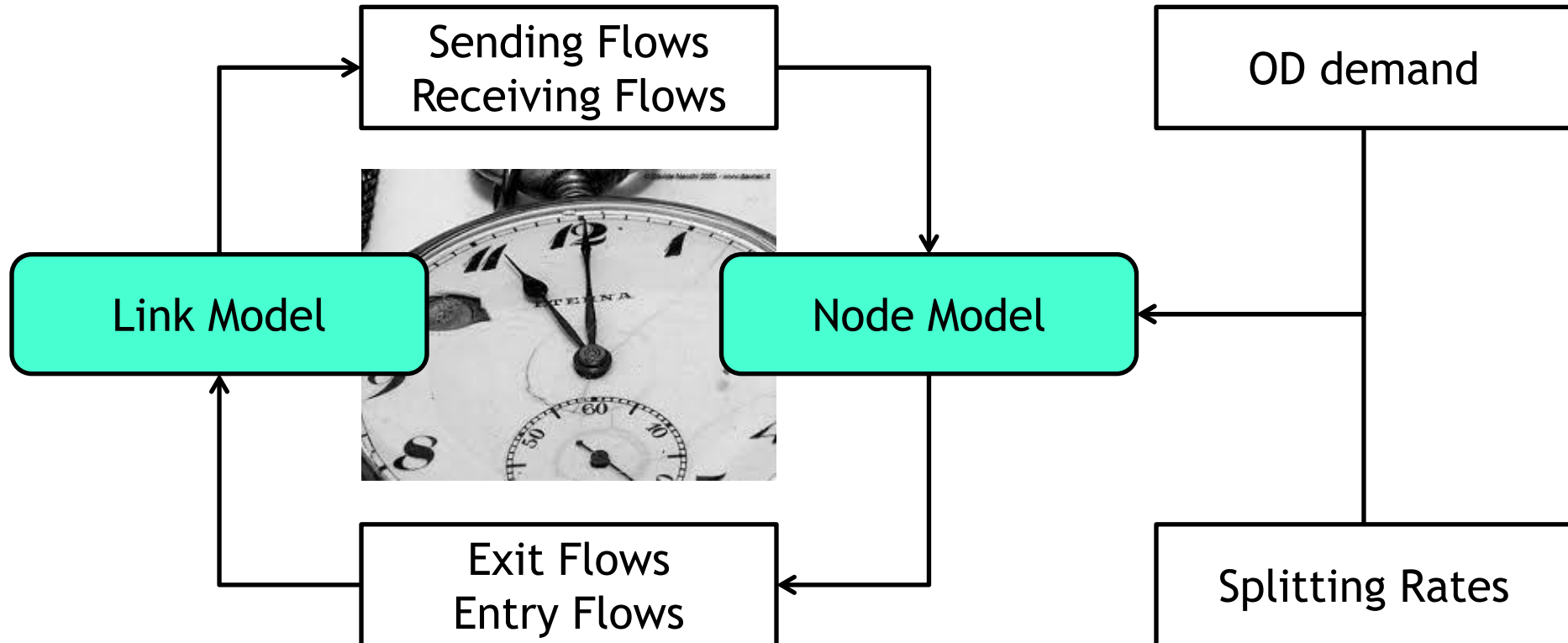
How does traffic look like?

- Traffic model (types of congestion)
 - ◆ Under saturation - queues only in front of signals, but vanishing every cycle
 - ◆ Over saturation on the link - persistent queues
 - ◆ Spillback - queue spillovers to backward links
- Granularity (time and space)
 - ◆ Microsimulation, Mesoscopic, Macroscopic
- Several possible compromises can be useful depending on the use case to address



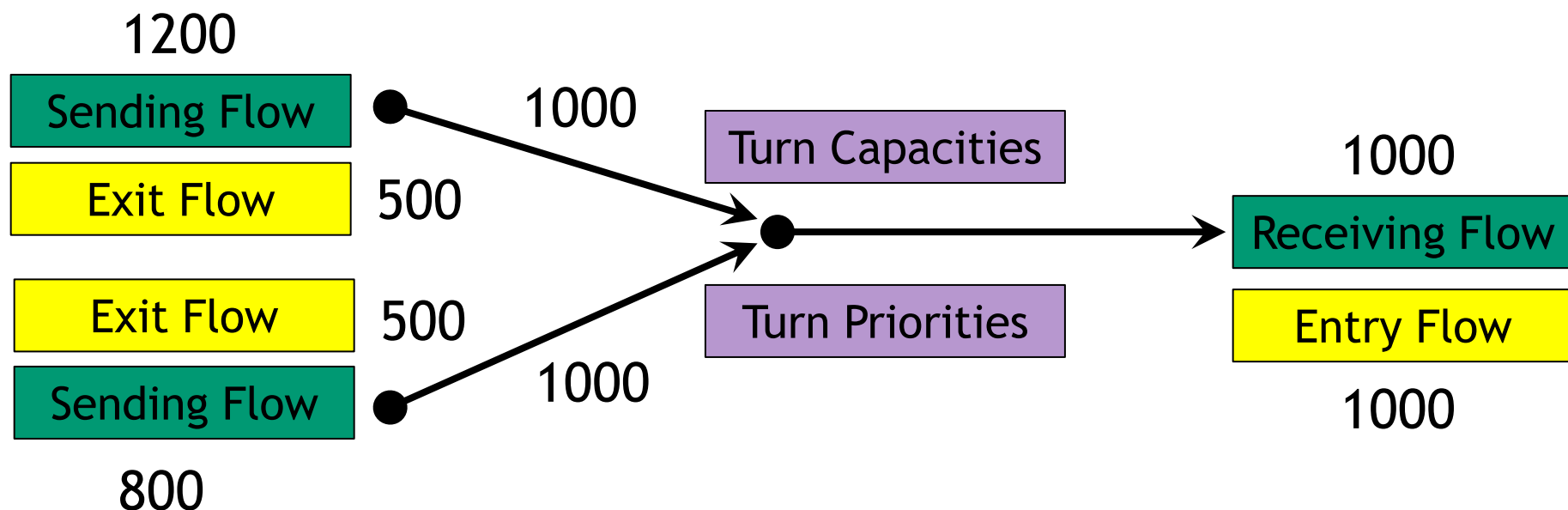


Link Transmission Model for DNL with fixed splitting rates



Node Model Merging

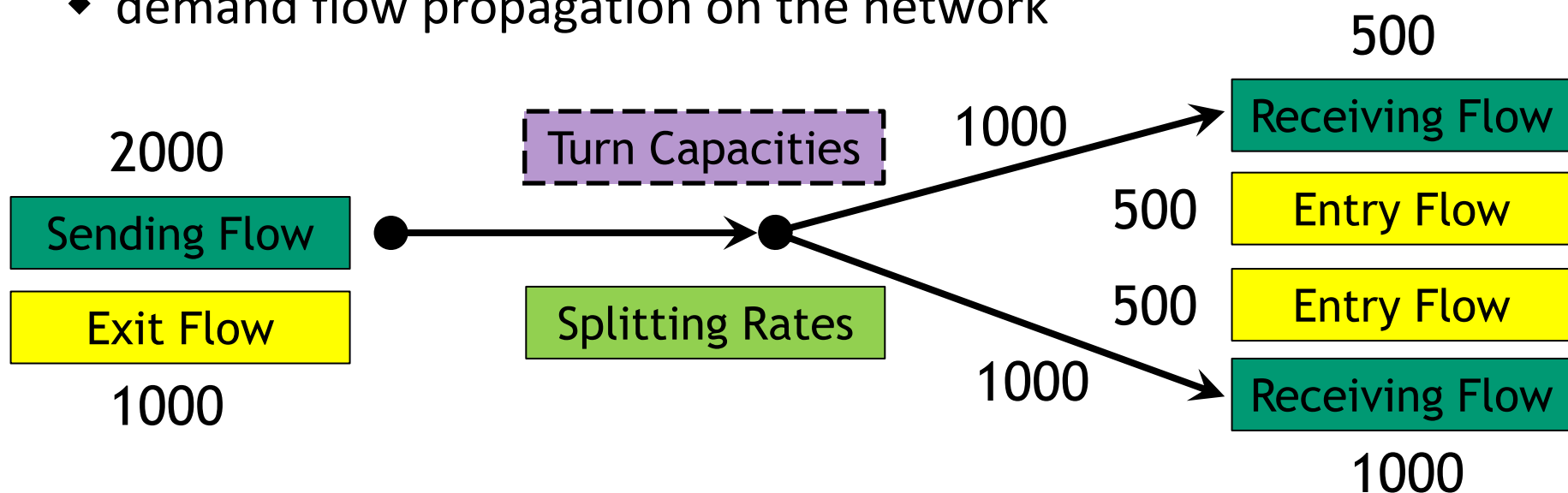
- Partition of scarce resource (receiving flow) among BS links, based on turn capacities and priorities
- If a sending flow does not fully exploit the assigned resource the rest is shared among hungry links





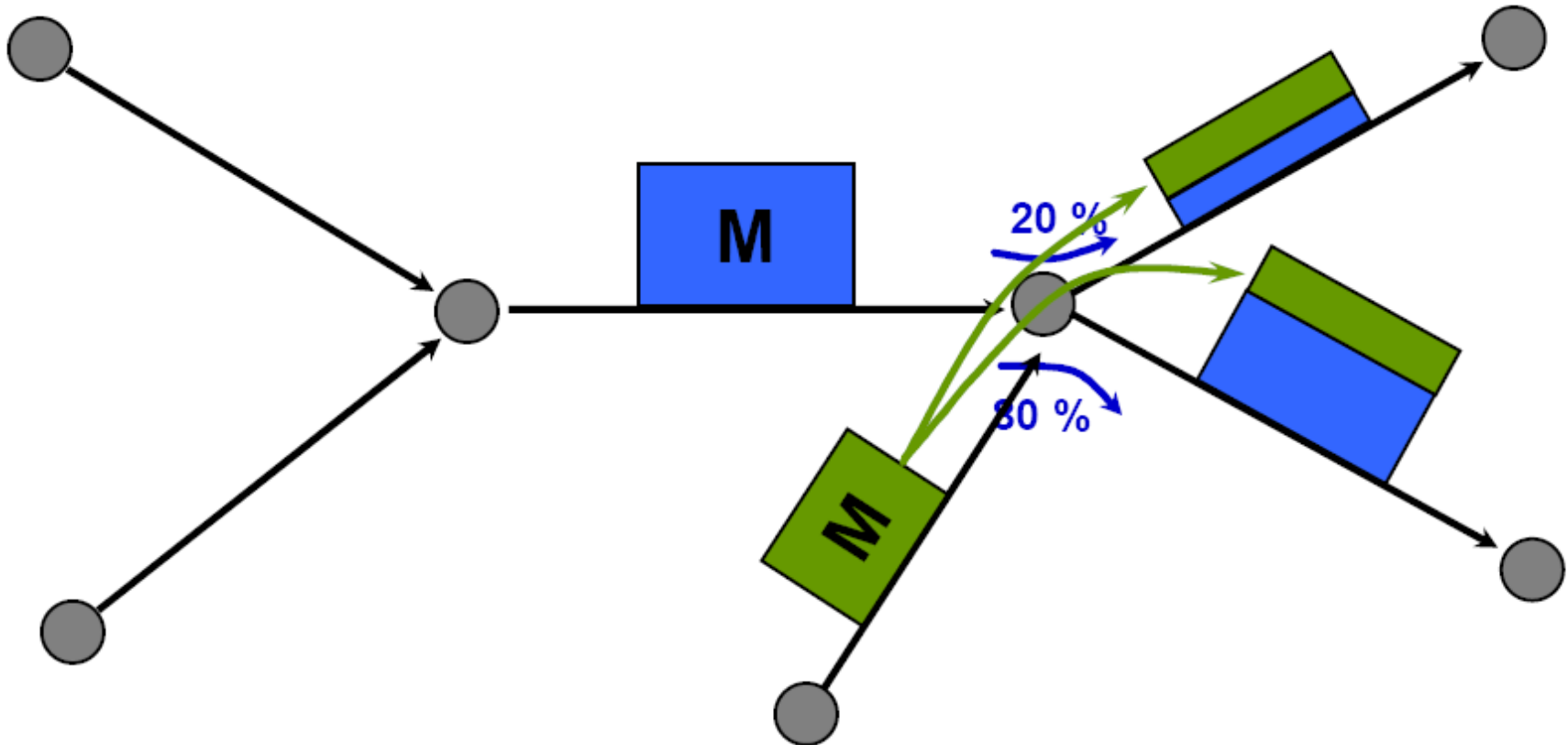
Node Model Diversion

- Assuming FIFO
- Min ratio between receiving and splitted sending
- Splitting rates (not destination specific) come from
 - ◆ route choice, for each destination
 - ◆ demand flow propagation on the network





Splitting Rates: aggregation of route choices



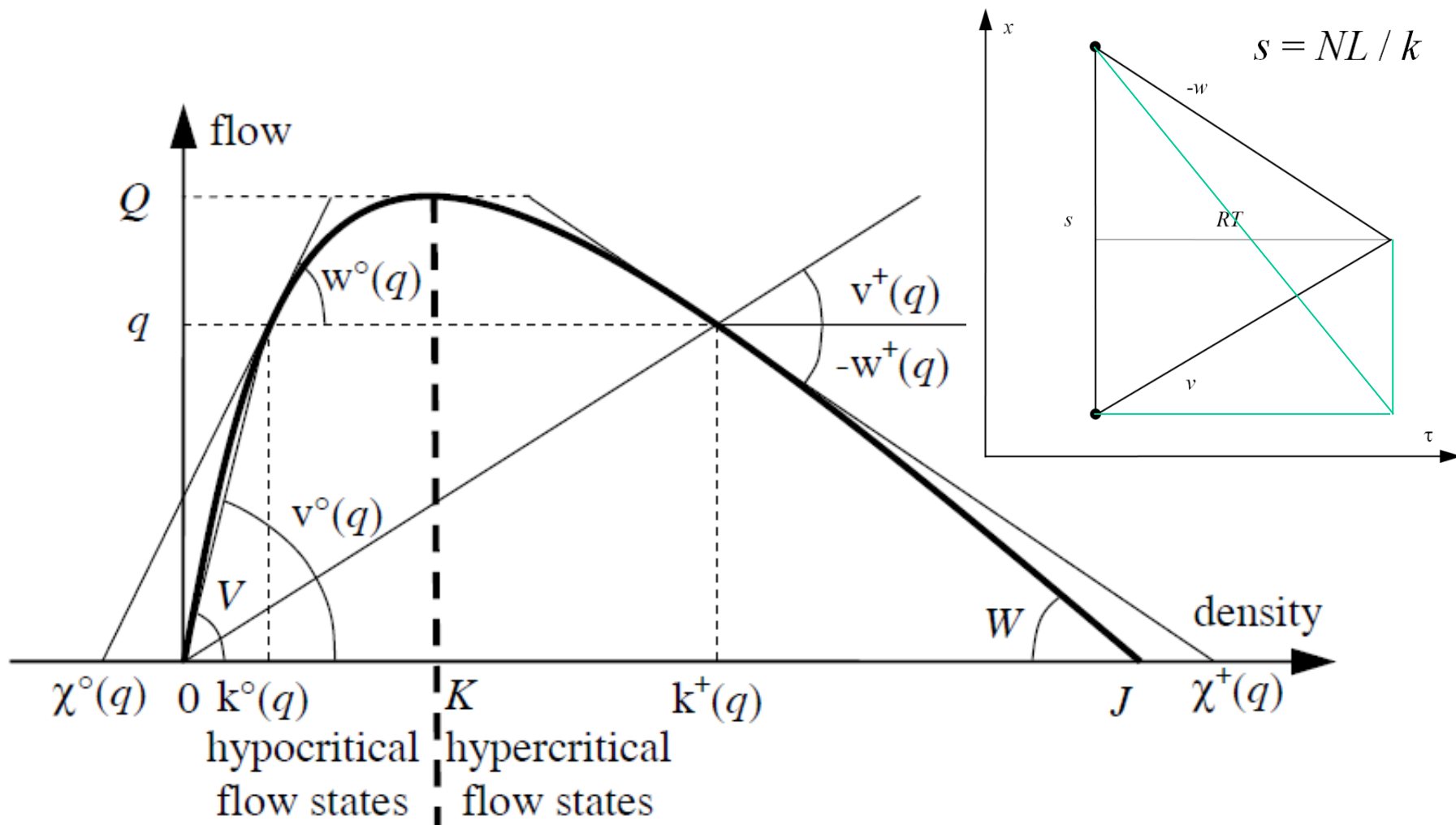


Necessary extensions of the node model for real applications

- Generalizations
 - ◆ Mixed merging and diversions
 - ◆ Lane intersection topology
 - ◆ Traffic signals
- Conflicting manoeuvres
 - ◆ Solved as merging plus diversion
- Partial FIFO violation at diversions to match microsimulator
 - ◆ Early lane change by blocking vehicles (smart polite)
 - ◆ Late lane change by blocked vehicles (sneaking)
 - ◆ Compressed virtual lanes

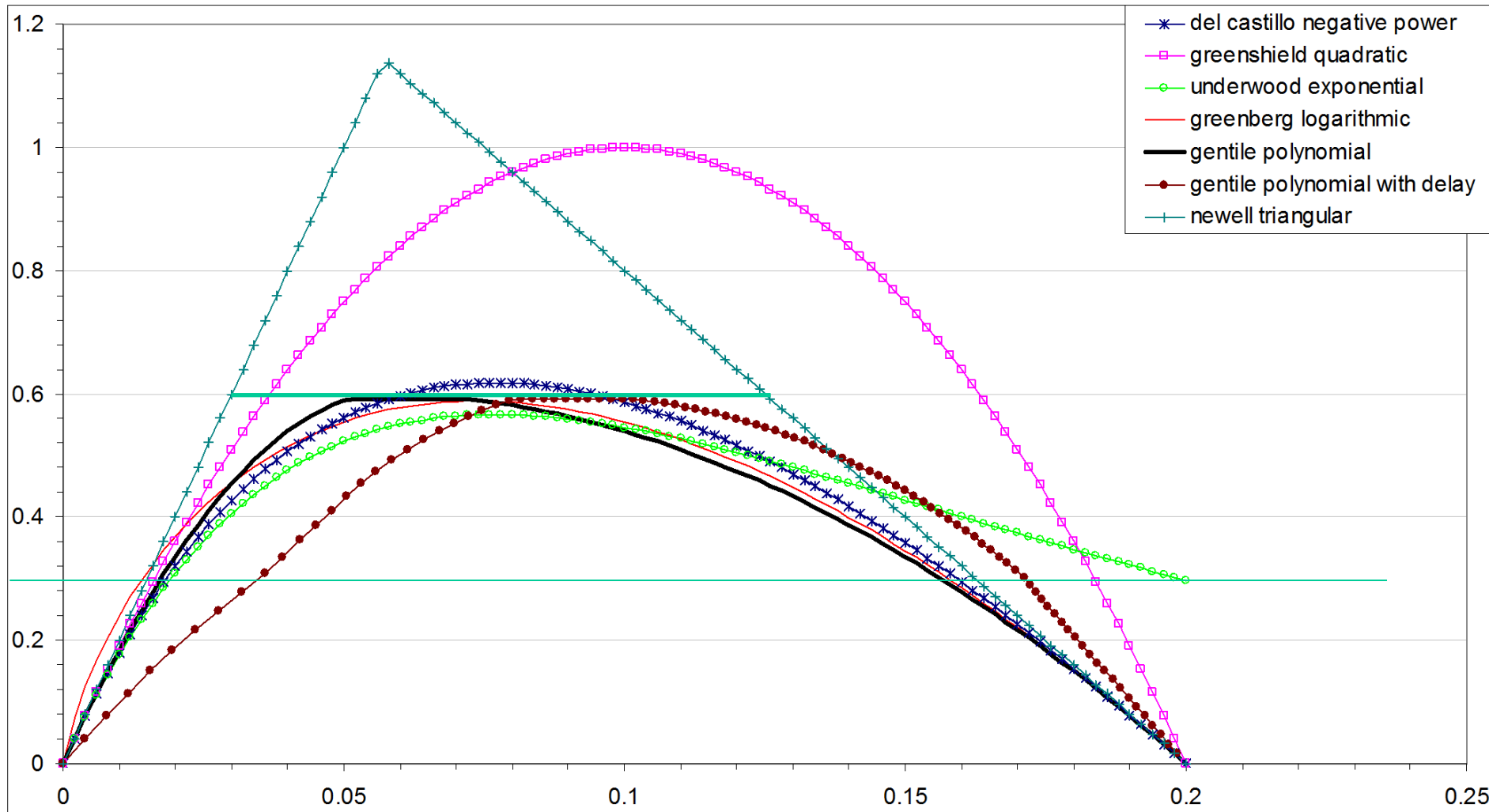


Concave Fundamental Diagram heterogeneous speed reaction time





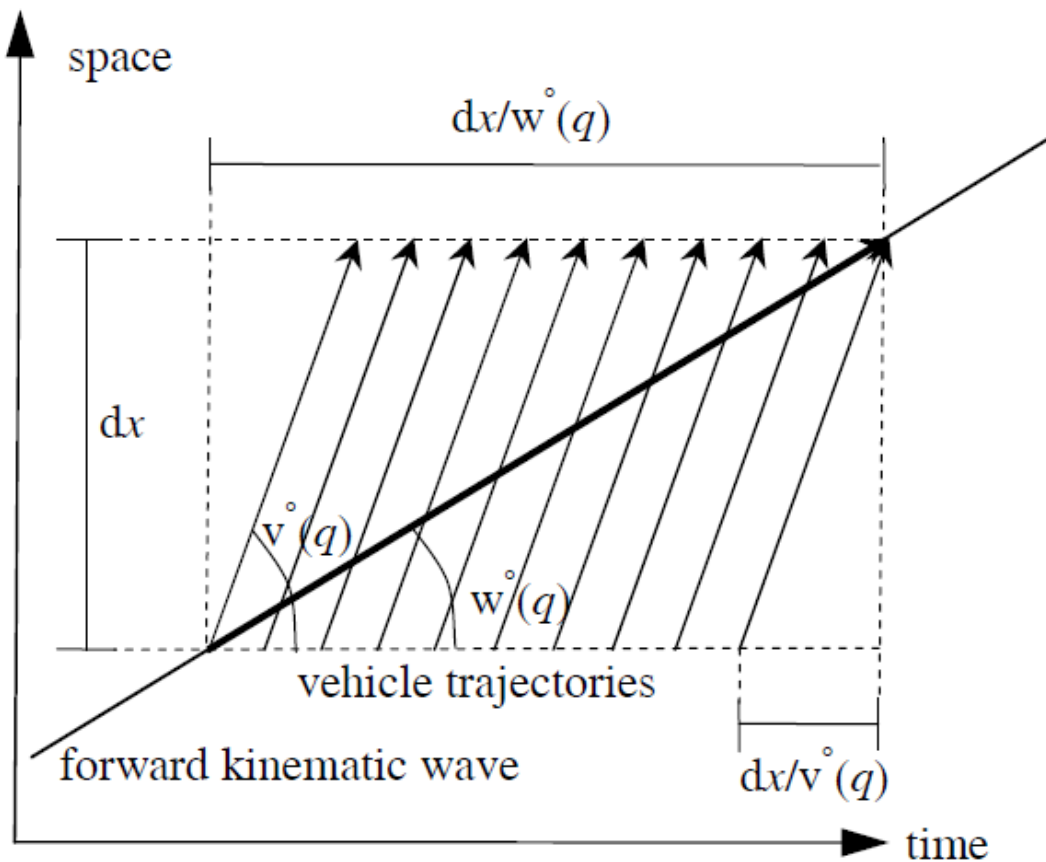
Fundamental diagrams with different shapes and parameters





Forward wave propagation of hypocritical flow states

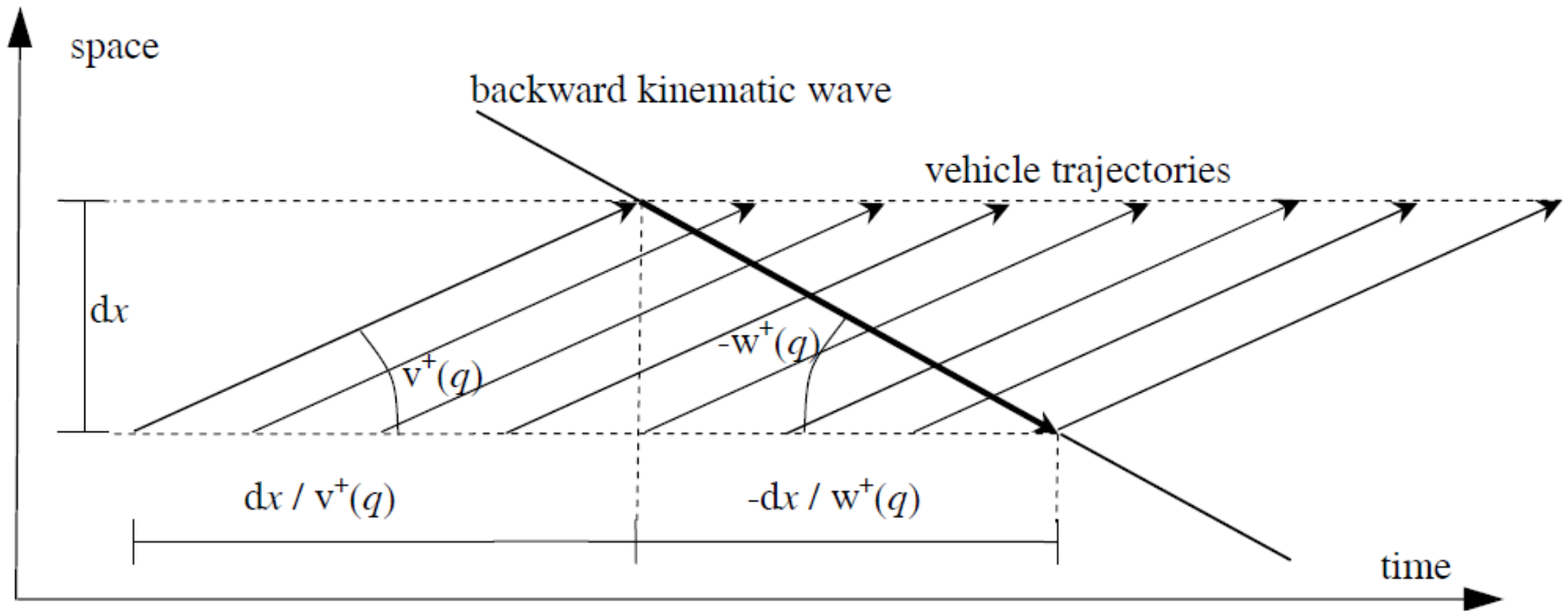
$$\hat{H}(x, \tau) = F(\tau) + f(\tau) \cdot x \cdot (1 / w^\circ(f(\tau)) - 1 / v^\circ(f(\tau))) = F(\tau) - x \cdot \chi^\circ(f(\tau))$$





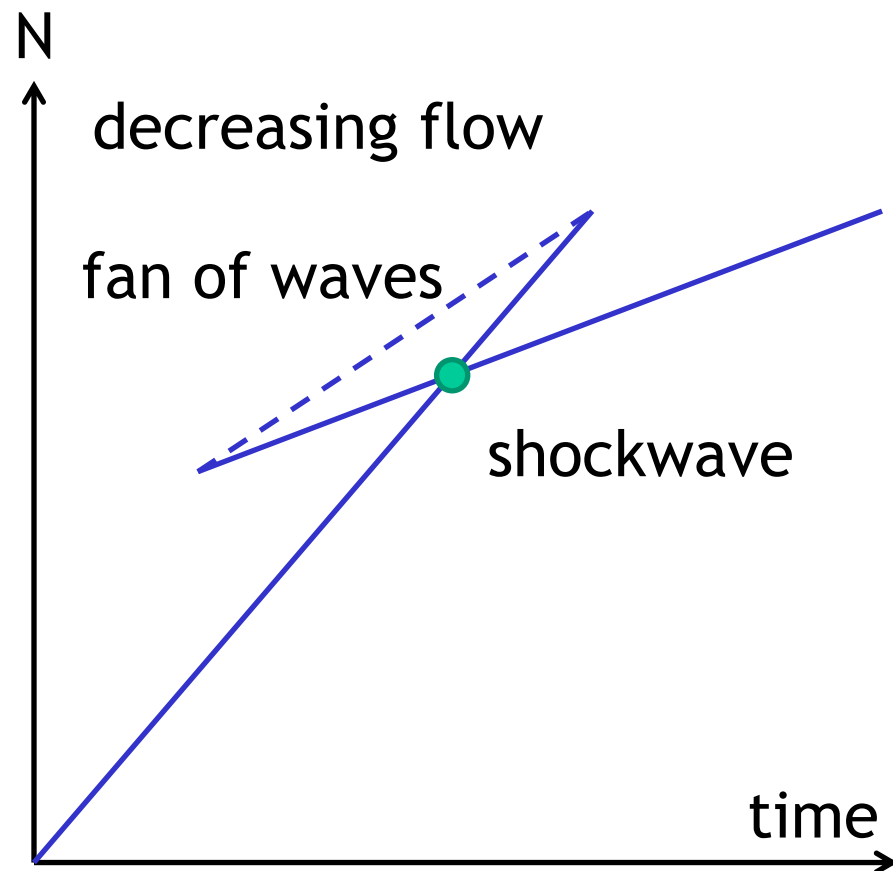
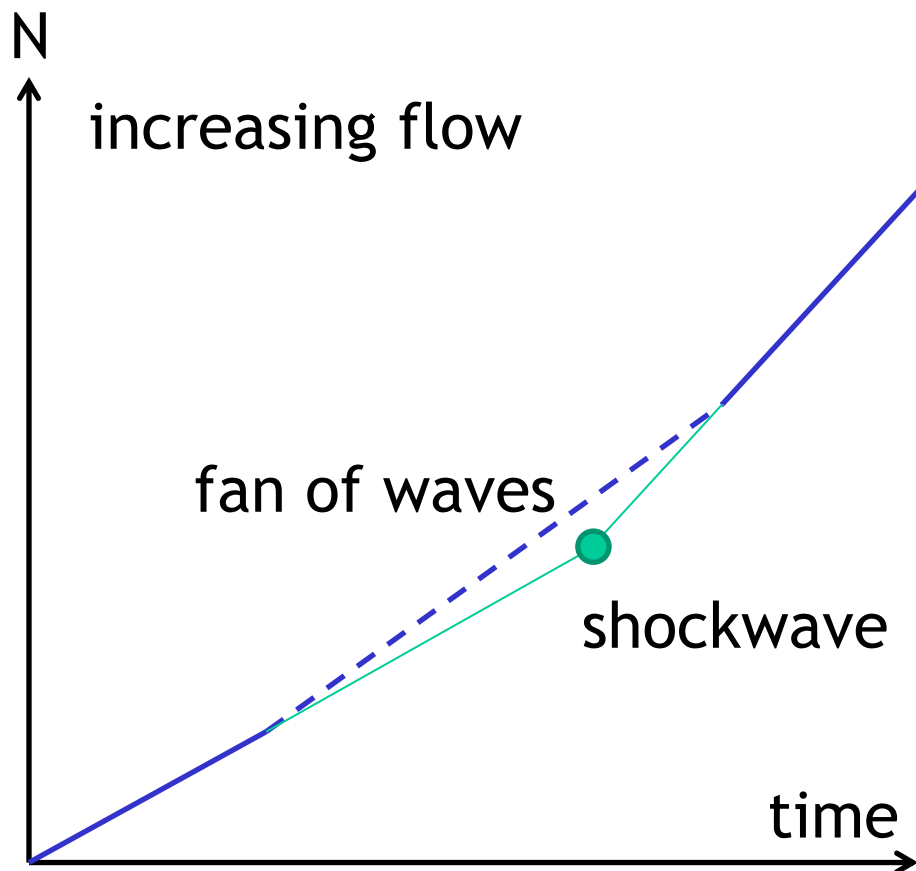
Backward wave propagation of hypercritical flow states

$$\hat{G}(x, \tau) = E(\tau) + (L - x) \cdot e(\tau) \cdot [-1 / w^+(e(\tau)) + 1 / v^+(e(\tau))] = E(\tau) + (L - x) \cdot \chi^+(e(\tau))$$





Newell Luke Minimum Principle: lower envelope of cumulative flows

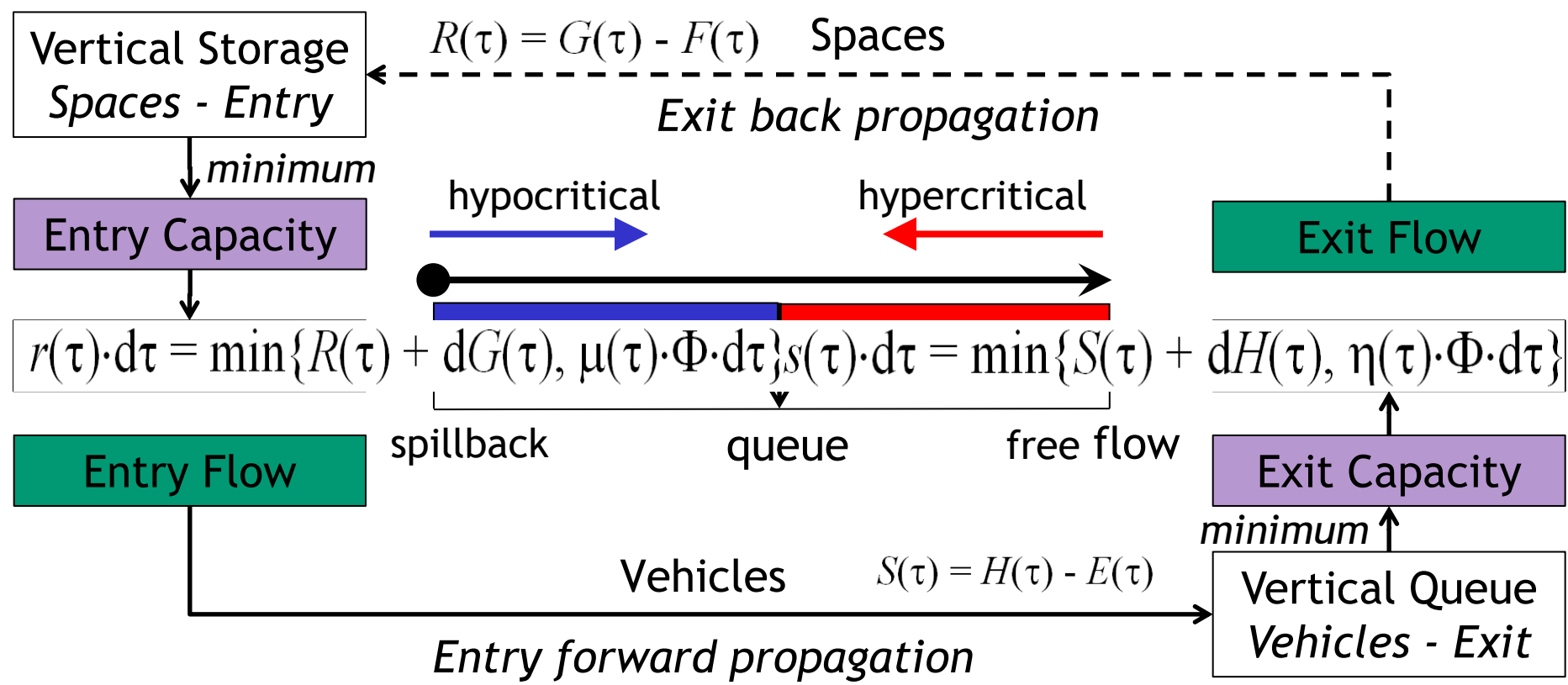




Link Model

yields sending and receiving flows

- Newell's solution of Kinematic Wave theory



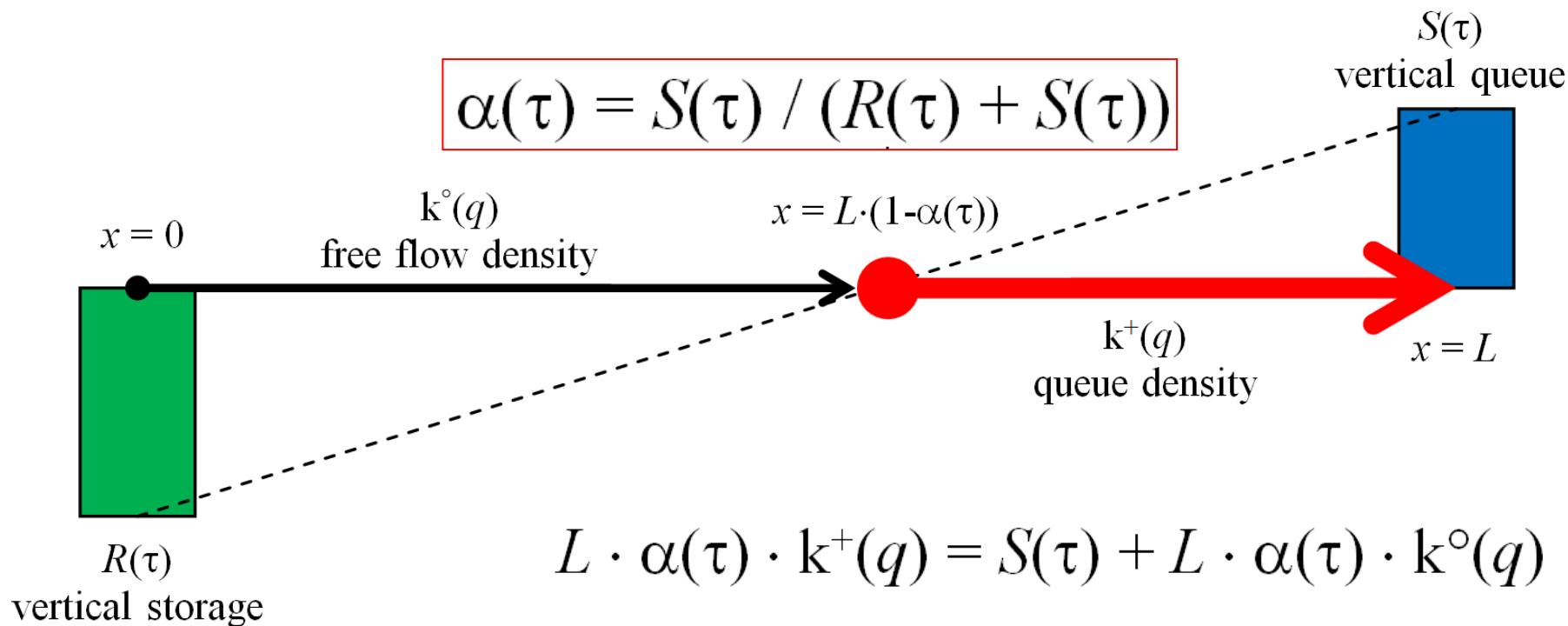


Estimate of the queue length assuming a constant flow

$$N(\tau) = F(\tau) - E(\tau)$$

$$S(\tau) = H(\tau) - E(\tau)$$

$$\alpha(\tau) = S(\tau) / (R(\tau) + S(\tau))$$



$$L \cdot \alpha(\tau) \cdot k^+(q) = S(\tau) + L \cdot \alpha(\tau) \cdot k^\circ(q)$$

$$N(\tau) + R(\tau) = L \cdot k^+(q)$$

$$N(\tau) - S(\tau) = L \cdot k^\circ(q)$$

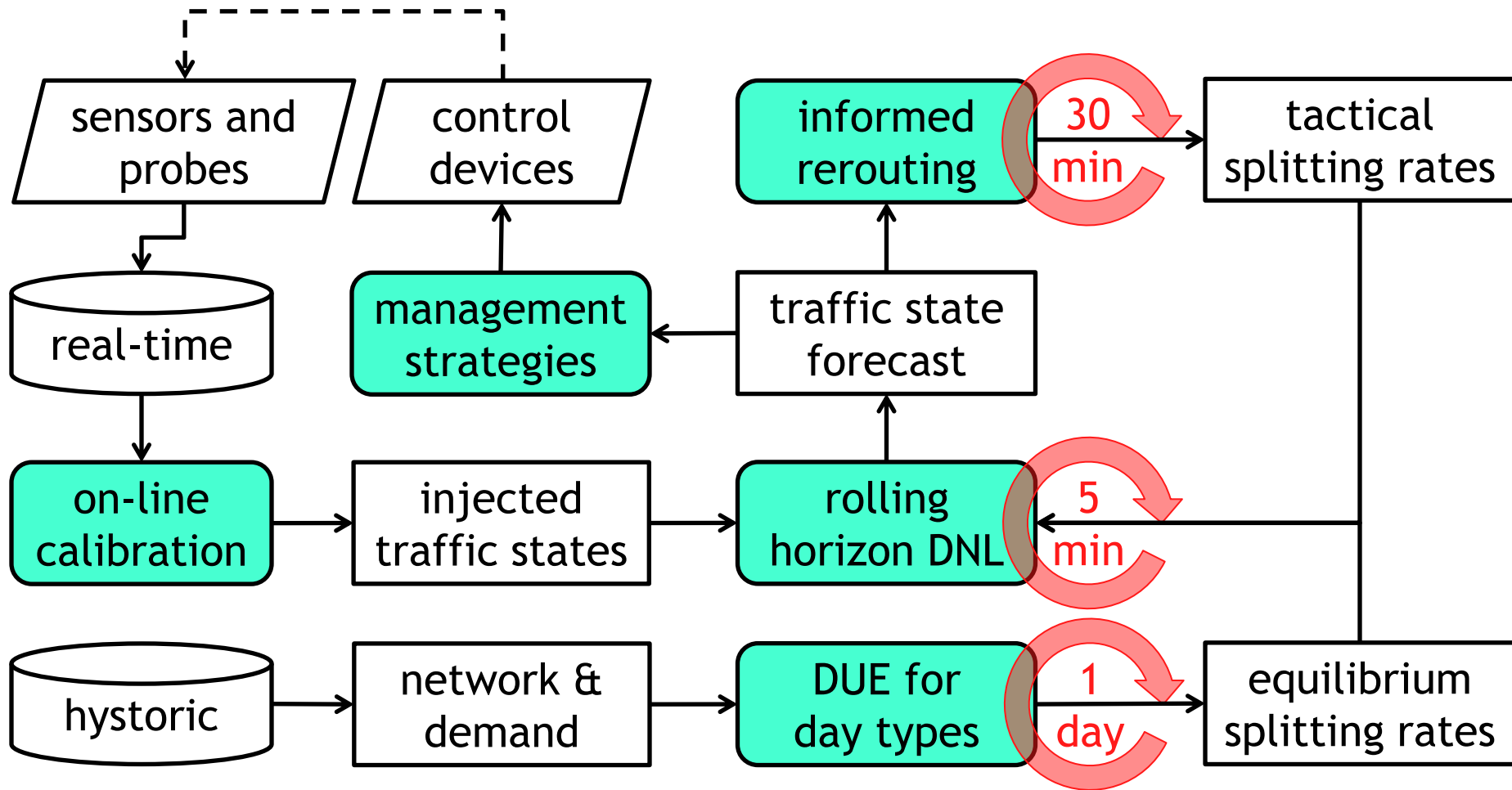
$$R(\tau) = G(\tau) - F(\tau)$$



HOW TO USE DUE AND DNL OFF-LINE AND IN REAL-TIME

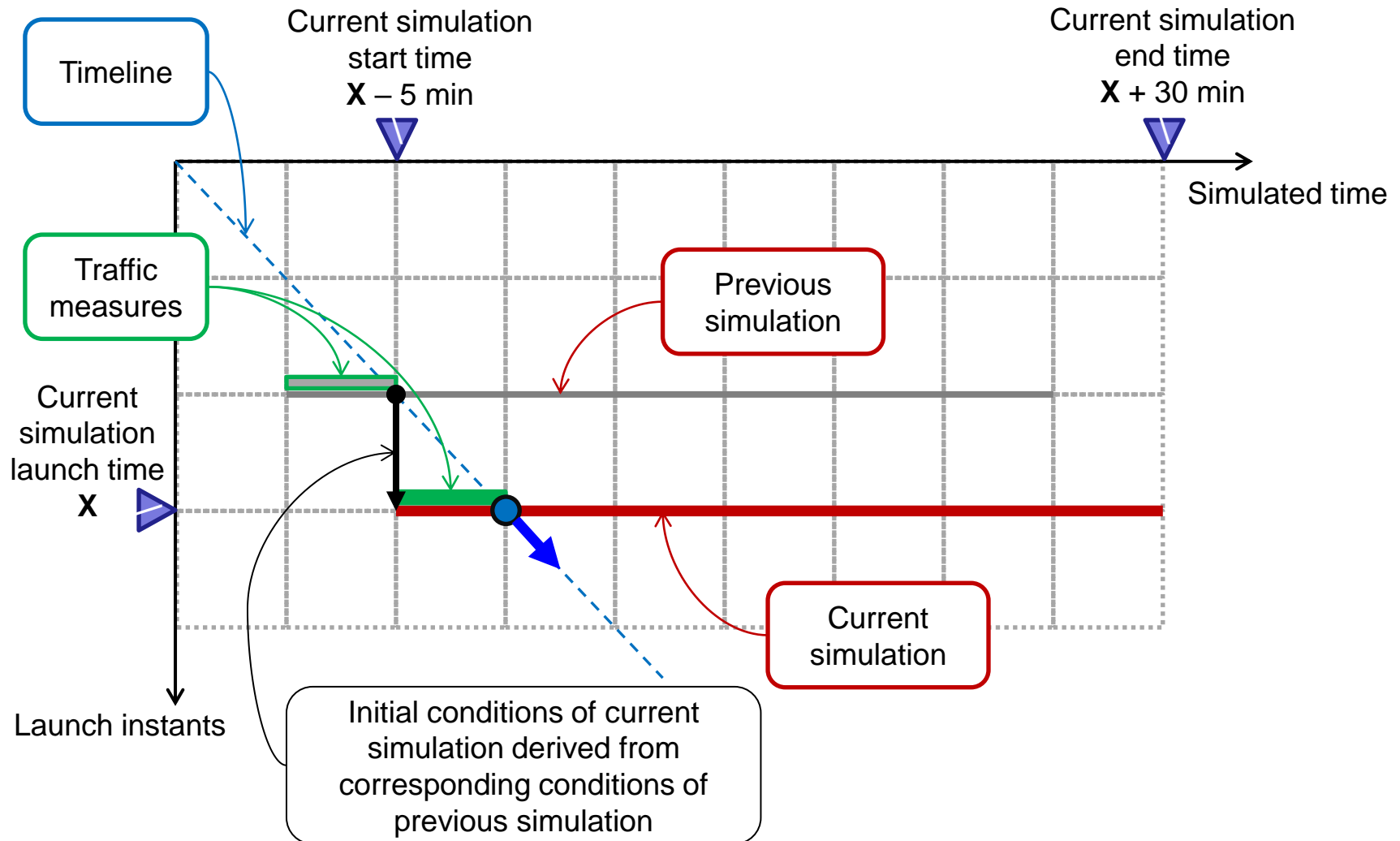


Different simulations for Traffic Forecast and Management





Rolling horizon approach with sequential simulations





NUMERICAL EXAMPLES

Dipole with bottleneck

The first battery of tests is performed on the simple dipole network of Figure 4, where it is possible to have expectations on the solution. All links share the following characteristics: free flow speed of 90 km/h, link capacity of 1800 veh/h, jam density of 150 veh/km, jam wave speed of 30 km/h, parabolic hypocritical branch of the fundamental diagram, linear hypercritical branch. All links have a base length equal length of 1 km. Travel demand is constant for 40 min with entry: $d_{14} = 1500$ veh/h.

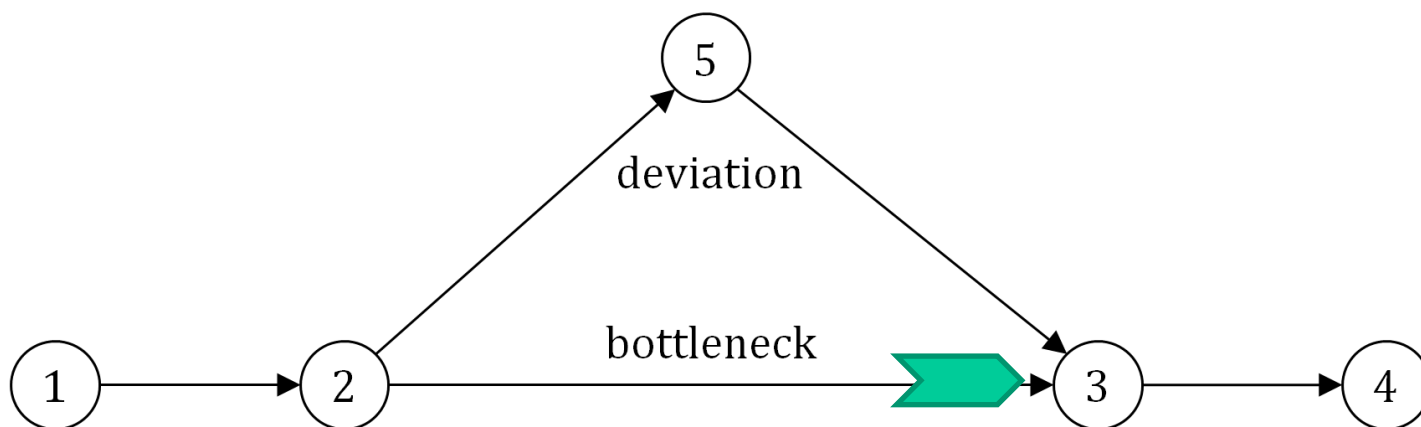


Figure 4. Topology of the dipole network.

Hypocritical congestion

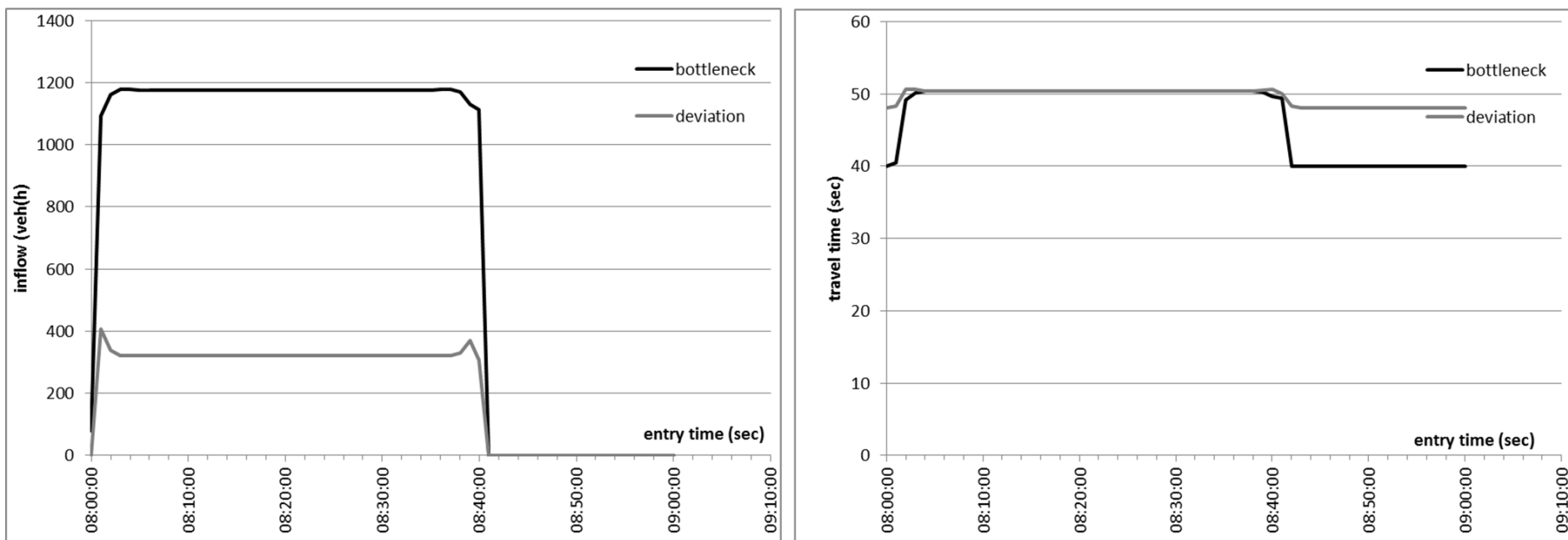


Figure 5. Dipole network with hypocritical congestion. The links of the deviation 2-5 and 5-3 have length of 600 m each. The bottleneck 2-3 has exit capacity of 1200 veh/h.

Queue congestion

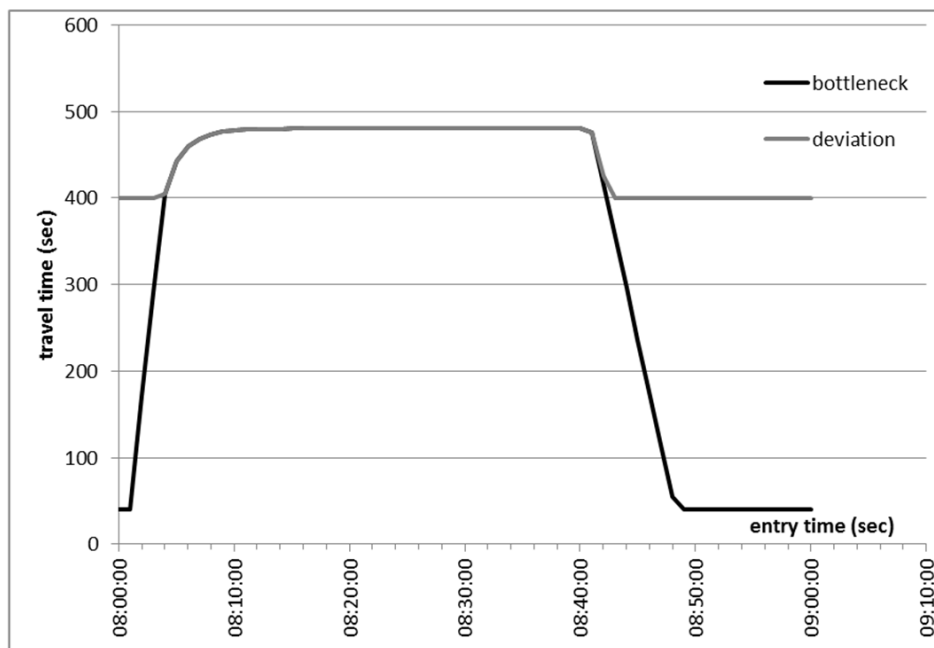
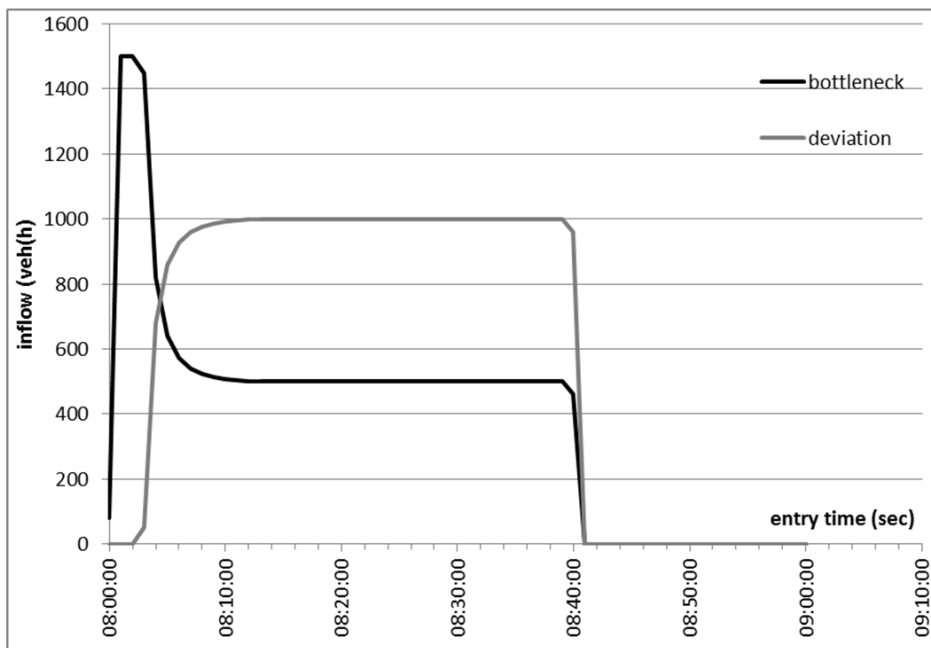


Figure 6. Dipole network with queue. The links of the deviation 2-5 and 5-3 have length of 5 km each. The bottleneck 2-3 has an exit capacity of 500 veh/h.

Spillback congestion

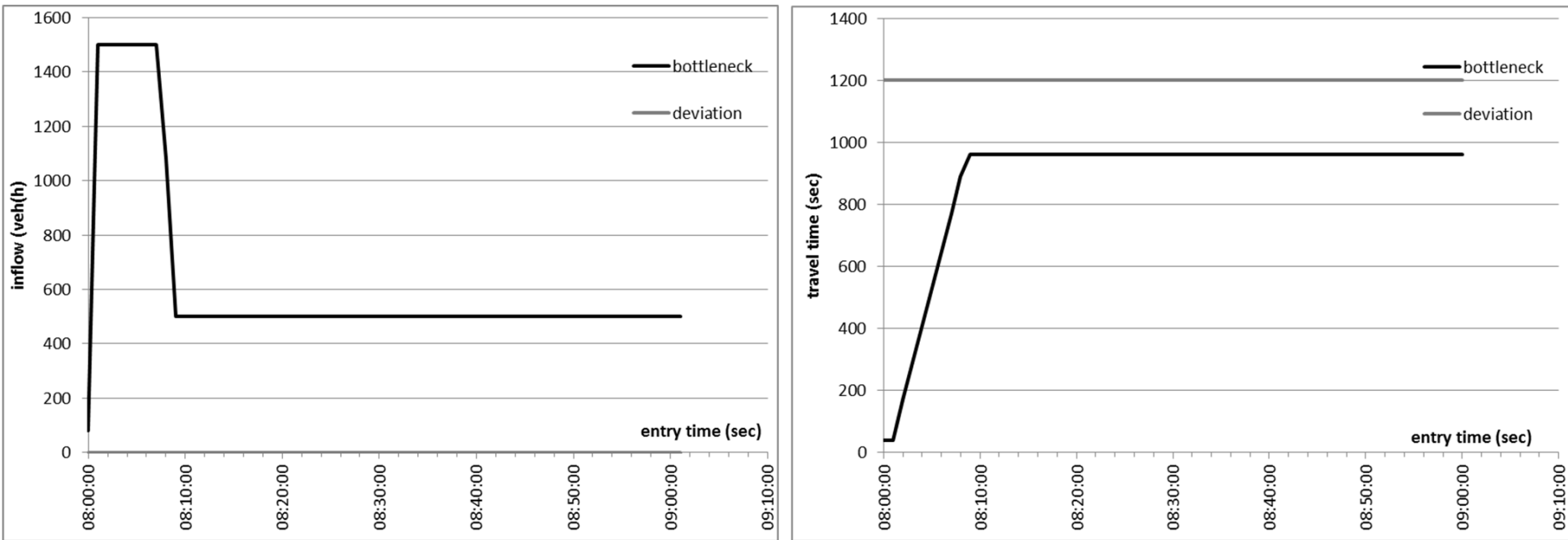
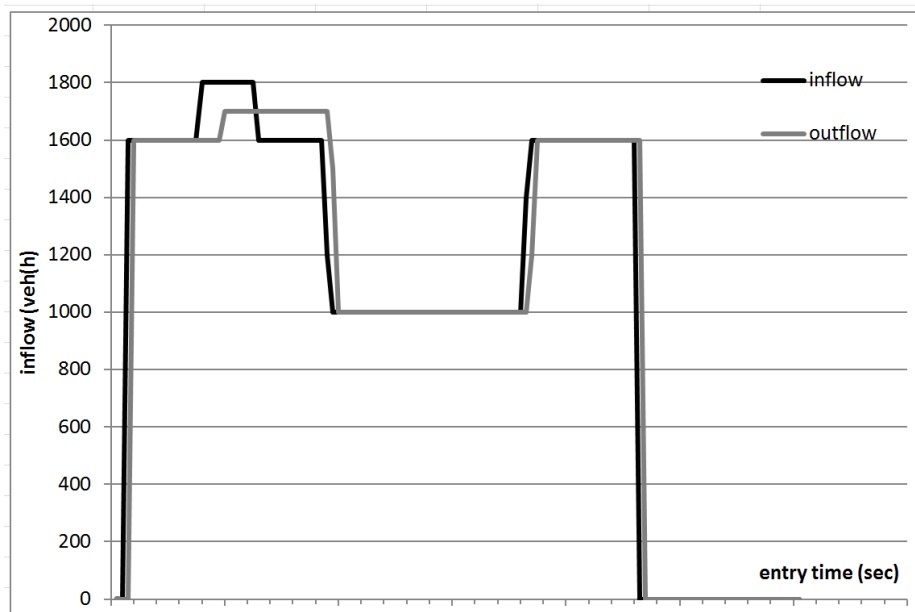


Figure 7. Dipole network in spillback. The links of the deviation 2-5 and 5-3 have length of 15 km each. The bottleneck 2-3 has an exit capacity of 500 veh/h.

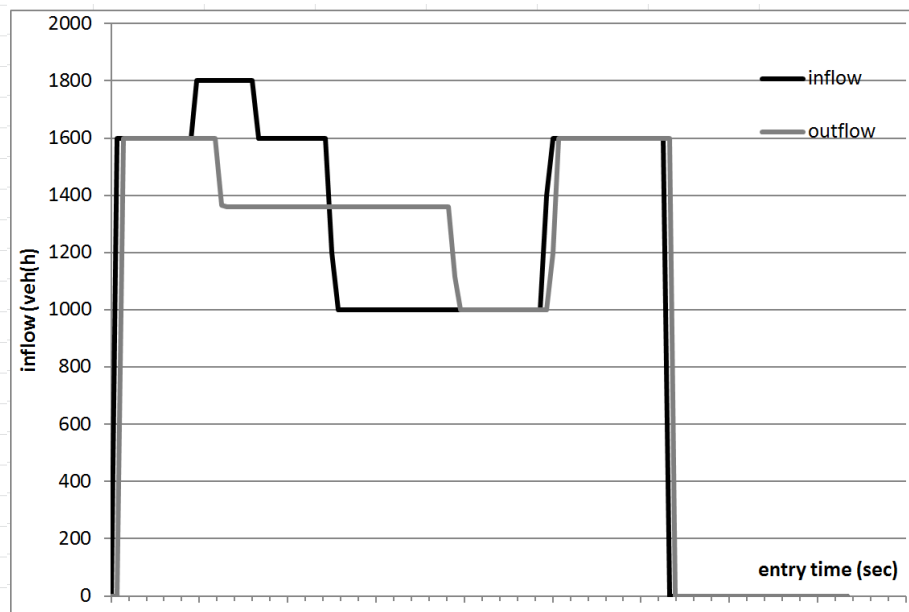


The effect of capacity drop

without



with (20%)





Convergence results for different congestion level

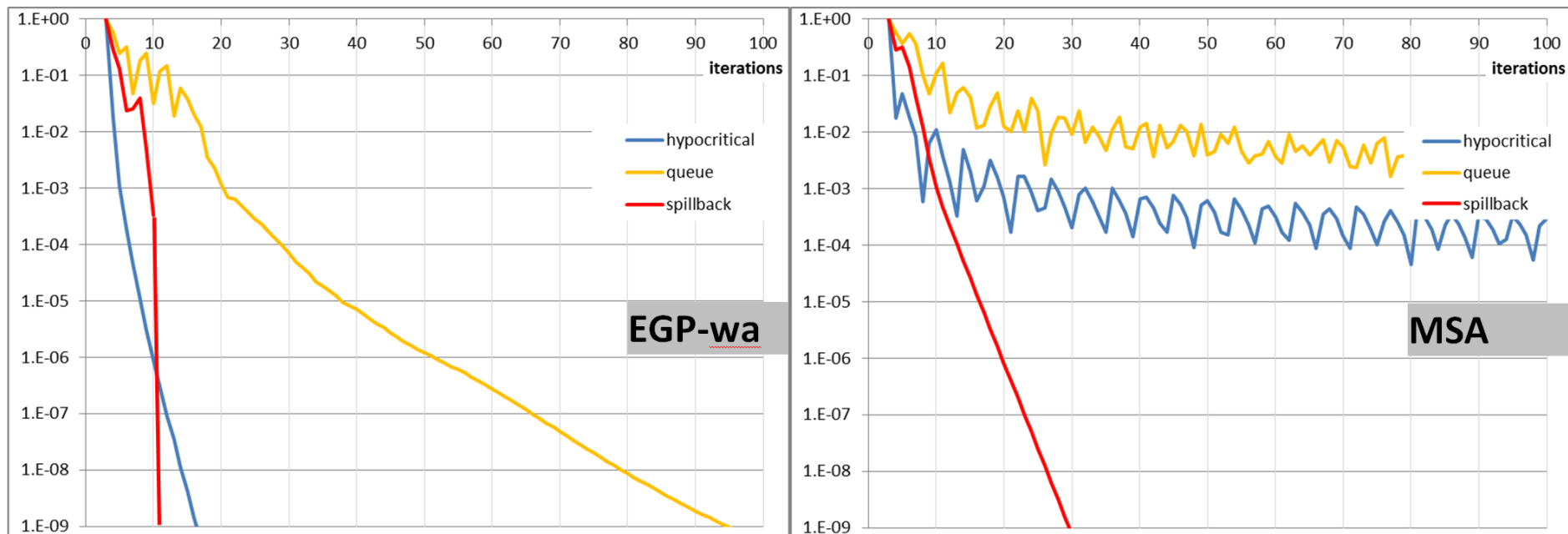


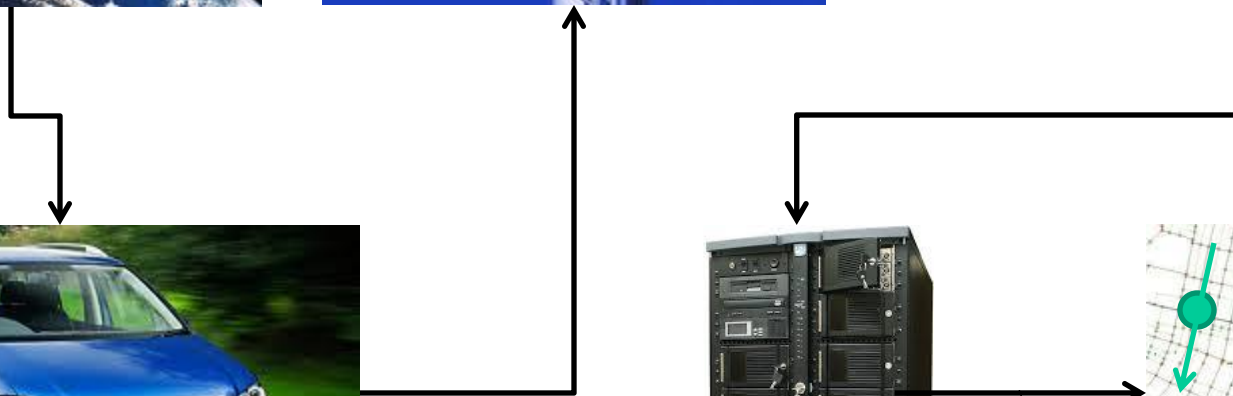
Figure 8. Convergence pattern for the dipole network – EGP outperforms MSA.



TOWARDS MORE DATA AND MODEL INTEGRATION

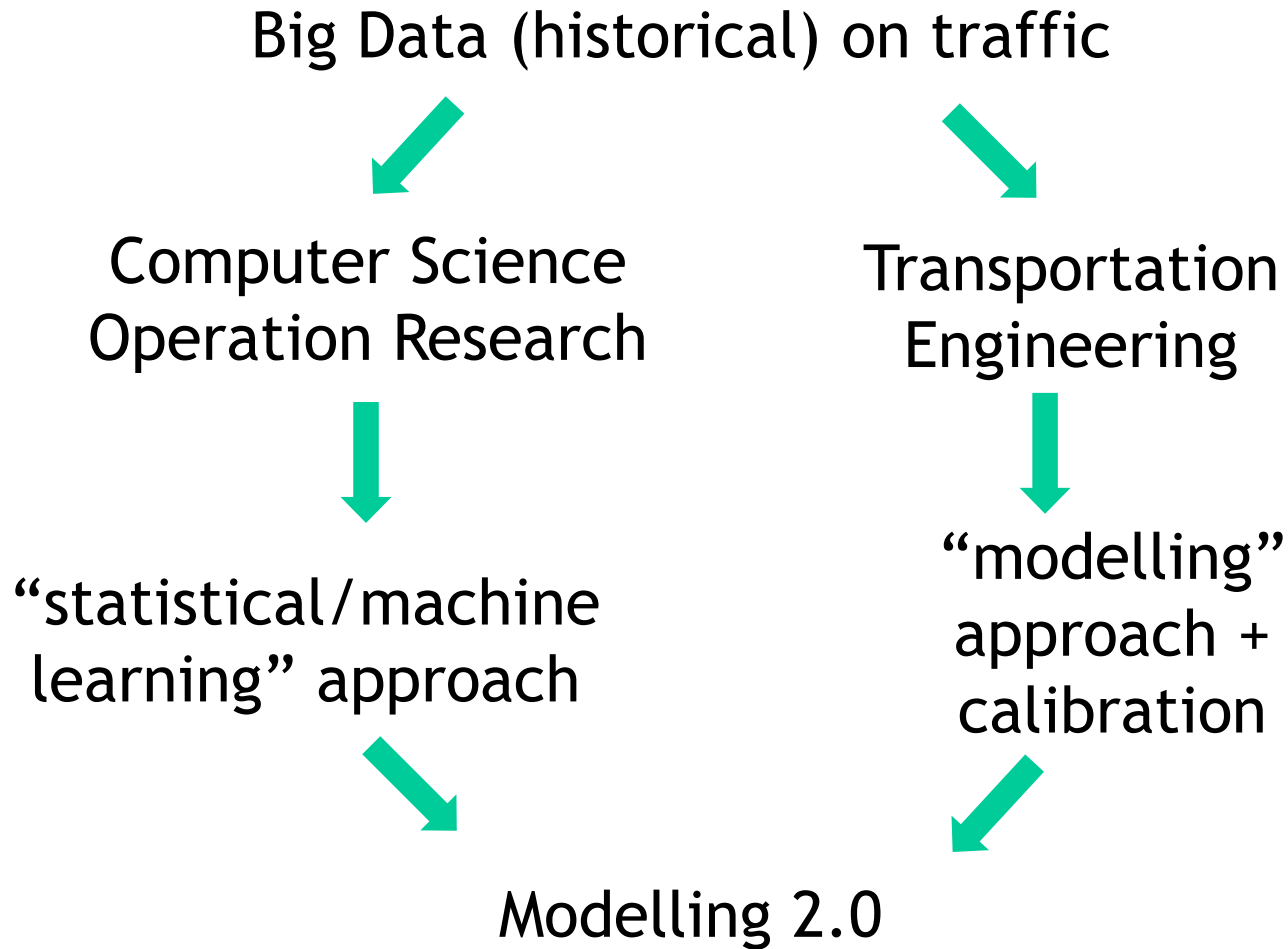


Key technology for ITS: GPS + Wireless TC → Map Matching



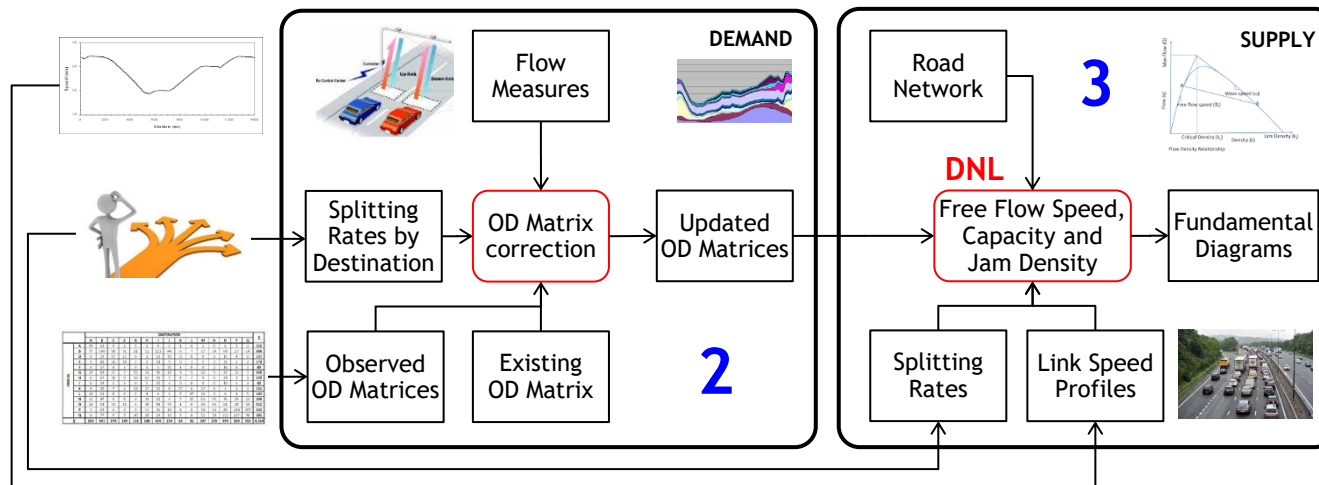
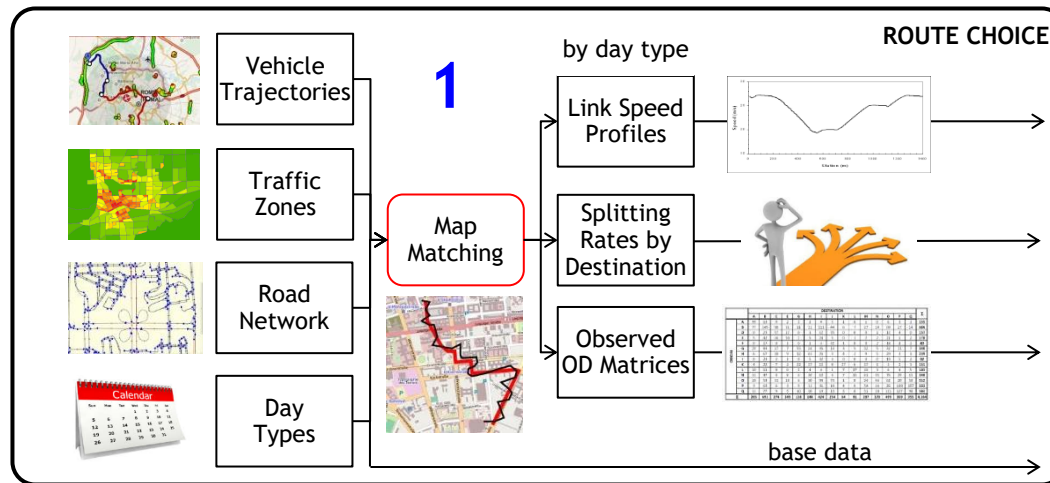


Big Data for modelling 2.0





Data driven model offline: 3 steps functional overview





Calibration issue: why measured traffic states differ from estimates?

- What is going on here?

there is a big queue



estim. 800 veh/h , 70 km/h meas. 1000 veh/h , 15 km/h

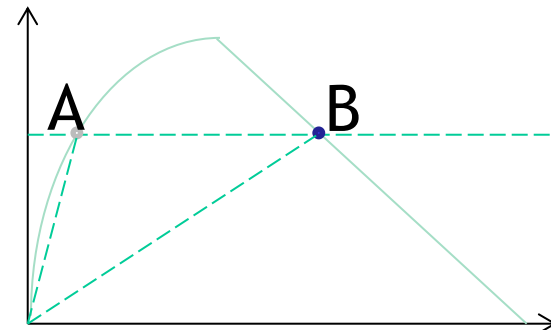
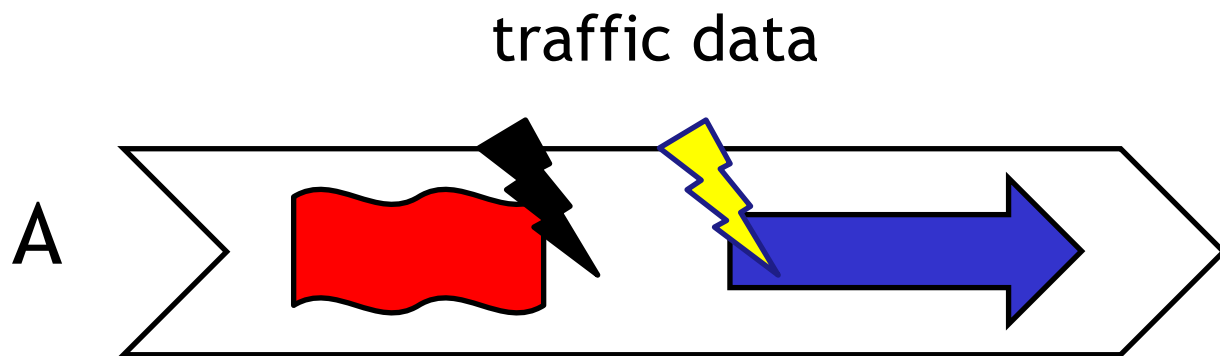
- We are reading the downstream capacity instead of demand flows
- To calibrate OD flows in DTA through an assignment matrix we shall use the number of vehicles on links
- Or we should re-run (at least) the DNL for each demand vector
 - Derivative free algorithms can help (SPSA, Nelder-Mead, ...)
 - Not many shots available (e.g. 1000)



Calibration of the DTA model in real-time: measure injection

- Static models
 - ◆ can be easily calibrated with respect to flows (not time)
 - ◆ have a hard time in simulating networks with heavy congestion
- In dynamic models
 - ◆ vehicle counts maybe almost uncorrelated with the demand flows
 - ◆ not really interested in a complete reconstruction back in time
 - ◆ want to forecast what happens next, for different scenarios
- We adopt a simpler approach
 - ◆ Measure injections in the network loading model
 - ◆ Modify flow, speed and density directly on links

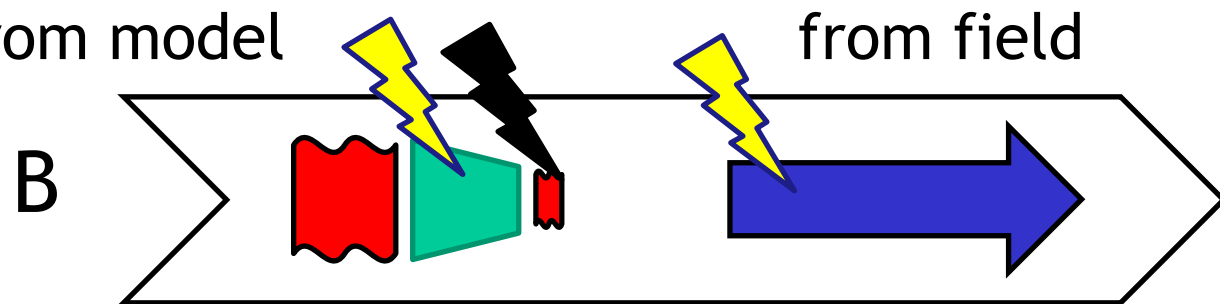
Flow correction: injection and propagation



hypocritical flow
only forward
propagation

congestion propagation
from model

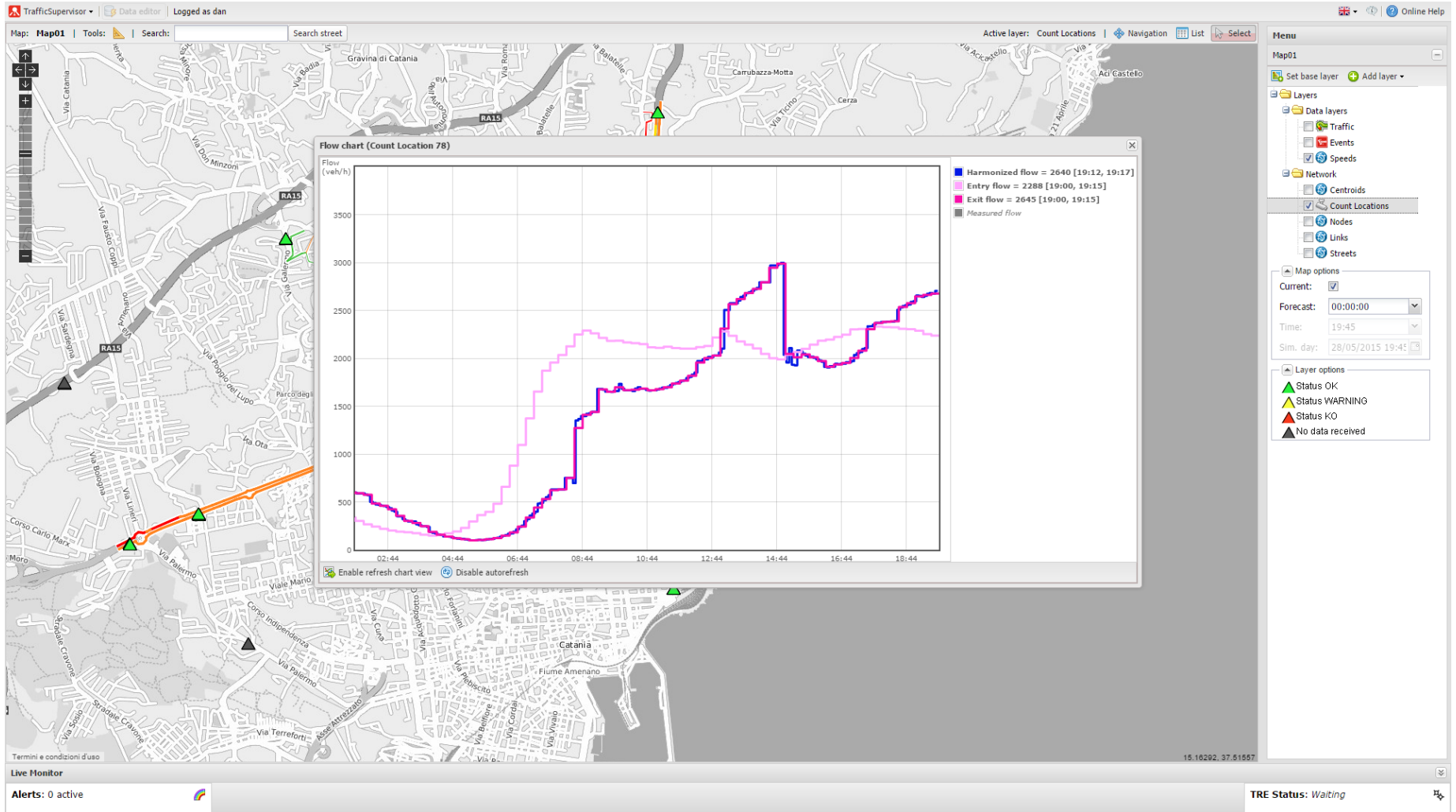
flow propagation
from field



hypercritical flow
also backward
propagation

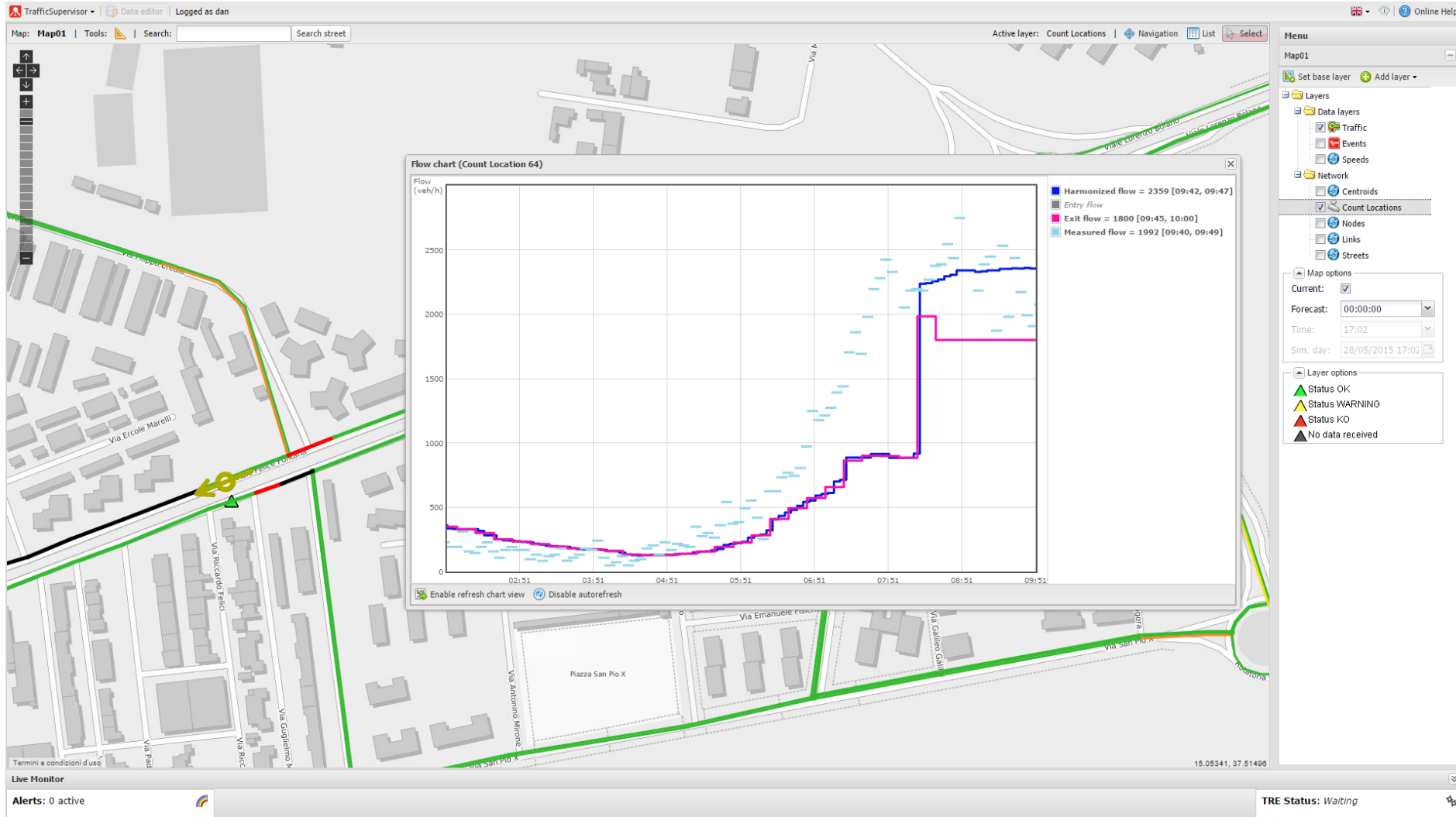


Exit flow consistent with measure disregarding entry flow



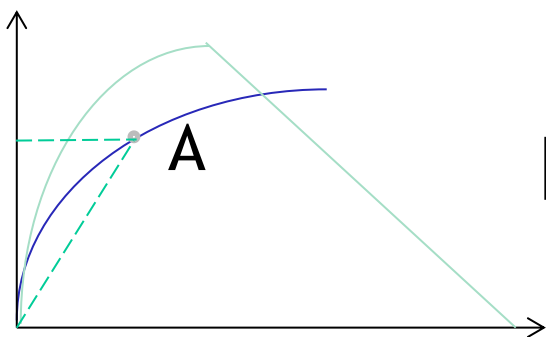


Matching is not always possible e.g. due to spillback in the model

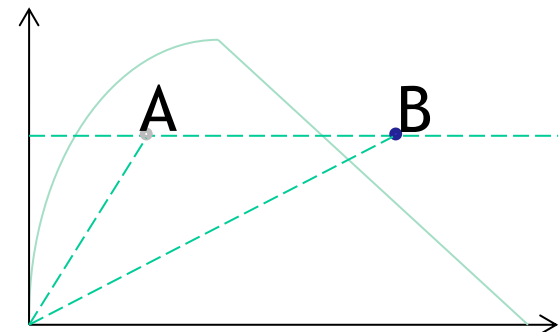




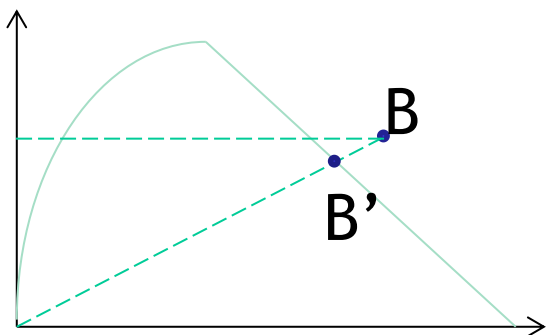
Speed correction: fundamental diagram distortion



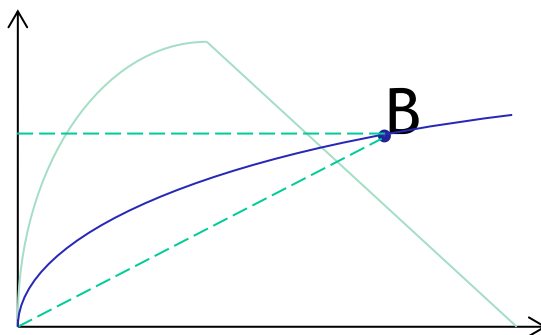
hypo state



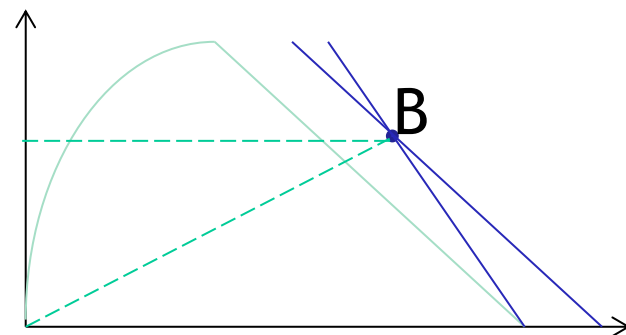
hyper state



1.



2.



3.

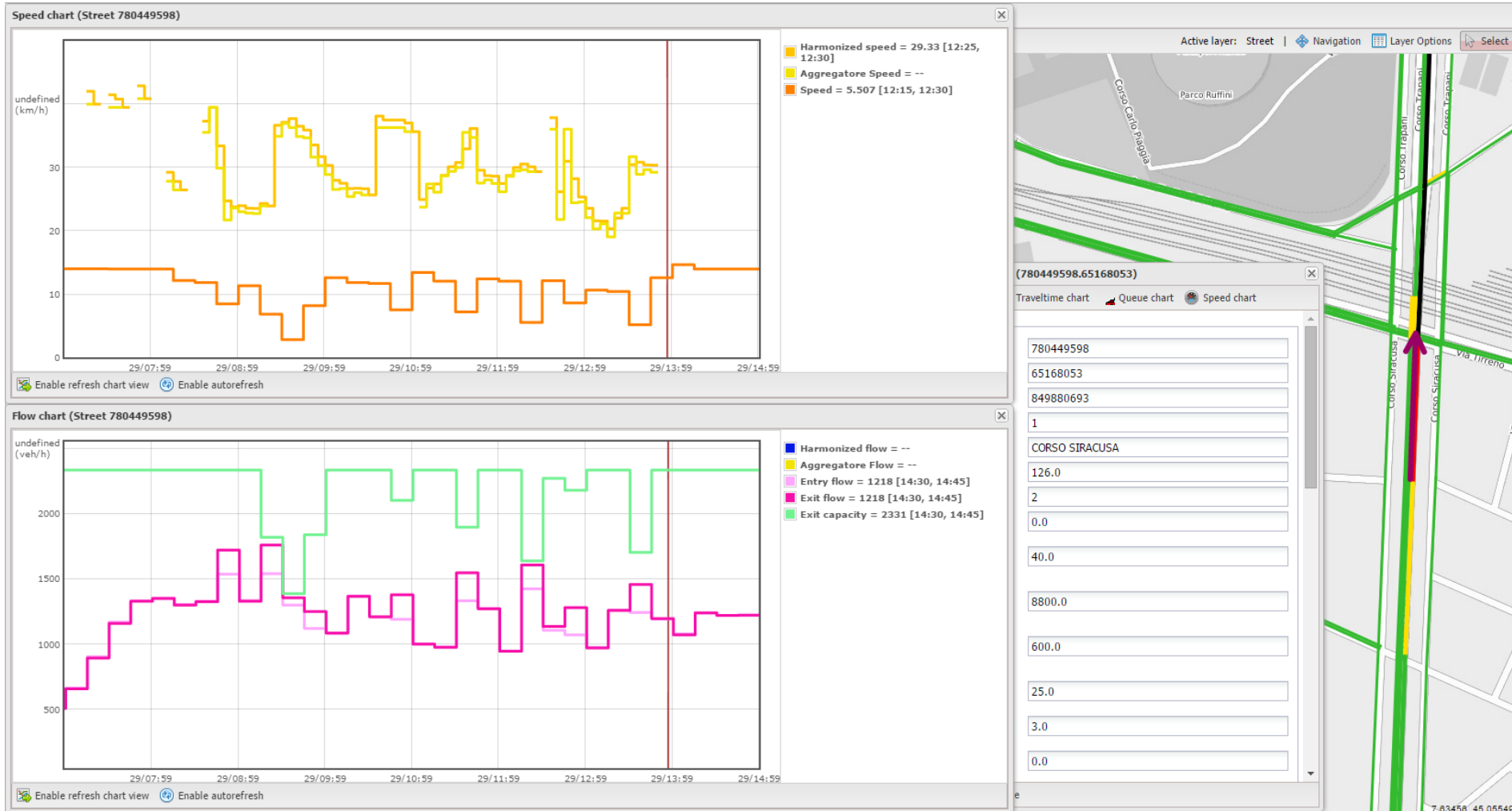


Shall model speed follow the measured speeds?





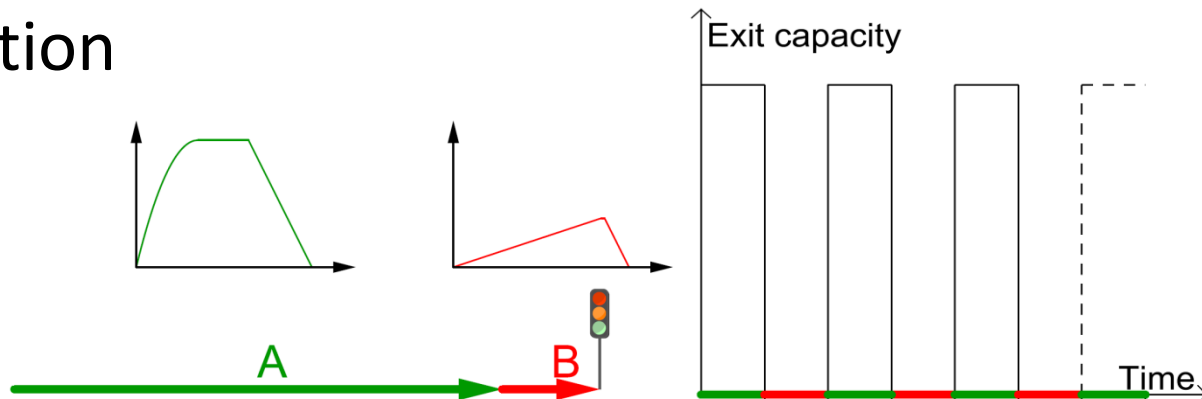
When spillback is simulated in front of a measure it is not possible



How to represent traffic lights and node delays

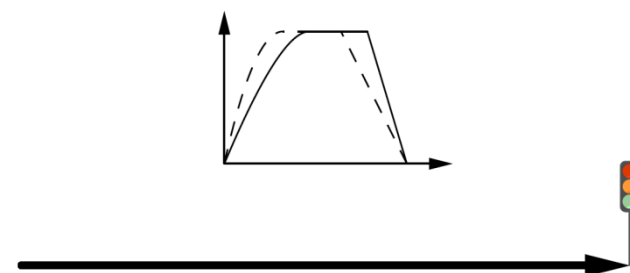
■ Explicit representation

- ◆ Arc splitting
- ◆ Pulsing



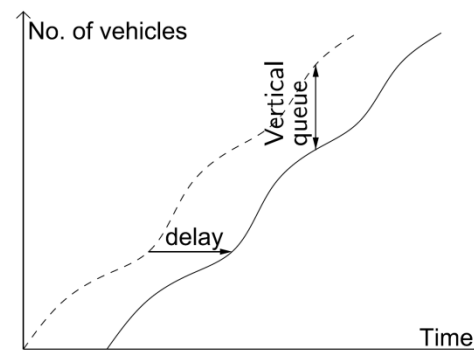
■ Fundamental diagram distortion

- ◆ include in the equation of the speed the additional travel time



■ Profile shifting

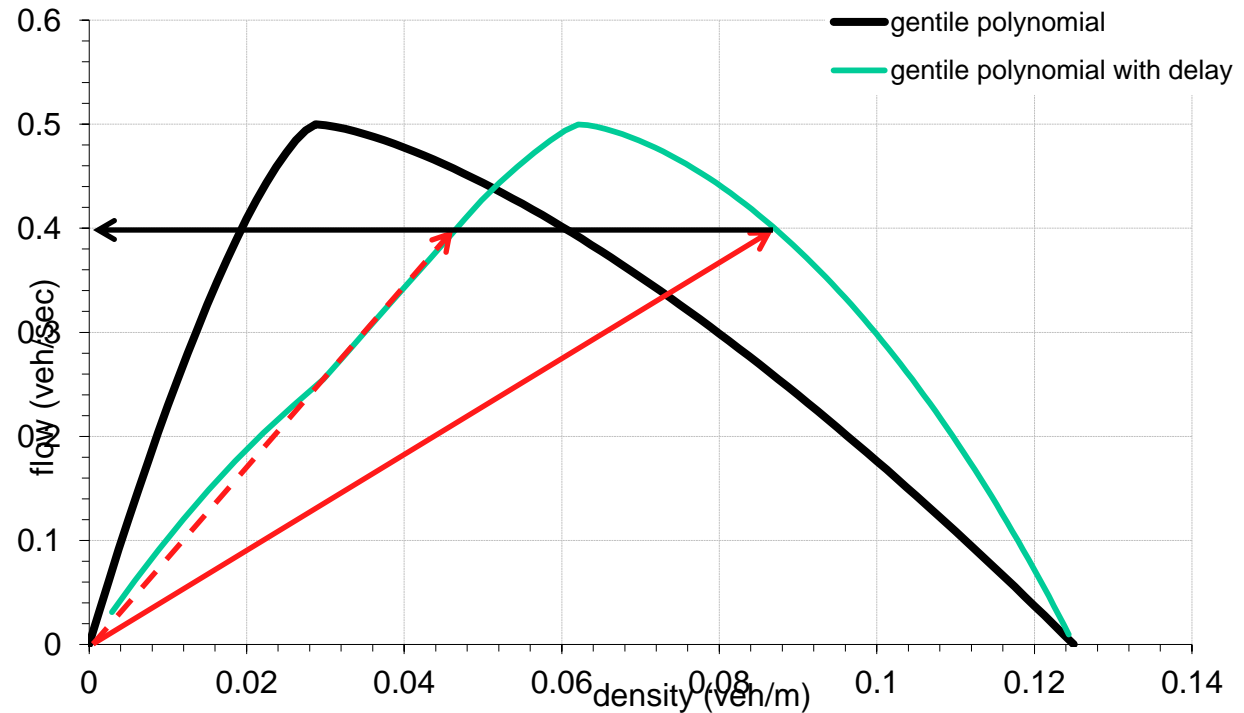
- ◆ Theory violation





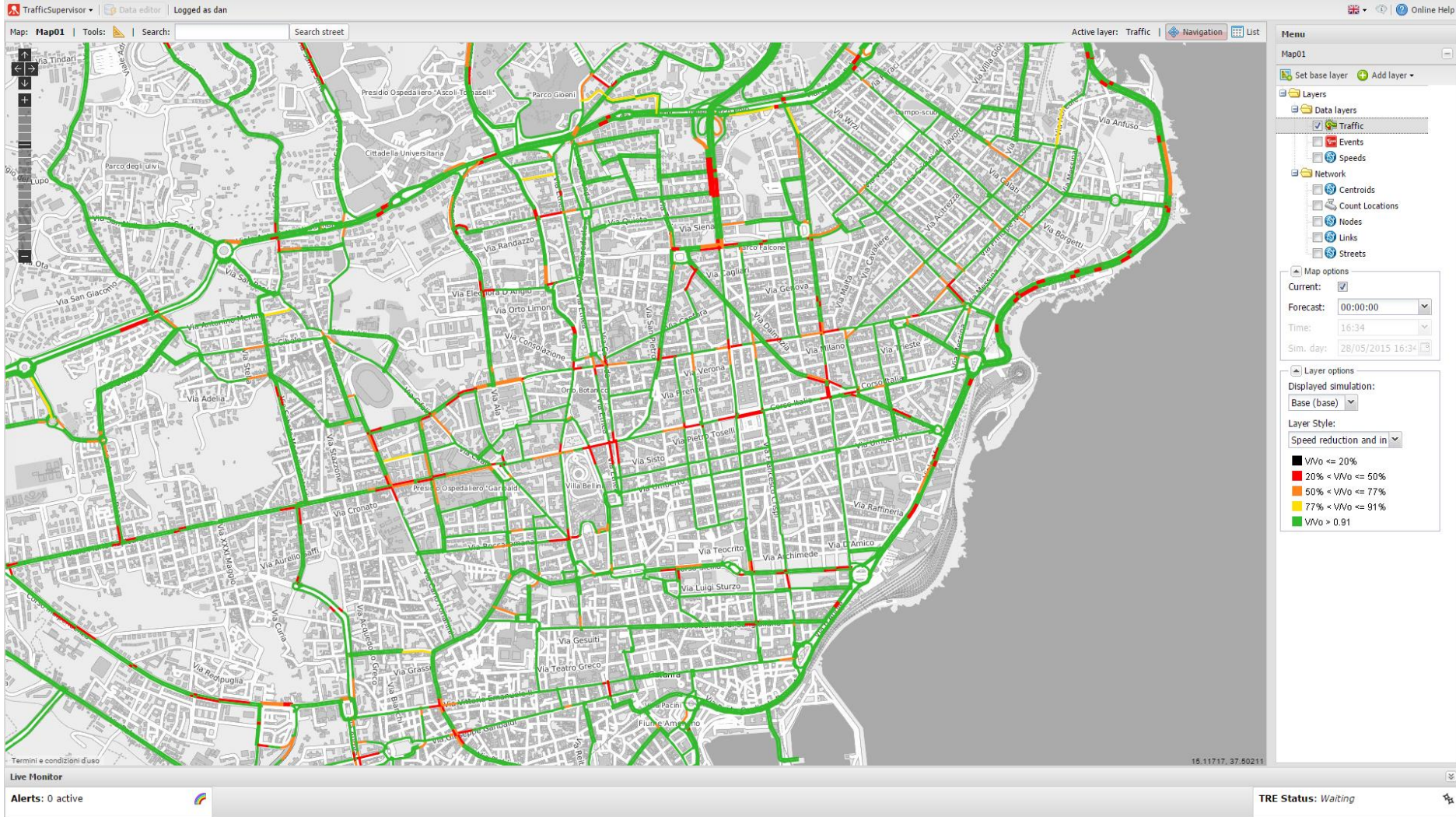
Flow from harmonized speed on the urban fundamental diagram

- Consider only hypercritical flows
 - ◆ otherwise too unstable
- Urban FD distortion
 - ◆ Fixed delay
 - ◆ Signal delay
 - ◆ Max speed



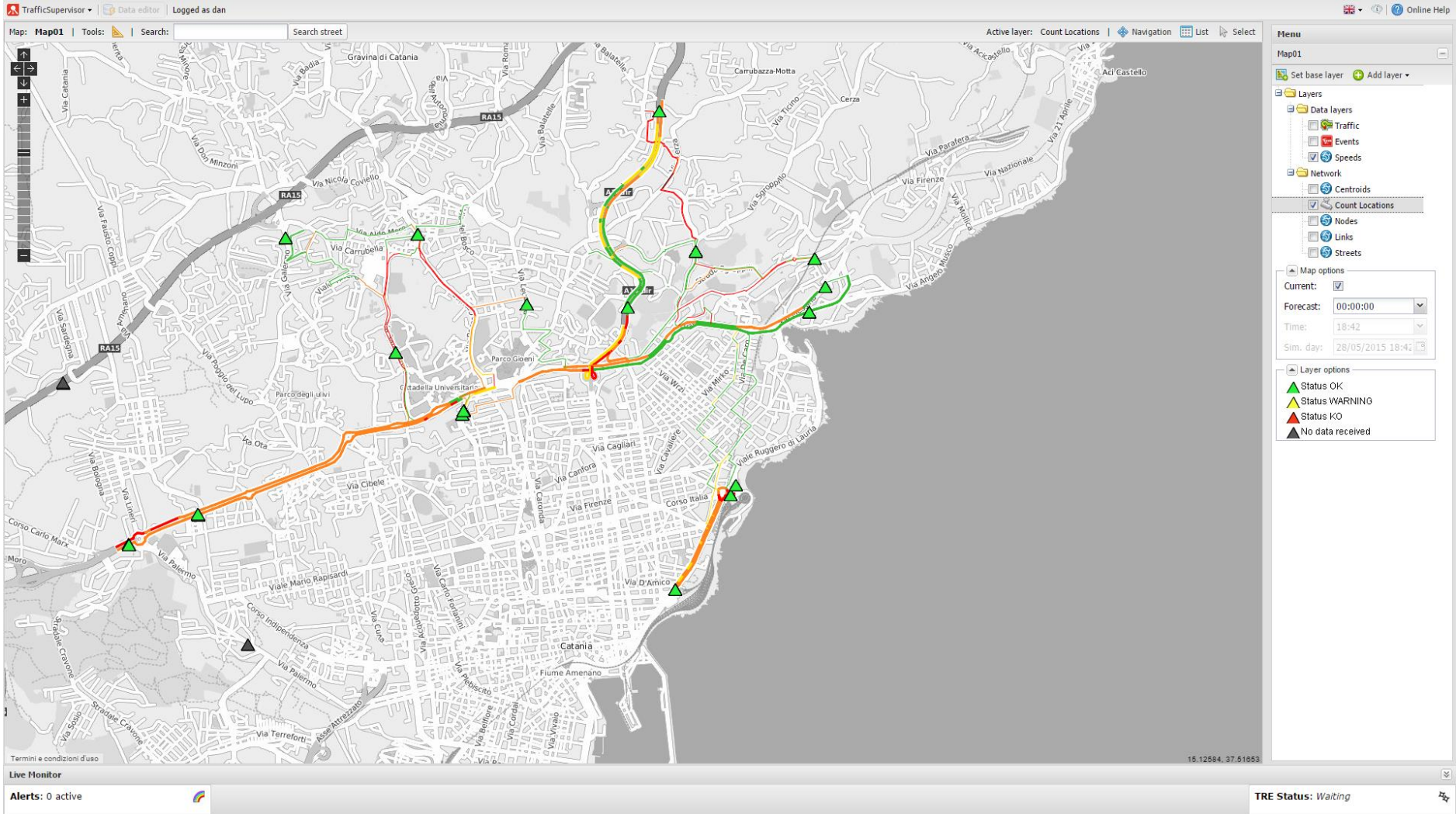


Effects of traffic signals lower speeds



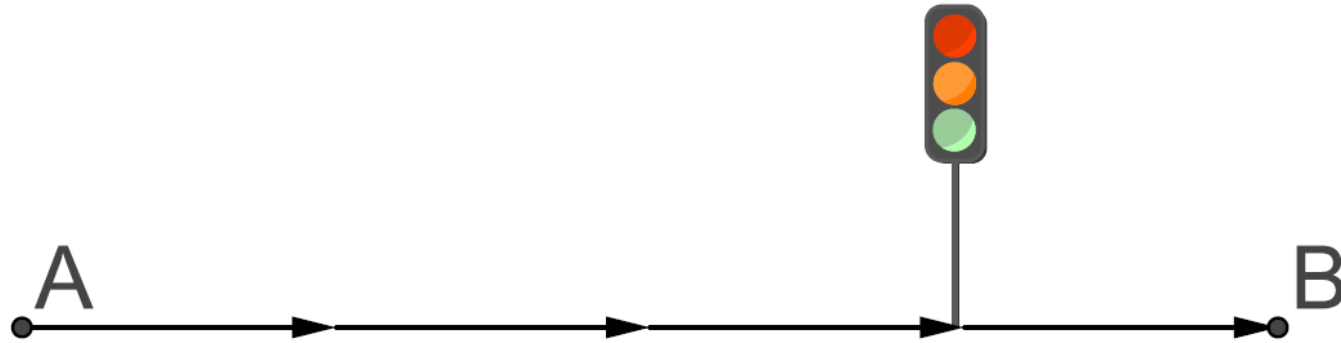


Travel times via Bluetooth portals





The presence of traffic lights in travel time measures



average speed



link speed





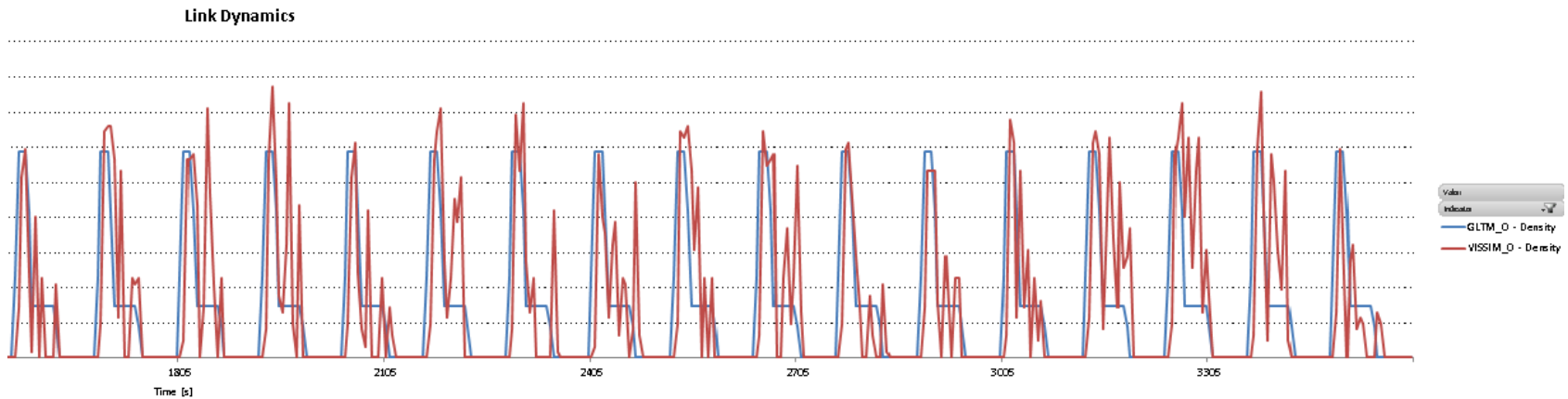
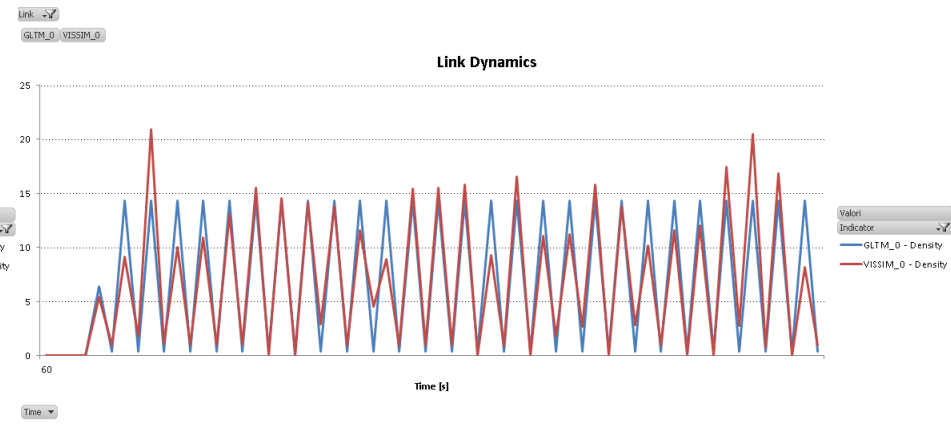
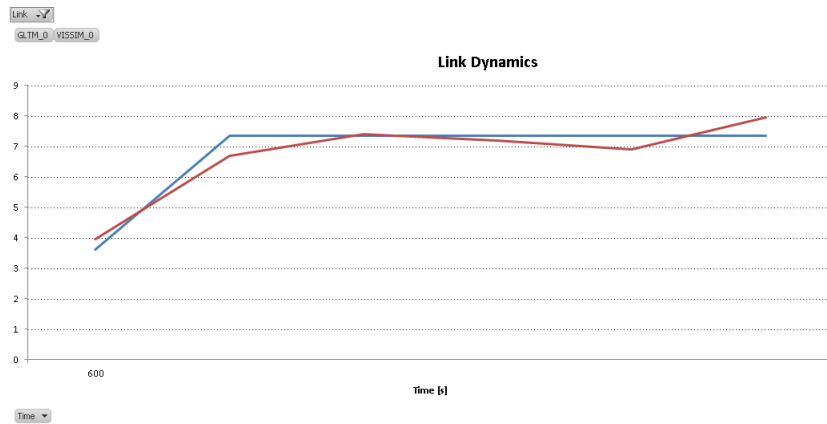
REAL WORLD APPLICATIONS HISTORY OF OPTIMA



VISSIM

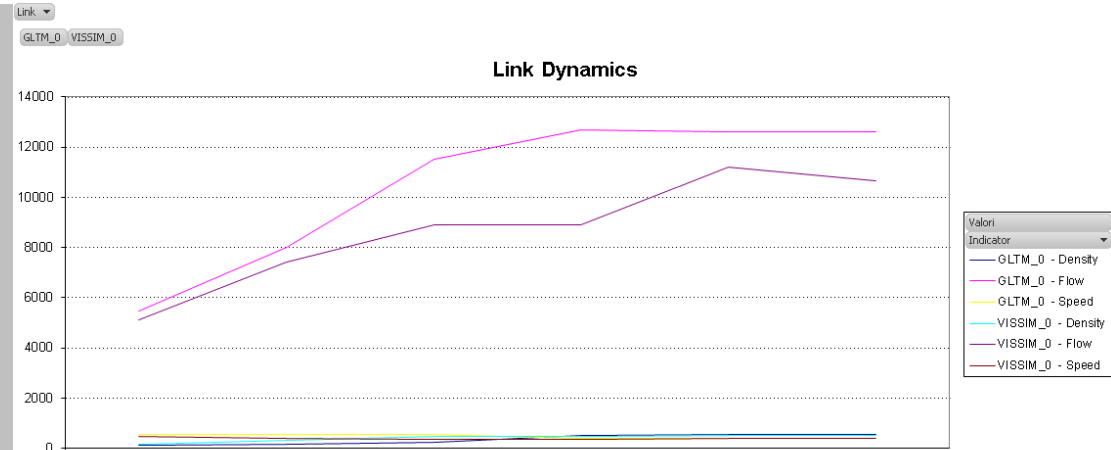
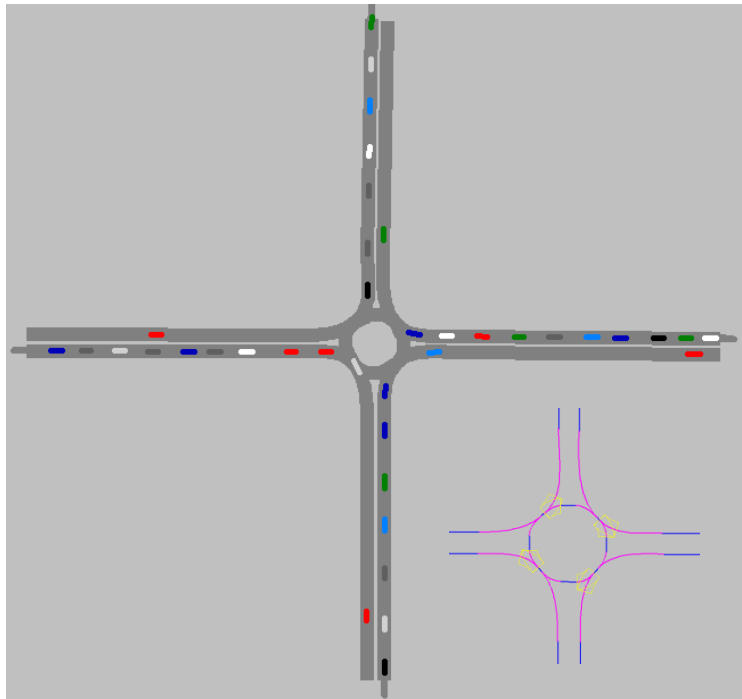
link with ending signal

Average density (number of vehicles)

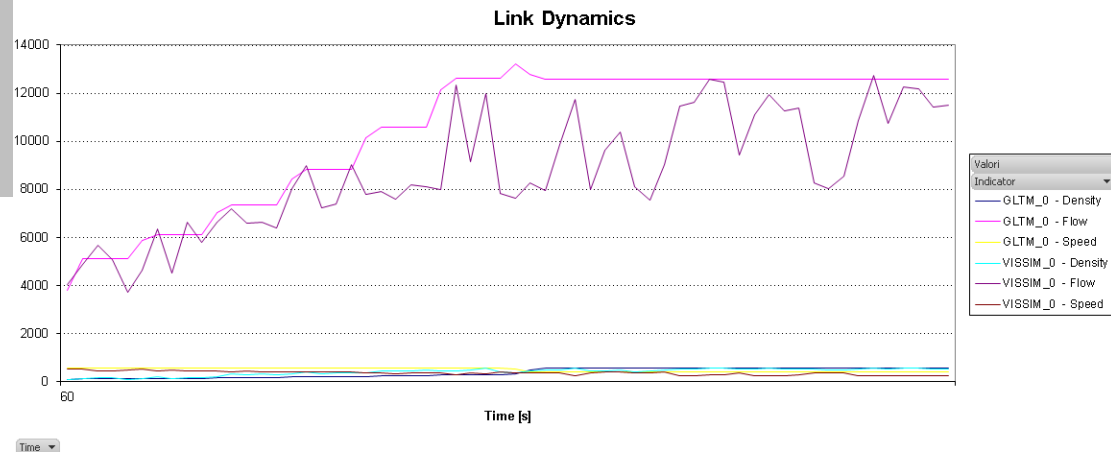


VISSIM

link with roundabout



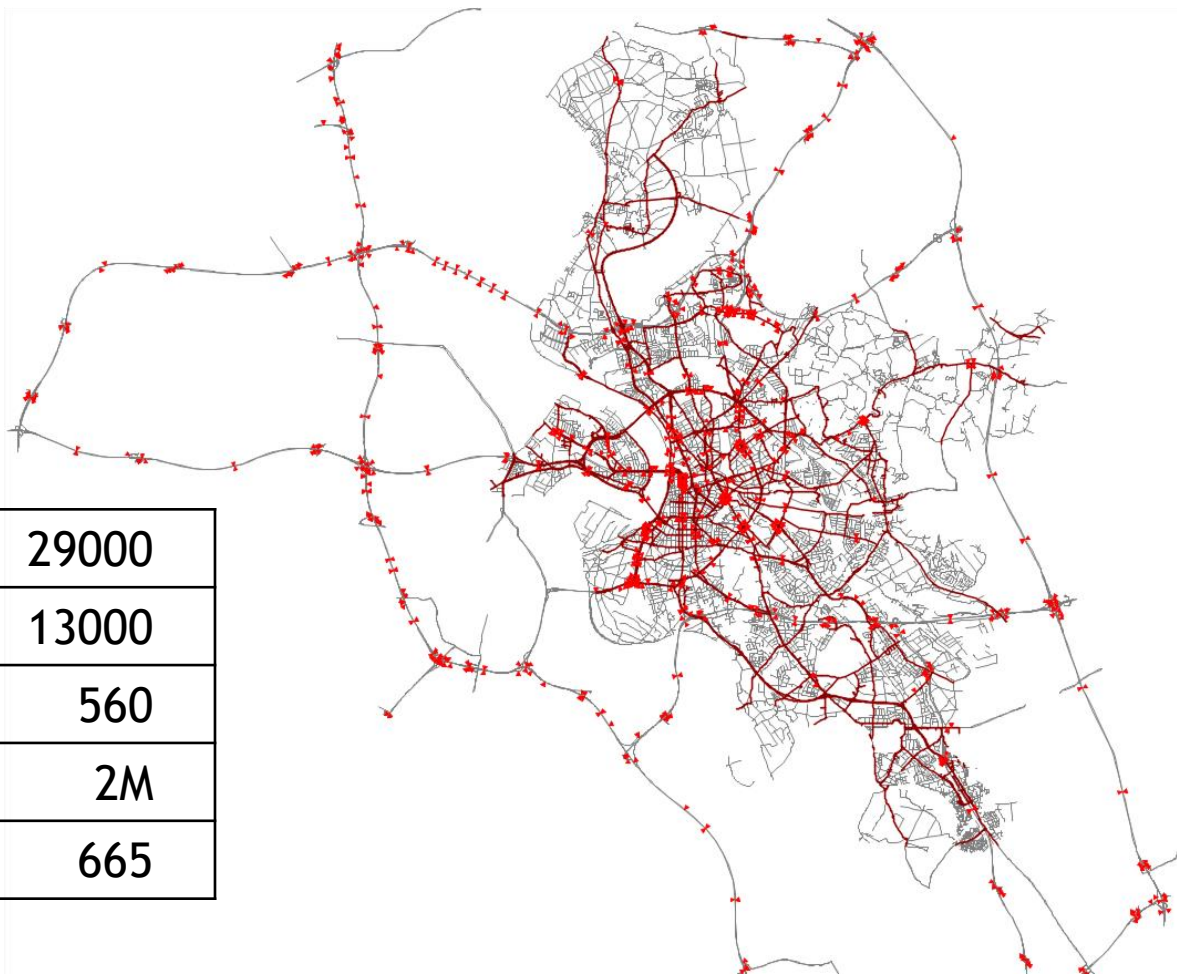
- New phenomena were added in the DTA simulation





Dusseldorf Test

validation of base functionalities

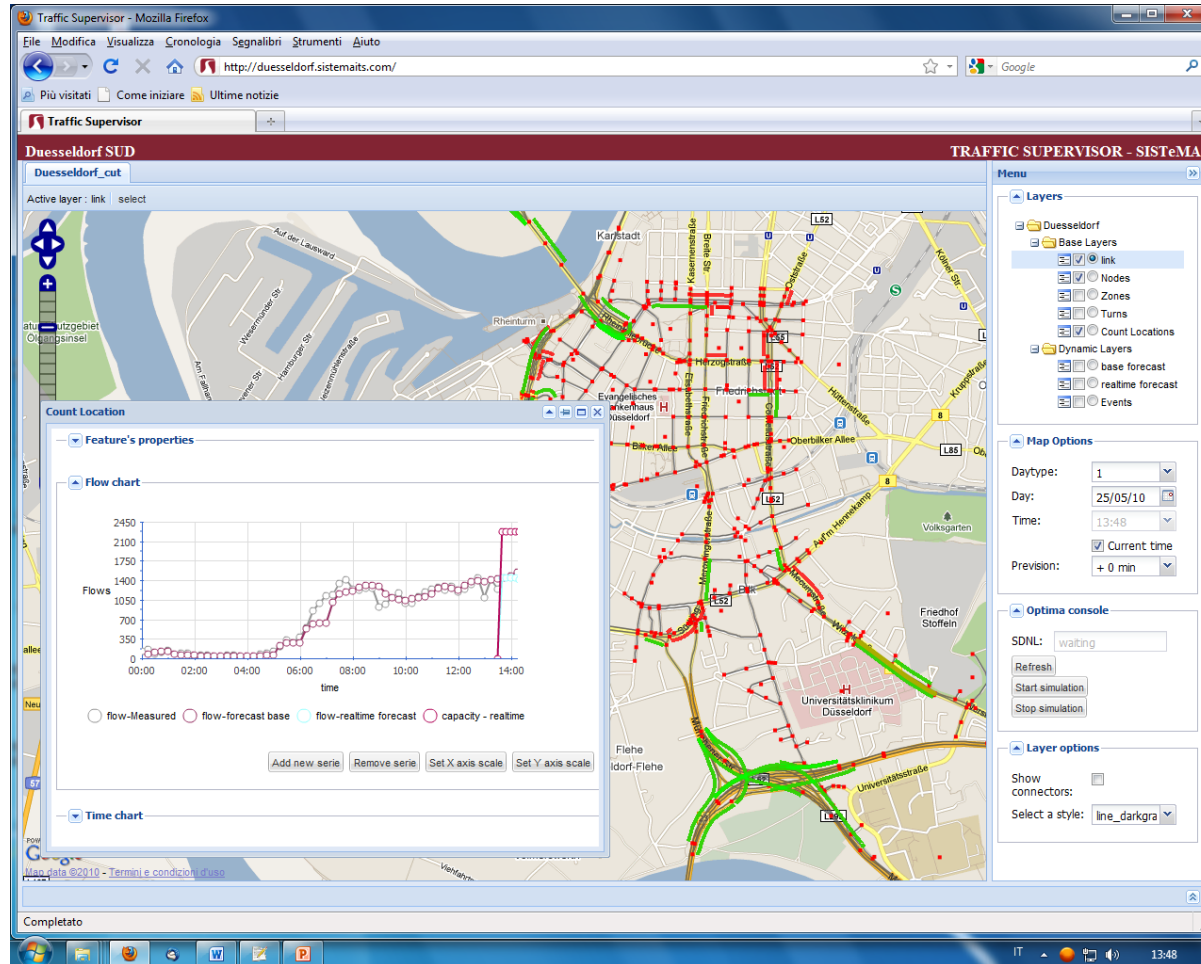


Links	29000
Nodes	13000
Zones	560
OD components	2M
Count locations *	665

* with some counts



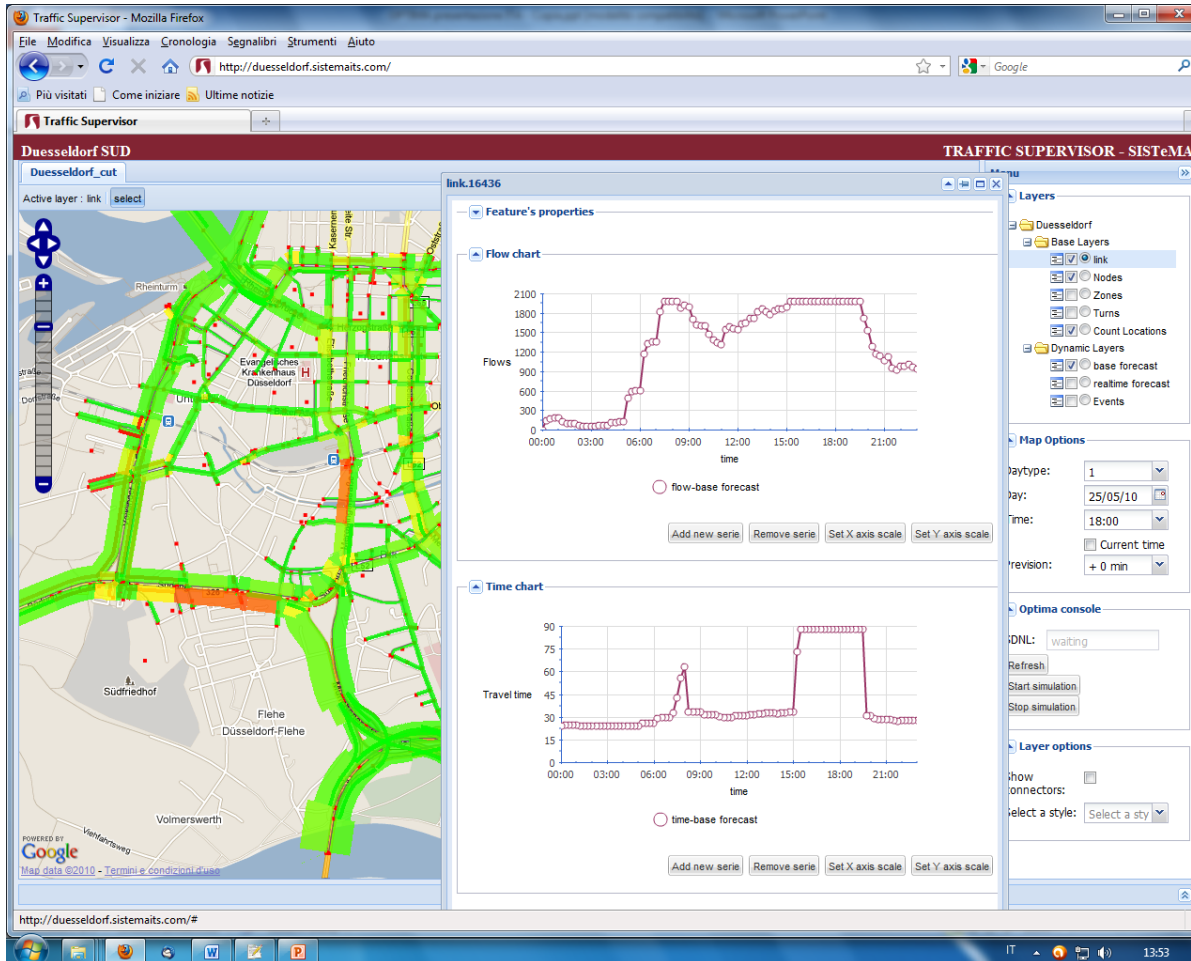
Realtime monitoring with loop detectors and FCD



- Fixed (and moving) probes
- Don't cover the whole network
- Allow forecast only when easy
- They can be integrated with transport models
- For realtime data completion and traffic forecast



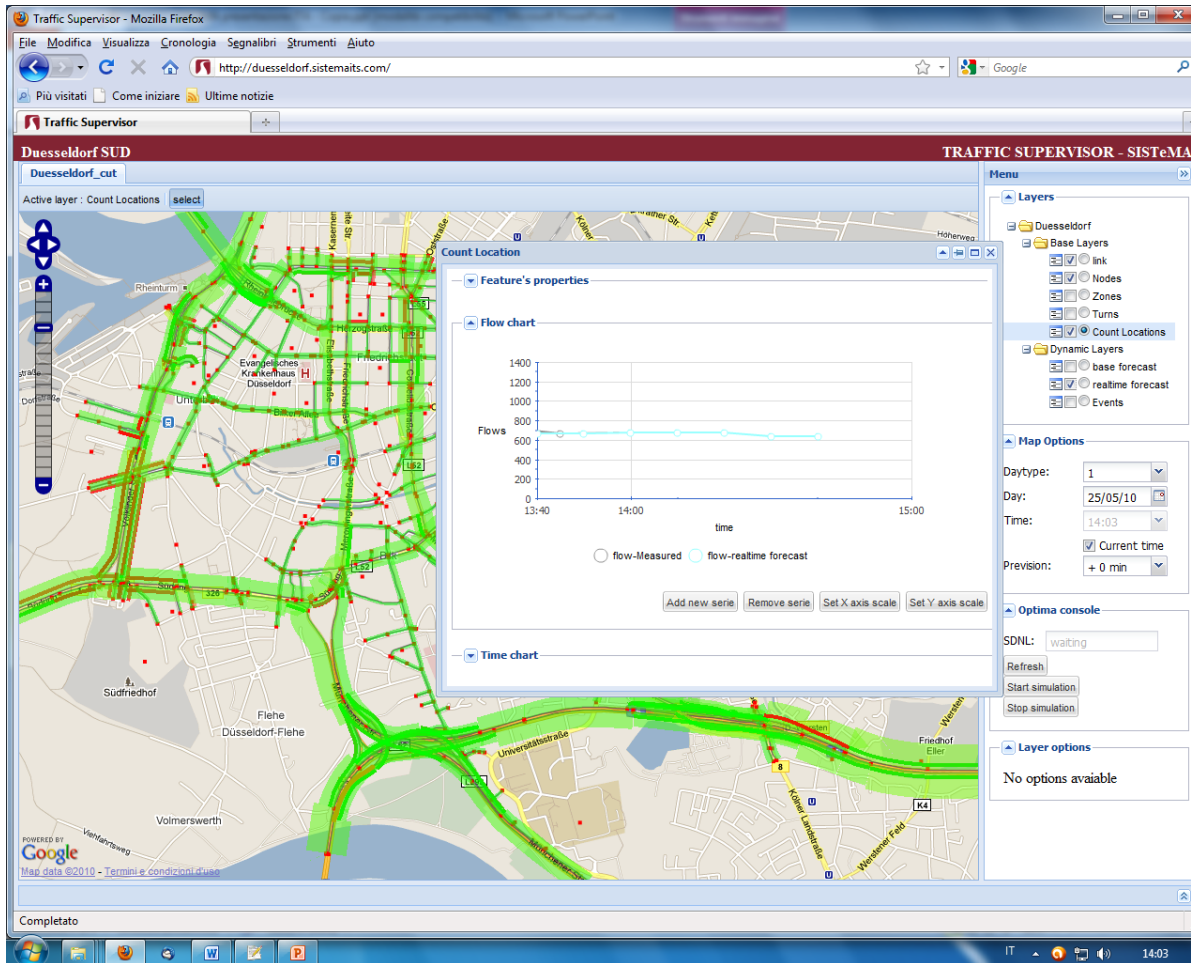
Day-type based forecast with Dynamic User Equilibrium



- Variables are functions of time
- Travel demand Origin-Destination matrices
- Road network with speeds and turn capacities
- Macroscopic flow model can reproduce queues and spillback
- Yields route choice as splitting rates



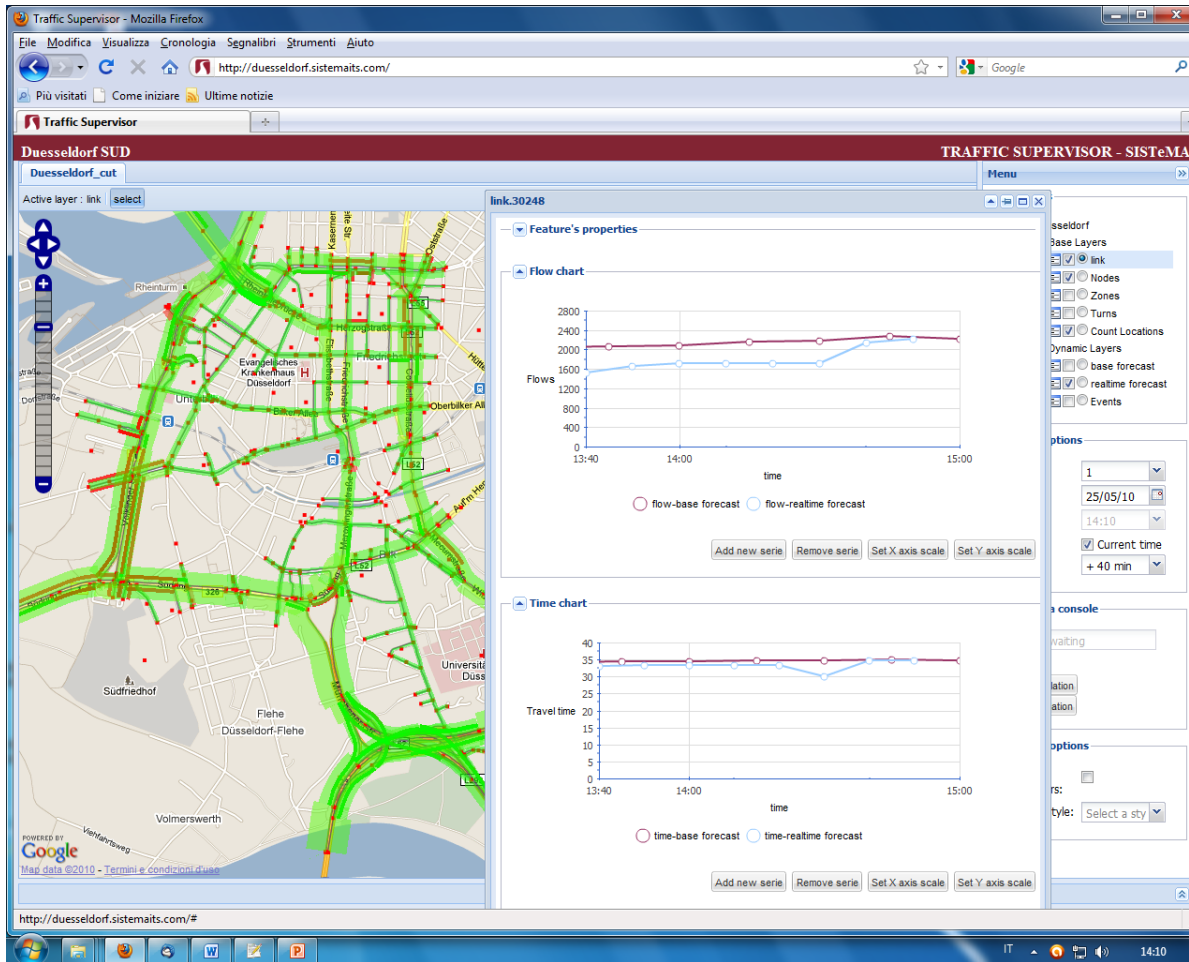
Realtime data completion



- Flow and queue corrections on monitored links wrt base forecast
- Propagate on the network based on daytype time varying splitting rates
- This allows to estimate congestion on all links

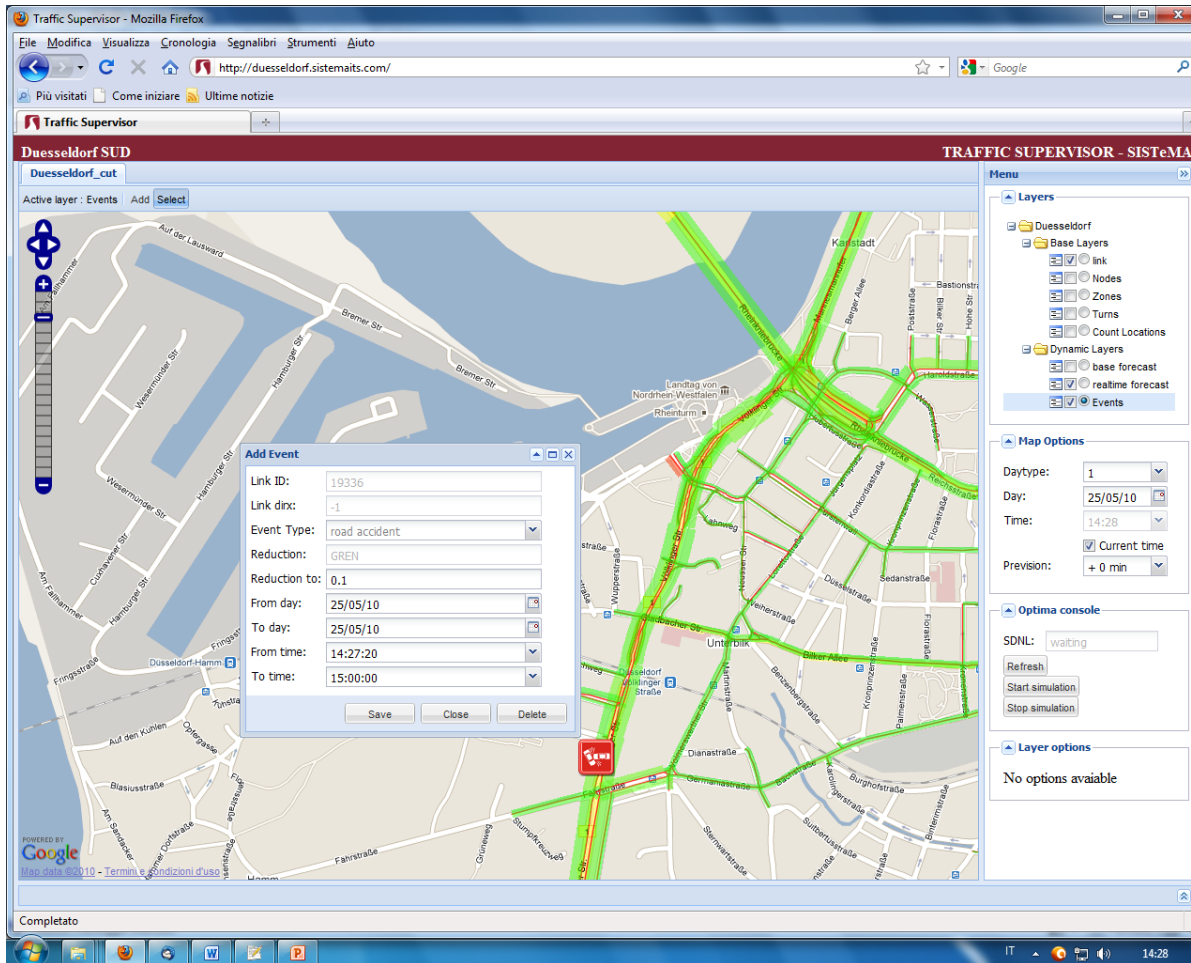


Realtime traffic forecast



- Rolling horizon simulation
- This allows for within day forecast
- Queues are persistent and last more than vehicle travel times

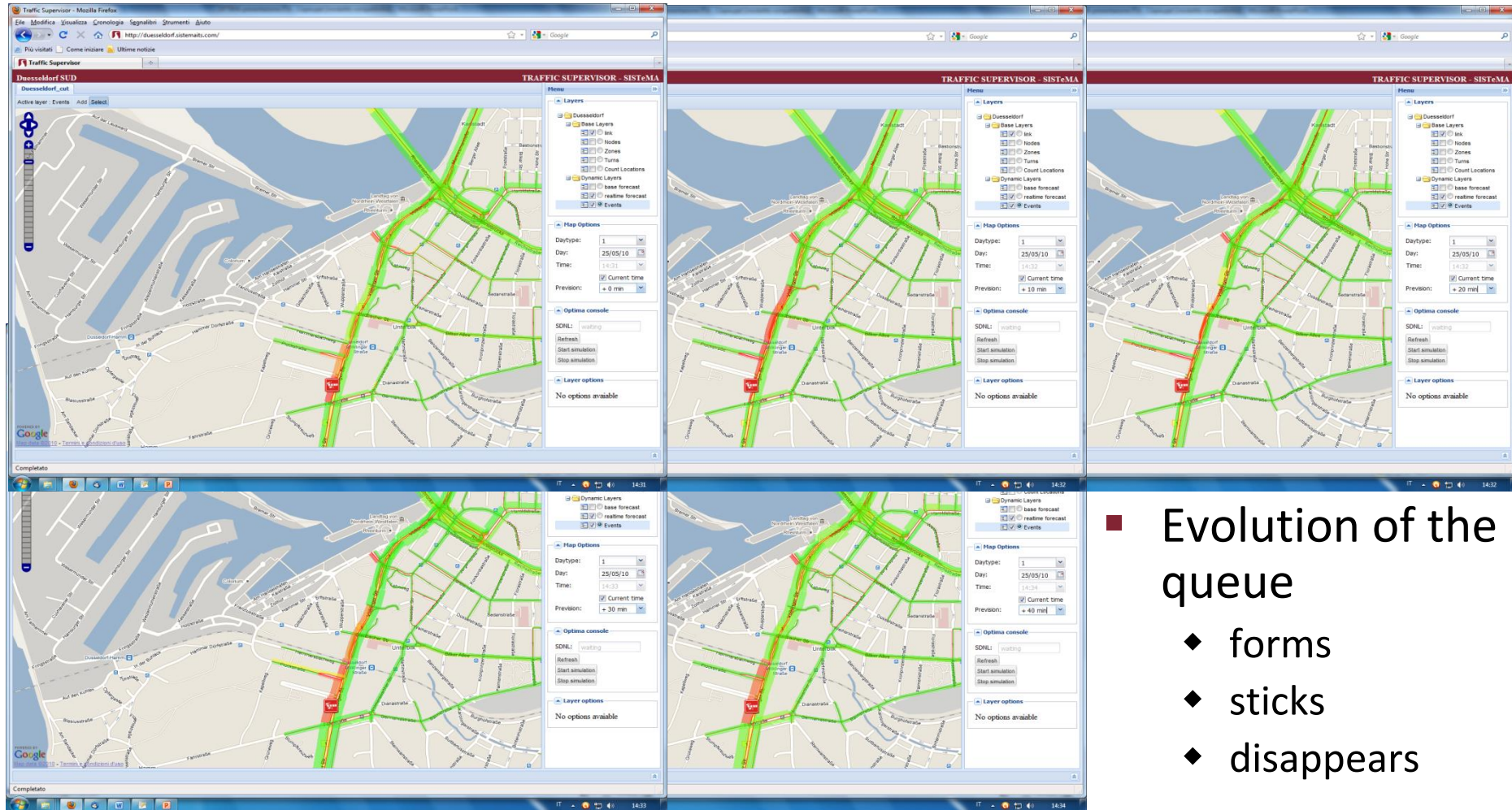
Event manual insertion



- Click on the link
- Insert
 - ◆ Event type
 - ◆ capacity reduction
 - ◆ from day and time
 - ◆ to day and time
- In this case, 30 minutes block
- Then click start simulation



Forecast the effects of events



- Evolution of the queue
 - ◆ forms
 - ◆ sticks
 - ◆ disappears



Dusseldorf Test performance evaluation

- Traffic state forecasts
 - ◆ up to 1 hour ahead every ten minutes

RAM requirements	
Simulation	0,5 Gb
DB	4,7 Gb
Calculation times	
Input & Initialization	4'39"
Import & Process Vehicle Counts	10"
Perform Dynamic Network Loading	1'39"
Export results into DB	19"
Total for a single run	2'08"



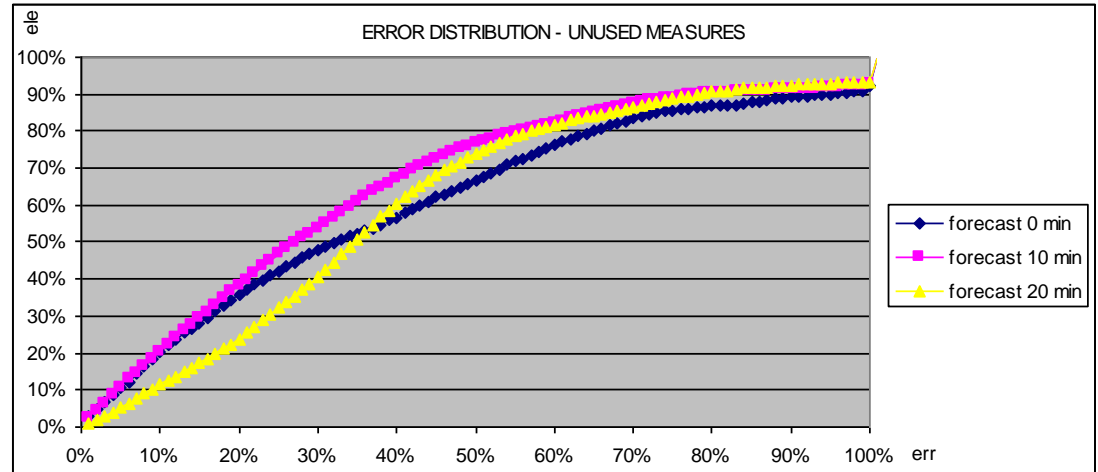
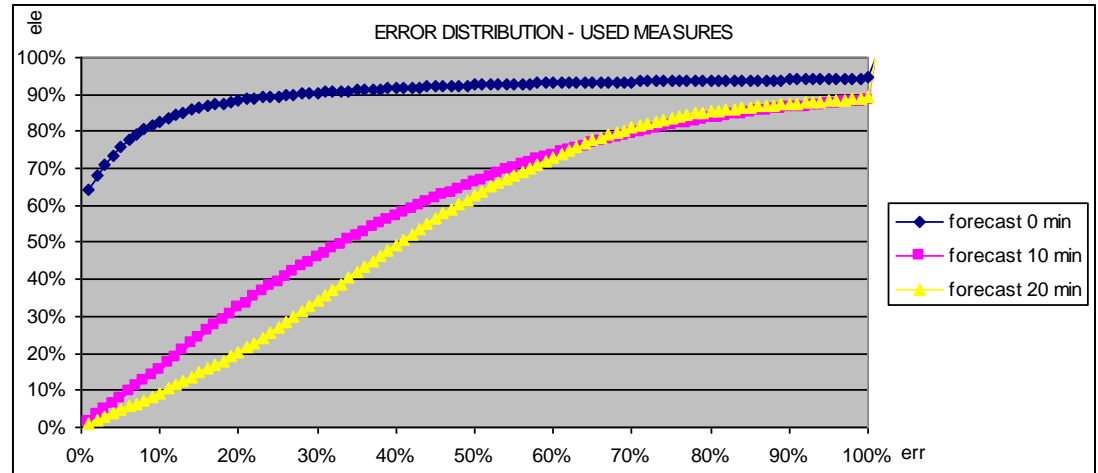
Dusseldorf Test aggregated quality evaluation

USED MEASURES

forecast	ro square
0 min	0.95
10 min	0.70
20 min	0.55

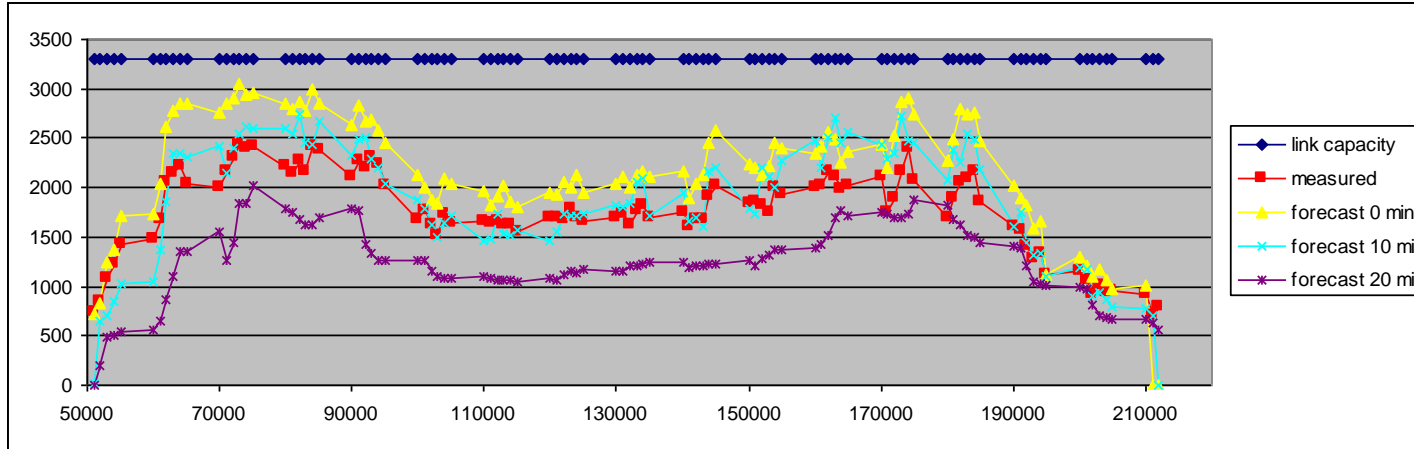
UNUSED MEASURES

forecast	ro square
0 min	0.81
10 min	0.85
20 min	0.59

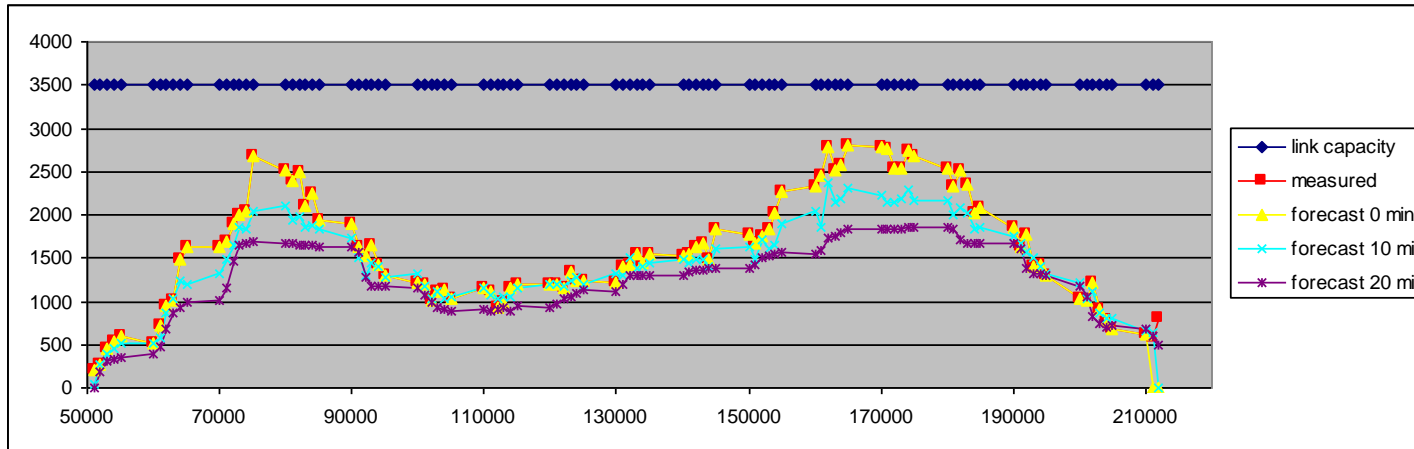




Dusseldorf Test quality evaluation by link



**Unmonitored
location**



**Monitored
location**



Traffic Information in Romania – Data Fusion and Warehouse

The image displays the TrafficSupervisor 2.0.7 software interface, which is used for traffic data fusion and warehouse management. The interface is divided into several panels:

- Top Left:** A street map of Düsseldorf, Germany, showing traffic flow and congestion levels. The map is color-coded, with green indicating free flow and red indicating congestion.
- Top Right:** A network map showing a dense network of roads and nodes. Nodes are color-coded (red and green) to represent different traffic states or data points.
- Bottom Left:** A 'Year Overview 2014' chart showing traffic volume over time. The chart includes a 'Detailed data' section for a specific date range (from 24/12/2014 to 29/12/2014).
- Bottom Center:** A data table with columns for 'Type', 'Status', 'Pubblico', and 'Proprietario'. The table lists various traffic data points and their associated information.
- Bottom Right:** A detailed map showing a circular selection area around a specific location, likely used for analyzing local traffic patterns.

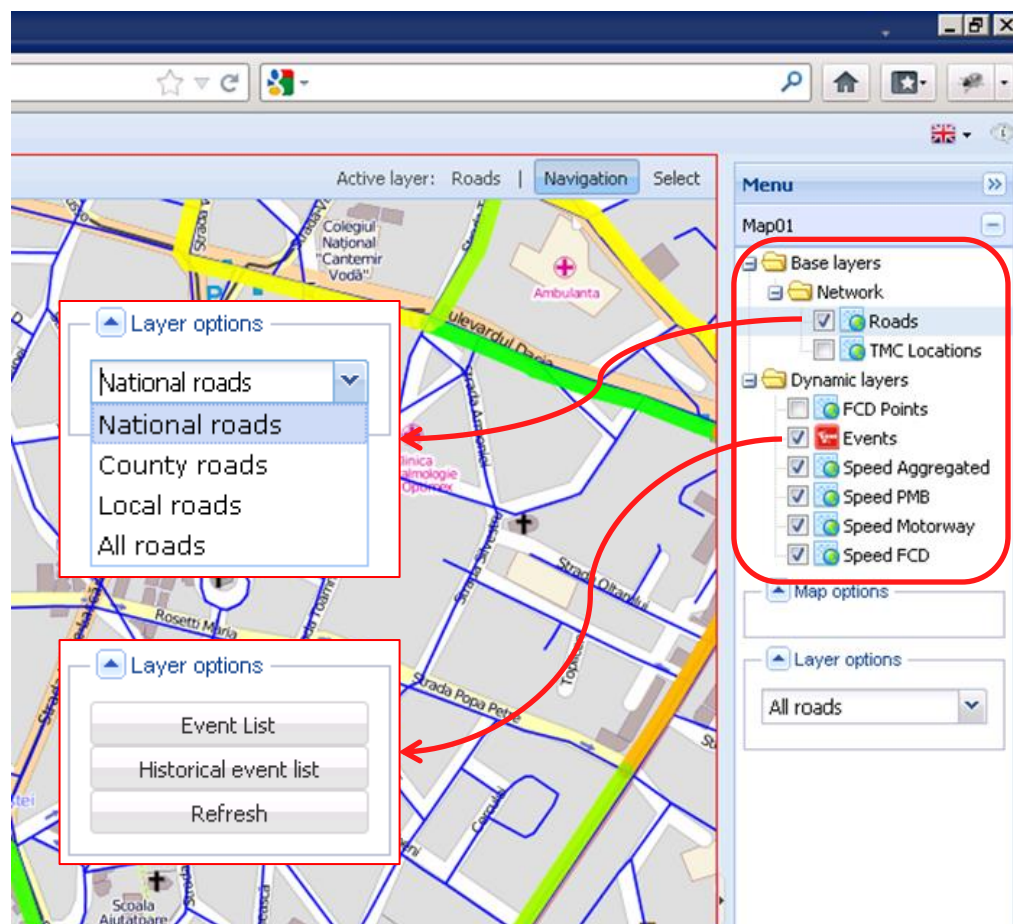


Broadcasting informations

The screenshot displays the TrafficSupervisor 2.0.5 interface. On the left, a map shows a route with various markers. A 'RDS Spy' window displays 'MUZICAL' with a 44% BER and a group CRC of 681. Below it, the 'Basic RDS Decoder' window shows program details for 'Serious Classics / Jazz (14)' from 'RO'. The central 'Group Analyzer' window displays a log of RDS data with columns for time, E, P, S, C, and various parameters. At the bottom, a 'Group Detector' window shows a grid of checkboxes for different group identifiers (0A-15A). The Windows taskbar at the bottom shows the Start button, system tray, and the date/time: 7:42 PM, 9/10/2012.

Map interface with GIS layer tree

- Static layers
 - ◆ Roads
 - ◆ Traffic signals
 - ◆ TMC locations ...
- Dynamic layers
 - ◆ FCD points
 - ◆ Events ...
- LOS layers
 - ◆ Harmonized Speeds
 - ◆ FCD speeds ...





Road layer: link attributes and speed chart

The image shows a GIS interface with several components:

- Map View:** A map of a city area with roads highlighted in yellow and green. A red box labeled '2' highlights the 'Navigation' and 'Select' buttons. A red arrow labeled '1' points to the 'Roads' layer in the 'Network' folder of the 'Map01' menu. A red circle labeled '3' highlights a specific road link on the map.
- Map01 Menu:** Shows the layer structure. Under 'Network', 'Roads' is checked and highlighted with a red arrow (1). 'Dynamic layers' is expanded to show the selected link.
- History Speed Chart (Top Right):** A dialog box for the selected link (ID: 54474). It lists attributes such as tail node id (44142), head node id (44499), link name (Bulevardul Golescu Dinicu, Bucuresti), link length (257.59454924834506 m), road hierarchy (5), bspe (35.0), flow capacity (900.0 veh/h), and direction (-1).
- Speed Chart (Bottom Right):** A line chart showing speed over time from 06:00 to 10:00. The y-axis represents speed (10-70). The legend includes Speed PMB (yellow), Speed FCD (red), Speed Aggregated (blue), and Speed CNADR (green). The chart shows fluctuations in speed, with a notable dip around 07:00.
- History Speed Chart (Bottom Left):** A smaller version of the attribute dialog box for the selected link.



Event processing

The image illustrates the event processing workflow in a traffic simulation software. It is divided into three main stages:

- add:** A map view showing a road network with a red arrow pointing to an 'Add' dialog box. The dialog box has fields for 'Done', 'Reset', 'Accept', and 'Cancel'.
- specify:** A configuration window titled 'Events' with tabs for 'Duration', 'Location', and 'Events'. The 'Events' tab is active, showing fields for:
 - Situation ID: ELSOL_SITN_1342444815459
 - Source: ELSOL
 - Valid:
 - Creation user: tommaso
 - Version user: tommaso
 - Creation time: 16/07/2012 16:20
 - Version time: 16/07/2012 16:20
 - Start time: 16/07/2012 16:20
 - End time: [empty]
- manage:** An 'Event List' window showing a table of events. The table has columns for Situation ID, Event ID, Version, Categories, Event description, and Situation Description.

Situation ID	Event ID	Version	Categories	Event description	Situation Description
31	31_L	67	Road management	on DN17A between Km21,4 03176 and Km21,8 03176 in both directions narrow lanes from 12:17 of 17/04/2012	on DN17A between Km21,4 03176 and Km21,8 03176 in both directions narrow lanes from 12:17 of 17/04/2012
32	32_L	67	Road management	on DN17A between Km21,7 and Km21,8 03176 in both directions narrow lanes from 12:17 of 17/04/2012	on DN17A between Km21,7 and Km21,8 03176 in both directions narrow lanes from 12:17 of 17/04/2012

visualize

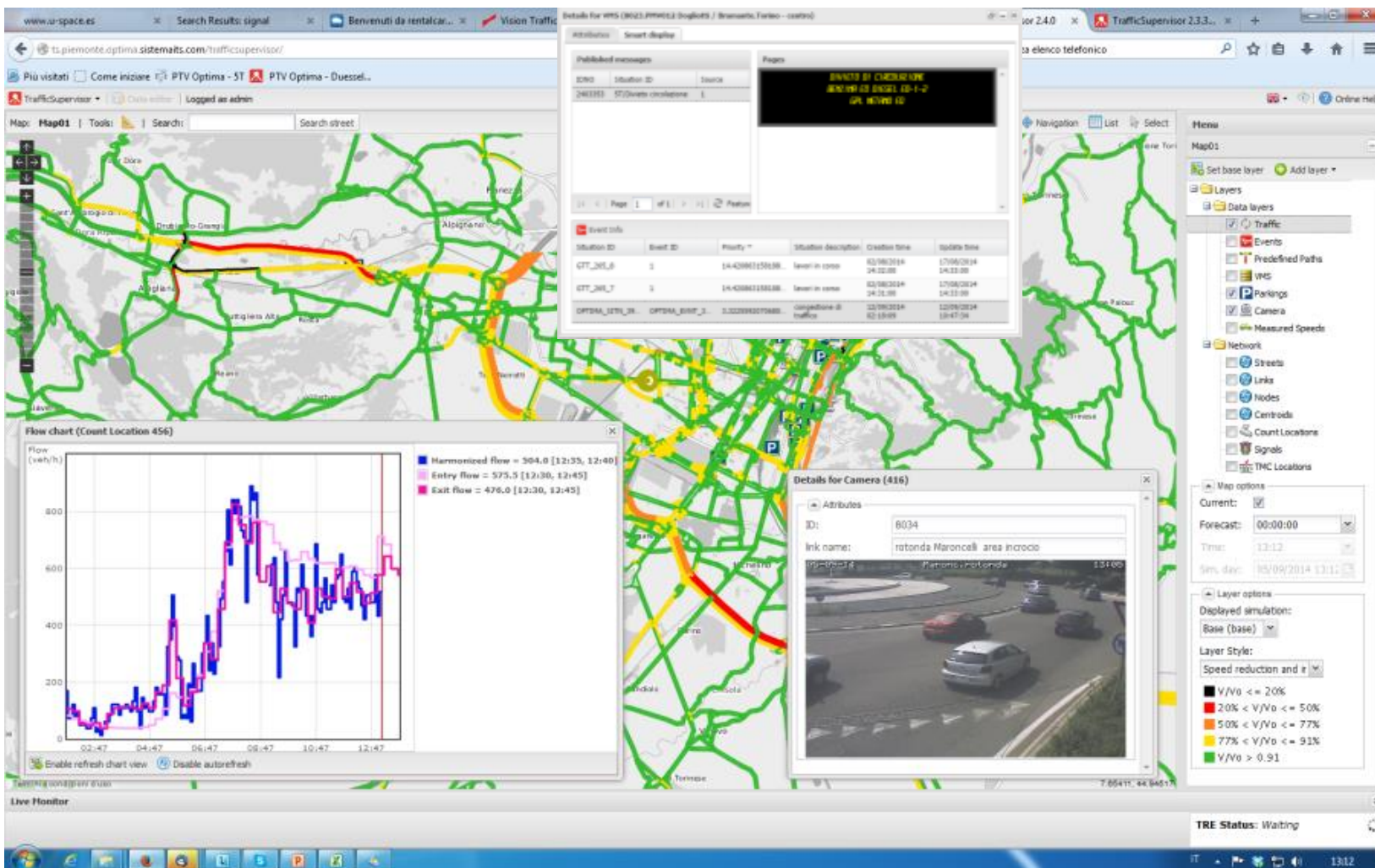
add

specify

manage

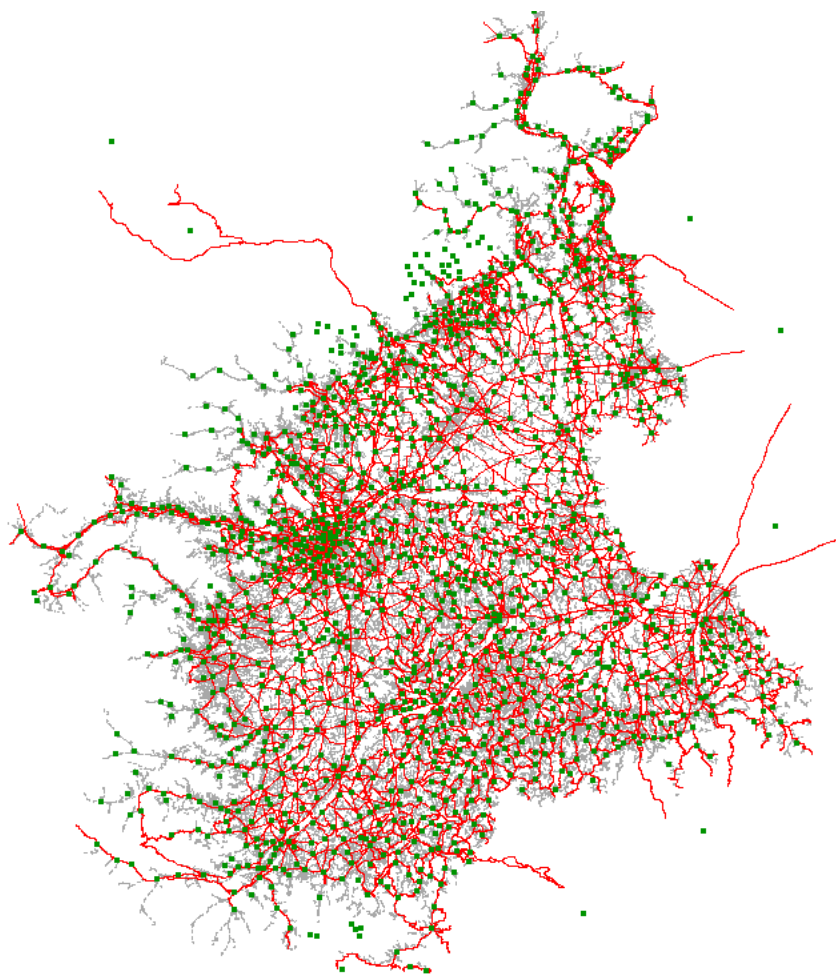


5T Regione Piemonte a comprehensive project





On a large network



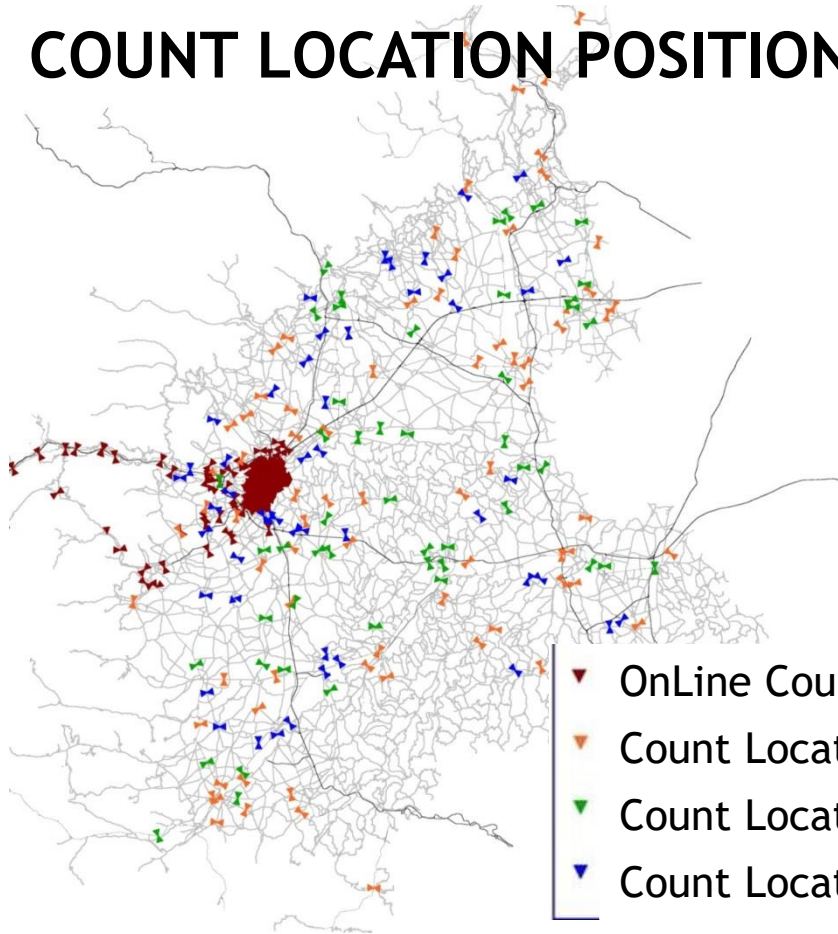
Number of Navteq Links	795.000
Model Links	268.000 (80.000 after graph simplification)
Zones	2.000 internal zones 8 cordon zones



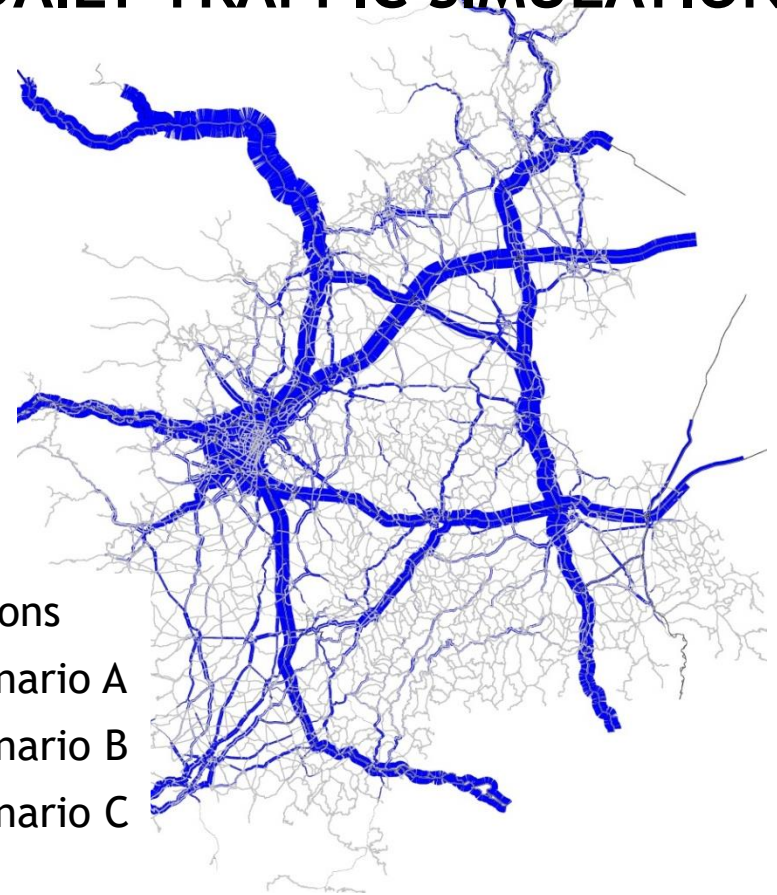
**Tecnologie
Telematiche
Trasporti
Traffico
Torino**

Network Sensor Location Problem

COUNT LOCATION POSITION



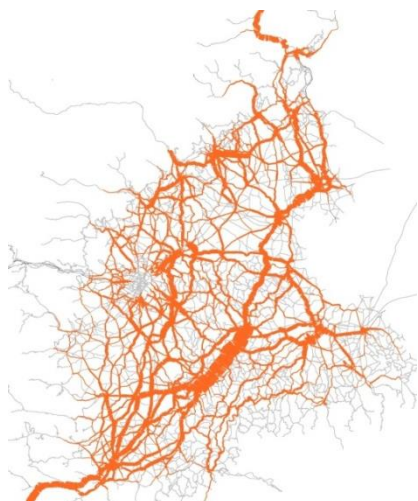
DAILY TRAFFIC SIMULATION



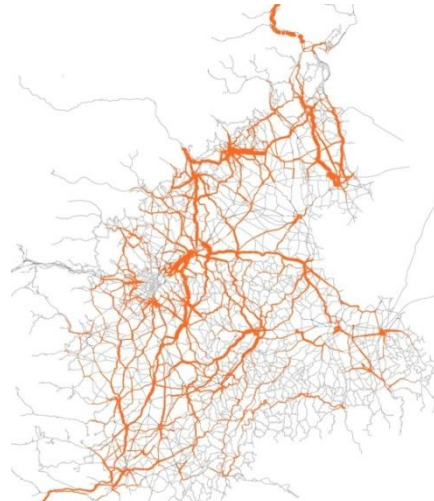
- ▼ OnLine Count Locations
- ▲ Count Locations Scenario A
- ▼ Count Locations Scenario B
- ▼ Count Locations Scenario C

Network Sensor Location Problem

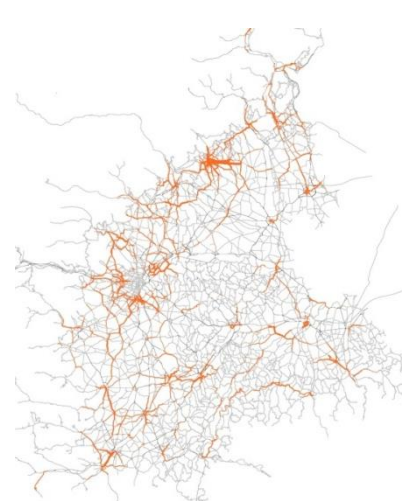
Scenario	% monitored link flows	% monitored OD flows	% monitored OD relations
Current	1.10%	24.21%	66.36%
A	1.20%	36.60%	78.60%
B	1.30%	44.20%	86.30%
C	1.37%	49.38%	90.62%



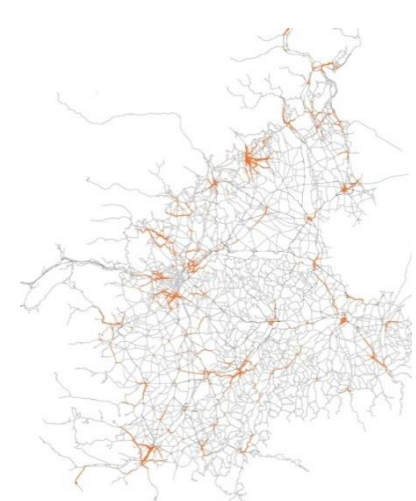
CURRENT SCENARIO



SCENARIO A



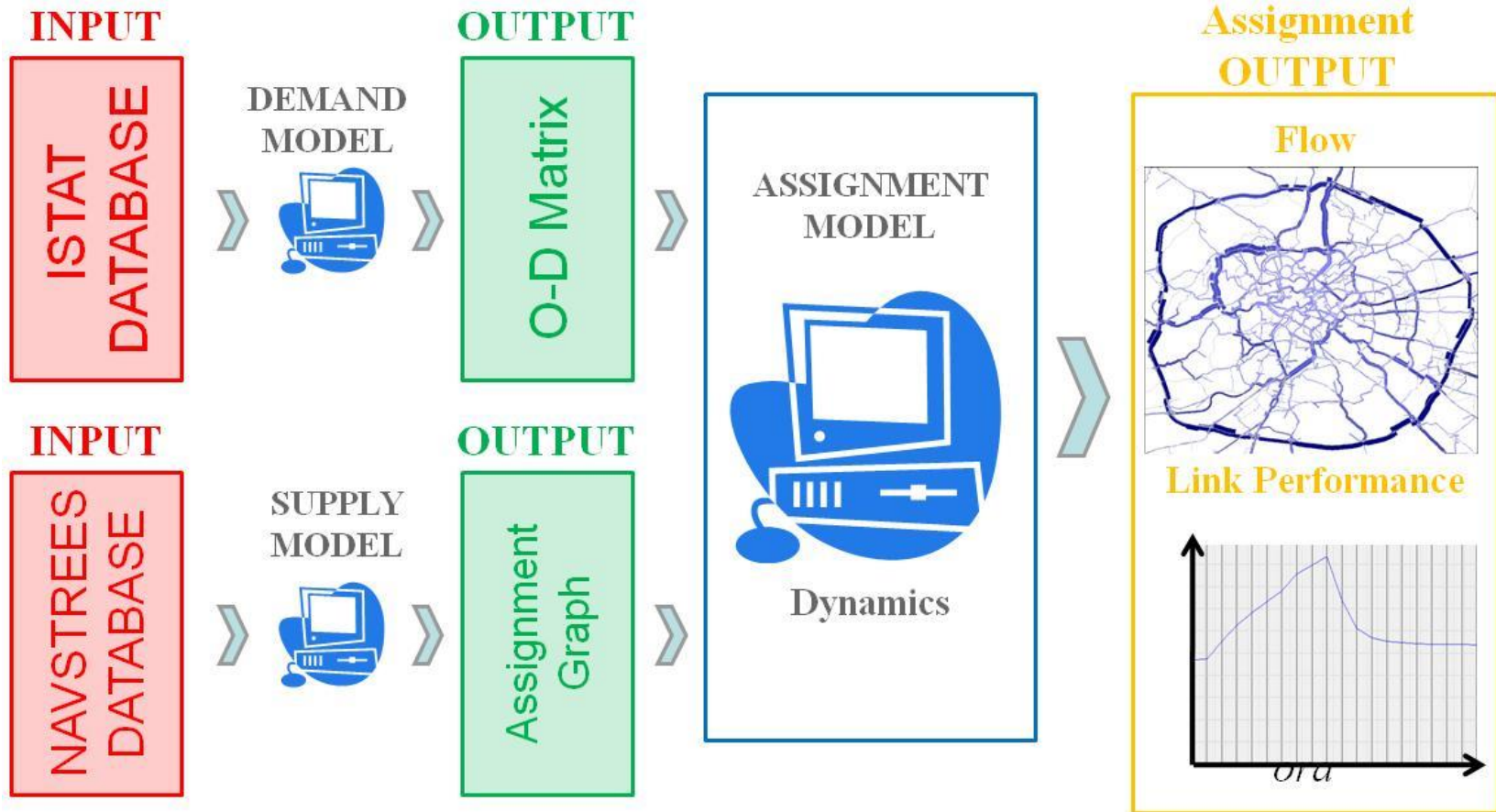
SCENARIO B



SCENARIO C



Transportation Model Builder with guided map updates





VMS

Virtual Message Sign

TrafficSupervisor | Data editor | Logged as daniele.tiddi

Map: | Tools: | Search: | Search street | Clear Search

Active layer: VMS | Navigation | Layer Options | Select

Menu

- Set base layer
- Add layer
- Data layers
 - Measured Speeds
 - Count Locations
 - Prefined Paths
 - Traffic
 - VMS
 - Camera
 - Parkings
 - Events
- Network
 - Streets
 - Links
 - Nodes
 - Centroids
 - Traffic Lights
 - TMCLocation

map options

Current:

Forecast: 00:00

Time: 16:30

Sim. day: 28/05

Layer options

- No data
- Status OK
- Status WARN
- Status DOWN

Details for VMS (8023.PHV012 Dogliotti / Bramante.Torino - centro)

Attributes | Smart display

Published messages

idno	vms	situation_id	event
564...	8023	-pubblicato-	

Pages

```

ZTL BUS CATEGORIA M3
ATTIVA A TORINO
WWW.BUSTURISTICI.TORINO.IT
    
```

Event Info

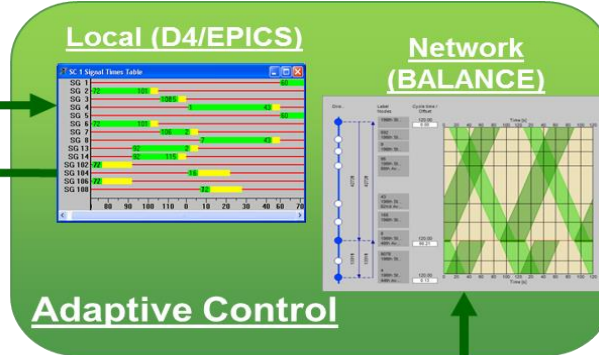
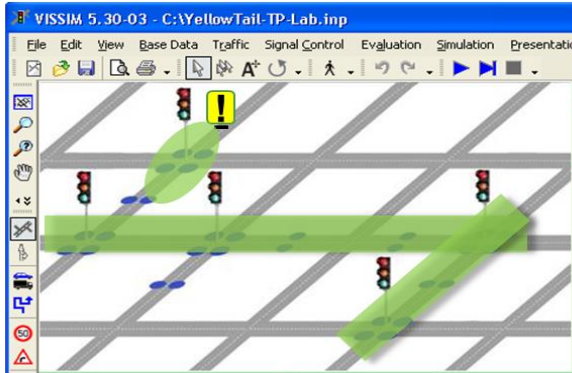
Situation ID	Event ID	Priority	Situation descriptio	Creation time	Update time
SOTTOPASSO LANZA_096_3	1	1980.12908588...	strada chiusa	27/05/2015 01:00:00	27/05/2015 10:53:00
A11431690402_...	1	0.00017088021...	riduzione di carreggiata	18/05/2015 08:00:00	19/05/2015 18:26:00

Live Monitor

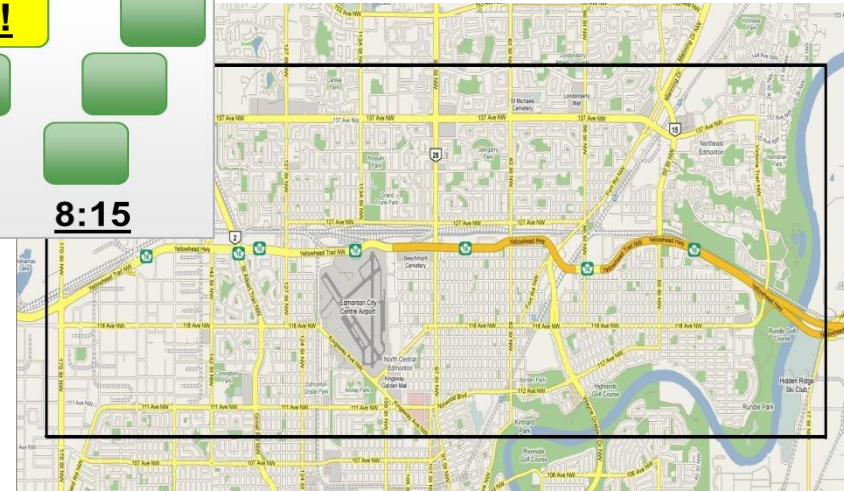
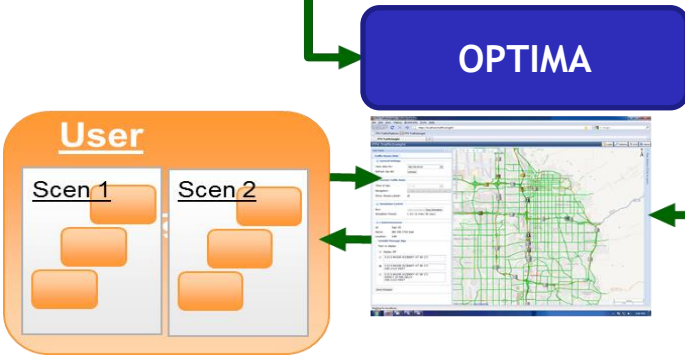
TRE Status: PerformingSimulation



Edmonton Lab (VISSIM) OPTIMA + BALANCE

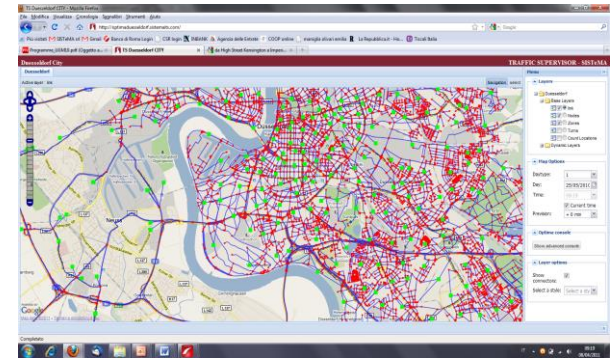
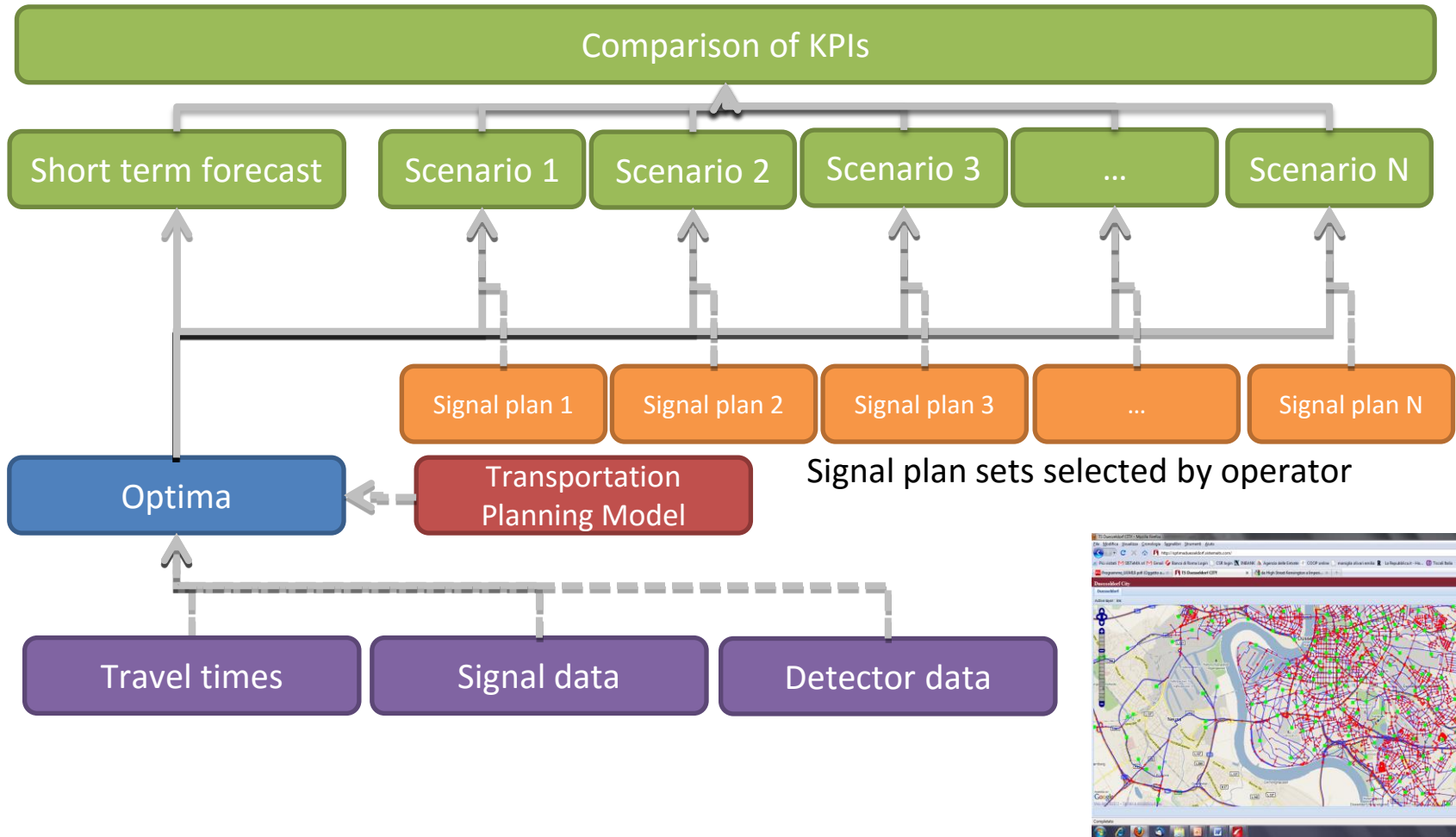


6 miles (10 km)
31 signals





London Pilot OPTIMA to drive SCOOT





Scenario evaluation and comparison with KPI

Optima console

Simulations Settings | Simulation Group Queue | SDNL

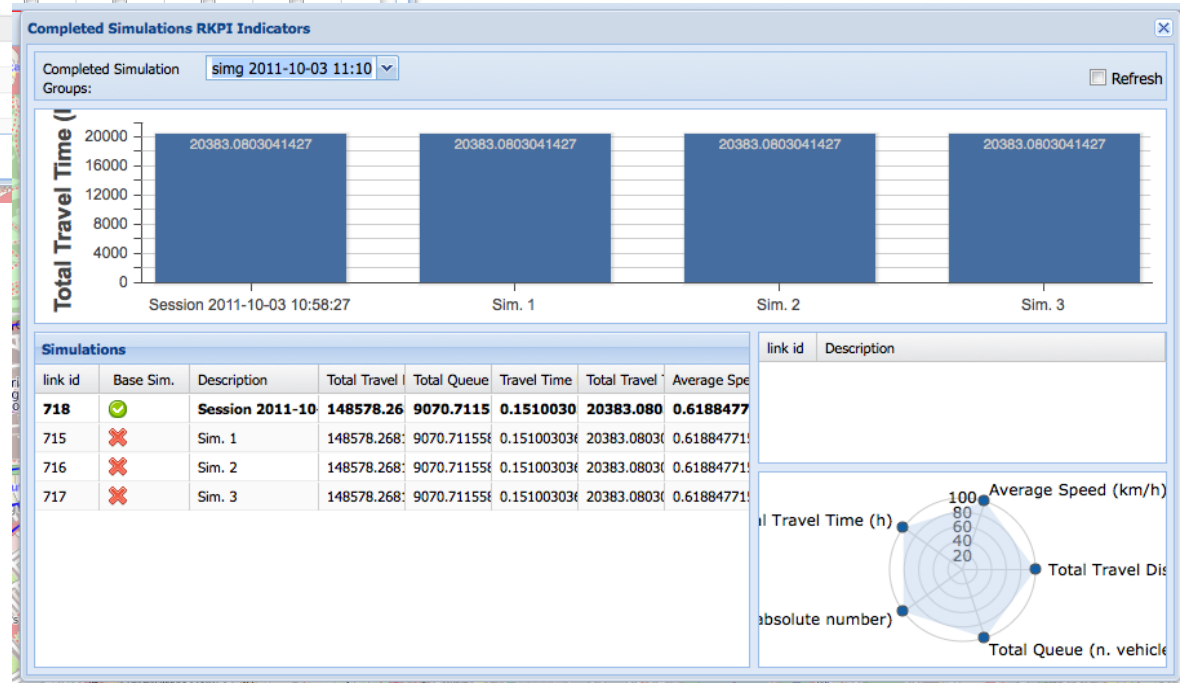
Scenarios			Base Sim.	Extra Simulations			
link id	Description	Priority	Active Scen.	Sim. 1	Sim. 2	Sim. 3	Sim. 4
1360000	136: GYRATOTY CLEARANCE	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1360000	136: VICTORIA BUS TERMINUS CLEARANCE	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1360000	135: STATE OPENING	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1360000	135: REMEMBRANCE SUNDAY	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1350000	135: ASSIST VICTORIA ST. EB R/T INTO ARTILLERY ROW (BT WORKS	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1350000	135: freewheel assists east west and right turn into artillery	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1350000	135: REVIEW TEST PLAN - OVERNIGHT EVENING (80s) (EMB 17-03-08	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1350000	135: REVIEW TEST PLAN - LATE EVENING (80s) (EMB 17-03-08)	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Group Name: simg 2011-09-30 17:06:53
Load From Previous Simulation Group: Select a group

Save

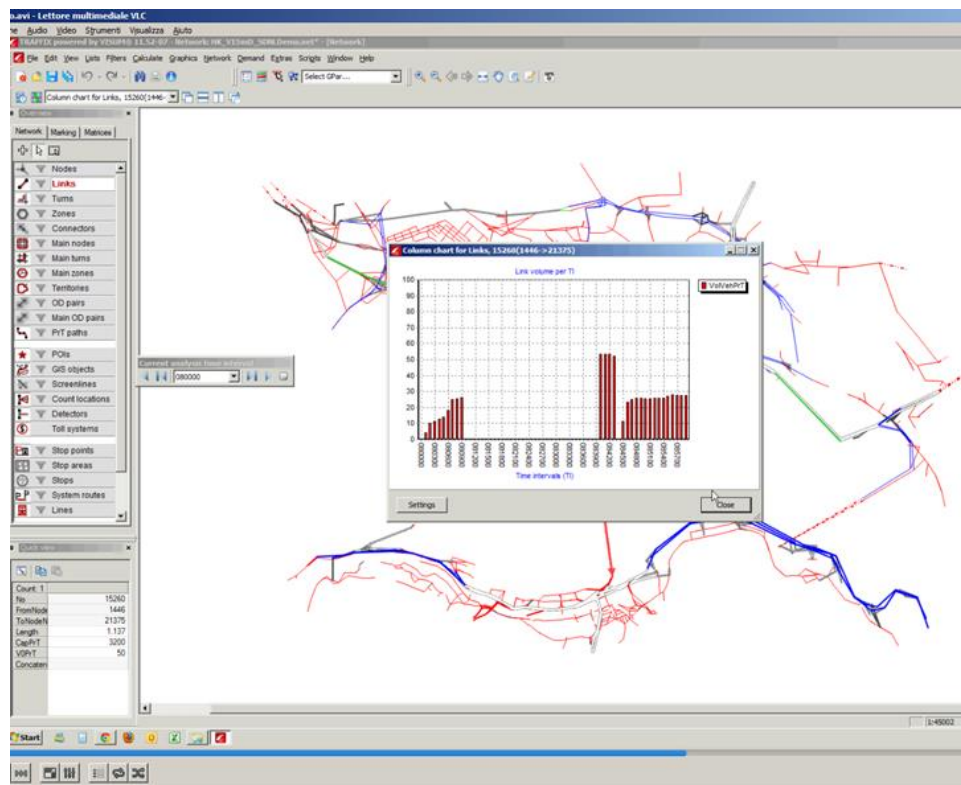
- Build alternative scenarios
- Run multiple simulations in real time
- And "do nothing" situation

- Evaluate KPI
- Compare and rank alternative solutions
- against "do nothing"



Hong Kong Off-line Event Impacts

- Real network
 - ◆ 30.000 links, 2000 zones
- Manual insertion of events
 - ◆ link closure, capacity reduction, speed reduction
- Simulation with drivers rerouting each 5 minutes
- Comparison of traffic situation with respect to
 - ◆ no-incident situation
 - ◆ no-rerouting situation (drivers are unaware of the incident until they stuck in it!)





Infomobility portal subscribe for alerts on forecast



Oggi a Catania
17°C poche nuvole

T. max 17°C

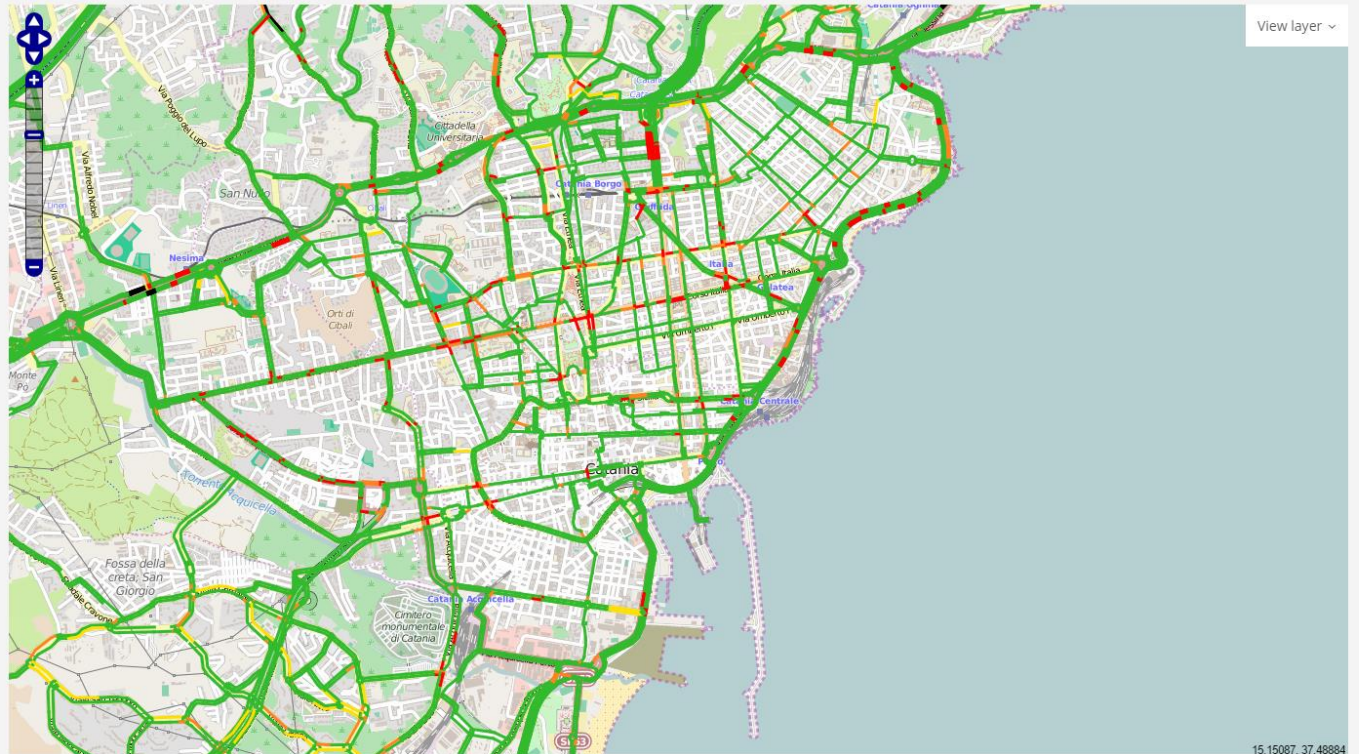
T. min 17°C

Umidità: 74 %

Vento: 1.52 km/h

Events reported

Nessun evento presente per le tipologie selezionate



Want to receive alerts by SMS?

Add mobile phone number in your profile, it's free!

Register

Featured news

13 Feb 2015

Test di prova

Stiamo lavorando per voi →

11 Feb 2015

Calendari controlli Autovelox
Febbraio 2015

7 Feb 2015

Apertura Outlet Novi Ligure

Articolo di prova di Daniele Tiddi. →



Dynamic Journey Planning of Rome with HyperPaths

roma.dps.sistemait.com

RICERCA SOLUZIONE INFO

Partenza: 30/11/2012 17.42

Arrivo: 30/11/2012 17.42

A Via Gradoli, 12-64, 00189 Rome, Ital

B Via della Caffarella, Parco Regionale

Fermate Pulisci Ricerca

Calcola Percorso

Mostra Opzioni Avanzate

Choose the desired time interval when to make your trip

Select your travel preferences

Click the "Get Route" Button

navigate the route

Click on a description text row to center the map on that action

Diversion stops and boarding alternatives have a red border

e description

- partenza da via baldissera 66 roma ore: 09:14 all'arrivo: 45m 16s tratte a piedi: 1295 metri mezzi: 2
- viaggia a piedi da via baldissera 66 roma a PORTONACCIO/ARIMONDI tempo di viaggio: 3m 57s distanza: 198 metri
- cammina: tempo di viaggio: 33s distanza: 37 metri
- alla fermata PORTONACCIO/ARIMONDI, sali sul primo mezzo che passa delle seguenti linee: 409 (STAZ.NE TIBURTINA (MB)), 545 (VERANO) ore: 09:23 all'arrivo: 36m 36s tratte a piedi: 794 metri mezzi: 2
- viaggia: fermate: 6 tempo di viaggio: 10m 36s distanza: 1734 metri

12.22813.41.92476

Fermata Via Nazionale

* ARRIVI *

71 In Arrivo

170 3 Ferm

70 4 Ferm

64 4 Ferm

H 10 Ferm 20'

03/11/2007 14:15

ROMA



VAO Multimodal Trip Planning of Austria

Verkehrswissenschaft Österreich

VAO

ROUTE RESULTS >> DETAILS <<

FROM Rosenhügelstraße, Wien
TO Stammersdorf, Wien
DEPARTURE Mo, 16.09.2013, 18:27
Individual settings have been set!

Public transport [Calculate route](#)

Car
18:27 18:58 0h 31min 29.2 km

Bike
18:27 19:44 1h 17min 21.8 km

Foot [Calculate route](#)

Bike & Ride [Calculate route](#)

Bike Carriage [Calculate route](#)

Park & Ride [Calculate route](#)

Kiss & Ride [Calculate route](#)

Car [Calculate route](#)

Bike
16.09.2013
18:27

Bicycle | 21.8 km | 1h 17min
dep 18:27 Rosenhügelstraße, Wien
arr 19:44 Stammersdorf, Wien

Show altitude profile

Total ascent: 71 m
Total descent: 139 m
Min. elevation: 156 m
Max. elevation: 225 m
Max. uphill gradient: 12%
Max. downhill gradient: 11%

Stammersdorf, Wien
arr 19:44





CONCLUSIONS AND OPEN ISSUES



Some open issue in DTA applied to real-time forecast

- Many types of data and models are available
 - ◆ how to exploit big data in construction and calibration of offline models?
 - ◆ can the machine learning approach be used to also extend measures?
 - ◆ How to best integrate real-time data to correct the DNL model?
- DUE and DNL are robust paradigms
 - ◆ how much does traffic information play a role in elastic demand?
 - ◆ what actually happens in real time with rerouting?