



# Optimising last mile processes by trip planning and fleet monitoring

Results from the INVENT/VMTL project



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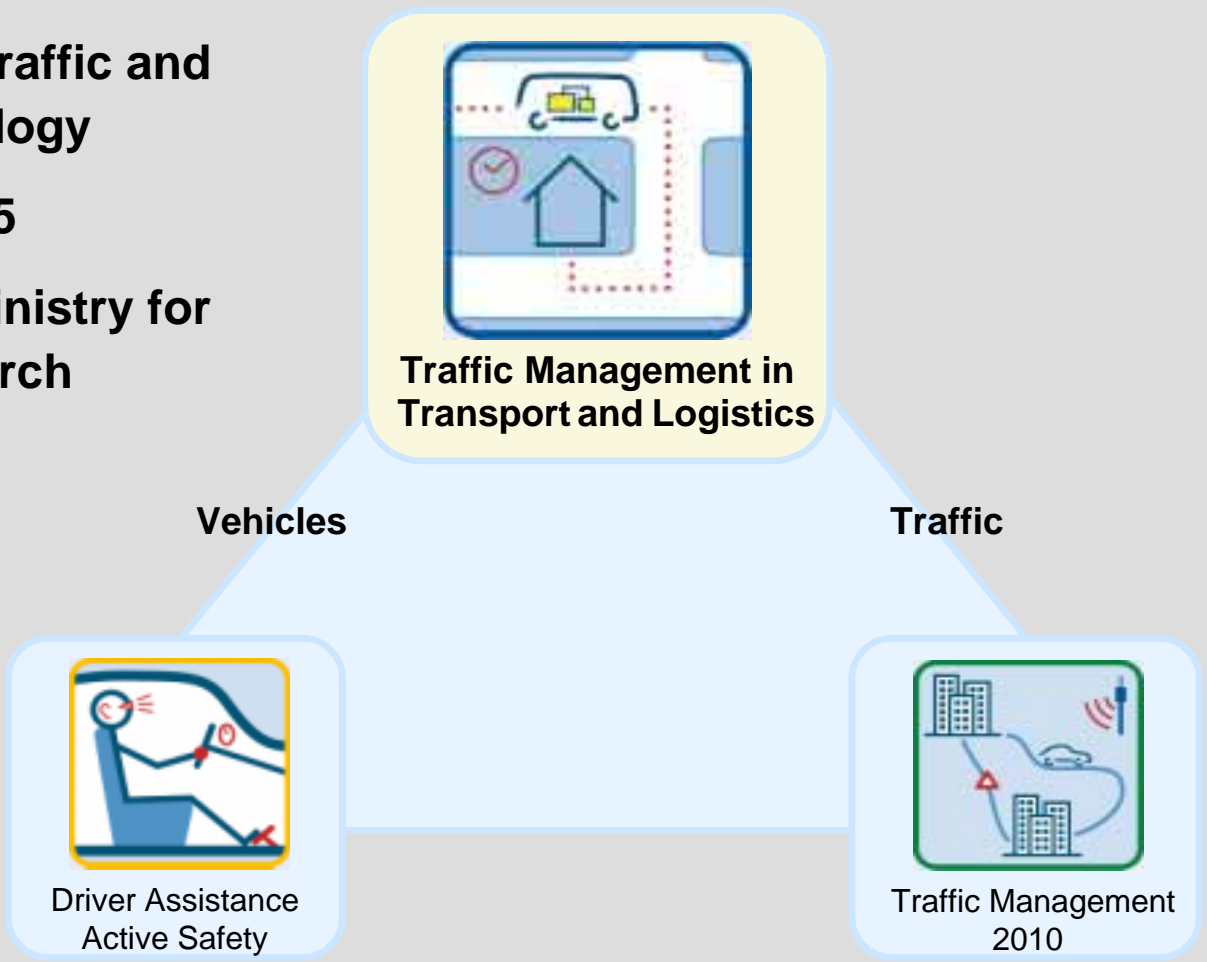


# The INVENT-VMTL project

**INVENT: intelligent traffic and user friendly technology**

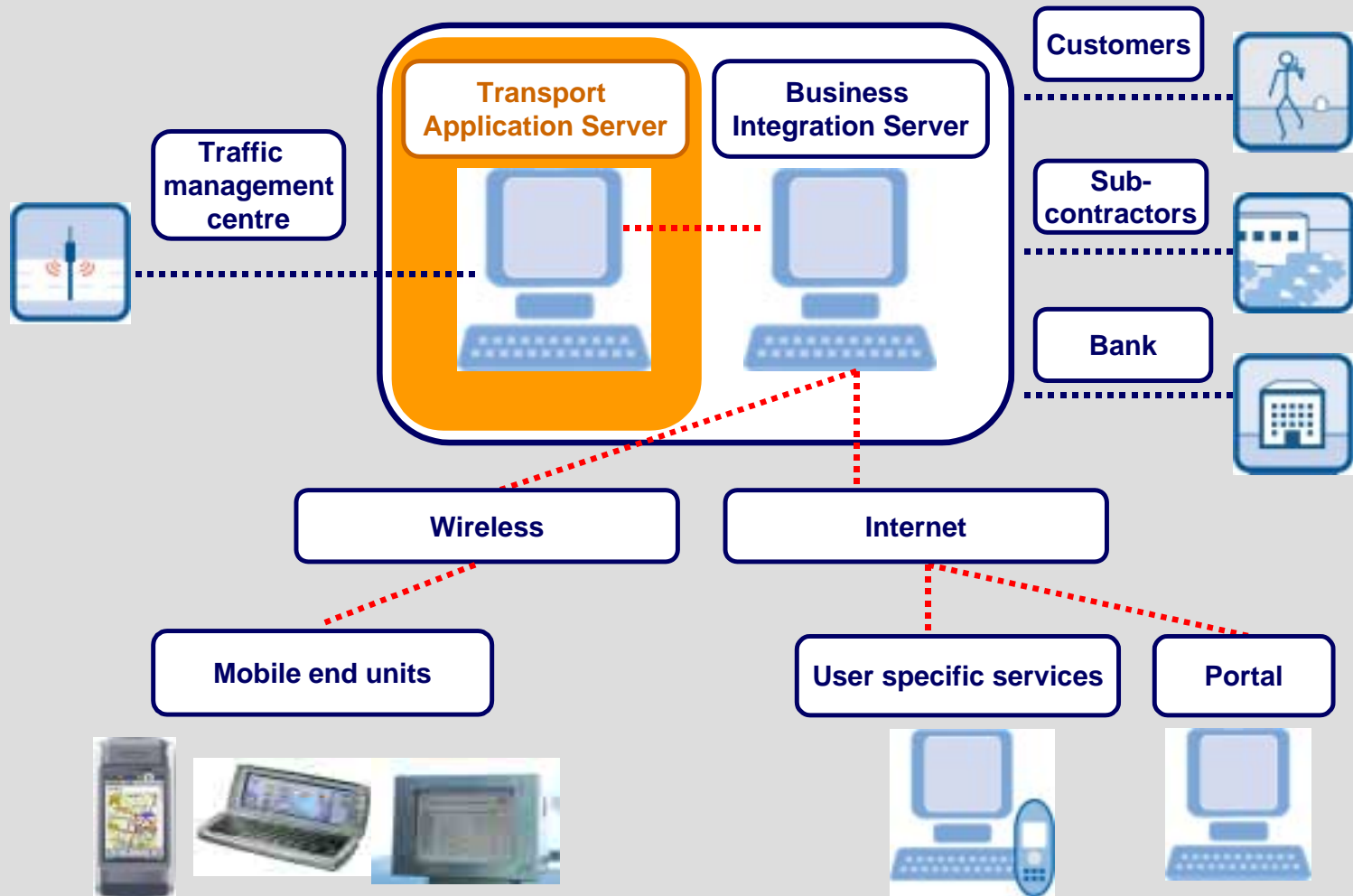
**Duration: 2001 - 2005**

**Funding: German ministry for education and research (BMBF)**





## VMTL System architecture

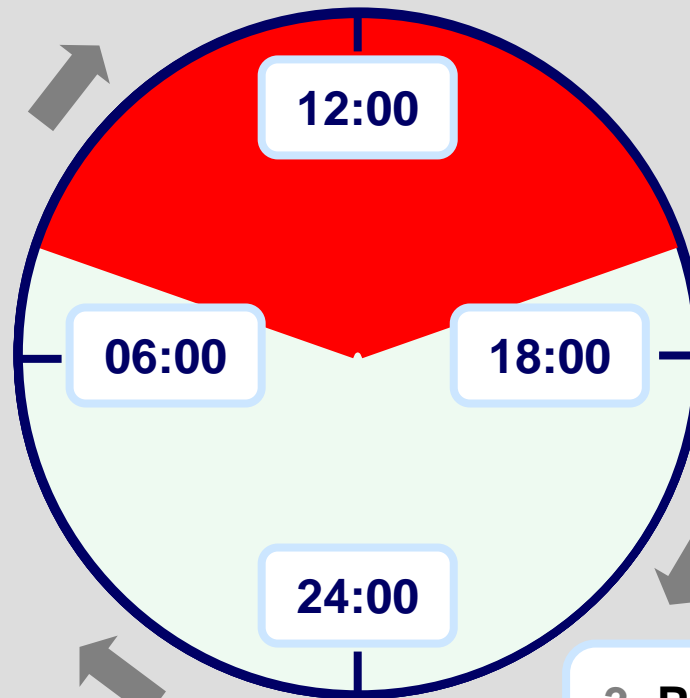




## Workflow

### 7. On Tour: Active control of the delivery processes

- 6. Tour transfer to On-board units
- 5. Announcement to the clients
- 4. Morning of the delivery day: Transport planning



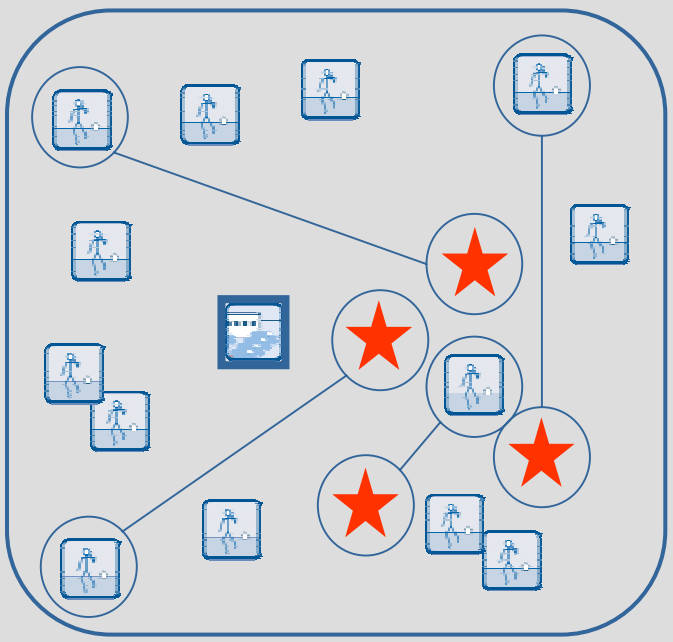
- 1. Eve of the delivery day: Transport planning
- 2. Announcement to the customers





3. Physical transport of goods to the depot



# Transport planning with alternative delivery locations

- Each customer can design his individual delivery profile where a set of delivery locations is defined
- A delivery location contains a) the address and b) the valid time windows for this address
- New scheduling algorithm developed and tested



-  Delivery locations, available today
-  Additional = alternative delivery locations, e.g. office, fuel station, Pick-Point, parking
-  Delivery locations which belong together
-  Depot



## Transport planning with alternative delivery locations

### Results:

- Scenario is based on nearby fuel stations, 15 to 25% of the addresses with alternatives
- New planning module leads to:
  - A reduction of the driven kilometres by up to 12,5%
  - A reduction of the driving time by up to 5,5%
- Improvement of the customer service
- Results depend on concrete scenario



*Without alternative delivery locations*

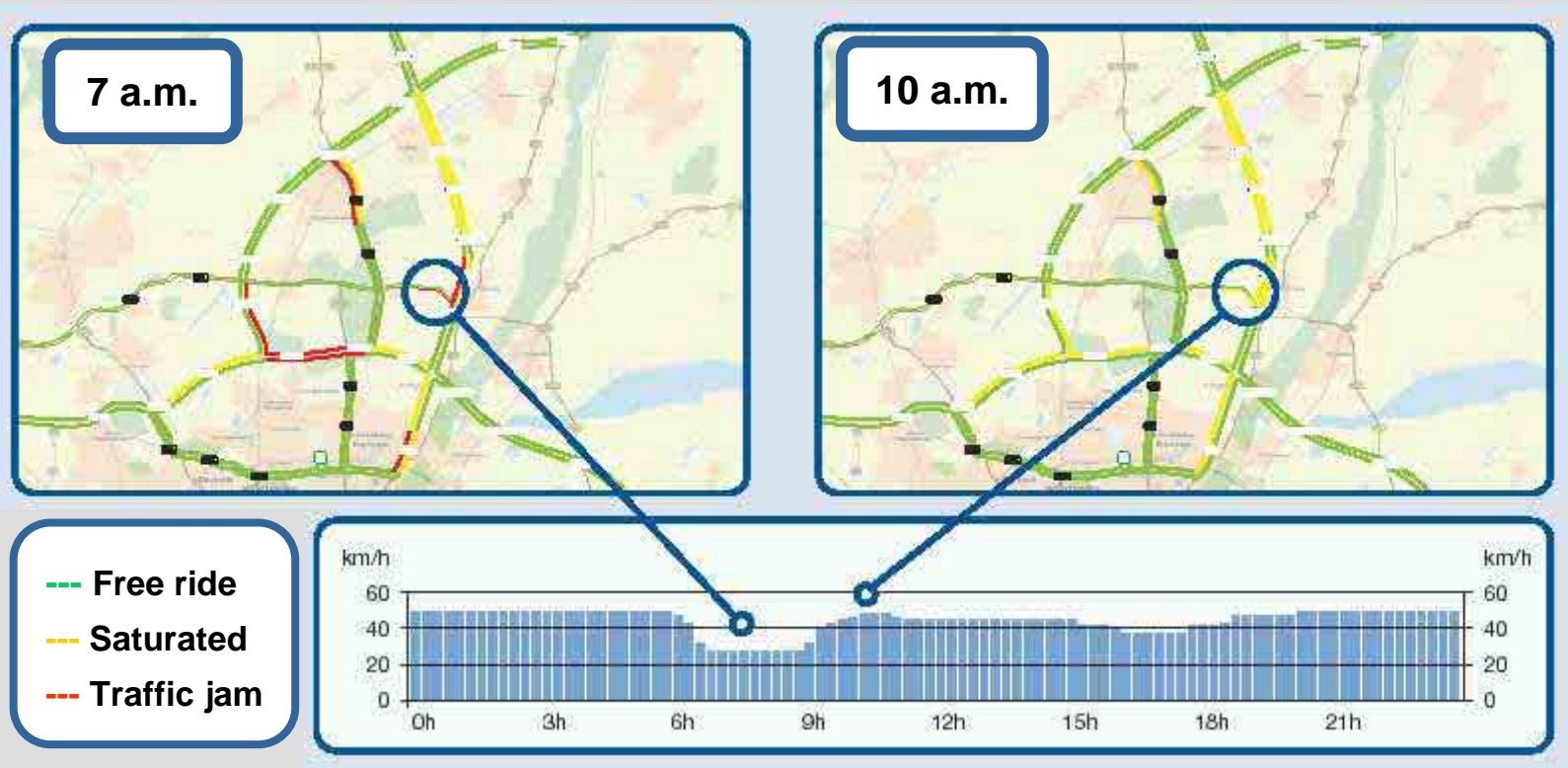


*Alternative delivery locations available*



# Transport planning with dynamic networks

Daytime specific travel times are used as additional information for the transport planning algorithm





# Transport planning with dynamic networks



## Conventional Planning

Net with static driving times:

228 km - 20:19 h

Control with dynamic driving times:

228 km - 21:49 h

Delays:    
 5-10   < 16   < 21   >= 21 Minutes



## New planning module

Net with dynamic driving times:

224 km - 20:42 h

Control with static driving times:

224 km - 20:12 h

No delays



## Transport planning with dynamic networks

### Results:

- The module is still under investigation but the first comparisons are very promising
- First results show that the newly developed planning module allows a more accurate planning of delivery tours
- The demand for this planning feature is increasing
- The quality of the available statistical traffic information is of high relevance
- Sensitivity analysis is still outstanding





## Fleet monitoring and traffic information

### Recurrent Workflow

- **Continuous monitoring of the tour progress at the depot**
- **Plan adaptation in case of:**
  - **New orders**
  - **Delays**
  - **Traffic situation**
- **Recalculation of ETAs based on current traffic situation**
- **Information to the customers if needed**
- **Download of adjusted tour data to the vehicle/driver**



# Fleet monitoring and traffic information

The screenshot shows the Dispatch software interface. At the top, there are menu options: Datei, Planungsgebiete, Ansicht, Extras, Fenster, Hilfe, Dispo. Below the menu is a toolbar with icons for map, information, and other functions. The main window is divided into several panes:

- Touren (Tours):** A table listing tours with columns: ExId, Ext, StartTime, SumQuai, SumQu, EndTir, Duratc, Distance, DrivingTir, Id.
 

ExId	Ext	StartTime	SumQuai	SumQu	EndTir	Duratc	Distance	DrivingTir	Id
134	2	20.04.2004 14:30:00	535	710	7:46:00	195	26020	101	0
135	0	20.04.2004 14:30:00	709	677	7:24:00	174	21000	0	0
- Tour 0a96a8c035c9068300000fard8bd8c00003:** A detailed tour schedule table with columns: Seq, Ex, Planned, Tir, Tar, TargetDa, ActualAr, ActualDe, Street.
 

Seq	Ex	Planned	Tir	Tar	TargetDa	ActualAr	ActualDe	Street
9		15:41:00	0	15:41:00	15:46:00	15:41:00	15:46:00	
10		15:46:00	0	15:46:00	15:51:00	15:46:00	15:51:00	
11		15:53:00	0	15:53:00	15:58:00	15:53:00	15:58:00	
12		16:00:00	0	16:00:00	16:05:00	16:00:00	16:05:00	
13		16:05:00	0	16:05:00	16:10:00	16:05:00	16:10:00	
14		16:13:00	0	16:13:00	16:18:00	00:00:00	00:00:00	
15		16:20:00	0	16:20:00	16:25:00	00:00:00	00:00:00	
16		16:27:00	0	16:27:00	16:32:00	00:00:00	00:00:00	
17		17:22:00	37	16:45:00	16:50:00	00:00:00	00:00:00	
18		17:29:00	37	16:51:00	16:56:00	00:00:00	00:00:00	
- Map:** A map of Munich-Freimann (74) showing a route with numbered points (11-16). A red circle highlights a specific area on the map, and a black arrow points from this area to the message alert below.
- MessageMonitorAlert:** A table showing alerts with columns: TimeStamp, Message.
 

TimeStamp	Message
20:47:02	Achtung! Verspätung auf der Tour Nr. 134
20:47:02	Abfahrt vom Tour Punkt Nr. 13 der Tour 134

Attention: Delay on tour no. 134



## Planning in detail

- **Standard planning with addresses and standard maps are usually sufficient**
- **When going into further detail and especially in urban areas:**
  - **Delivery addresses give no hints on parking possibilities**
  - **Delivery addresses can be different from the exact delivery location**
  - **Delivery vans cannot u-turn in every street**
  - **Delivery sequence depends on these details**



**1** Delivery address

**2** Delivery location (ramp)



## Summary

- **Transport planning in more detail is possible**
- **Customers can receive more precise delivery time windows, early information and change information**
- **Cost reduction for the transport operators using optimisation potentials can be achieved**
- **Traffic information provision has to be improved**
- **Planning of alternative delivery locations depends on information infrastructures**



# Thank you!

*For further information  
on the INVENT-project please visit:  
[www.invent-online.de](http://www.invent-online.de)*

*Compare also:  
BESTUFS Workshop in Dublin (April 2003)*