



# TOMS

## Traffic Online Monitoring System for ITS Austria West





# ITS West Upper Austria

**Goal:** Real-time traffic situation for Upper Austria (deliver to the „Verkehrsauskunft Österreich“ – VAO)



**Solution:** Development of  
Traffic Online Management System (TOMS)

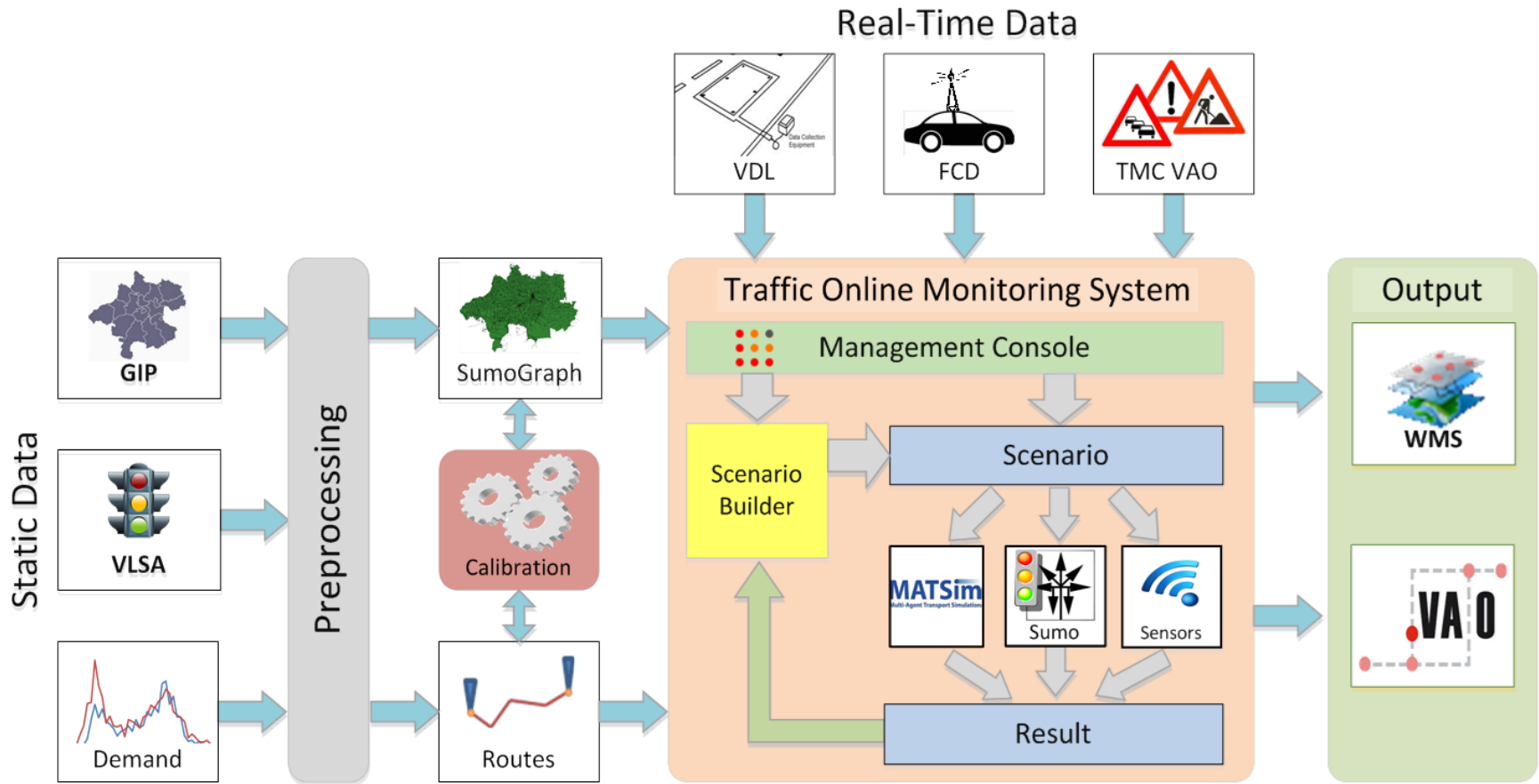
**Partner:** Government of Salzburg, Salzburg Research GmbH,  
Government of Upper Austria, Logistikum Steyr

**Duration:** 2011 - 2014





# System Overview





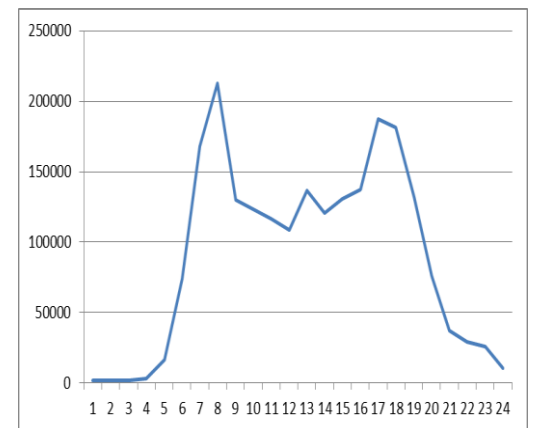
# Preprocessing Static Data

## ■ The Road network

- GIP (Graphenintegrationsplattform)  
<http://www.gip.gv.at/>
- Filtered geographically und functionally (level of significance) depending on urban or rural
- Netconvert for generating a Sumo or MATSim network file

## ■ The Routes File

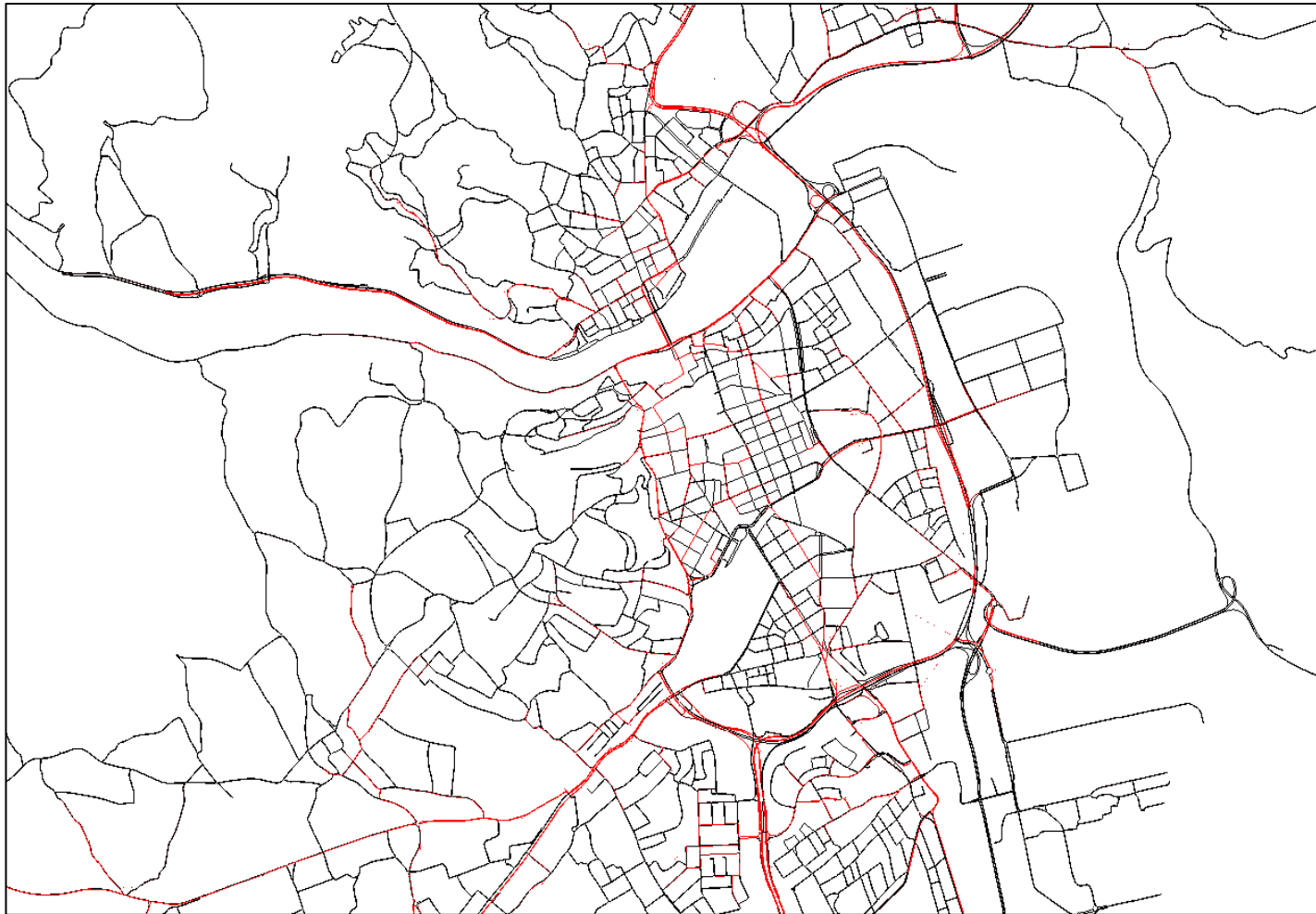
- Demand model from 2014 with hour-based distribution of trips, used to:
  1. Produce Trips
  2. Compute best routes
  3. Balance drives by
    - Alternative route
    - Shifting vehicles





# Calibrating the Demand Model

- around 10:00AM: huge traffic jams in the simulation





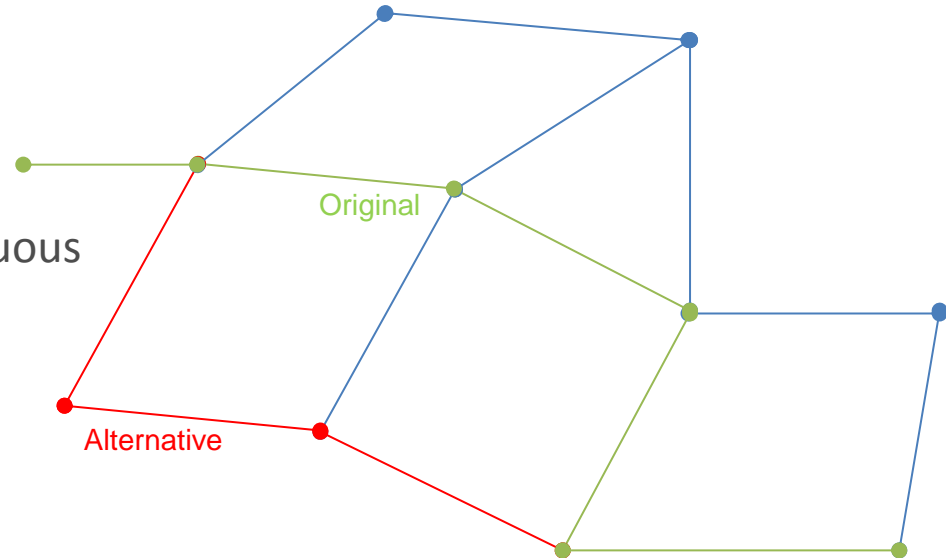
# Calibrating the Demand Model

- Calibration Run:
  - Start time for Sumo is 00:00
  - End time begins with 6:00AM
    - Advances in one hour increments
    - Ends with 8:00PM
- Dump to Calibrator every 2 min
  - Delayed or early vehicles are detected
- After Sumo ends
  - Delayed vehicles are randomly:
    - Rerouted
    - Shifted
  - Early vehicles are postponed



# Calibrating the Demand Model

- Modified Dijkstra for alternative routes
- “Significantly different route“:
  - 50% of length
  - 10 min driving time
- Route must be different from all those already computed
- Not too long – max 5% longer
- The „difference“ must be a contiguous set of road segments





# Calibration of Upper Austria

- Microscopic Simulation 1h 24min
  - (end times for Sumo between 6:00 and 16:00, runs 9 weeks)

```
03/17/2014 09:24:36: -----
03/17/2014 09:24:36:           Calibration attempt 3
03/17/2014 09:24:36:           end time 8
03/17/2014 09:24:36: -----
03/17/2014 09:24:36: Started sumo.exe with arguments D:\Projekte\ITS_West\ITS-West\
17.03.2014 09:24:53: Client 10.32.1.151:57377, joined
03/17/2014 10:41:19: Client 10.32.1.151:57377, disconnected
03/17/2014 10:41:36: There were 36016 seriously delayed vehicles
03/17/2014 10:48:54:           28784 were shifted, 13839 were rerouted
03/17/2014 10:48:54:           there were 4426 vehicles that arrived too early.
```

- Mesoscopic Simulation 14min

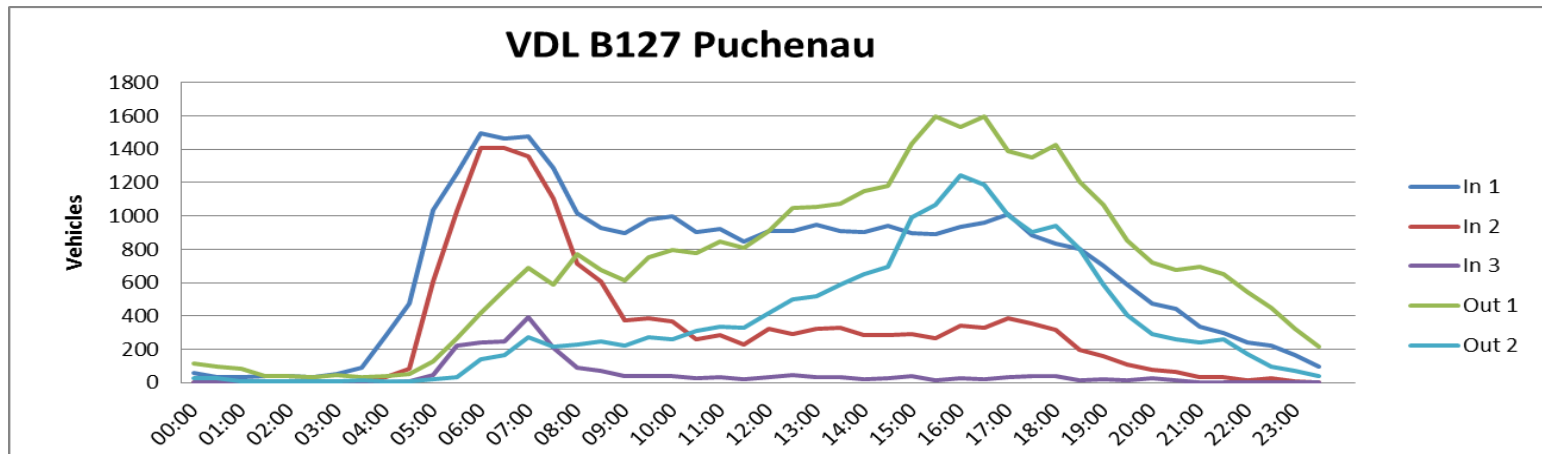
```
05/09/2014 10:06:19:           Calibration attempt 0
05/09/2014 10:06:19:           end time 9
05/09/2014 10:06:19: -----
05/09/2014 10:06:19: Started meso.exe with arguments C:\Users\ppau\Documents\develop
5/9/2014 10:06:34 AM: Client 10.32.0.162:61833, joined
05/09/2014 10:21:47: Client 10.32.0.162:61833, disconnected
05/09/2014 10:22:13: There were 21416 seriously delayed vehicles
05/09/2014 10:25:11:           13263 were shifted, 8153 were rerouted
05/09/2014 10:25:11:           there were 2017 vehicles that arrived too early.
05/09/2014 10:25:41:
```





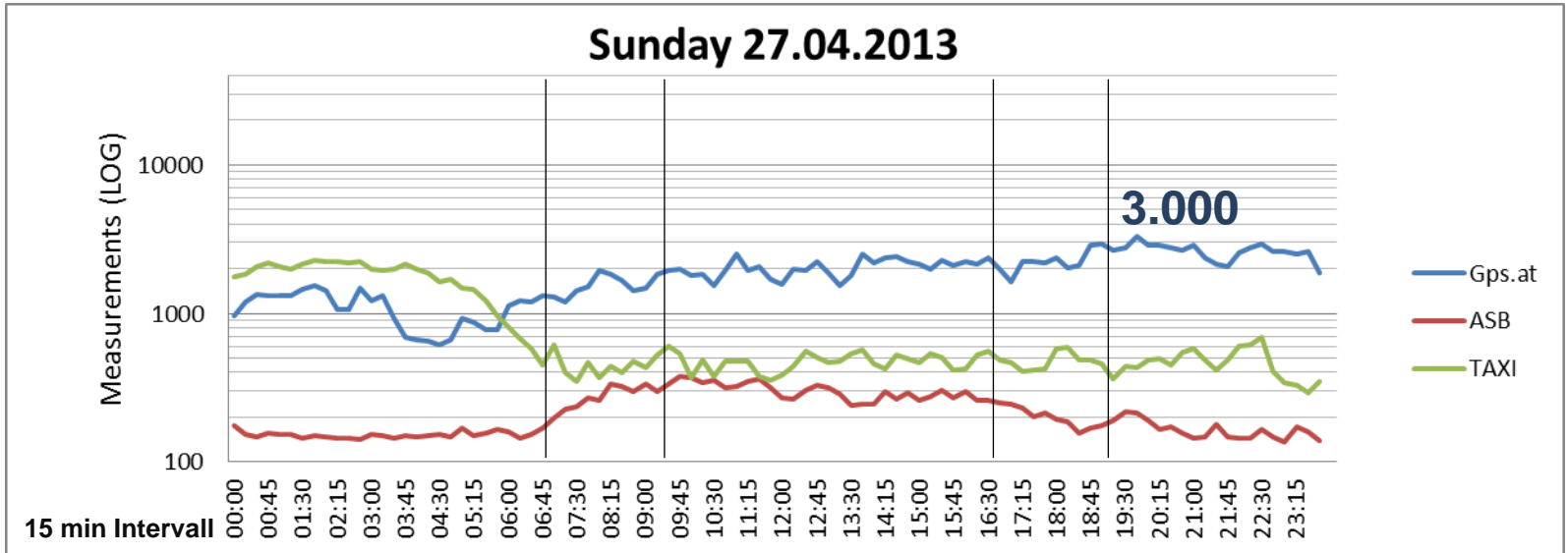
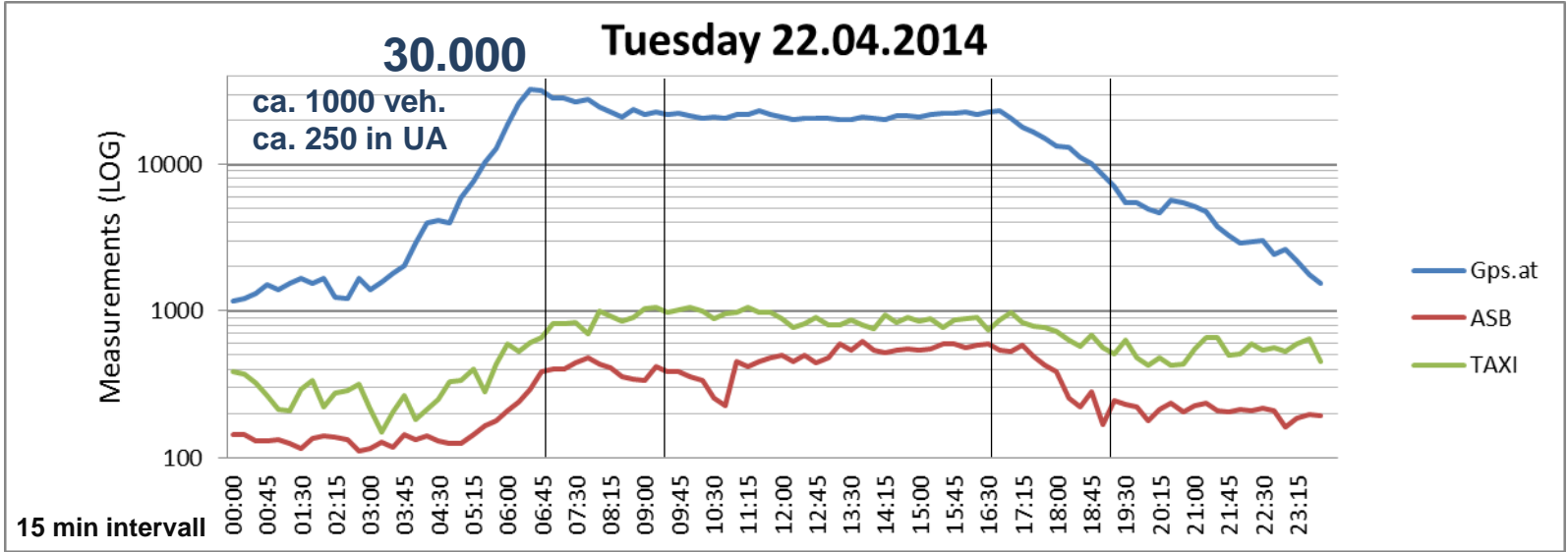
# Integration of Real Time Data - VDL

- Vehicle Detection Loops
  - Geocoded in a preprocessing step
  - Individual or average velocities
  - Nr. of passed vehicles
- Data used also for *online calibration* of the simulation
  - Insert new vehicles with random routes
  - Remove vehicles





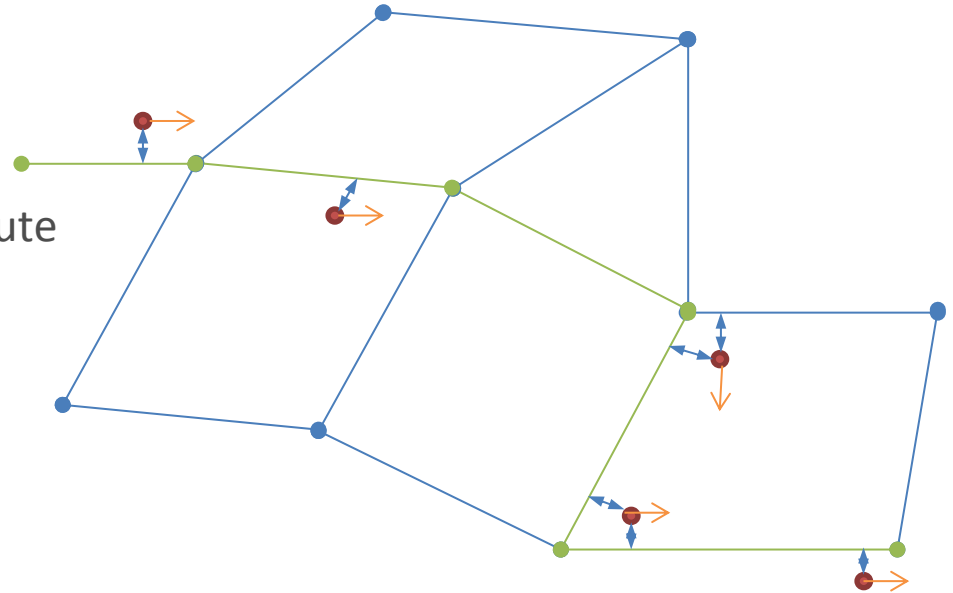
# Integration of Real Time Data - FCD





# Integration of Real Time Data - FCD

- Dijkstra
  - Calculates the route with minimal sum of edge weights
  - Weight is normally driving time
- Modified Dijkstra for Floating Car Data
  - Weight = driving time – reduction
  - Reduction depends on:
    - Nr. measurements/edge
    - Distance to the edge
    - Direction
  - Calculate most plausible route
  - Calculate velocities for all road segments
    - Using time between measurements

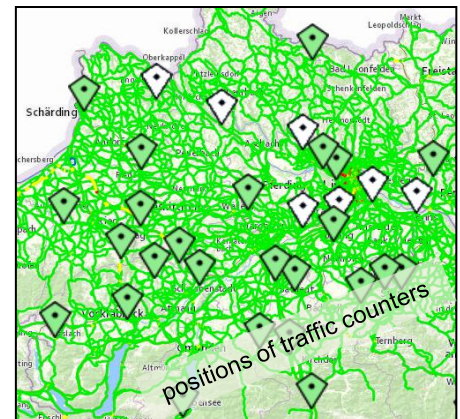
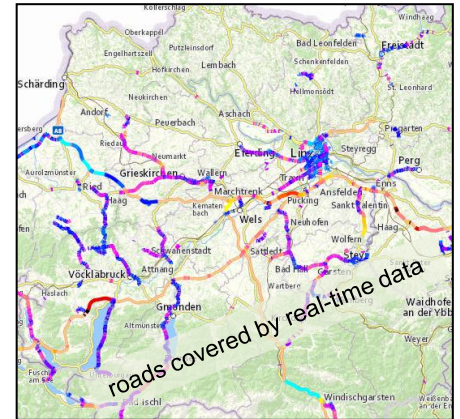




# TOMS

**Main Task:** Simulation and real-time data are used to generate periodically an online snapshot of the traffic situation of Upper Austria

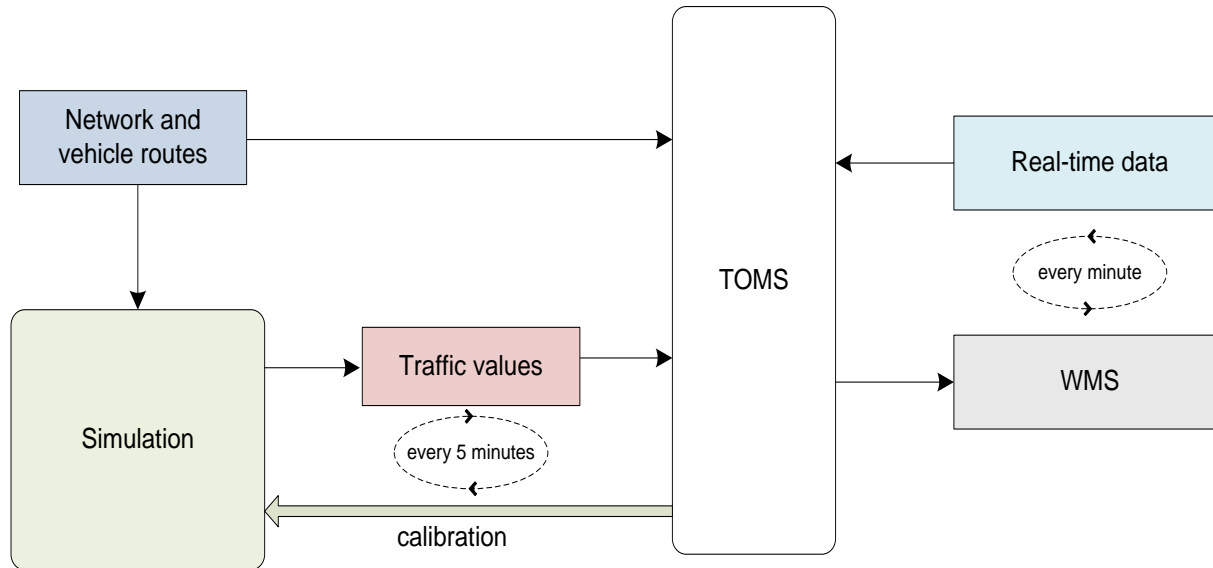
- Real-time data do not cover all roads
- Traffic simulation can be used to fill the gaps
- Sensor data calibrates the simulation (add/remove vehicles)





# TOMS

Starts simulation loop	Starts real-time data loop
Collect simulation output	Collect and process real-time data
Extract traffic values from all roads in the dump	Override the default or simulated velocities
Calibrate: Insert adjustments computed from real-time data	Generate a LOS (Level of Service) output





# TOMS

**ITS West - Management Console**

File View Tools Help

**Simulations**

Simulation servers

**KHK-DESKTOP**

MATSim SUMO on KHK-DESKTOP

SUMO Simulation mode: real time

Output WMS Layer: (none)

Output to main WMS Layer

Start

Simulation data

MATSim/KHK-DESK  
OP

SUMO/KHK-DESKTOP

Last step statistics Messages Vehicle counters Ro

Simulation time	0
Processing time last loop	0
Edges in last dump	0
Vehicles in last dump	0
Vehicles counted in induction l...	0
Speed modifications	0
Vehicles: rerouted	0
Vehicles: removed	0
Vehicles: added	0
Edges: 'delay'	0
Edges: 'jam'	0

**WMS Layers**

Published WMS Layer Velocity/RISC Verkehr 1/RISC Verkehr 2/RISC

sensor ID: 9555171  
reading nr.: 3  
reading time: 16:00:27  
speed: 27  
allowed speed: 30  
edge ID: E304080433To

**Real-time Data** Video

ASFINAG Statistics Integration in WMS Layers Configuration

GPS\_AT Nr. relevant sensors: 299 Last time interval: 16:01:13 - 16:30:23

Nr. readings: 2177

Samariter Nr. street segments: 924

Show statistics for relevant sensors  
 Show statistics for all sensors

Show Roads

Nr.	ID	Nr. readings	Street segm...	Bad ...	Ignored ...	Min speed	Max speed	Average speed
1	553719	24	4165242To	3	0	3.00	143.00	39.71
2	554552	12	384362From	0	1	9.00	153.00	44.44
3	554511	24	4217386To	1	0	11.00	105.00	58.52
4	554642	6	380811From	0	0	3.00	167.00	59.17
5	554661	5	4081482To	0	0	19.00	37.00	25.25
6	554723	26	381011From	2	0	0.00	77.00	30.04
7	554855	5	4079462To	0	0	14.00	17.00	15.67
8	554914	13	4084248To	0	1	7.00	110.00	28.18
9	554940	4	4081320To	0	1	11.00	25.00	18.00
1	554961	5	379635From	0	1	15.00	36.00	26.00
1	554969	3	4079887To	0	0	5.00	25.00	15.00
1	554982	6	381502From	0	1	16.00	30.00	22.40
1	554986	3	4082669To	0	0	13.00	25.00	19.00

**Output**

Updating real-time traffic data.  
Roadworks: 34 (194 edges).  
Observed street segments: 74 (OOE), 0 (ASFINAG).  
Driven street segments: 924,6,1273 (taxis), 243,0,32 (Samariterbund), 2758,0,248 (GPS).  
Data for 70181 road segments to upload to VAO...  
...uploaded.

05/07/2014 16:31:11: Exported in main WMS layer: 0 road segments with delays, 0 with t-jams, 138 affected by roadworks, 52 with roadblocks.  
Next update will be at 04:32:00.





# Future work

- Intensive testing of mesoscopic simulations
- Replay function
- Validating the traffic situation with video cams

