

# Estimating Real-Time Urban Traffic States in VISUM Online (PTV TrafficPlatform) PIARC Conference – Kuala Lumpur 2006

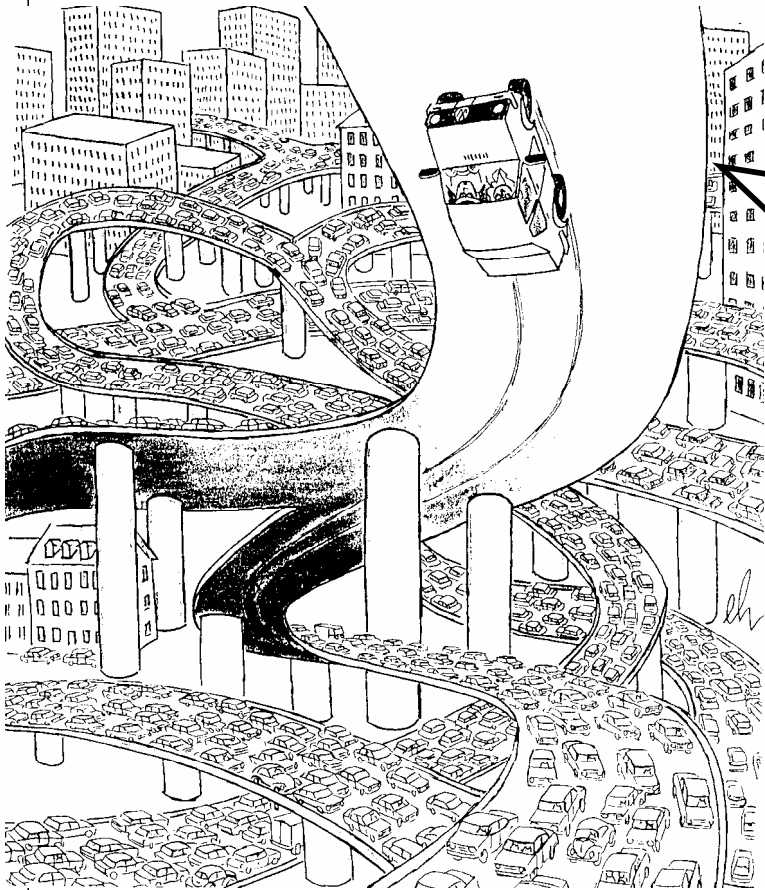
Dr. Gerhard Ploss, Dr. Peter Vortisch



No „Big Brother“  
but „Intelligent Traffic Management“....



... Including the Needs of New Mobile Services...



*„Maybe you are right,  
Darling... But I follow  
exactly my new  
navigation system...“*

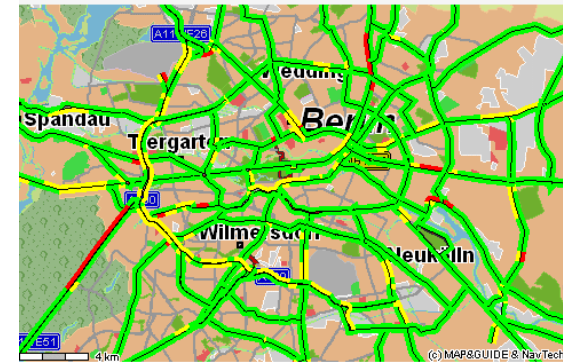
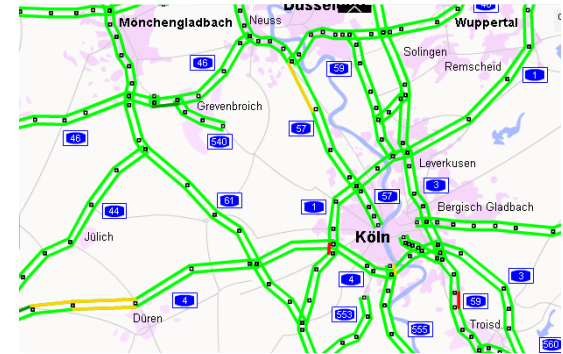
## Traffic State as Basis for Information and Control

Traffic state contains

- > for the road user:  
*Congestion or free flow*
- > for navigation devices:  
*Travel times*
- > for variable direction signs and traffic forecast:  
*Traffic values, ODs and routes*

A current traffic state requires

- > *current* measurement data
- > *fast* processing





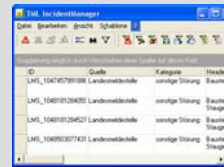
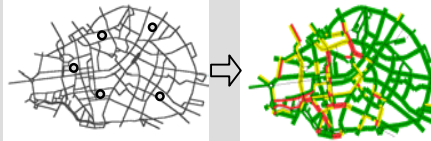
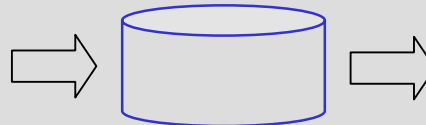
## PTV TrafficPlatform (VISUM Online) – Objectives

### Input



Monat1				
Becke	21955	111	112	121
219209	Sonnen	195	565	110
111	72	0	1	0
112	332	1	2	1
121	91	0	1	0
122	116	1	2	1
211	242	1	5	1
212	144	1	4	1
213	272	1	6	1
214	224	1	5	1
221	211	1	4	1
222	187	0	5	1

### PTV TrafficPlatform



### Output



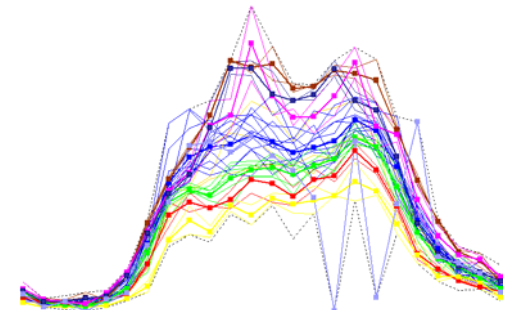
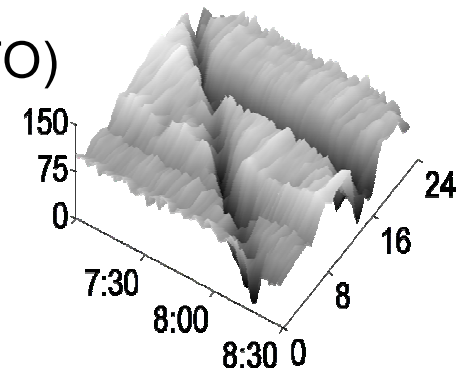
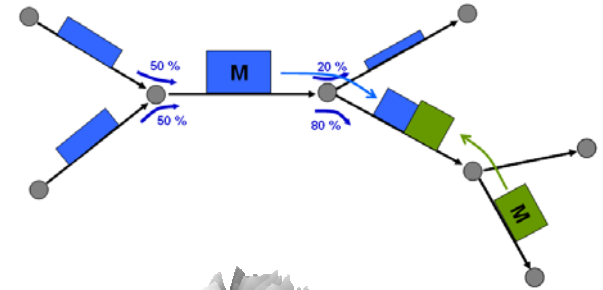
- Detector data
- Floating car data
- Traffic reports
- Road-works
- Networks
- OD-Matrices

- Data management
- Data distribution
- Estimation of traffic state
- Forecast & Scenarios
- Incident management

- Visualization
- Mobile services
- Dynamic route guidance
- Evaluation & Reports
- Transportation planning
- Traffic control

## Intelligence

- OD Estimation (Calibration) and Routing
- Algorithms for Urban Traffic (Propagation)
- Algorithms for Motorway Traffic (ASDA/FOTO)
- Floating Car Data
- Data Fusion
- Forecast & Scenarios
- Cluster Analysis
- Statistics & Evaluation



## Intelligent Models consider Road Networks...



**Measurements**

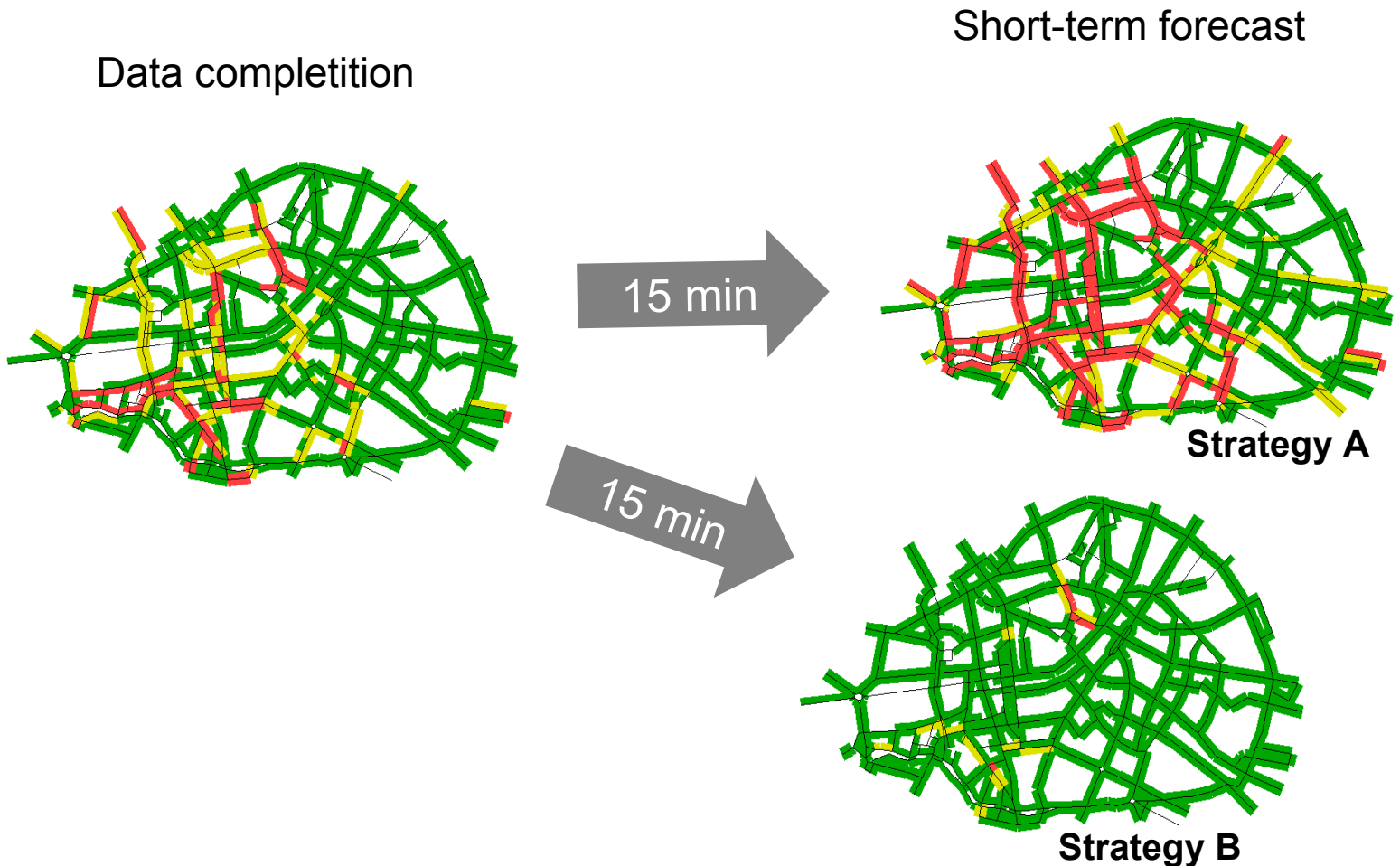


**Local Models**



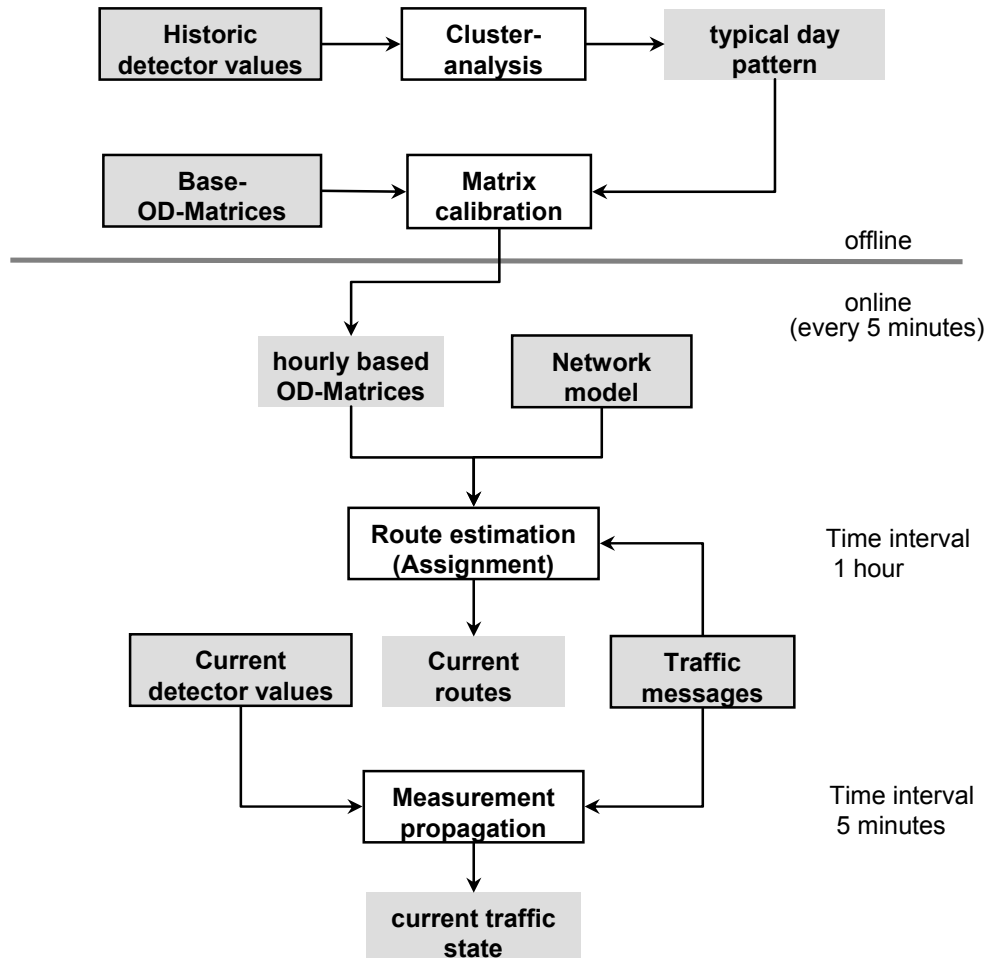
**Network Models**

## Estimation of Traffic State and Forecast

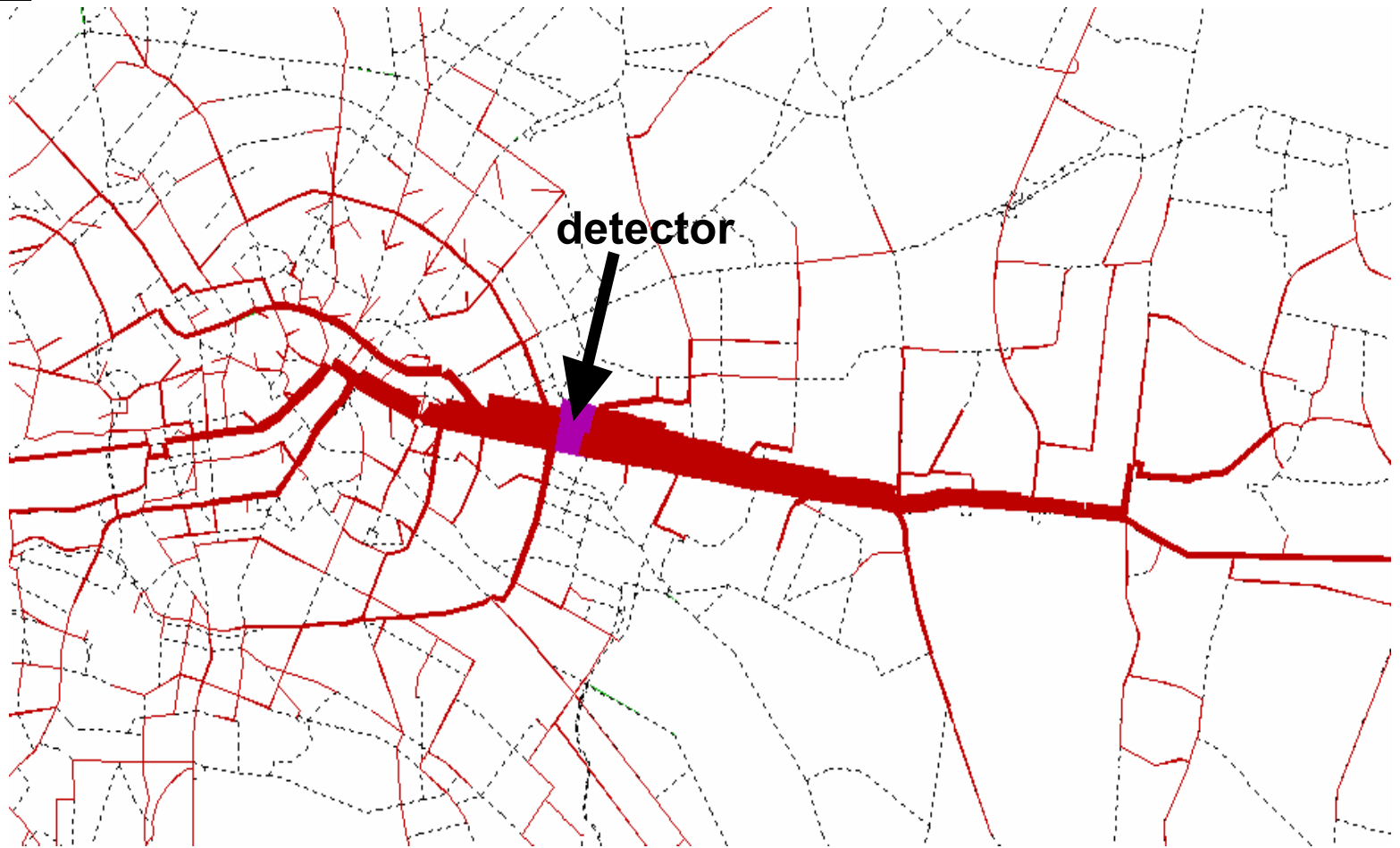




## Work Flow of the Traffic State Estimation

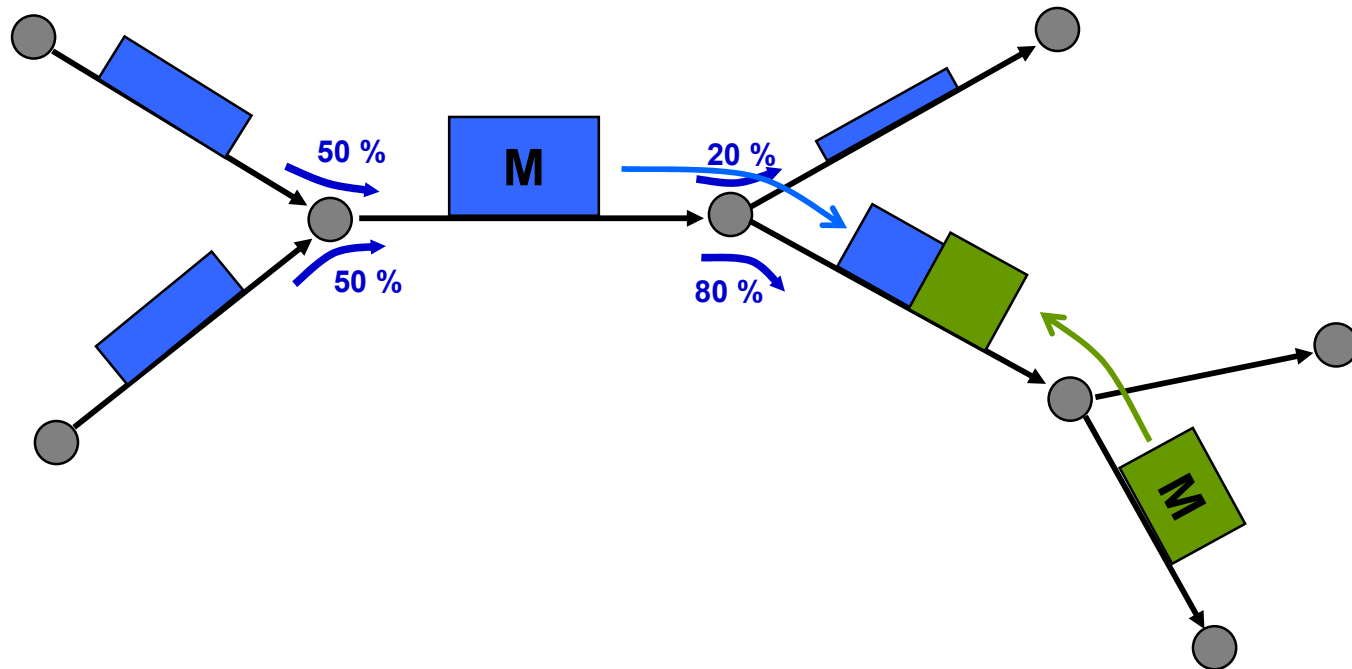


## Flow Bundle



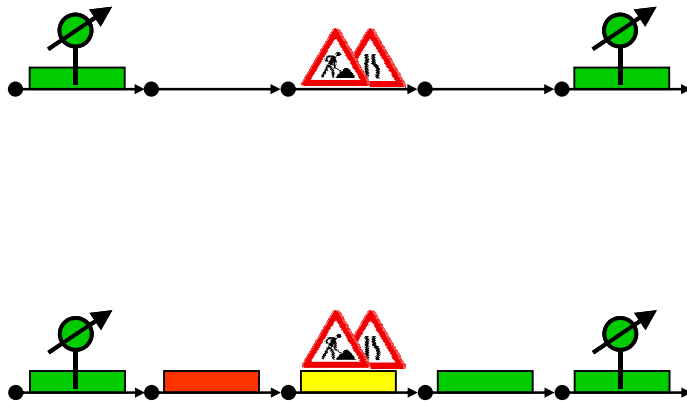
## Innerurban Traffic: Measurement Propagation

Propagation of measured traffic volumes along routes in the network

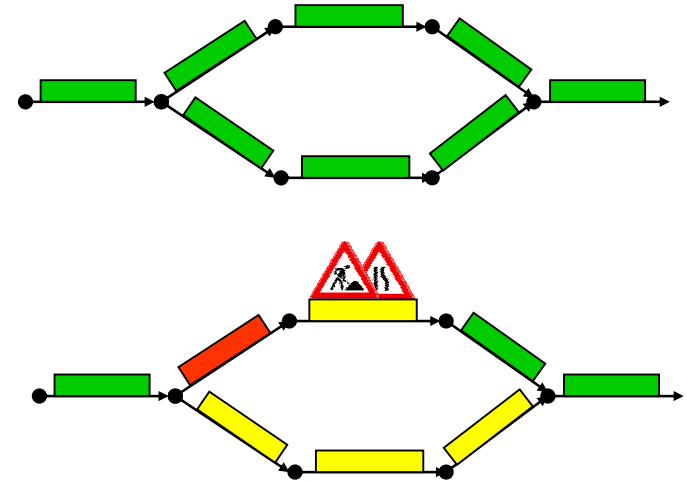


## Requirement: Sensitivity to Real-time Events

Impact on link:



Resulting impact on network:

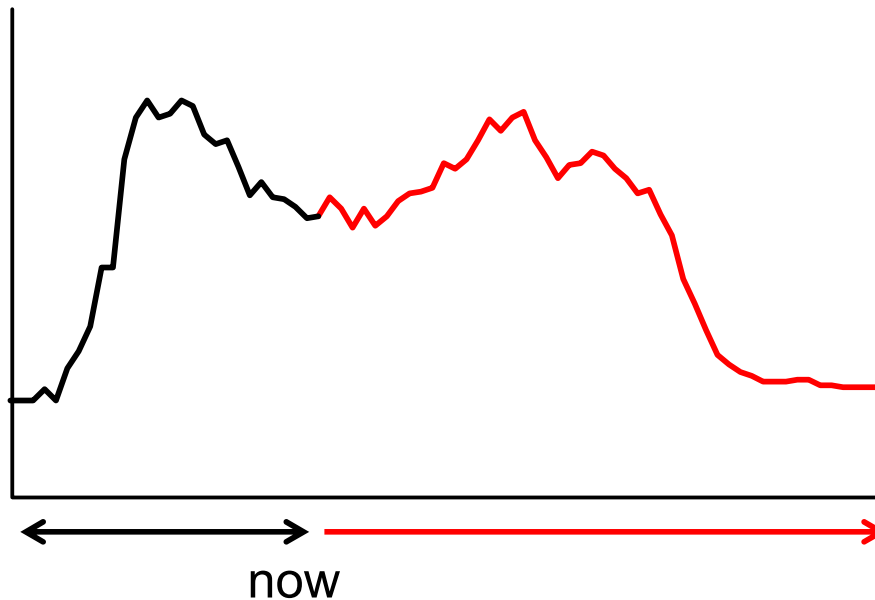




## Local Forecast by Time Series Selection

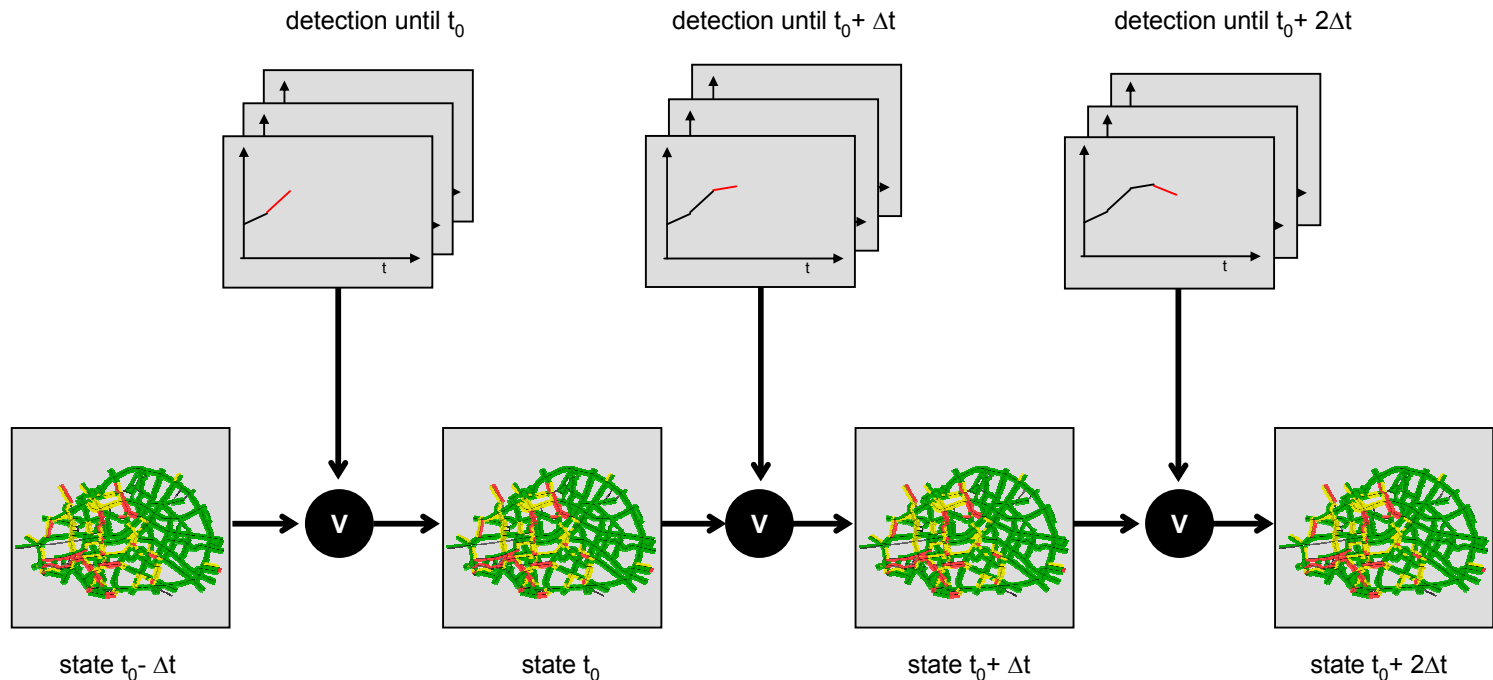
**Idea:** Traffic patterns for comparable days are similar, because the activities of mobile persons are repetitive.

**Task:** Recognition of the correct pattern for the day

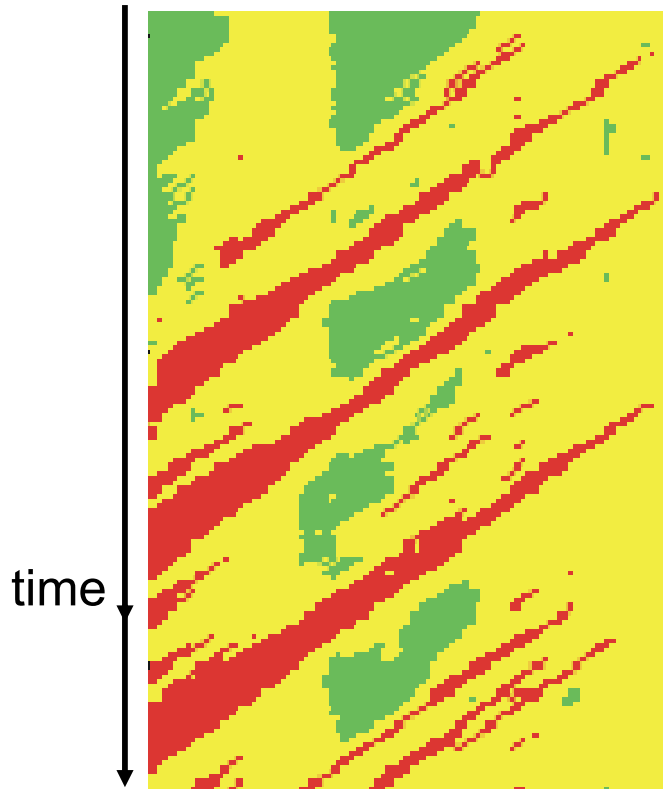


## Short-term Forecast

**Idea:** Forecasting of local measurement values and use of the propagation method



## Model-based Data Completion



### **Spatial interpolation:**

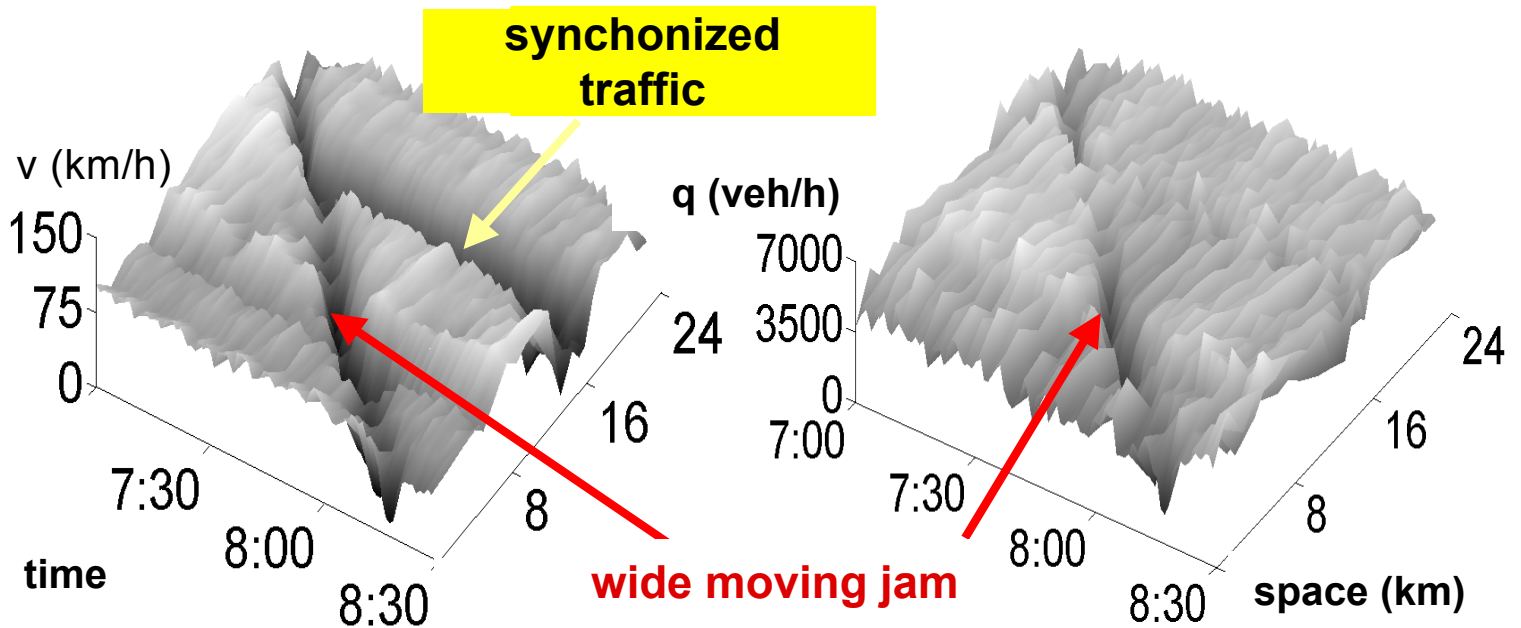
simple, but wrong  
better: model based

### **Temporal extrapolation: Forecasting**

## Model for Freeway Traffic: ASDA/FOTO by Prof. Kerner

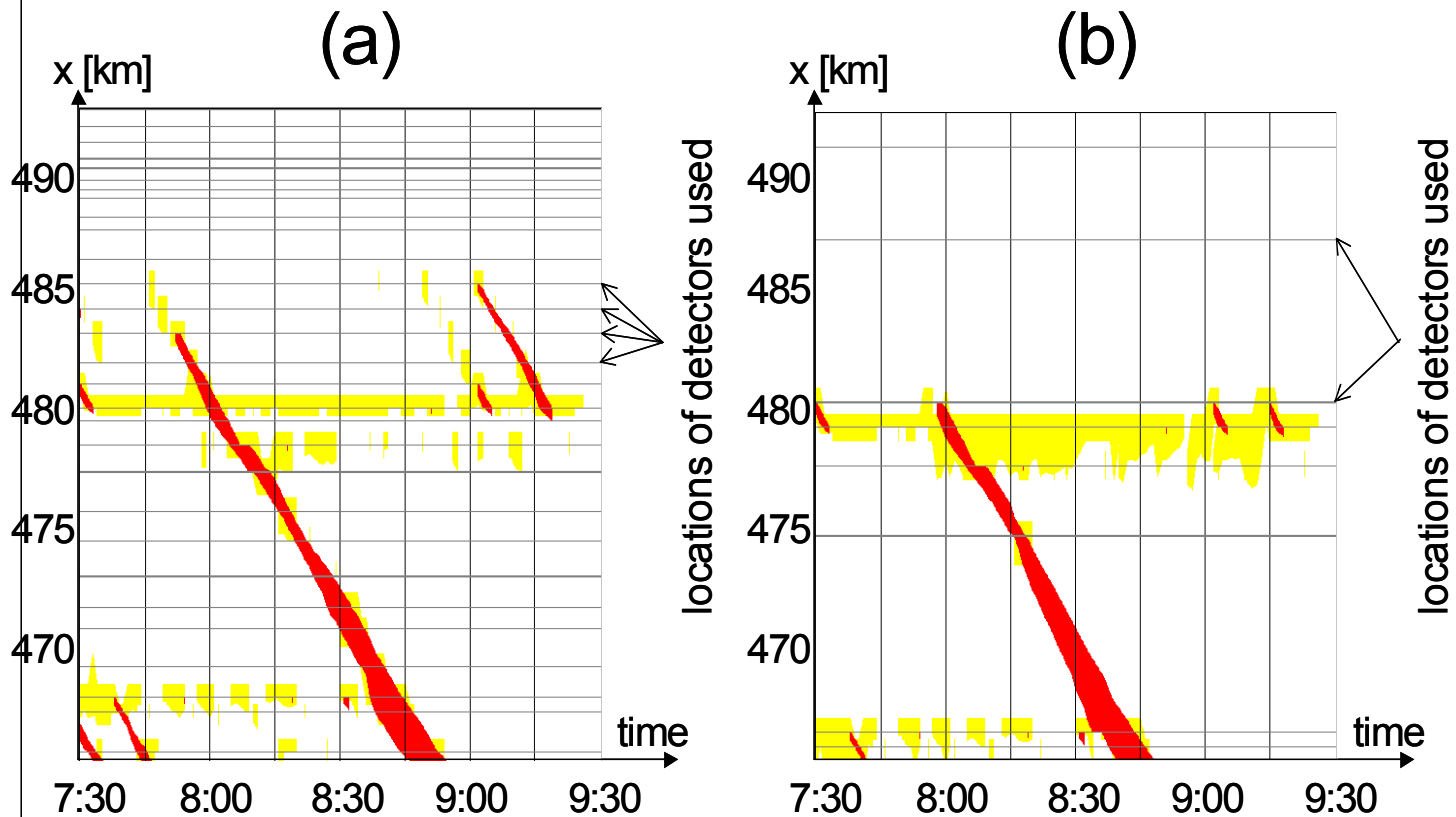
Theory on physics of traffic flow: 3 phases (free, „synchronised“, jam)

Kerner, Journal of Physics A, 2000





## ASDA-FOTO with Sparse Detection



space-time-diagrams A5 southbound: (a) 31 detectors; (b) 9 detectors

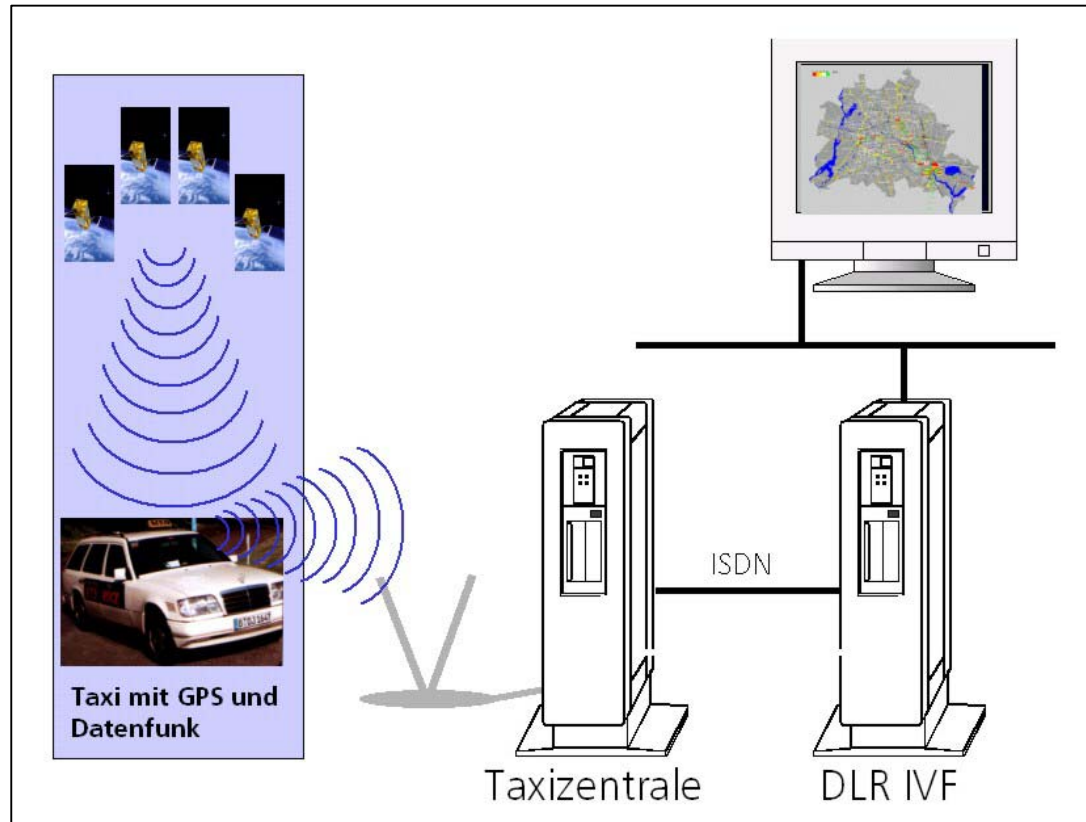
## Data Source: Taxi Cab - FCD

Positioning of taxi cabs via GPS

Position is sent to operating center via taxi channel (no additional cost!)

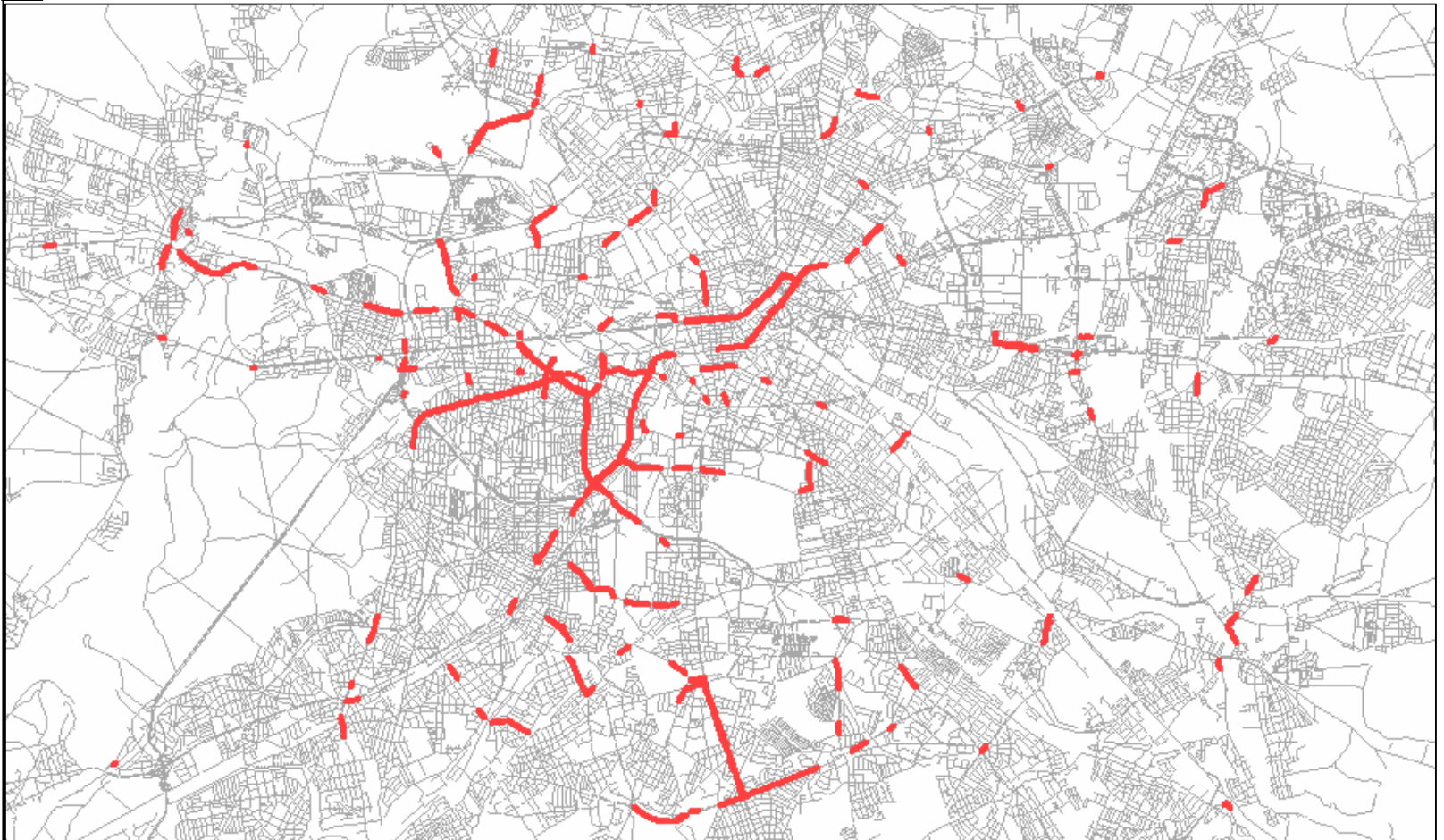
High frequency of position reports (less than 2 minutes)

Routing between reported positions in the operation center

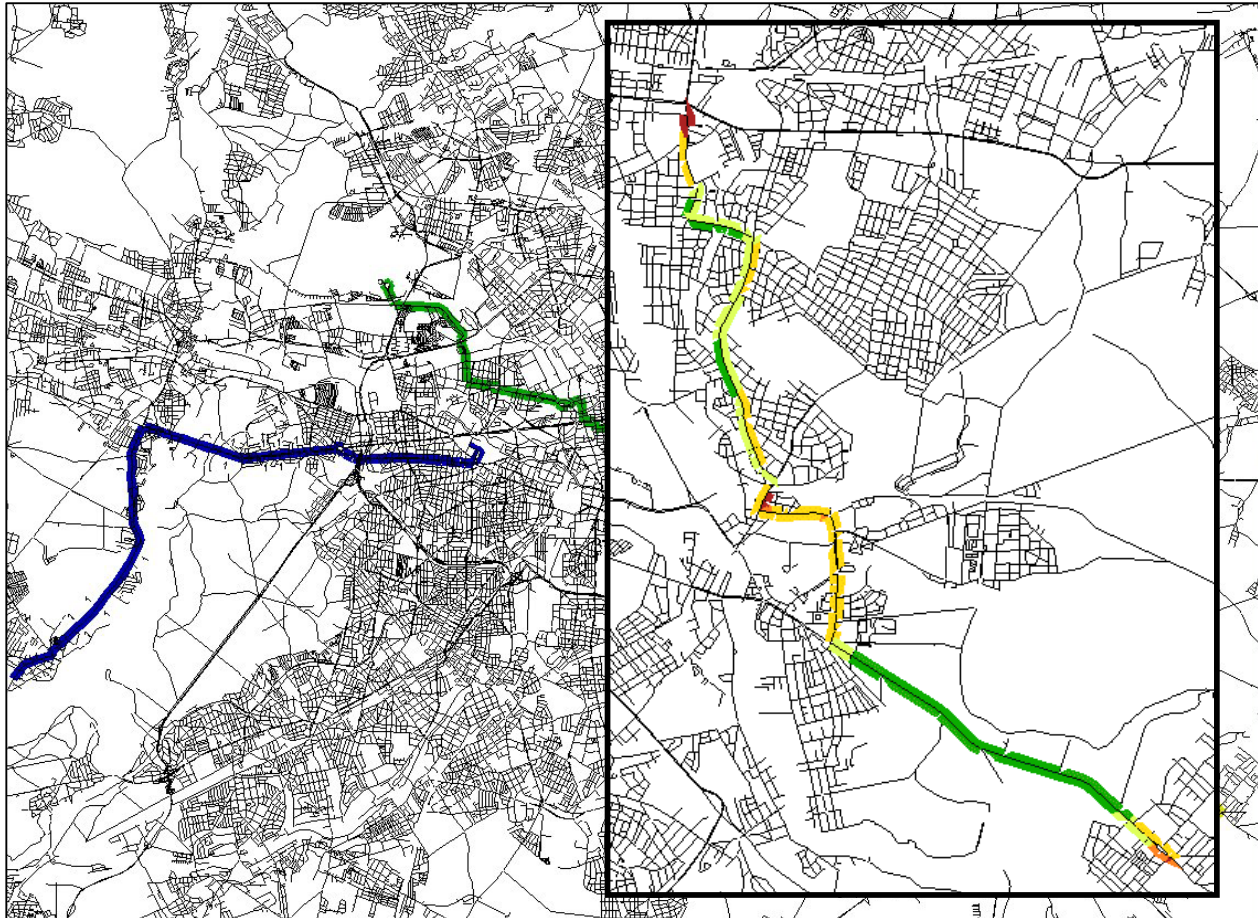


Source: DLR

## Filtering of Exclusive Lanes for Taxi Cabs and Buses



## Data Source: FCD from Buses



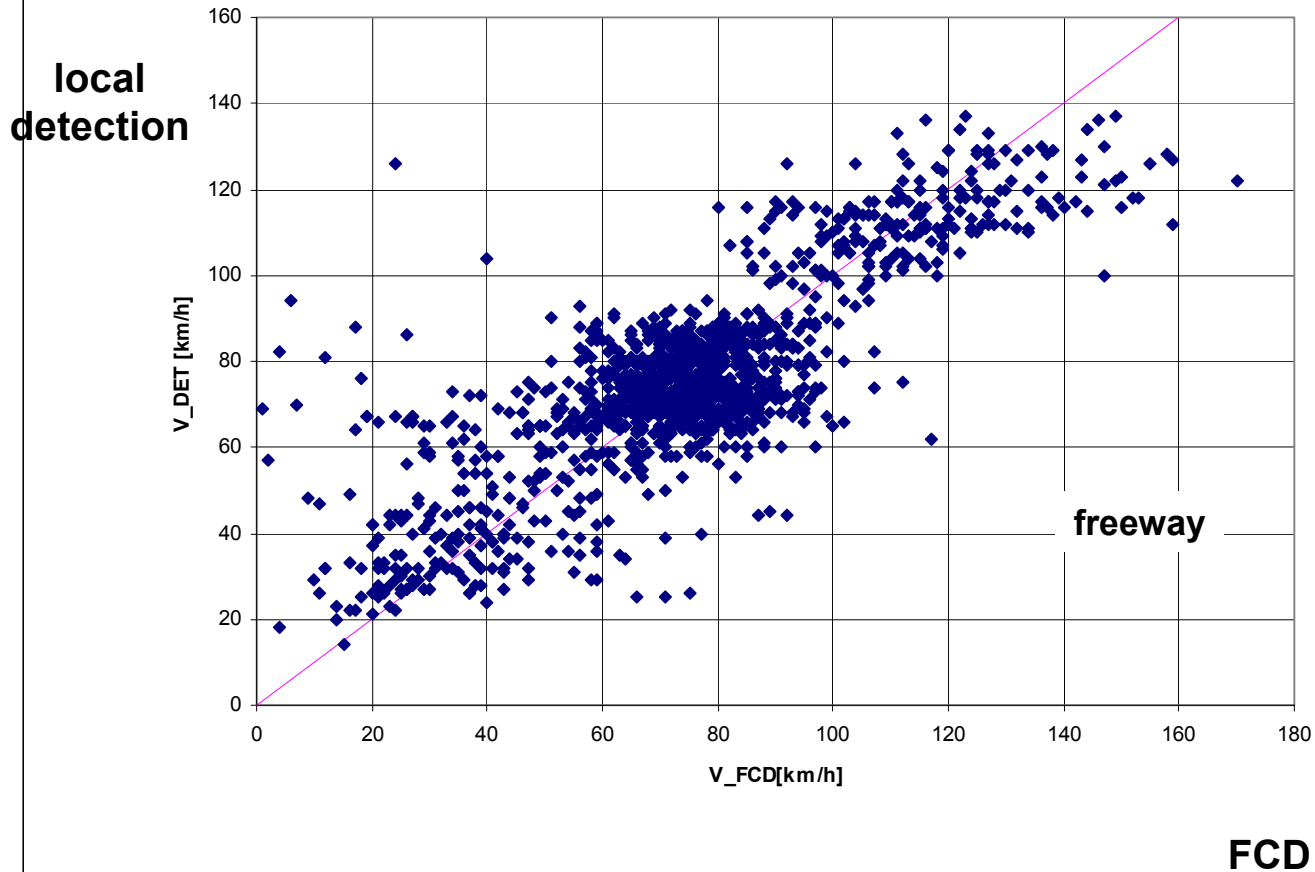
**Position reported every 2 minutes**

**Map-matching considers line routes**

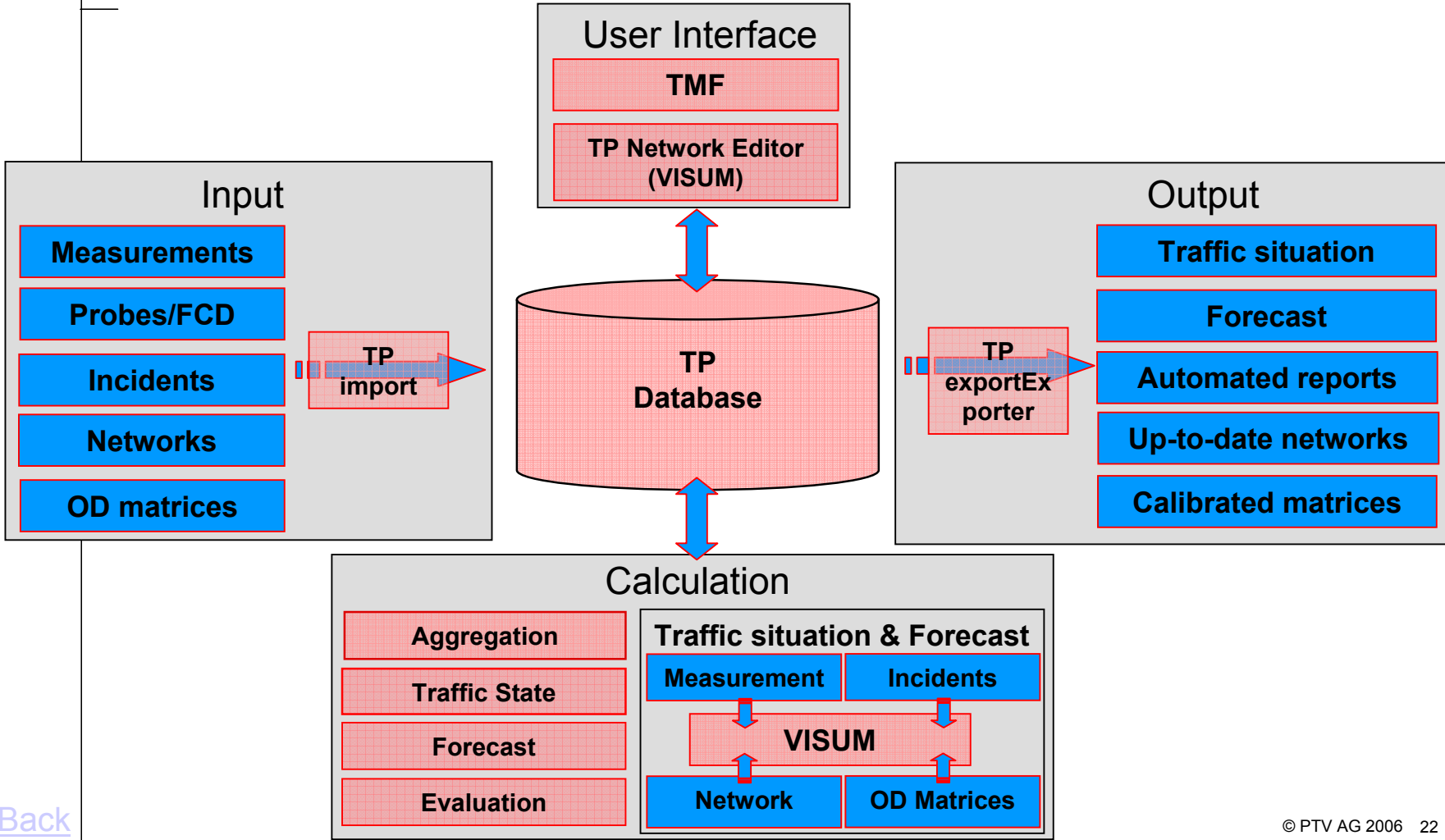
**Dwell times at stops considered**



## Comparison of Speeds from FCD vs. Local Detection



## System Architecture



## TP Database

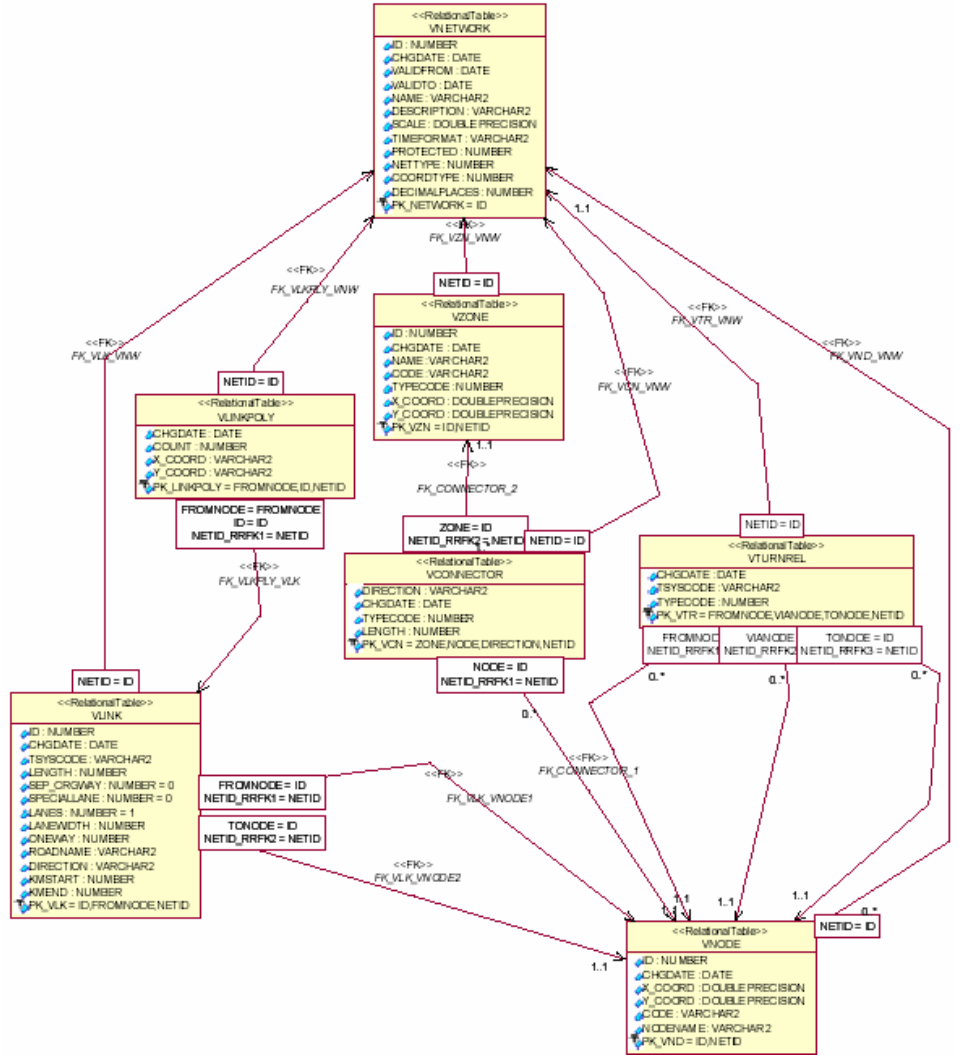
- > **Standard for Traffic Management**
- > **Relational database for**
  - > ORACLE
  - > MS SQL Server
  - > MS ACCESS
  - > mySQL
- > **300 tables in numerous modules**

**Static**

Network  
Detectors  
POIs

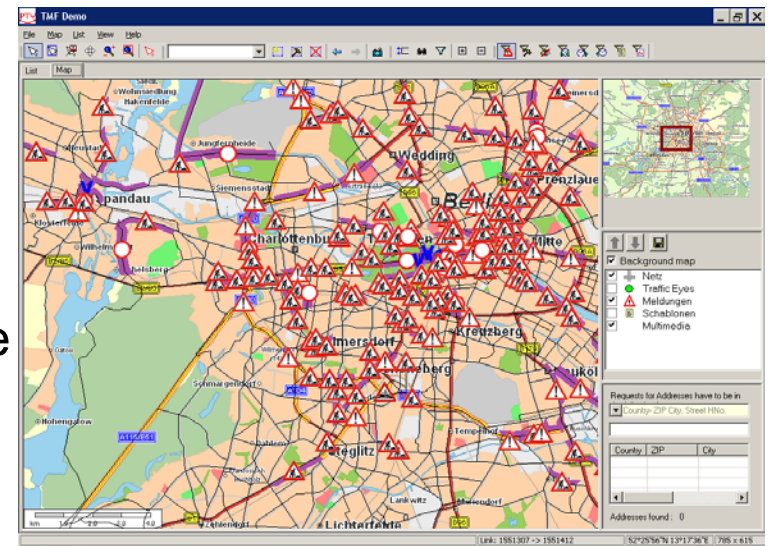
**Dynamic**

Raw data  
Aggregated data  
Results



## Overview - PTV TrafficManagementFramework (TMF)

- > Graphical User Interface for Traffic Management
- > Main Tasks
  - > Visualization
  - > Evaluation
  - > Management
- > Access to content of a database
- > Intuitive operation
- > Flexible customization
- > Desktop and browser solution



## TMF - Overview

Framework

Navigation

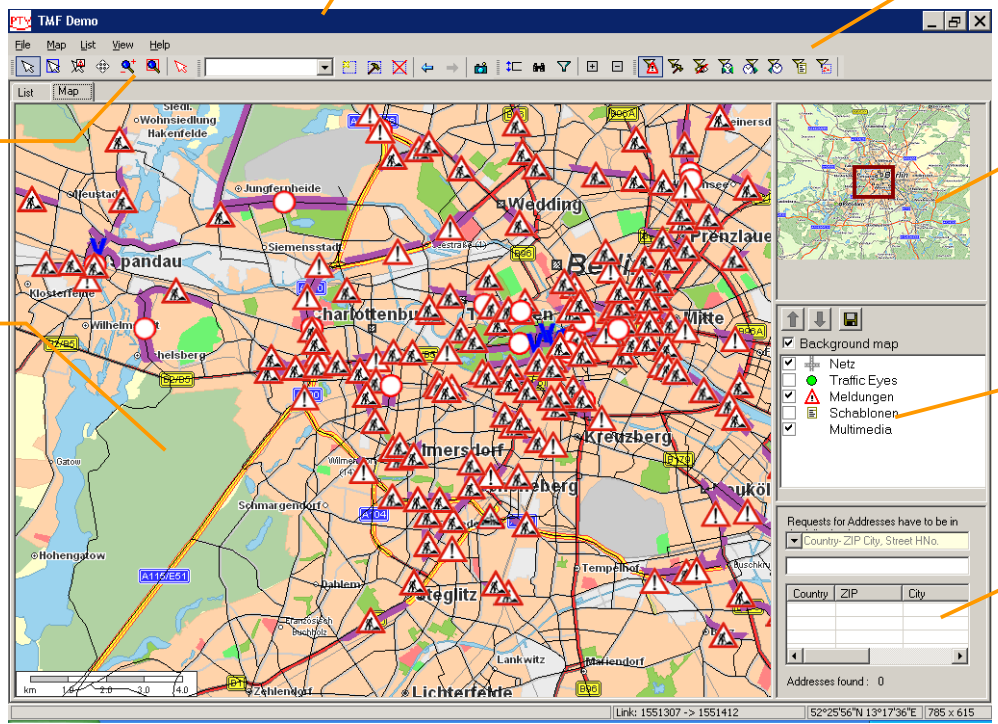
Display window

Filter

Smart map

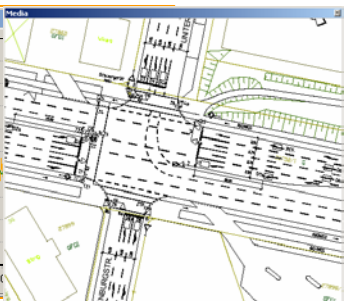
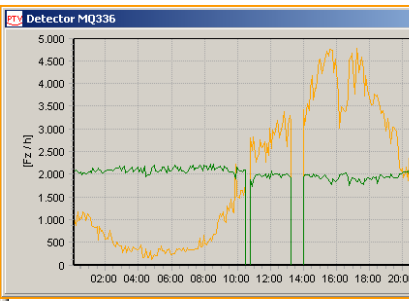
Layer control

Further application



PTV Segment

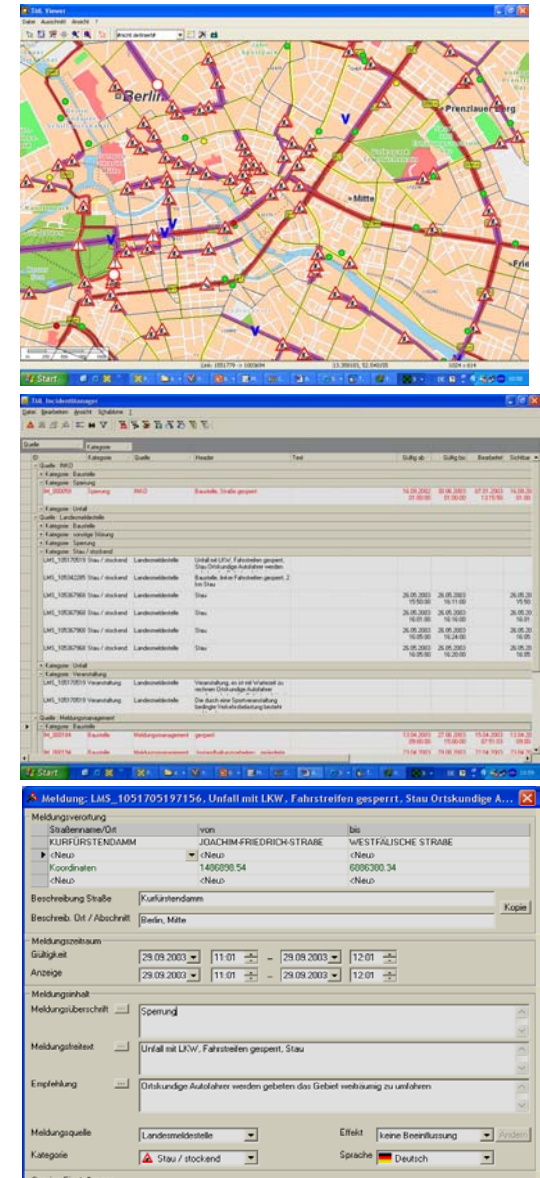
Field	Value
Roadname	BRUNNENSTRASSE
From crossing	GLEIMSTRASSE
To crossing	BERNAUER STRASSE
Segment	1005792
From node	1001203
To node	1001204



Detailed information

## Incident Manager

- > Different sources
- > Different categories
  
- > Unique referencing
- > Solution of conflicts
- > Support of TMC, TPEG and other formats
  
- > Defines impact on traffic:  
(traffic condition and dynamic route guidance)
  - > Location: Number of links in the network
  - > Time: Valid period of an incident
  - > Effect: Reduction of capacity and speed



The screenshot displays the PTV TrafficPlatform Incident Manager interface. At the top, a map of Berlin shows various incident markers (triangles) across the city. Below the map, a table lists incident details:

ID	Kategorie	Quelle	Proble...	Titel	Datum	Uhrzeit	Beendet	Status
LMS_10517051	Stau / stockend	Länderselbstmelde	Unfall mit LKW, Fahstreifen gesperrt, Stau	Unfall mit LKW, Fahstreifen gesperrt, Stau	28.09.2003	11:01	12:01	11
LMS_10517052	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517053	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517054	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517055	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517056	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517057	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517058	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517059	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517060	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517061	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517062	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517063	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517064	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517065	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517066	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517067	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517068	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517069	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517070	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517071	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517072	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517073	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517074	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517075	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517076	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517077	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517078	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517079	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517080	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
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LMS_10517082	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517083	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517084	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517085	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517086	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517087	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517088	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517089	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517090	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517091	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517092	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517093	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517094	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517095	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517096	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517097	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517098	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517099	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11
LMS_10517100	Stau / stockend	Länderselbstmelde	Stau	Stau	28.09.2003	11:01	12:01	11

Below the table, a detailed view of an incident is shown:

**Meldung: LMS\_1051705197156, Unfall mit LKW, Fahstreifen gesperrt, Stau Ortskundige A...**

Strassenname/Dat: vom JOACHIM-FRIEDRICH-STRASSE bis WESTFÄLISCHE STRASSE  
 Kurfurts-Tendamm  
 Koordinaten: 1406990,54 6096300,34  
 Beschreibung Straße: Kurfurts-Tendamm  
 Beschreib. Dtl. / Abschnitt: Berlin, Mitte  
 Meldungszeitraum: Gültigkeit 28.09.2003 11:01 - 28.09.2003 12:01  
 Anzeige 28.09.2003 11:01 - 28.09.2003 12:01  
 Meldungsinhalt: Sperrung  
 Meldungsüberschrift: Unfall mit LKW, Fahstreifen gesperrt, Stau  
 Empfehlung: Ortskundige Autofahrer werden gebeten das Gebiet vorsichtig zu umfahren  
 Meldungsquelle: Länderselbstmelde Effekt: keine Beeinträchtigung  
 Kategorie: Stau / stockend Sprache: Deutsch



## Browser Solution

The screenshot shows the VMZ website interface. At the top, there is a navigation bar with a logo on the left and a search bar on the right. The search bar includes a dropdown menu for regions (Bayern, Berlin, Brandenburg, Bremen), a section for 'Immobilienuche: Direktauswahl' with radio buttons for 'Wohnung', 'Haus', 'Grundstück', and 'Gewerbeimmobilien', and a 'Suchen' button. A 'Land Berlin' logo is also present. Below the search bar is a main menu with categories like 'Hauptmenü', 'Verkehrslage', and 'Verkehrsmeldungen'. A central area features a dropdown for 'Verkehrslage' set to 'aktuelle Verkehrslage' and another for 'Ausschnitt-Auswahl' set to 'Innenstadt / A100'. Below this is a map of Berlin with traffic flow indicators. A sidebar on the left contains a detailed navigation menu. At the bottom, there is a copyright notice: '©2000-2002 VMZ Berlin Betriebsgesellschaft mbH'.

The screenshot shows a Microsoft Internet Explorer browser window displaying the ViaContent website. The browser's address bar shows the URL 'http://bz2.viacontent.nl/regio/omappage.aspx'. The website interface includes a 'Kies de regio:' dropdown menu set to 'Delft Regio hoofdweg'. Below this is a 'Toon dit deel' button. A sidebar on the left contains a 'Beschikbare berekeningen op 18.9.2004' section with a dropdown set to '16:05', an 'Andere Dag' button, and a 'Wegleur geeft aan' dropdown set to 'Intensiteit'. The main content area features a detailed traffic map of the Voerburg area, showing various roads and traffic flow indicators. The ViaContent logo is visible at the bottom left of the map area. The browser's taskbar at the bottom shows several open applications, including 'Start', 'Postzorging...', 'VISUM', 'Internet...', 'MapInfo Prof...', 'C:\Projekte\A...', 'TextPad - C...', and 'Microsoft Po...'. The system clock in the bottom right corner shows '16:29'.



## What is the VMZ Berlin?



- > Actually, the VMZ Berlin (Verkehrsmanagementzentrale) mainly is a Traffic **Information** Center
- > An interface to the VKRZ Berlin (Traffic Control Center) is in progress.
- > Contracted in 1999 by the Senat of Berlin; in operation since 1.7.2003
- > Operated by: VMZ Berlin (Siemens and DaimlerChrysler)

## What the VMZ Berlin provides

**„Comprehensive and up-to-date mobility services for all transport users and all means of transport in Berlin“**

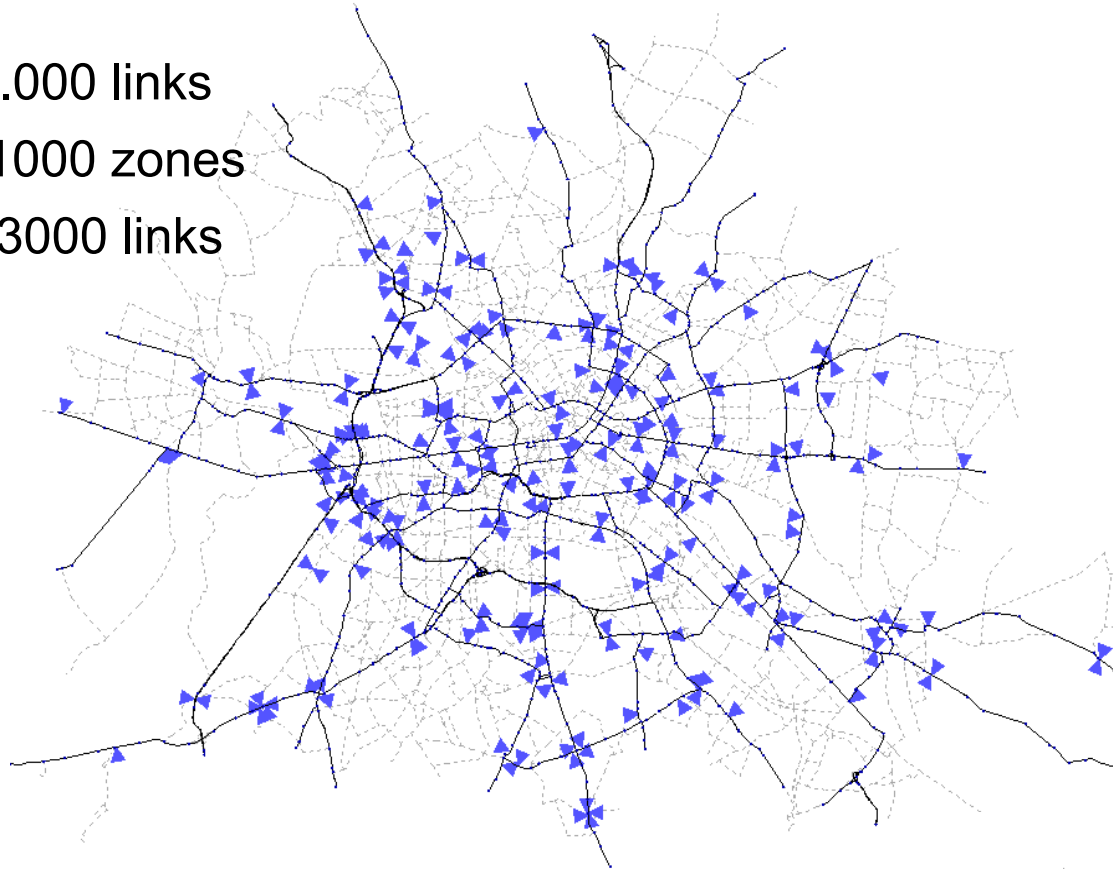
**Better traffic information shall provide the basis for a more efficient traffic flow.**

### **Information broadcast media:**


- > Internet
- > Variable message signs on roads
- > mobile phone services (SMS, WAP)
- > radio stations

## Traffic Management Centre Berlin

- > ca. 400 Detectors
- > Network with ca. 10.000 links
- > OD Matrix with ca. 1000 zones
- > Traffic State on ca. 3000 links



www.vmzberlin.de




Bayern  
Berlin  
Brandenburg  
Bremen

**Immobilienuche: Direktauswahl**

Wohnung       Haus  
 Grundstück       Gewerbeimmobilien

**IMMOBILIEN SCOUT 24**

Suchen

Land  Berlin

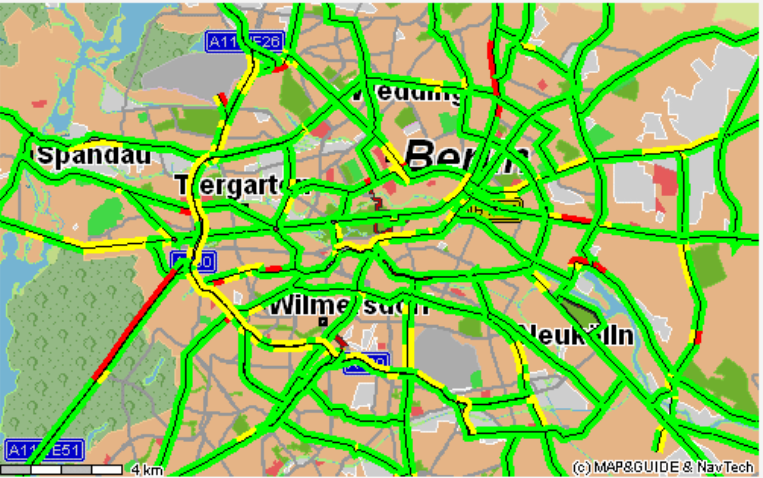
Deutsch | English

wie schnell gehen Sie von Ihrem Wohnort zum Flughafen, wenn Sie am nächsten Sonntag um 10 Uhr zum Flughafen fahren, und wie schnell Sie am Montag den folgenden Tag gültig ist.

**Auswahl**

Verkehrslage      Ausschnitts-Auswahl

aktuelle Verkehrslage      Innenstadt / A100



(c) MAP&GUIDE & NavTech

Hauptmenü

- Startseite
- Stadtplan
- An- und Abreise Berlin
- Routenplanung
- Busse und Bahnen
- Fluginformationen
- Weitere Mobilitätsdienste
- Parken in Berlin
- Veranstaltungen in Berlin
- Verkehrslage**
- Verkehrsmeldungen
- Meldungskarte
- Lage und Prognose
- Verkehrskameras
- Persönl. SMS-Stauwarner
- Wetterinformationen
- Site Map
- Über VMZ Berlin
- AGB

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## Quality Check of the Estimated LOS

### Laboratory experiments

### Scenario as part of approval

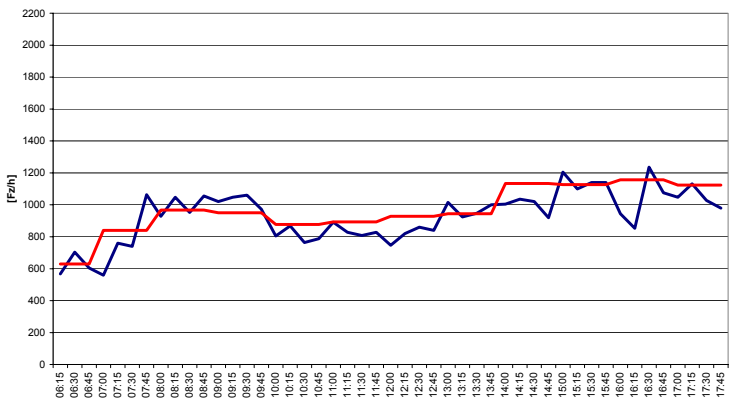
### Examination with additional detection

- > Mobile detection devices
- > 14 locations per day
- > 10 15-min-periods relevant
- > Considered: flow and speed => LOS
- > Compared: calculated and predicted LOS to measured situation

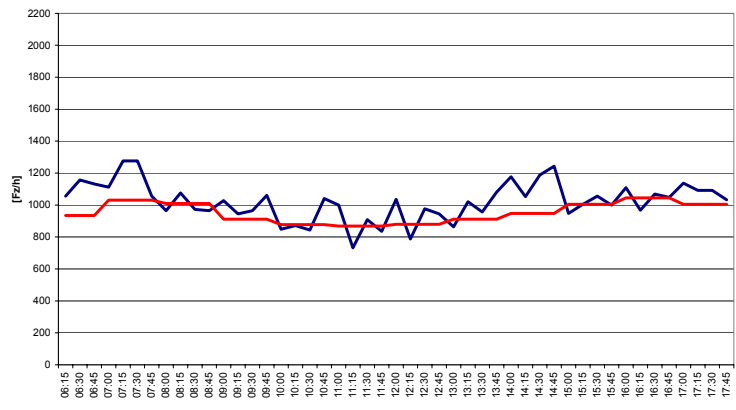


## Comparison of Volumes

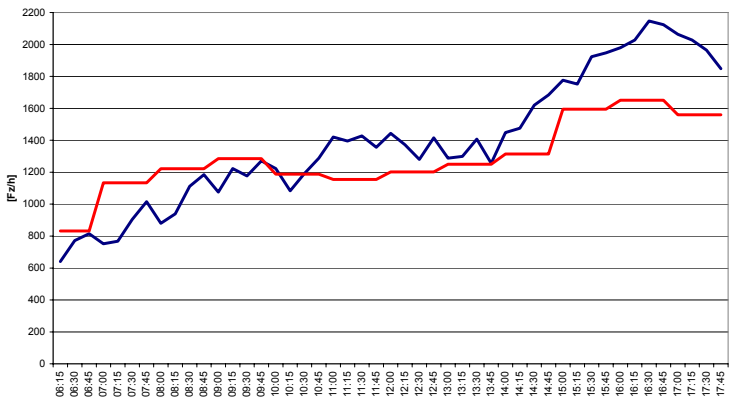
**B1: Invalidenstraße**



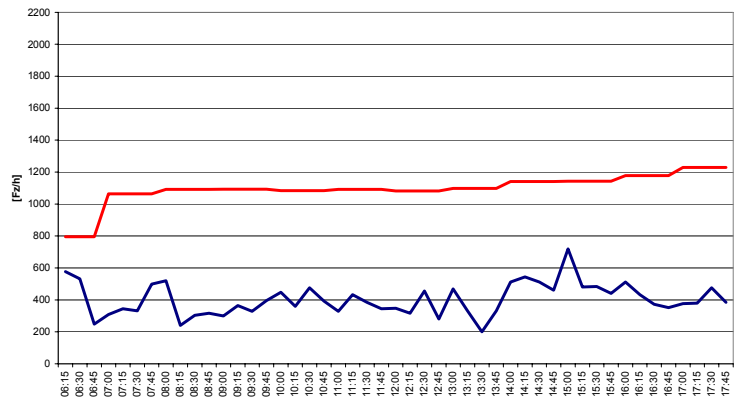
**B3: Treskow-Allee**



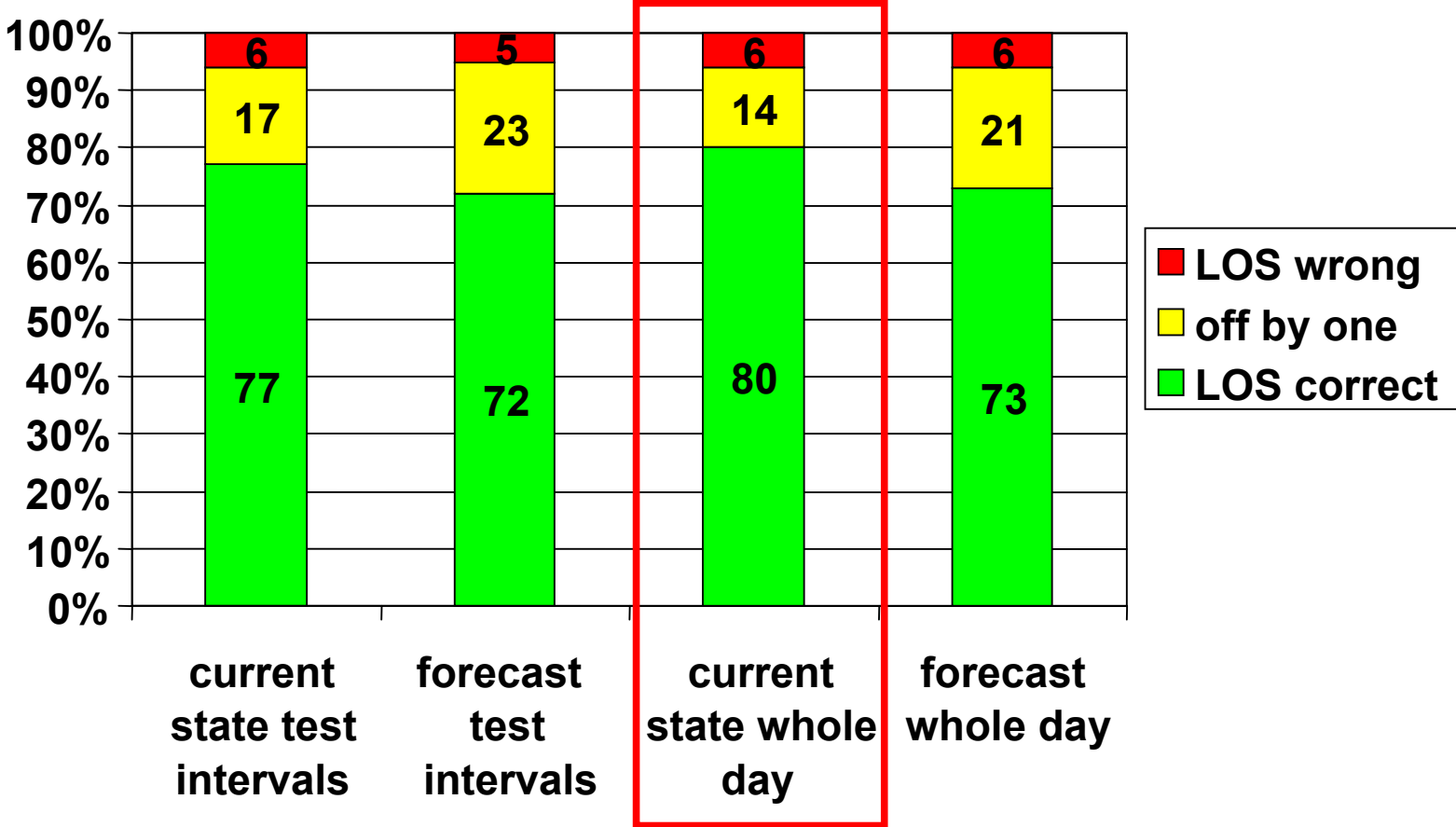
**B4: Heerstraße**



**B7: Warschauer Straße**



## Results from Field Test





[www.ptv.de](http://www.ptv.de)  
[gerhard.ploss@ptv.de](mailto:gerhard.ploss@ptv.de)



PTV Planung Transport Verkehr AG, 76131 Karlsruhe

