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Traffic Management and ITS Implementations in Frankfurt Rhein-Main

Prof. Dr.-Ing. Manfred Boltze

August / September 2000

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Transport Planning and Traffic Engineering

Contents

Traffic Management and ITS Implementations in Frankfurt Rhein-Main

1. General

Region and City Frankfurt Rhein-Main

City of Frankfurt am Main

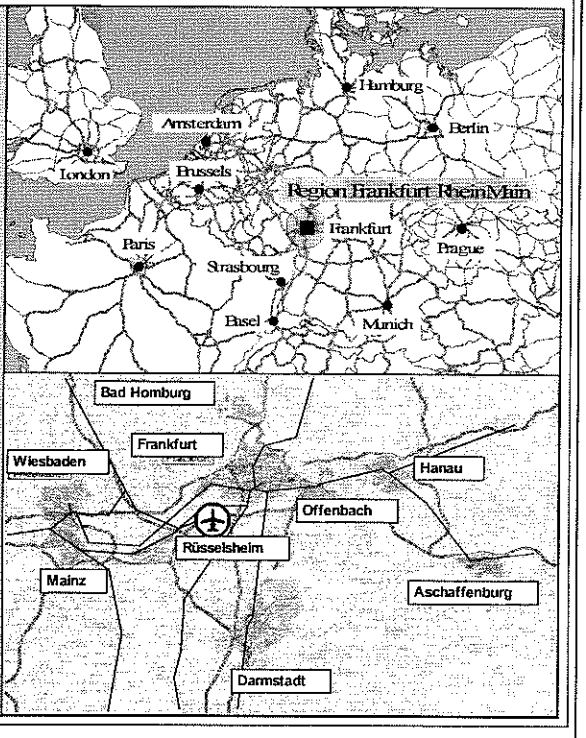
- 645.000 inhabitants
- 560.000 jobs
- 290.000 commuters
  - 90.000 by public transport
  - 200.000 by car

Due to the narrow boundaries of the City, Frankfurt depends very much on a co-operation with other cities and countries in the Rhein-Main Region.

Region and City Frankfurt Rhein-Main

Region Rhein-Main

- 3.8 mio. inhabitants
- 1.9 mio. jobs
- polycentric metropolitan area
- historically grown concentration of functions
- high degree of functional interdependencies
- located in the heart of Europe and in the center of Germany
- very good location in all traffic networks
- throughpassing traffic
- HIGH DEMAND FOR MOBILITY



Frankfurt Airport

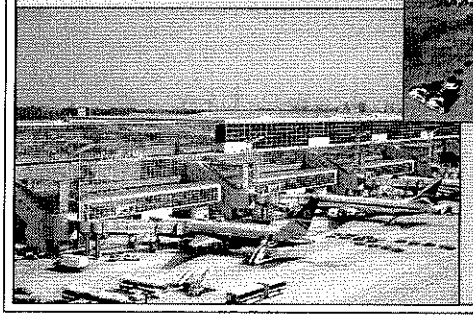
42 mio. passengers/year (2nd in Europe)

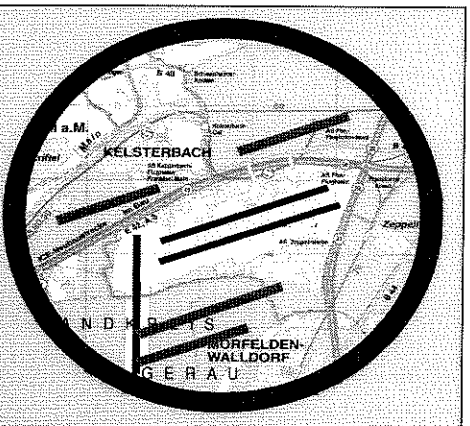
1.4 mio. tons airfreight/year (1st in Europe)

420.000 movements/year

170 airlines

57.500 employees





→ Todays capacity is limited to 460.000 movements/year.

→ According to current forecasts capacities will be consumed in 2003.

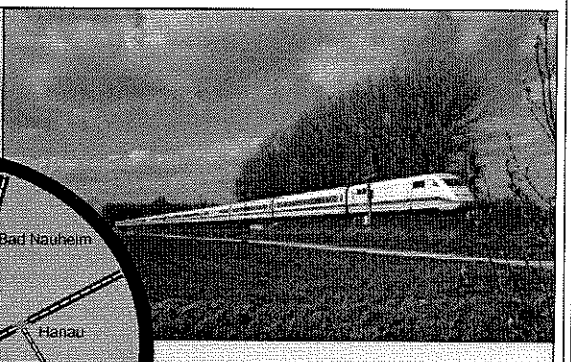
→ New Runway under consideration.

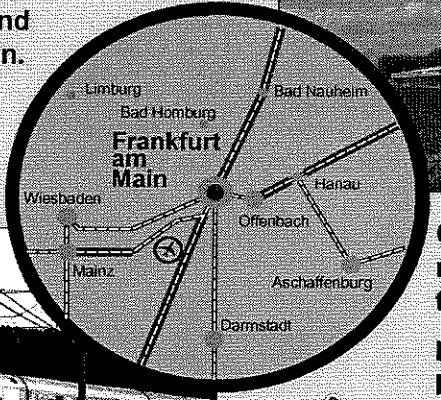
Regional Rail Infrastructure

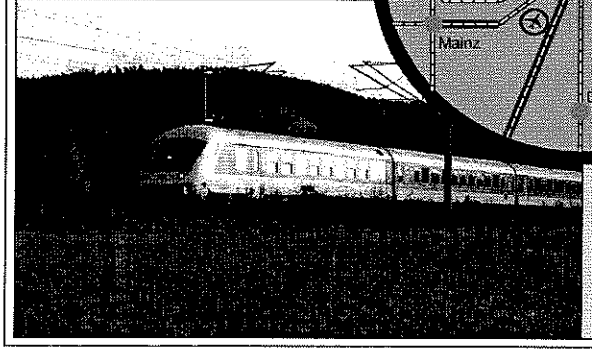
High-speed line Köln (Cologne) - Frankfurt under construction.

Regional distribution and international connection.

Access to the Trans-European Transport Network (TEN-T).





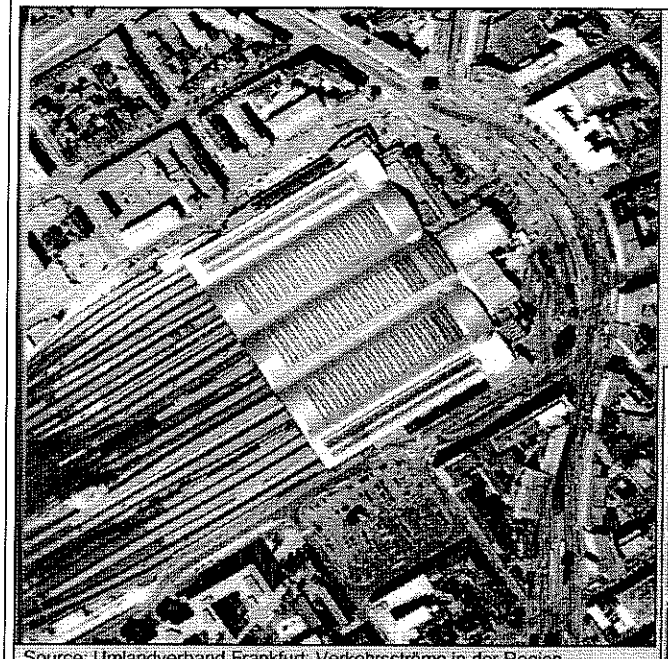


Overlapping of local, regional and long-distance trains.

Increased travel-times at Frankfurt Central Station due to being a dead-end station.

Frequent delays and congestion.

Regional Rail Infrastructure - Project "Frankfurt 21"



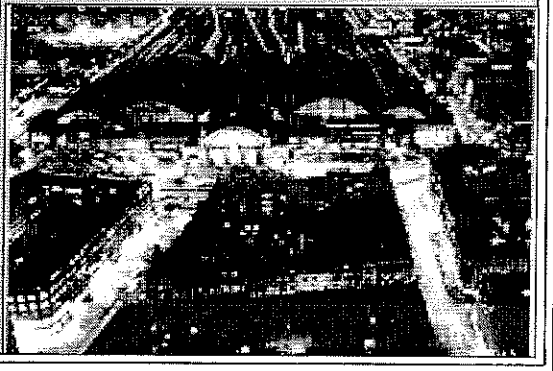
Source: Umlandverband Frankfurt: Verkehrsströme in der Region Frankfurt RheinMain - Die Bedeutung einer einheitlichen Datenbasis für die Verkehrsplanung.Frankfurt am Main, 1999

Main Station Frankfurt

300.000 passengers/day

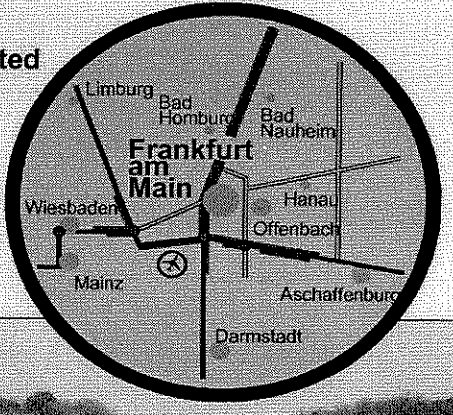
Dead-end station with severe capacity problems

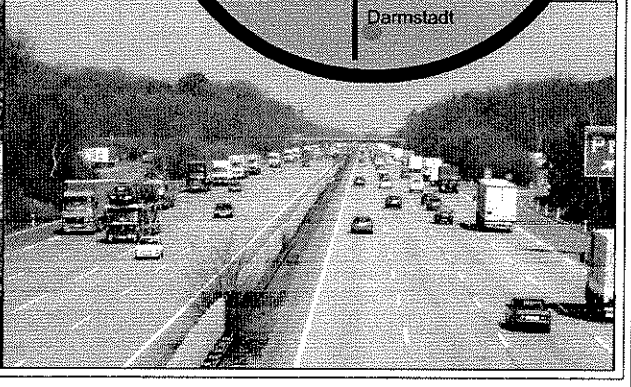
Feasibility study "Frankfurt 21" for an additional tunnel to allow through-passing traffic (with major effects also on regional rail traffic)



Regional Road Infrastructure

- **High quality road network**
- **Expansion of regional road infrastructure limited to connective elements and additional lanes**
- **Extension of intersection "Frankfurter Kreuz" (300.000 vehicles/day)**
- **Frequent congestion of regional road infrastructure.**

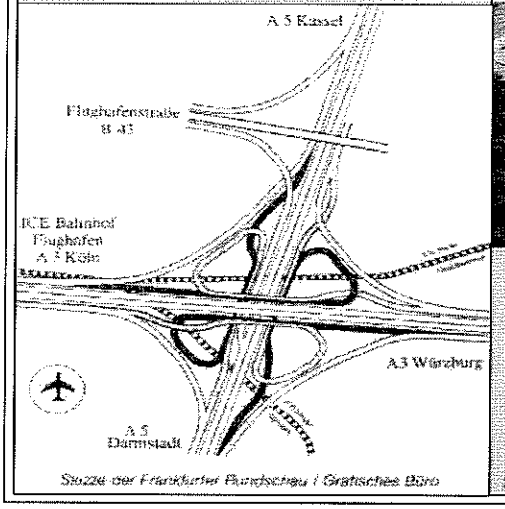




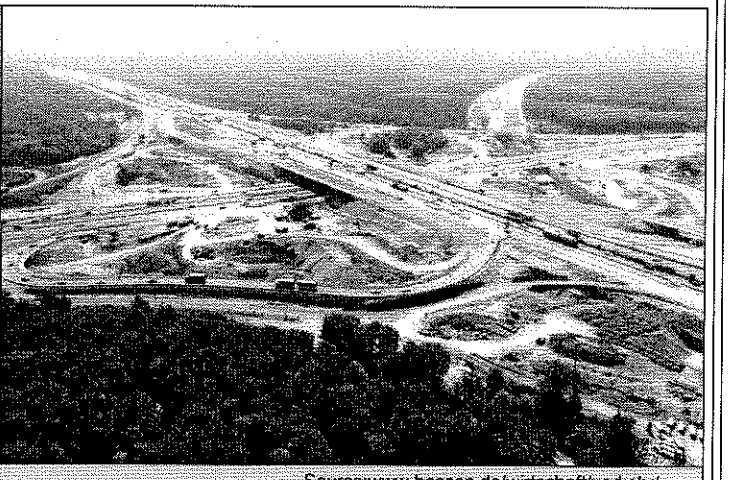
Source: www.hessen.de/wirtschaft/verkehr/

Extension of Intersection "Frankfurter Kreuz"

Systematical reduction of weaving traffic.



Skizze der Frankfurter Rundschau / Grafisches Büro



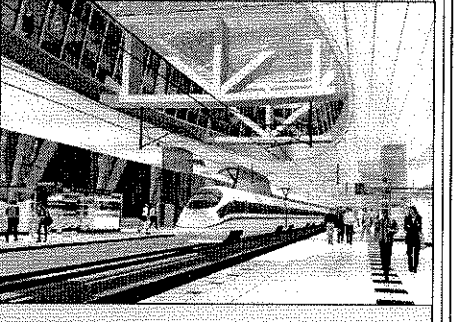
Source:www.hessen.de/wirtschaft/verkehr/

Source: VSVI Journal 1/96

Intermodality at Frankfurt Airport

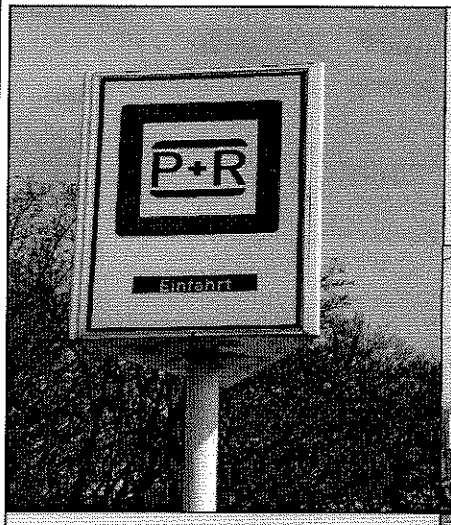
Frankfurt Rhein-Main Airport (110.000 passengers/day)

New AIRail Terminal for High-speed Trains at Frankfurt Rhein-Main Airport

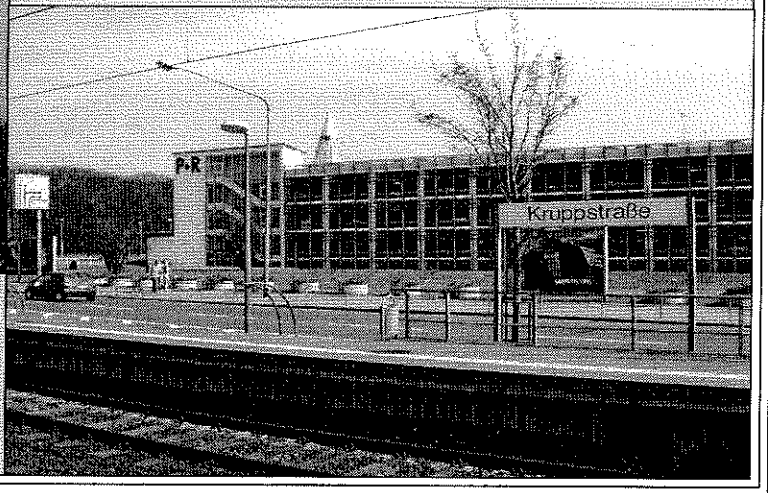


Motorway intersection „Frankfurter Kreuz" (300.000 vehicles/day)

Comprehensive P+R Infrastructure



- Approximately 25.000 P+R spaces in the region.
- City of Frankfurt financed P+R facilities outside the city to decrease commuting by car.



- Preference for small P+R facilities close to homes instead of big P+R terminals close to the city centre.

2. Organisational Aspects

Organisational Aspects

Traffic problems and the high number of involved institutions indicate an urgent need for co-operation of regional traffic and transport actors.

The Region Rhein-Main is no unit in terms of organisation.

Significant progress in information exchange and co-operation:

1994 Founding of RMV - Rhein-Main Public Transport Authority.

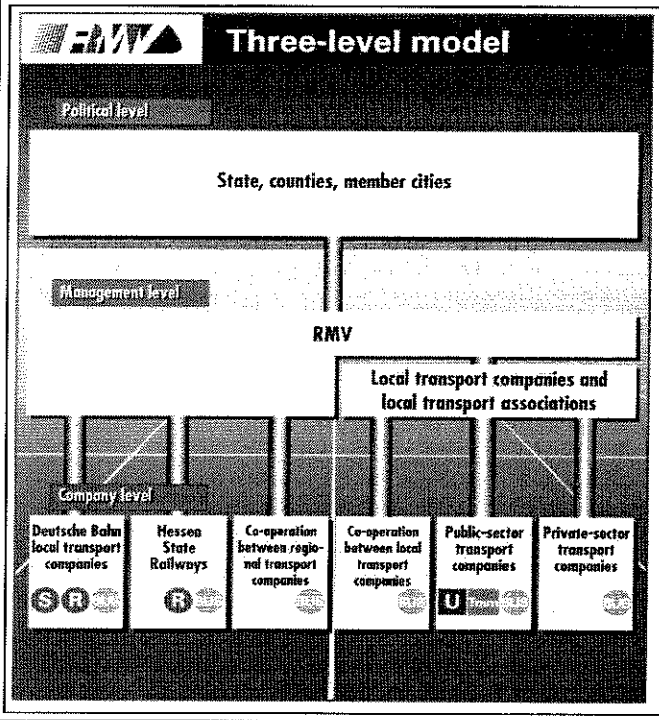
1998 Founding of
ZIV - Institute for Integrated Traffic and Transport Systems and
FIV - Association for Promoting Integrated Traffic and Transport Systems.

Joined project work - partly initiated by EC research projects (FRUIT, RHAPIT, ENTERPRICE, TASTe).

Common goal concept for traffic management.

Memorandum of Understanding from all cities and counties of the region to initiate a framework for co-operation in traffic management (WAYflow).

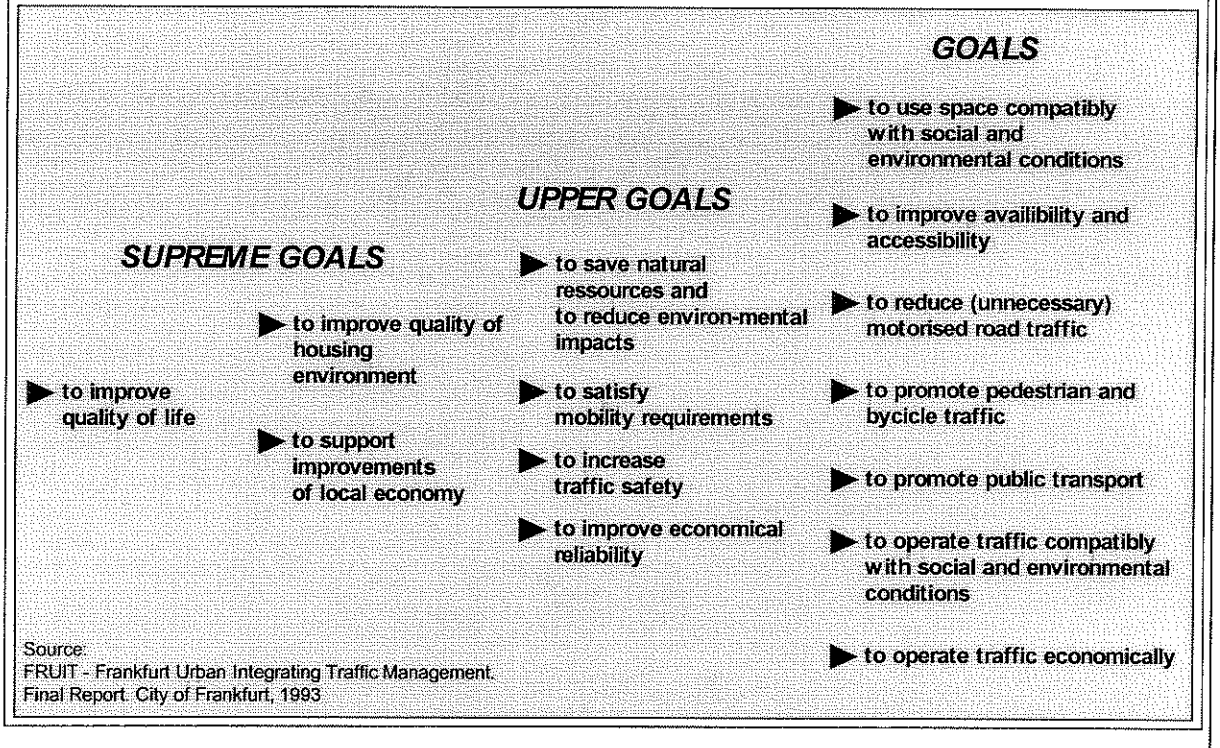
RMV - Rhein-Main Public Transport Authority



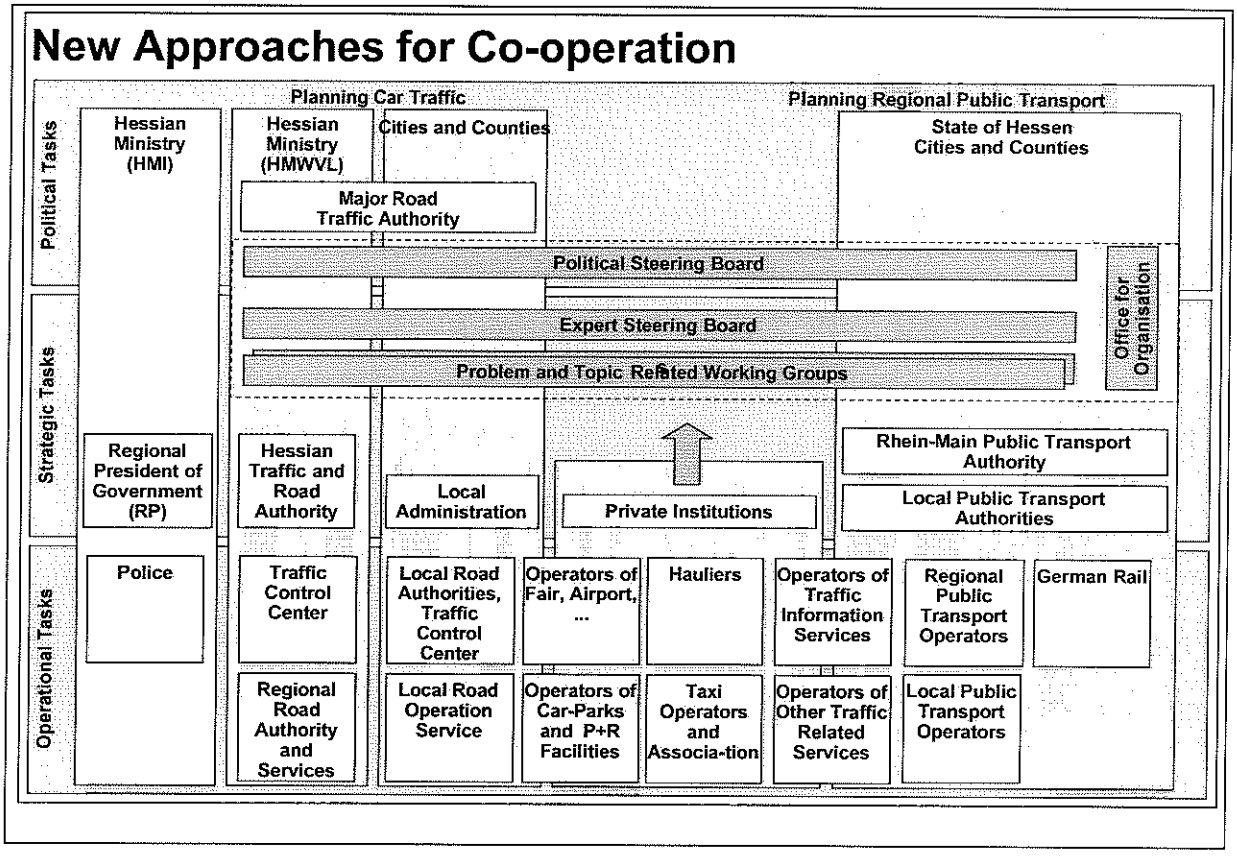
- Integrated planning for all public transport sub-systems
- Uniform tariff system for regional public transport
- Integrated Information Services
- Uniform Marketing Strategy
- "Job Tickets", "Semester Tickets", "Kombi Tickets"

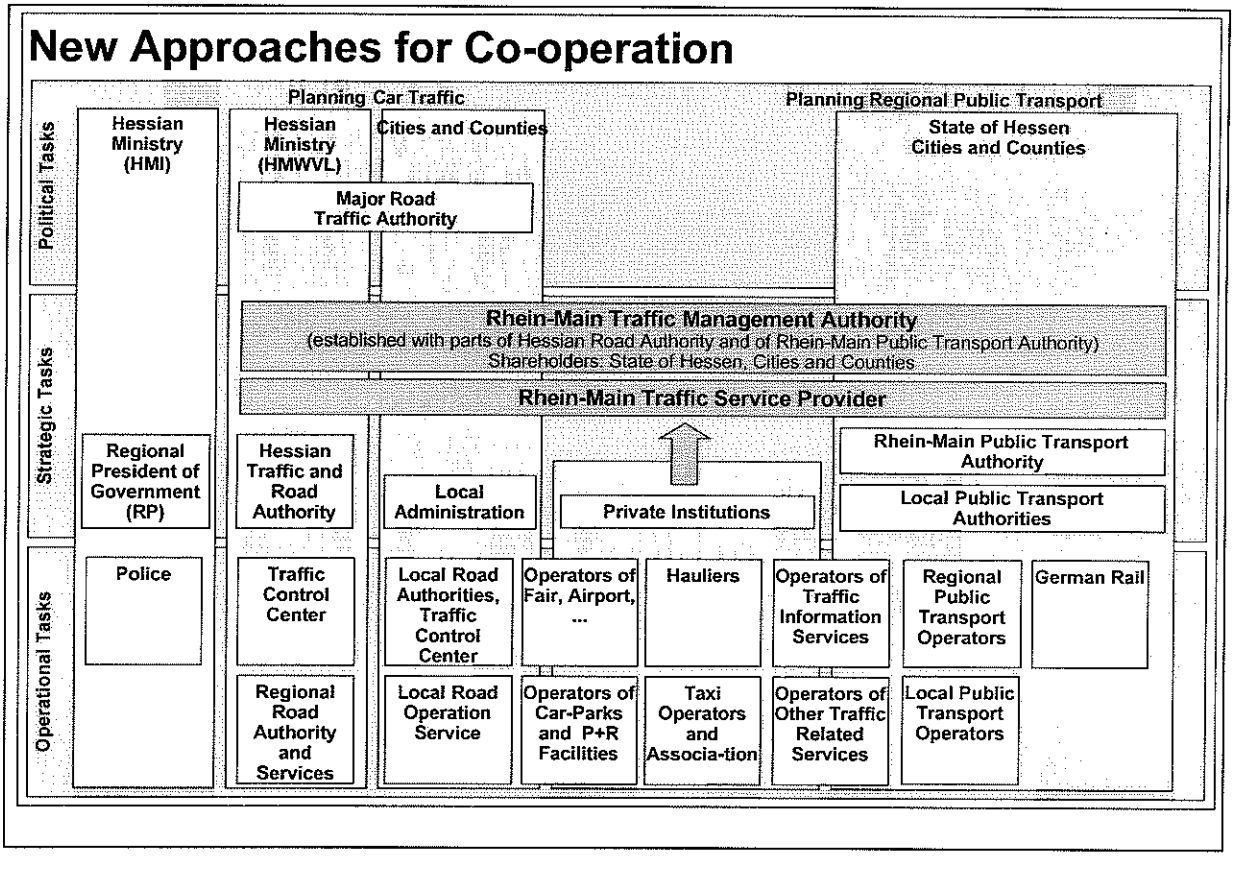
Source:
Rhein-Main Verkehrsverbund GmbH:
The Mobility of the Future. Hofheim, 1995.

Common Goal Concept



Source:
FRUIT - Frankfurt Urban Integrating Traffic Management.
Final Report. City of Frankfurt, 1993


New Approaches for Co-operation
Planning Car Traffic
Planning Regional Public Transport
Political Tasks
Strategic Tasks
Operational Tasks
Hessian Ministry (HMI)
Hessian Ministry (HMWVL)
Cities and Counties
State of Hessen Cities and Counties
Major Road Traffic Authority
Political Steering Board
Expert Steering Board
Problem and Topic Related Working Groups
Office for Organisation
Regional President of Government (RP)
Hessian Traffic and Road Authority
Local Administration
Private Institutions
Rhein-Main Public Transport Authority
Local Public Transport Authorities
Police
Traffic Control Center
Local Road Authorities, Traffic Control Center
Operators of Fair, Airport, ...
Hauliers
Operators of Traffic Information Services
Regional Public Transport Operators
German Rail
Regional Road Authority and Services
Local Road Operation Service
Operators of Car-Parks and P+R Facilities
Taxi Operators and Associa-tion
Operators of Other Traffic Related Services
Local Public Transport Operators


New Approaches for Co-operation
Planning Car Traffic
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Hessian Ministry (HMI)
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Cities and Counties
State of Hessen Cities and Counties
Major Road Traffic Authority
Rhein-Main Traffic Management Authority
(established with parts of Hessian Road Authority and of Rhein-Main Public Transport Authority)
Shareholders: State of Hessen, Cities and Counties
Rhein-Main Traffic Service Provider
Regional President of Government (RP)
Hessian Traffic and Road Authority
Local Administration
Private Institutions
Rhein-Main Public Transport Authority
Local Public Transport Authorities
Police
Traffic Control Center
Local Road Authorities, Traffic Control Center
Operators of Fair, Airport, ...
Hauliers
Operators of Traffic Information Services
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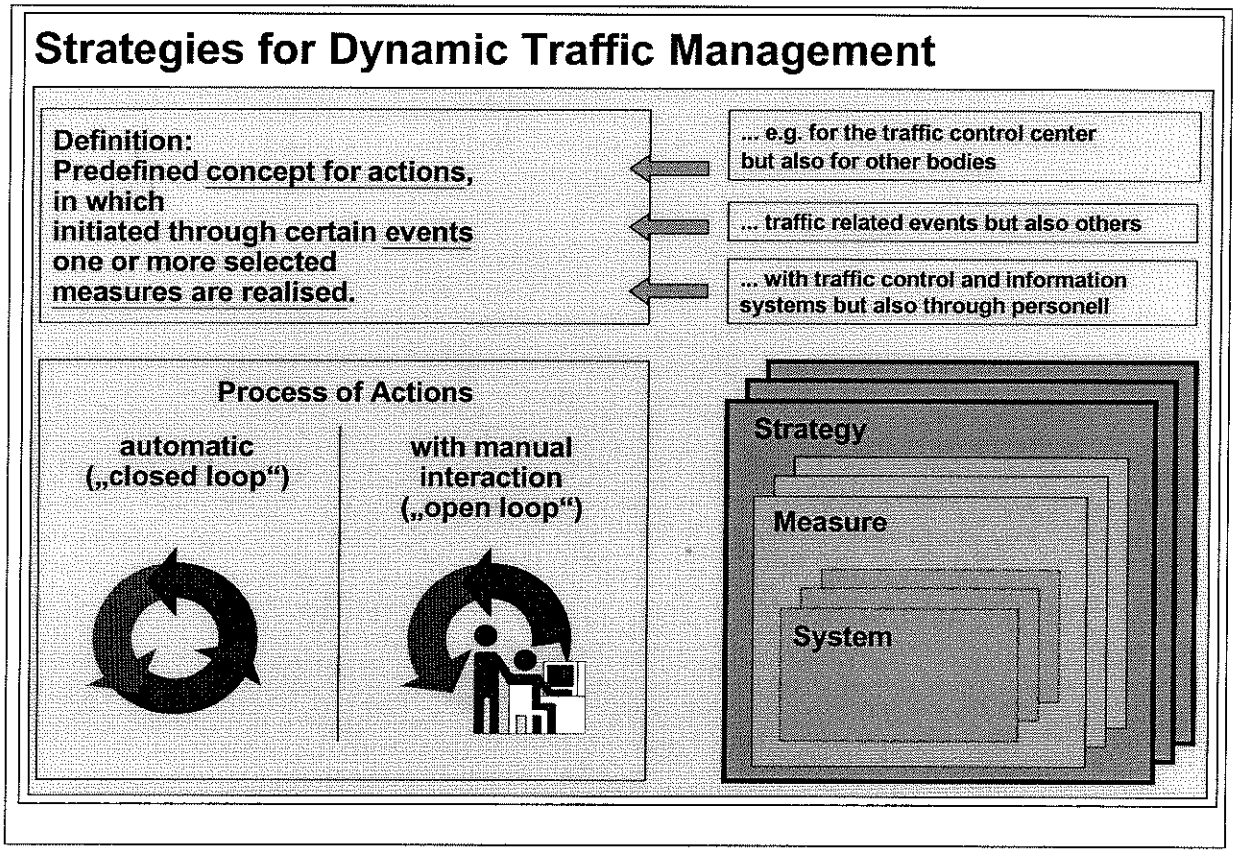
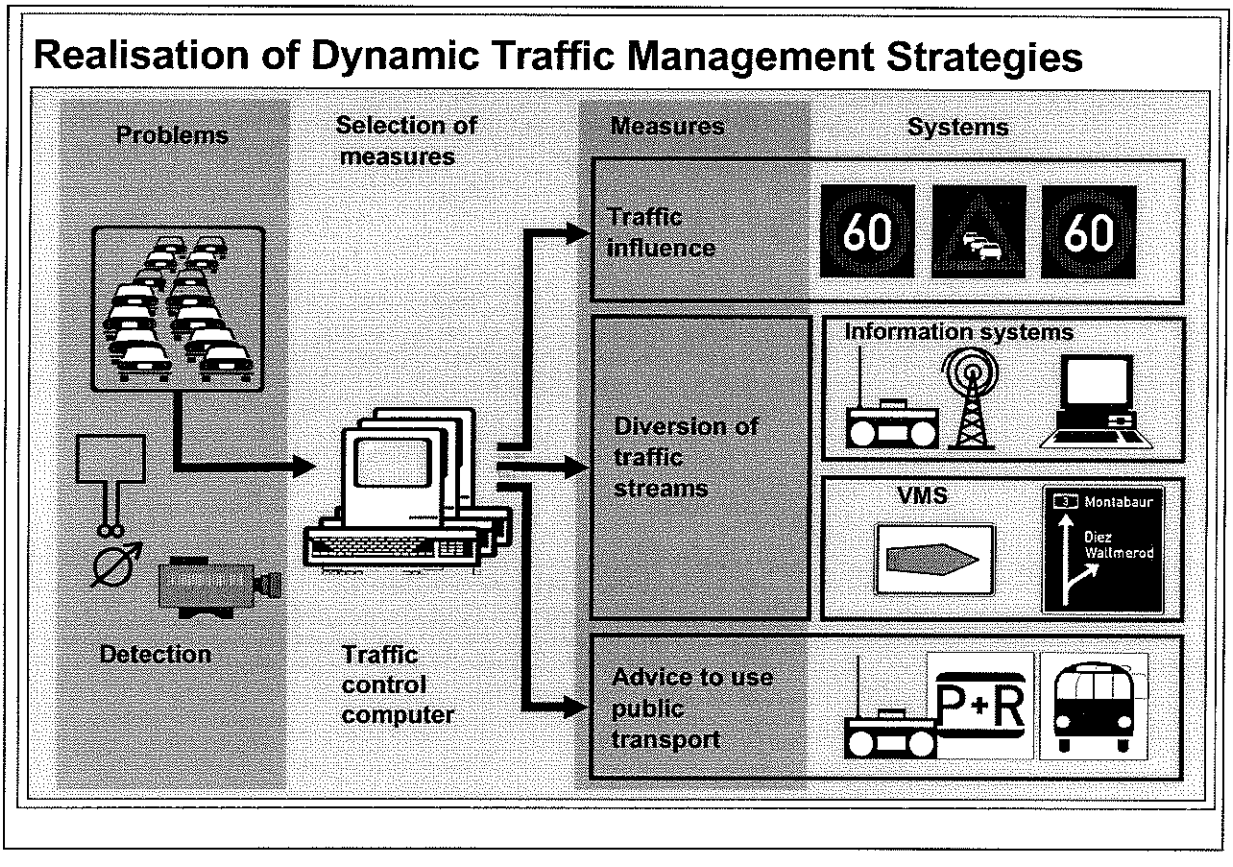
Local Road Operation Service
Operators of Car-Parks and P+R Facilities
Taxi Operators and Associa-tion
Operators of Other Traffic Related Services
Local Public Transport Operators

3. Strategies for Dynamic Traffic Management





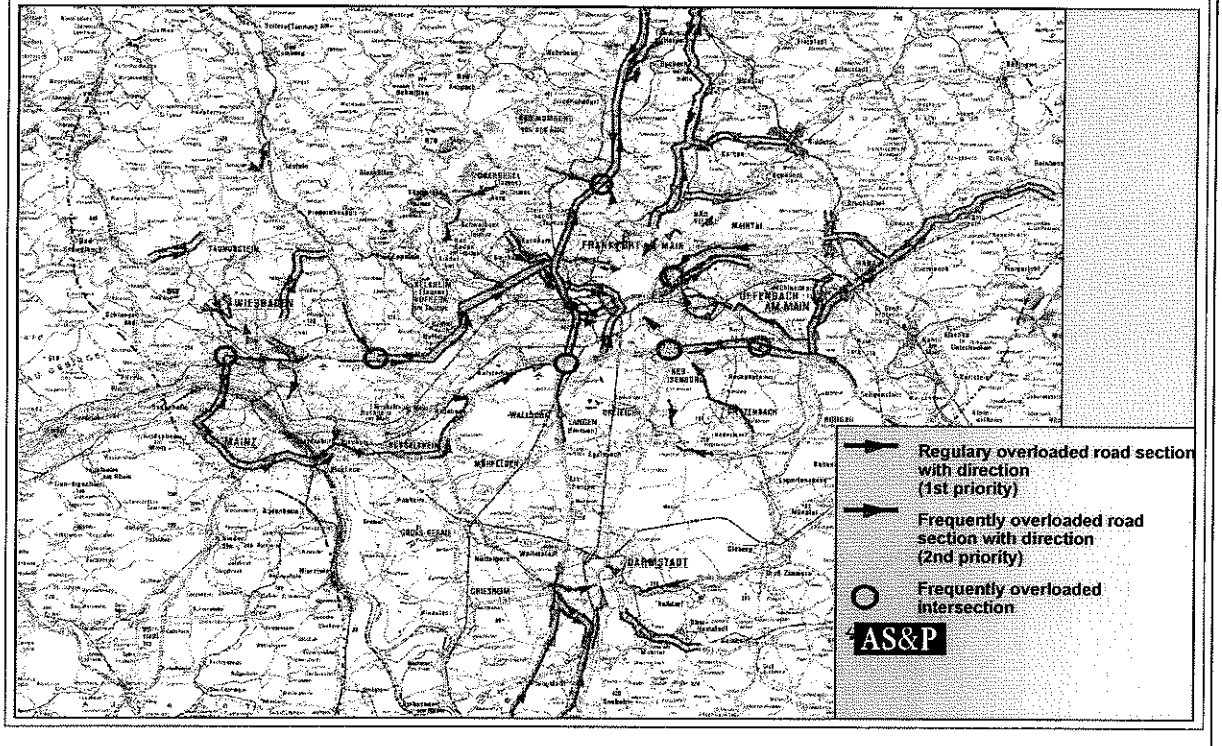
Problem-oriented Elaboration of Strategies

Problems

- **road network overloaded**
- **public transport network overloaded**
- **parking facilities overloaded**
- **bottlenecks in the road network** (construction sites, accidents, ...)
- **bottlenecks in the public transport network** (breakdowns, ...)
- **delays in public transport**
- **events, not foreseen events**
- **environmental problems** (weather, smog, ...)
- ...

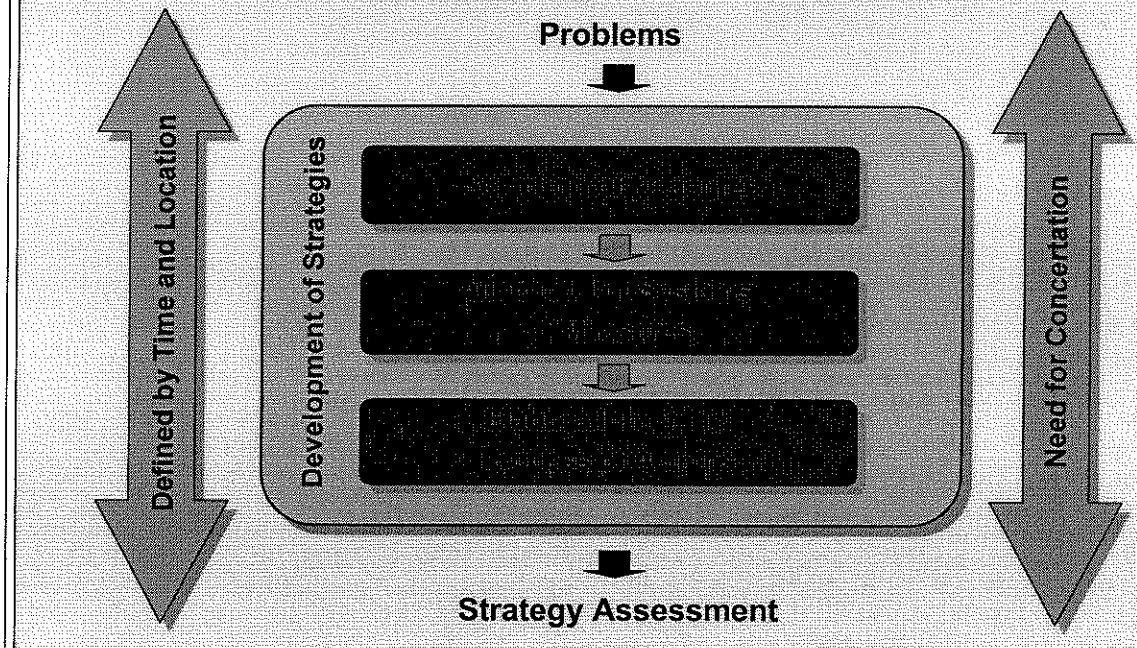
Strategies against Problems

Important Basis: Systematical Analysis of Problems



Prof. Dr.-Ing. Manfred Boltze
Darmstadt University of Technology (Germany), Transport Planning and Traffic Engineering

Steps to Develop Traffic Management Strategies



Examples of Measures for Traffic Management

Cars

- deviation of traffic streams
- allowance to use the emergency lane
- access control
- speed control
- provision of additional parking space (incl. P+R)
- modal shift from cars to public transport (PT)

PT

- provision of additional busses, trams, ...
- provision of sustitution for transport means
- ensuring connection in public transport

Matrix of Problems and Measures

Problems \ Measures	Deviation of traffic streams	Allowance to use the emergency lane	Access control	Speed control	Provision of additional parking space	Modal shift from cars to public tranport	Provision of additional busses, trams, ...	Provision of substitution for transport means	Ensuring connection in public transport
Overloaded road network	X	X	X	X		X	X		
Overloaded public transport network							X		
Overloaded parking facilities	X				X	X	X		
Bottlenecks in the road network (construction sites, accidents, ...)	X	X				X	X		
Bottlenecks in the public transport network (breakdowns ...)							X	X	
Delays in public transport									X
Events, not foreseen events	X	X	X		X	X	X		
Environmental problems (weather, smog, ...)	X		X	X	X	X	X		

AS&P, 1997

Matrix of Measures and Systems

Measures \ Traffic Control Systems	Variable Message Signs	Variable Direction Signs	Free text displays	Parking guidance systems	Traffic lights	Operation and control systems (PT)	Staff
Deviation of traffic streams		X	X	X			X
Allowance to use the emergency lane	X		X				X
Access control	X	X	X		X		X
Speed control	X		X				X
Provision of additional parking space			X	X			X
Modal shift from cars to public tranport			X	X			X
Provision of additional busses, trams, ...						X	X
Provision of substitution for transport means						X	X
Ensuring connection in public transport			X			X	X

AS&P, 1997

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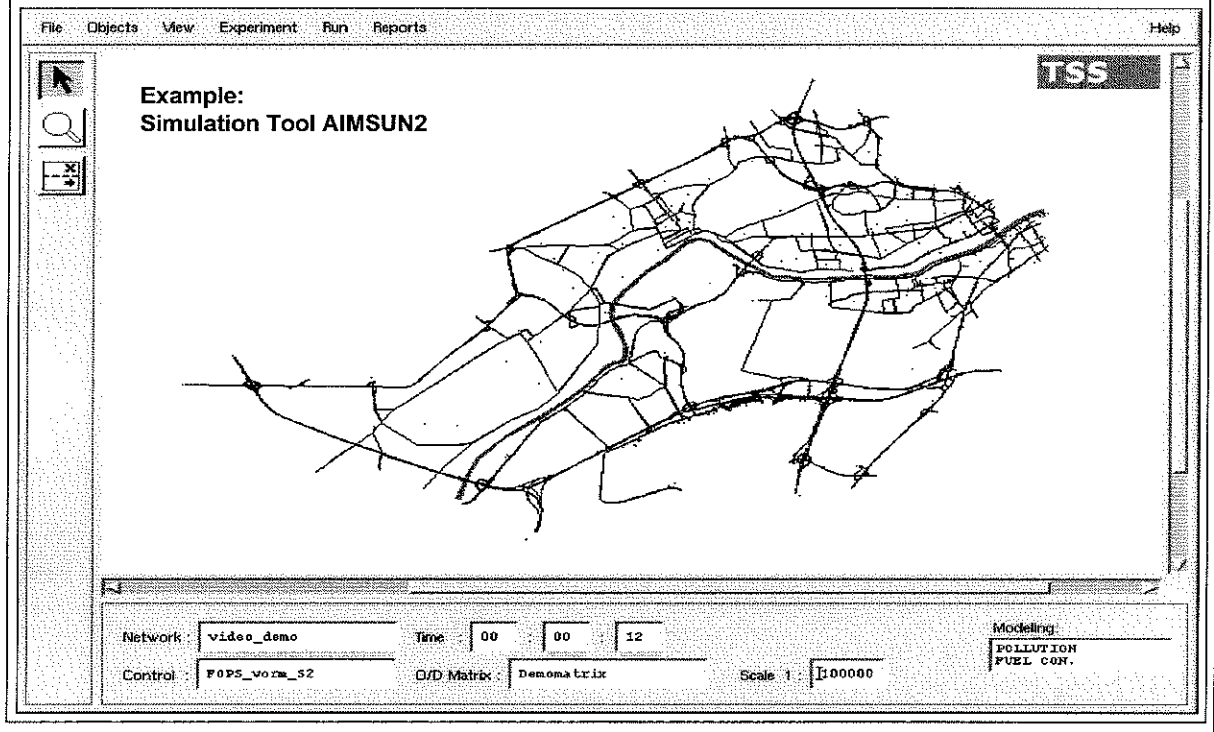
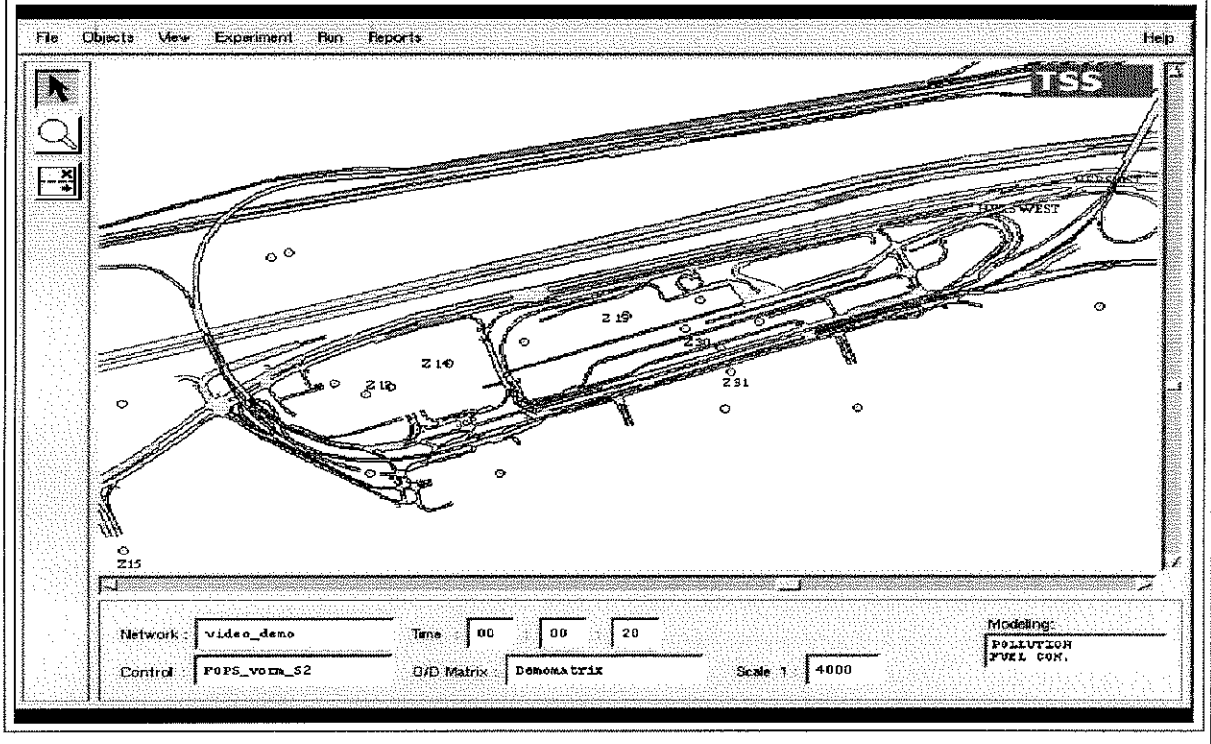
Darmstadt University of Technology (Germany), Transport Planning and Traffic Engineering

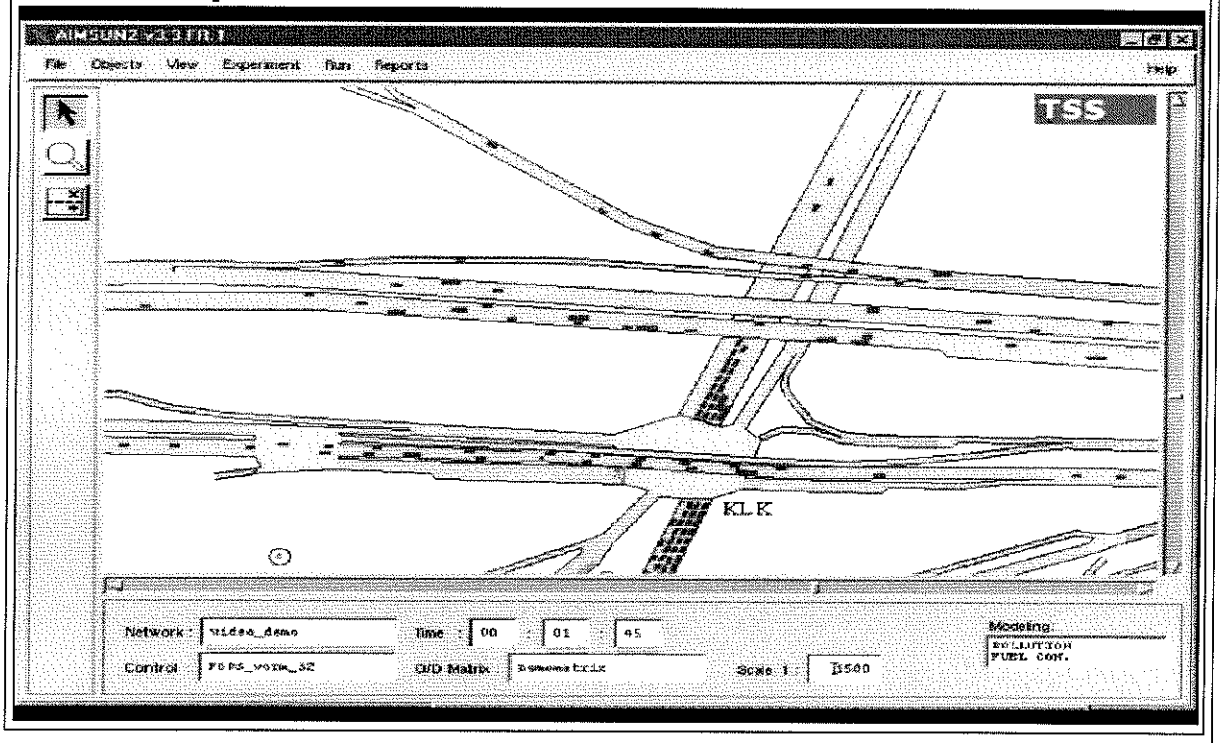
Assessment of Dynamic Traffic Management Strategies



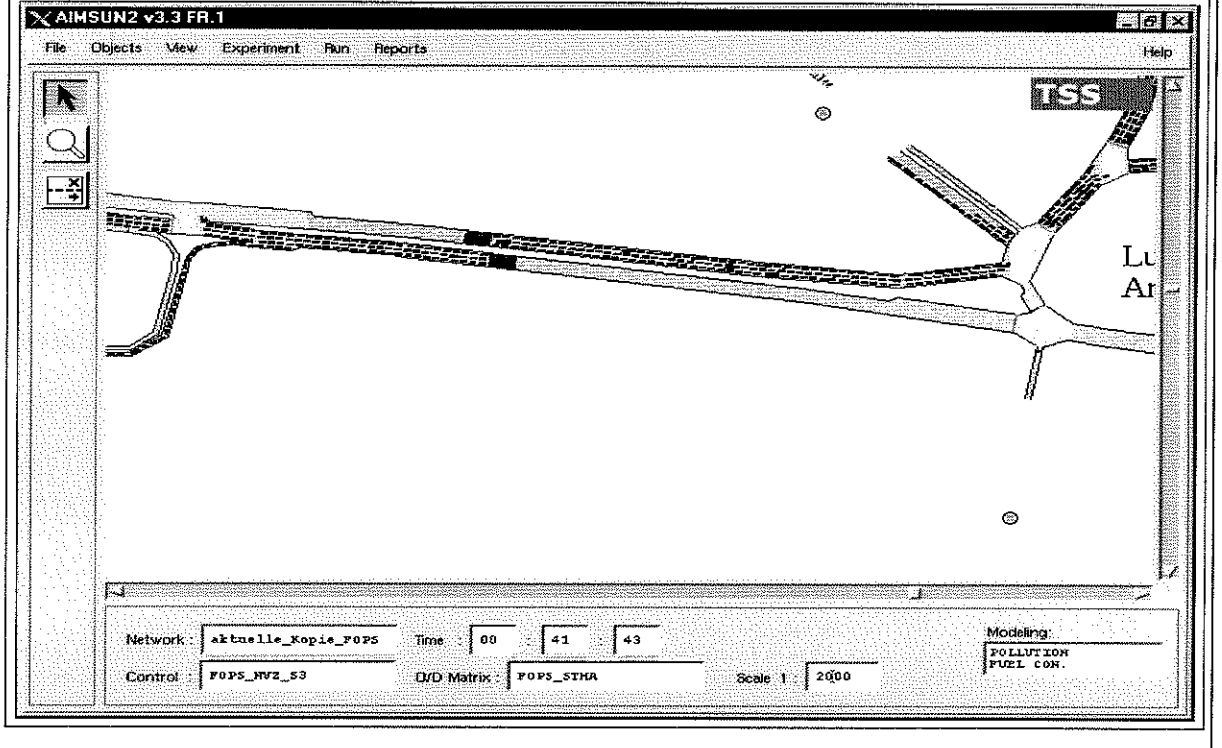
Microscopic Simulation with AIMSUN 2



Microscopic Simulation with AIMSUN 2



Microscopic Simulation with AIMSUN 2



4. Examples for Traffic Management Measures

Traffic Control on Highways

Source:
Dambach-Werke GmbH, Gaggenau, 1992

Examples for Traffic Management Measures in Frankfurt

Parking management (dynamic PGI system, parking pricing, reservation of parking space for residents)

Computerised Operation and Control System for public transport vehicles

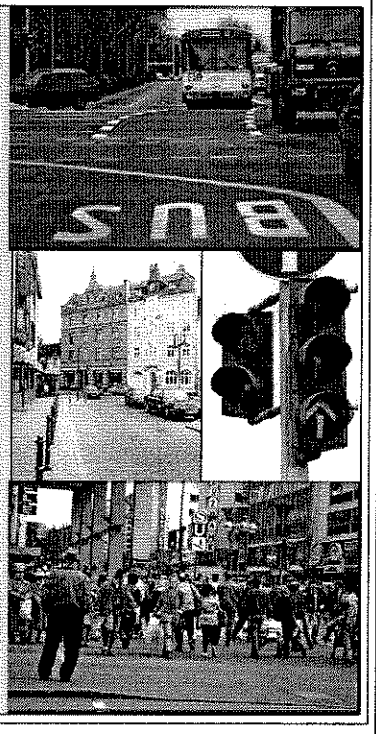
Priority treatment for all tram and bus lines (infrared detection and radio transmission at 320 inter-sections, separate bus lanes and separate signals)

Speed limit 30 km/h in app. 200 residential areas

Advanced traffic signal control with green waves and access reduction (760 traffic lights, 320 intersections with traffic detection)

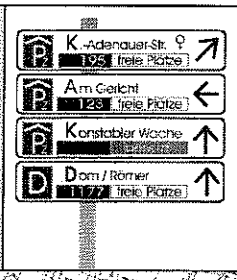
More pedestrian crossings in the inner city and an enhanced bicycle route network

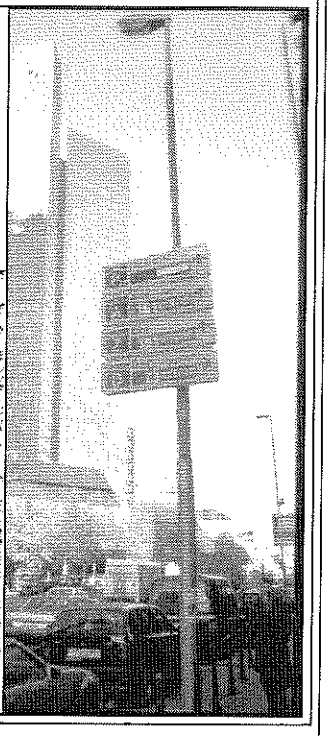
Passenger information systems et al.

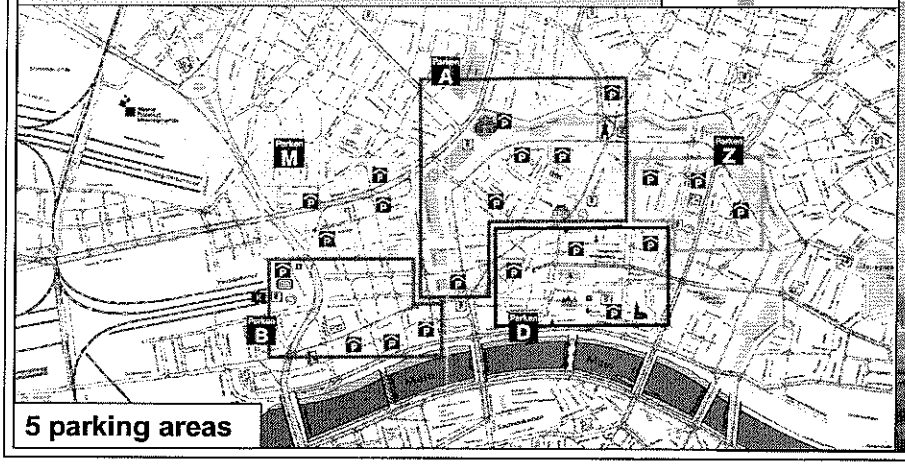


Dynamic Parking Guidance and Information System

- 23 garages
- 12.800 parking spaces
- 90 dynamic signs
- planned: extension with P&R signs

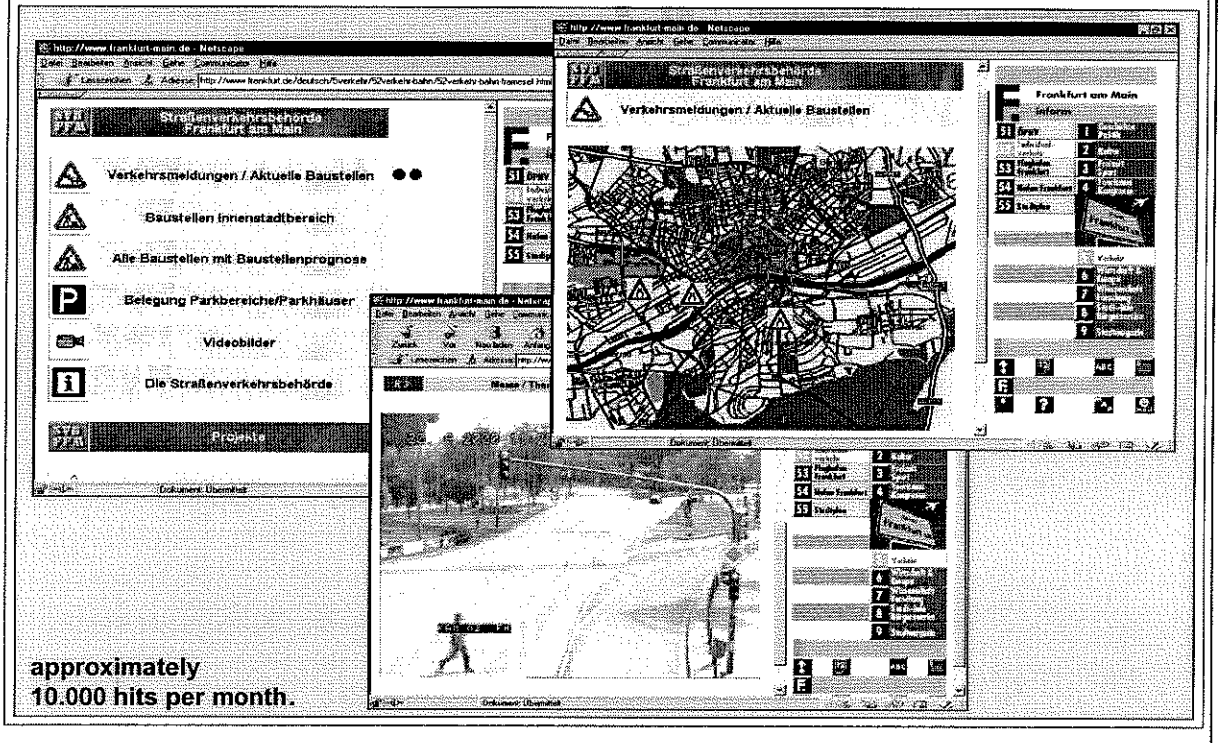






5 parking areas

www.frankfurt.de: Frankfurt´s Traffic Information



approximately
10.000 hits per month.

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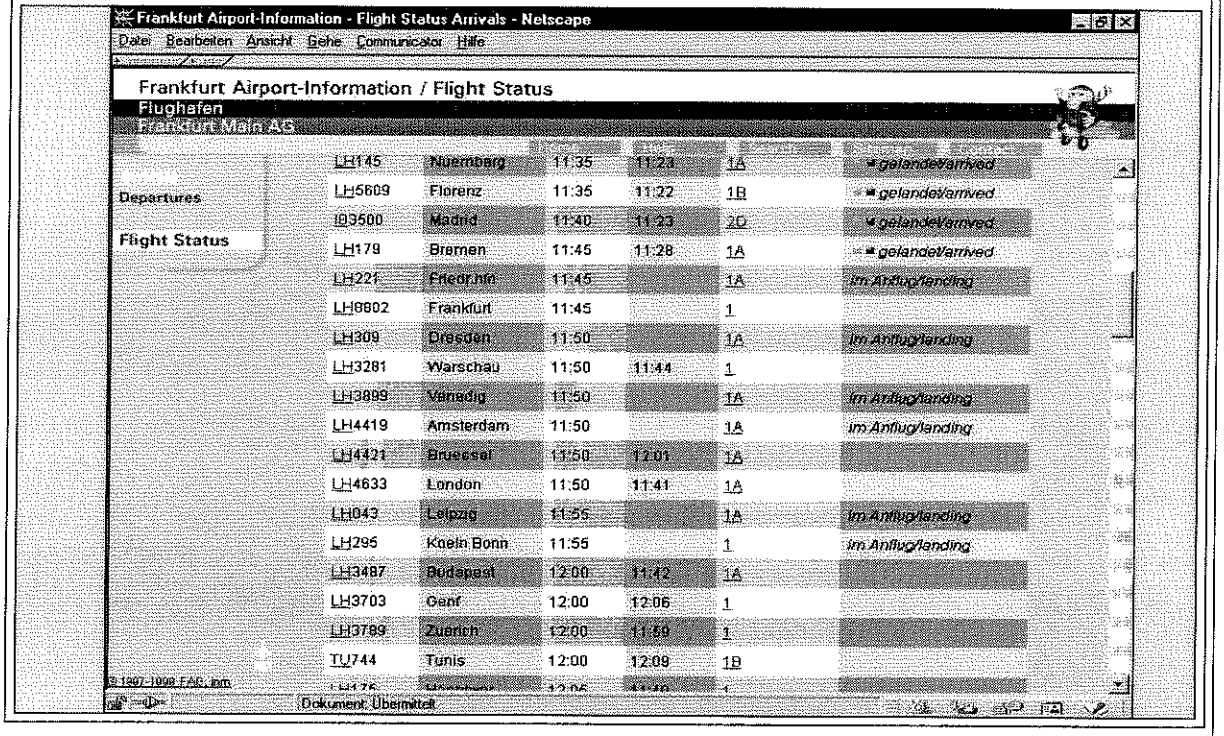
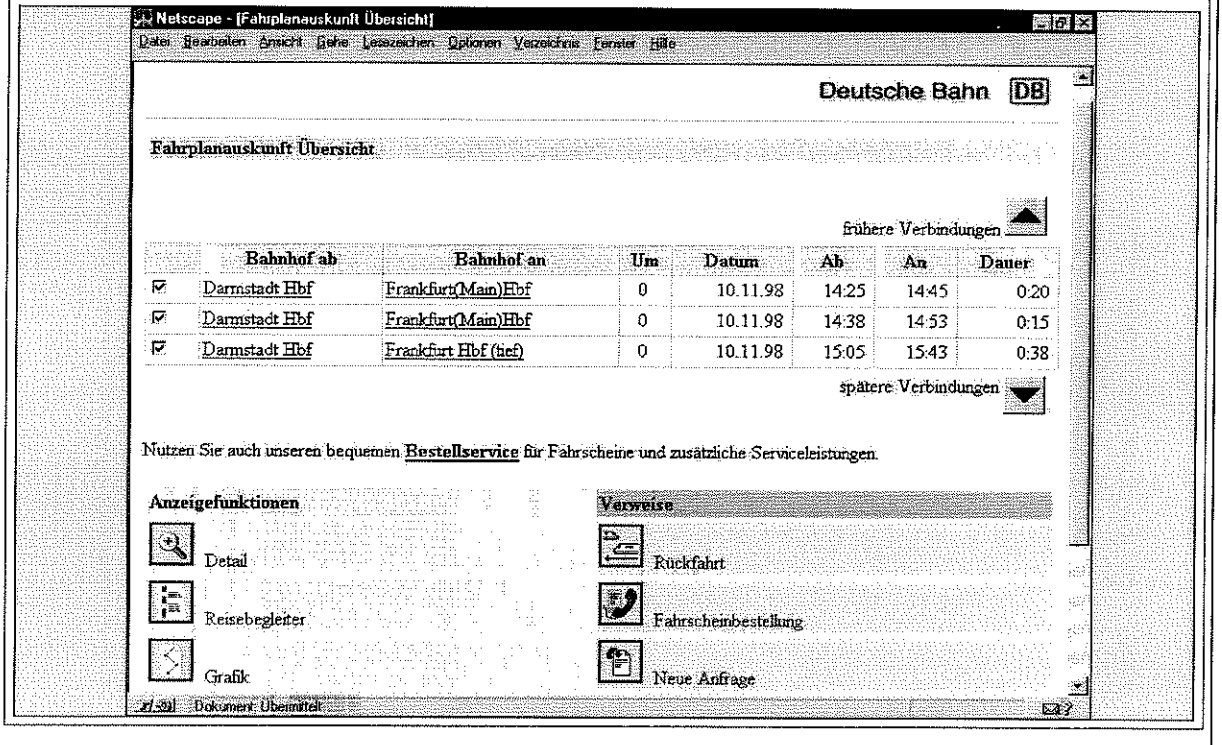
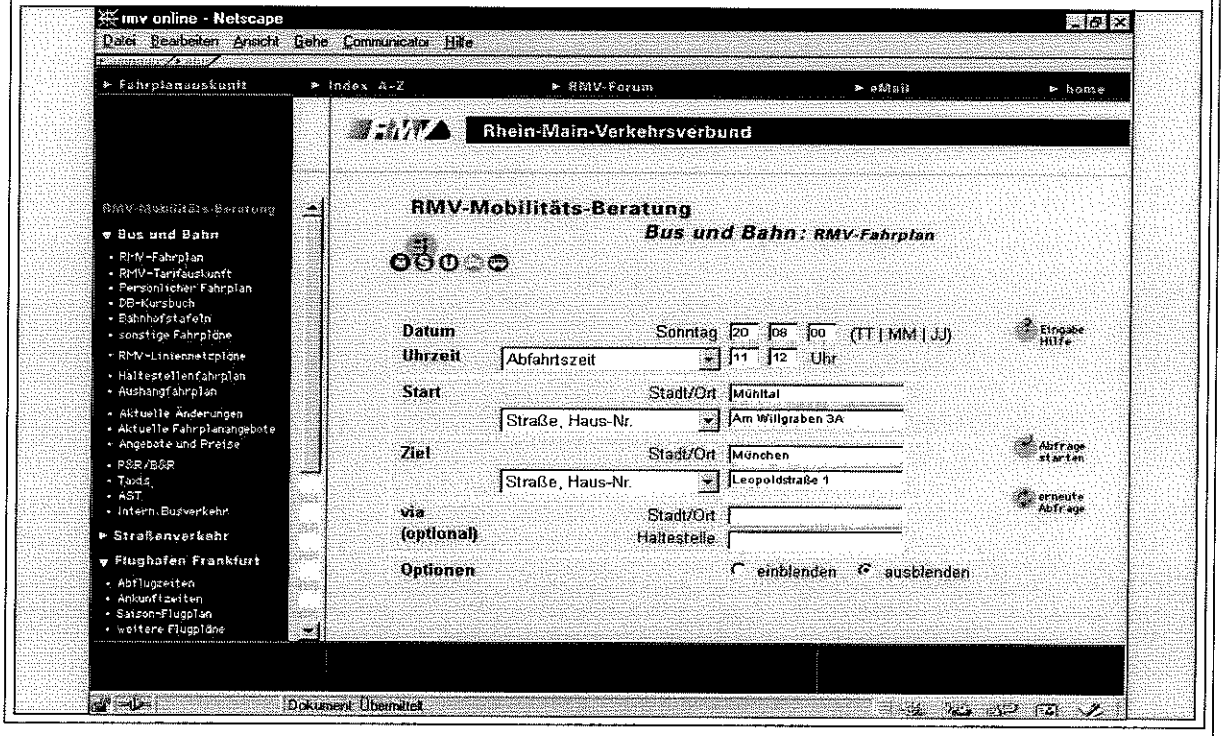
www.flughafen-frankfurt.de: Flight Information



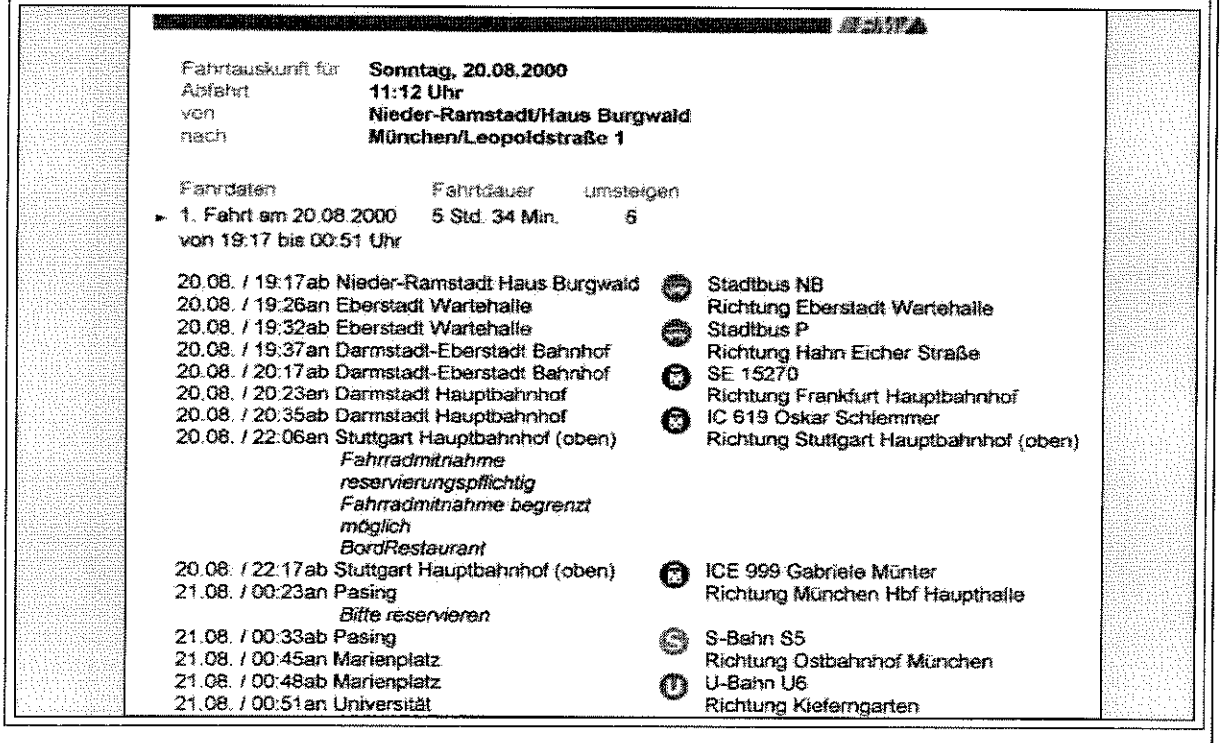
www.bahn.de: German Rail Schedule Information



www.rmv.de: RMV Schedule Information



www.rmv.de: RMV Schedule Information

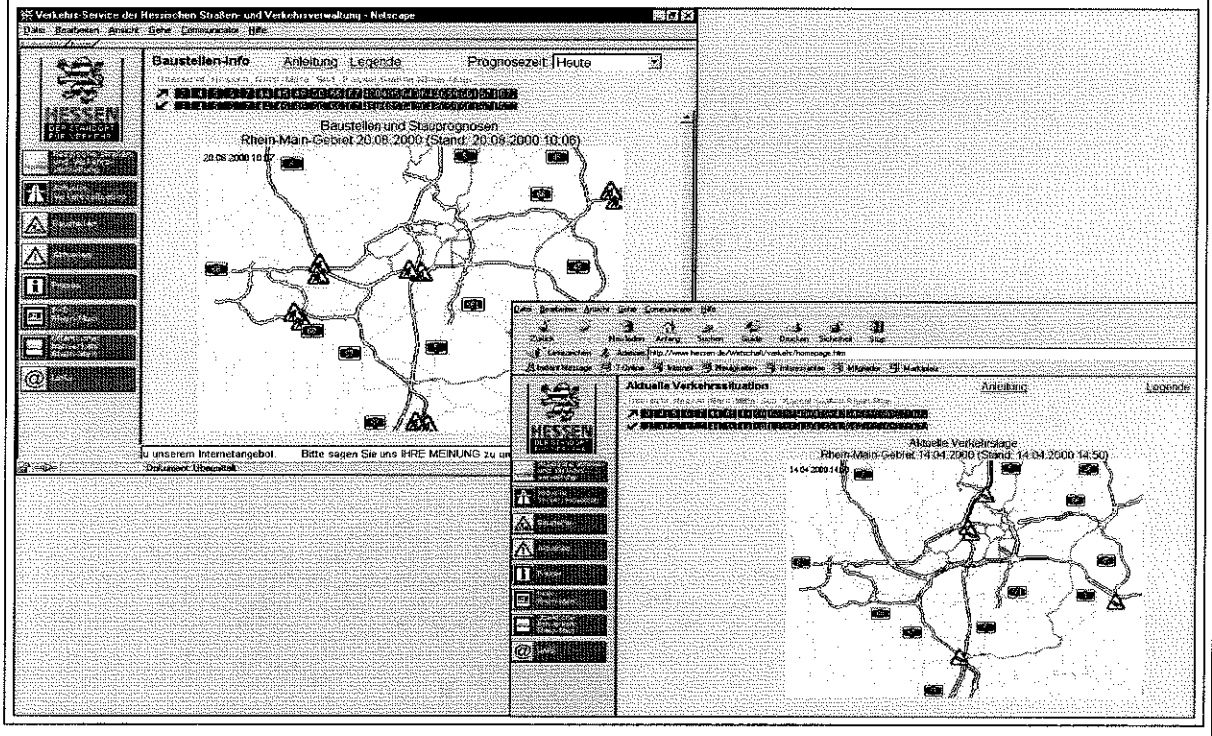


Fahrtauskunft für **Sonntag, 20.08.2000**
Abfahrt **11:12 Uhr**
von **Nieder-Ramstadt/Haus Burgwald**
nach **München/Leopoldstraße 1**

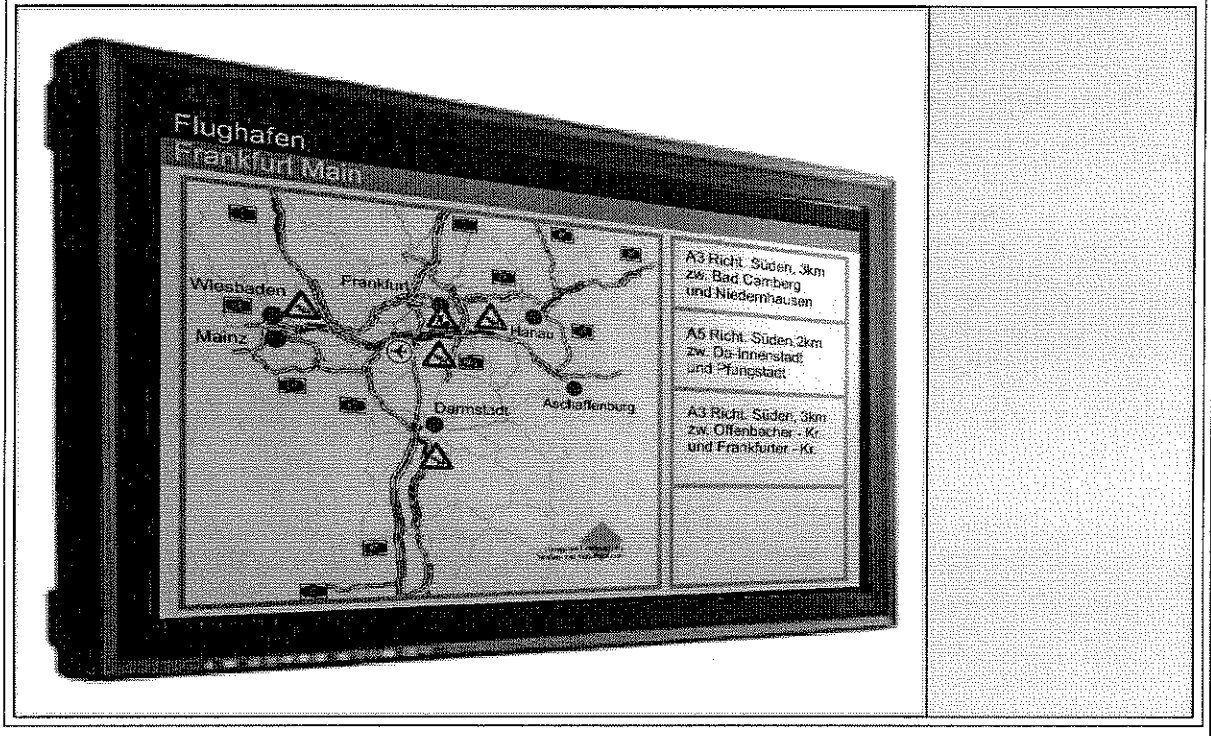
Fahrdaten	Fahrtdauer	umsteigen
► 1. Fahrt am 20.08.2000 von 19:17 bis 00:51 Uhr	5 Std. 34 Min.	6

20.08. / 19:17ab Nieder-Ramstadt Haus Burgwald — Stadtbus NB
20.08. / 19:26an Eberstadt Wartehalle — Richtung Eberstadt Wartehalle
20.08. / 19:32ab Eberstadt Wartehalle — Stadtbus P
20.08. / 19:37an Darmstadt-Eberstadt Bahnhof — Richtung Hahn Eicher Straße
20.08. / 20:17ab Darmstadt-Eberstadt Bahnhof — SE 15270
20.08. / 20:23an Darmstadt Hauptbahnhof — Richtung Frankfurt Hauptbahnhof
20.08. / 20:35ab Darmstadt Hauptbahnhof — IC 619 Oskar Schlemmer
20.08. / 22:06an Stuttgart Hauptbahnhof (oben) — Richtung Stuttgart Hauptbahnhof (oben)
Fahrradmitnahme reservierungspflichtig
Fahrradmitnahme begrenzt möglich
BordRestaurant
20.08. / 22:17ab Stuttgart Hauptbahnhof (oben) — ICE 999 Gabriele Münter
21.08. / 00:23an Pasing — Richtung München Hbf Haupthalle
Bitte reservieren
21.08. / 00:33ab Pasing — S-Bahn S5
21.08. / 00:45an Marienplatz — Richtung Ostbahnhof München
21.08. / 00:48ab Marienplatz — U-Bahn U6
21.08. / 00:51an Universität — Richtung Kiefernagarten

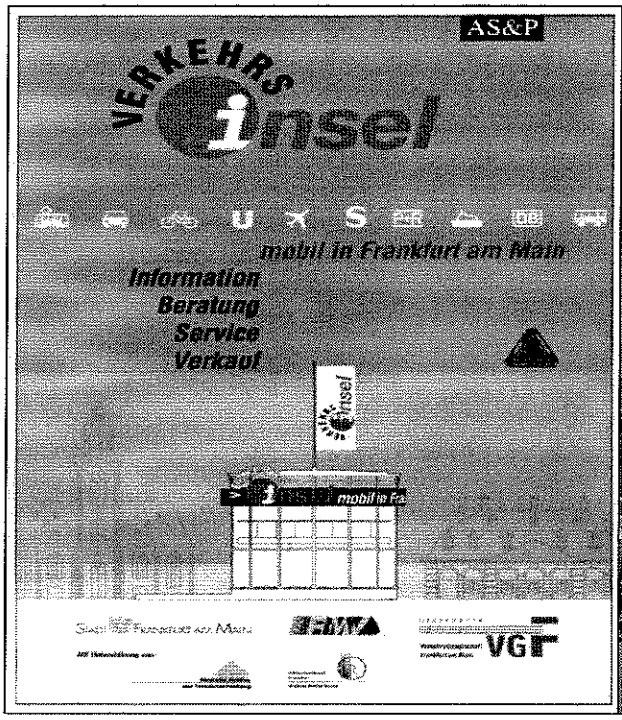
www.hessen.de: Highway Traffic Information Service



Proposal for Driver Information at Frankfurt Airport

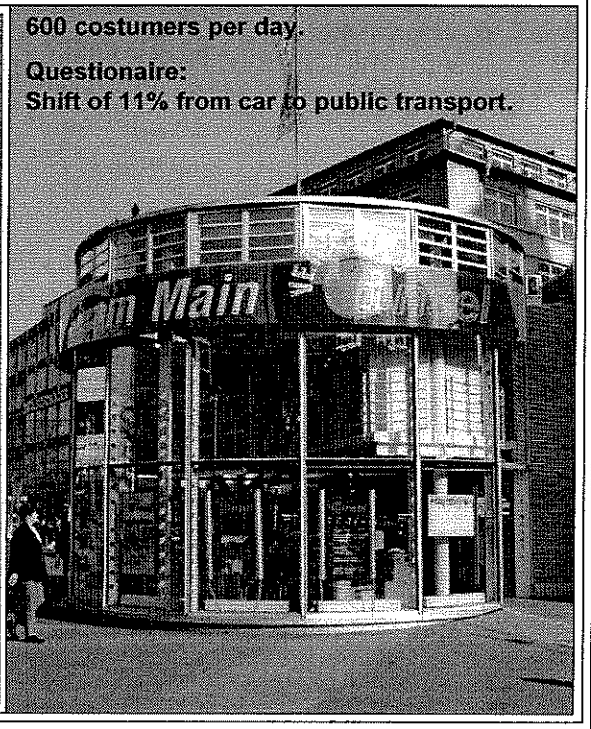


Mobility Service Centers

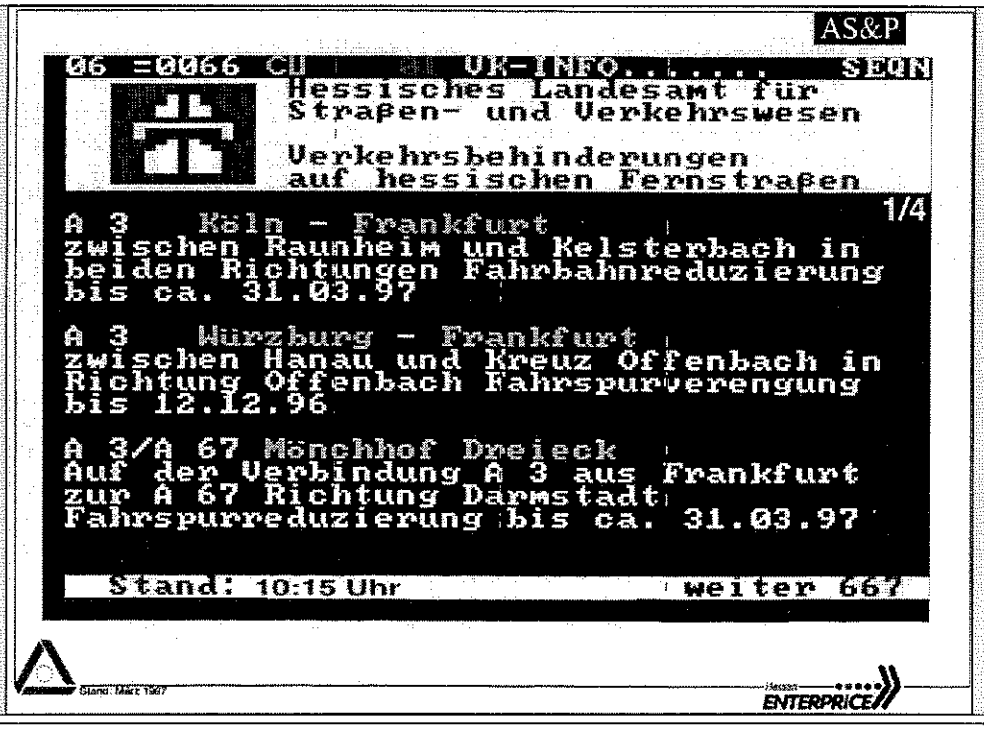


600 costumers per day.

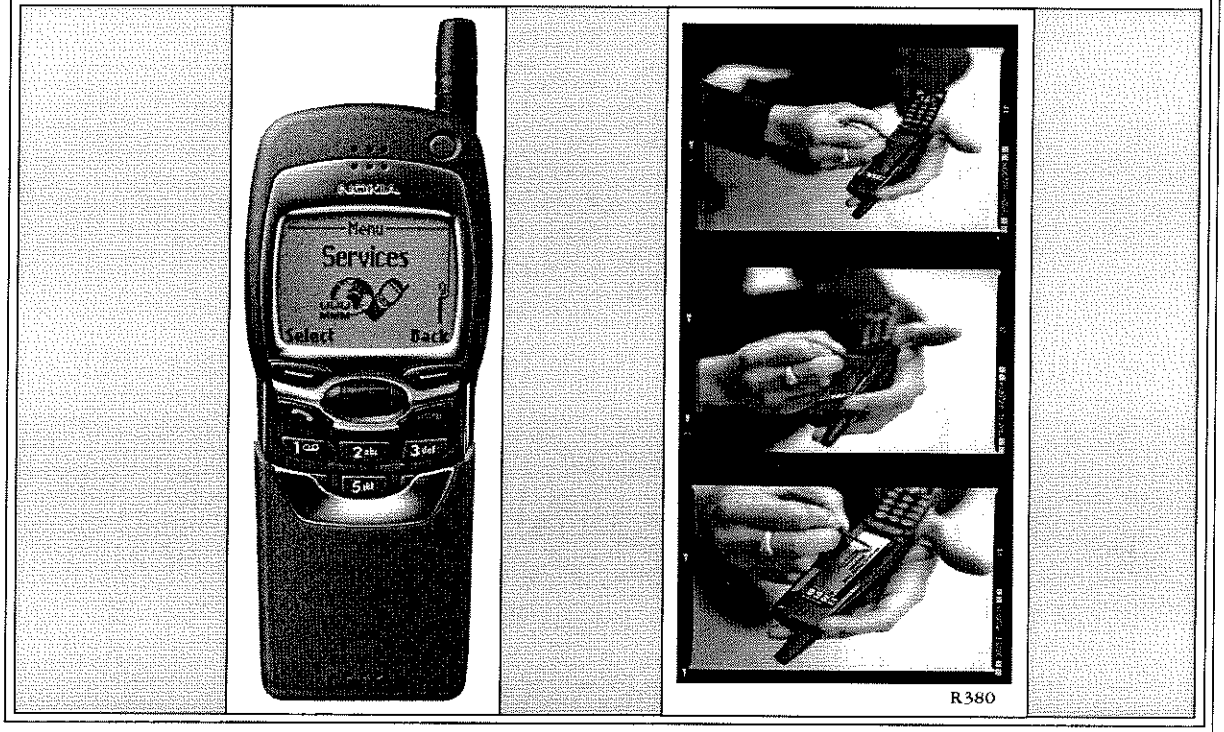
Questionaire:
Shift of 11% from car to public transport.



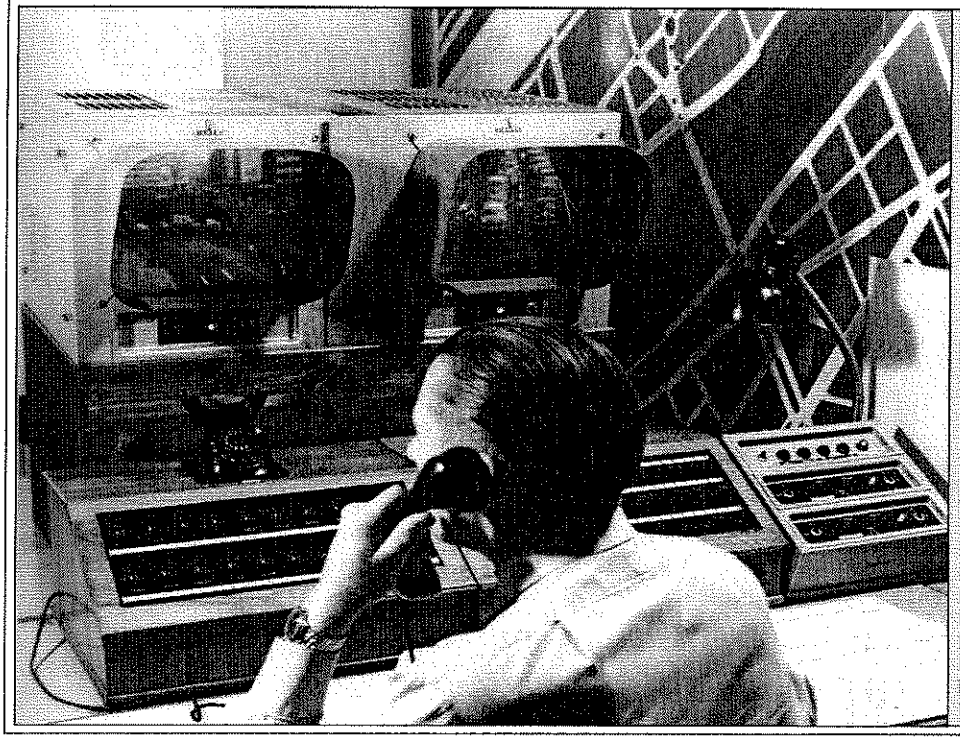
TV Text: Traffic Information



Traffic Information Based on WAP Technology



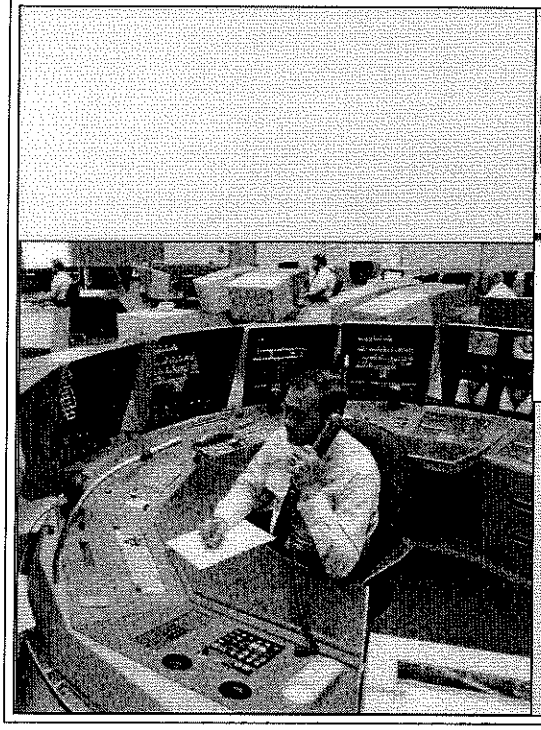
Frankfurt´s Traffic Control Centers

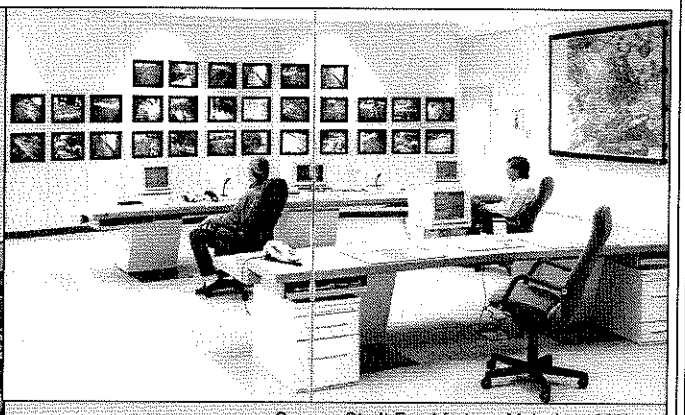


Schaltzentrale 1951, Polizeipräsidium Frankfurt

Source:
B. Hirsch:
Verkehrsleitzentrale Frankfurt am Main.
Schriftenreihe des Hochbauamtes zu Bauaufgaben der Stadt Frankfurt am Main.
Der Magistrat der Stadt Frankfurt am Main, Dezernat Bau, Hochbauamt, 1992

Frankfurt´s Traffic Control Centers

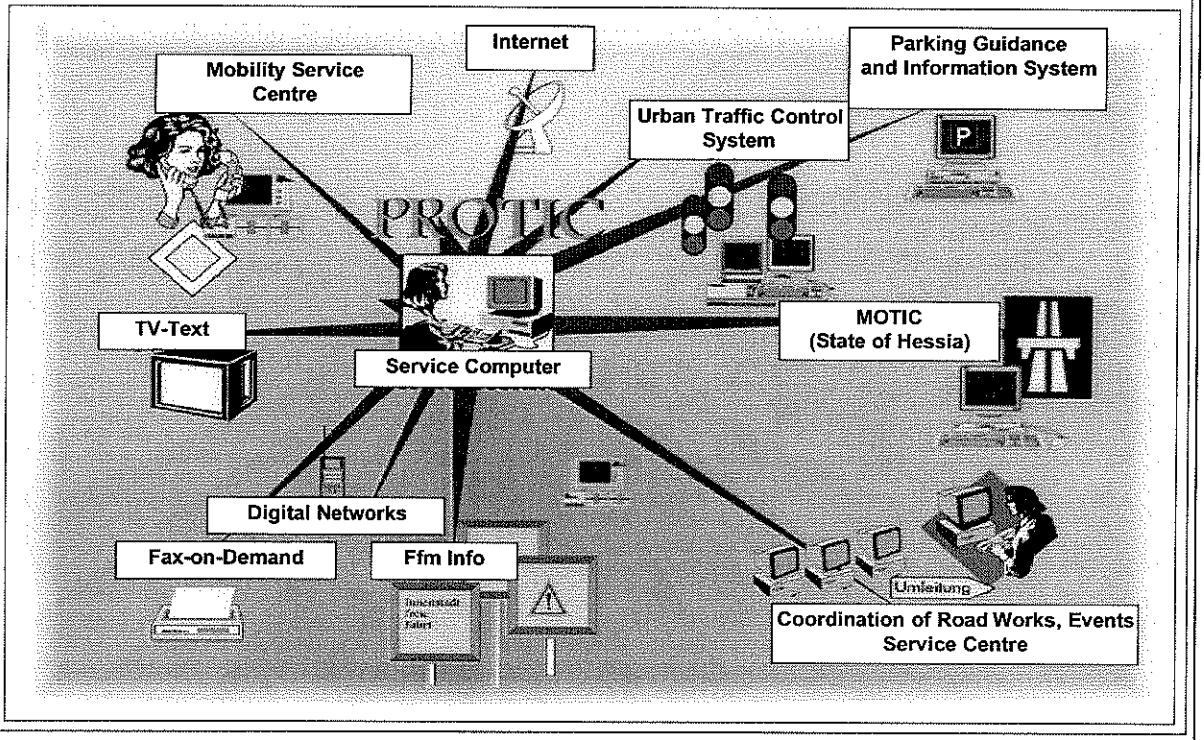




Source: Stadt Frankfurt am Main (ca 1998)

Source:
Stadtwerke Frankfurt am Main,
o. J. (ca. 1990)

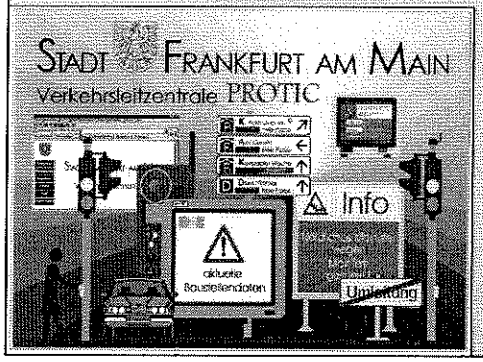
Integrated (Intermodal) Traffic Management Center



Integrated Intermodal Traffic Management Center
Planned Extension of Frankfurts PROTIC

Interfaces to other control centers:

- **Public Transport**
- **Police**
- **Taxi**
- **Fire Department**
- **Freight**
- **other Cities**



Main future tasks :

To produce an intermodal report on traffic situation including traffic prognosis (using simulation tools) and an assessment of this situation.

To control intermodal traffic based on pre-defined, network-related traffic management strategies.

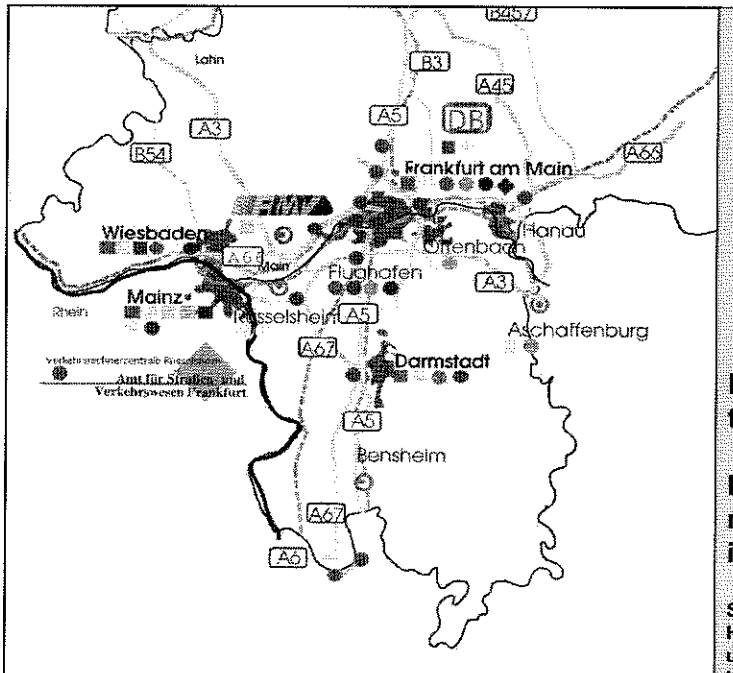
To gain concertation of such traffic management strategies with regional partners.

To give recommendations to other control centres in case of unexpected situations.

To provide intermodal traffic information for various information service providers.

5. The Projekt WAYflow

Map of Traffic Control Systems in Rhein-Main Region



Every dot indicates a seperate traffic control system.

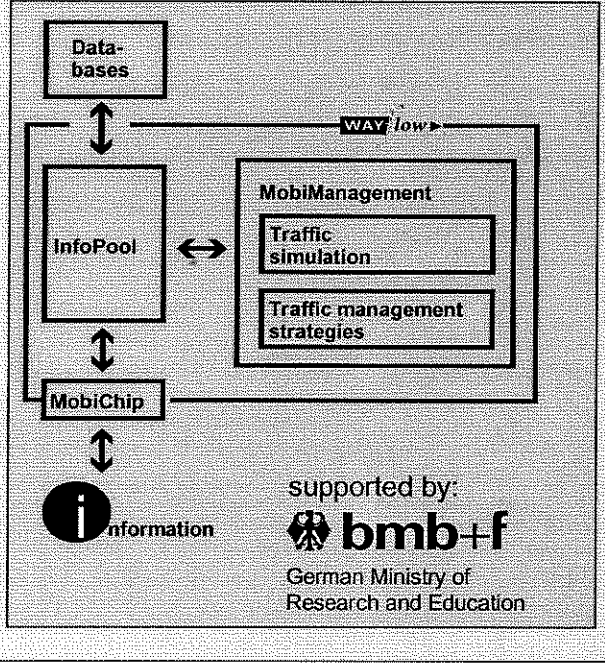
In 1997, there where already more than 60 different systems in Hessen.

Source:
Hessisches Ministerium für Wirtschaft, Verkehr und Landesentwicklung: Leit- und Informationssysteme für den Verkehr. Wiesbaden, 1997

WAYflow► The Project

Aim:	**The realisation of a new and comprehensive concept of regional traffic management**
Beginning:	**October 1998**
Duration:	**4 years**
Main partners:	**RMV (Rhein-Main Public Transport Authority), HLSV (Hessen State Road and Traffic Authority), Philips Semiconductors, debis IT Services, DB Regio AG (German Rail).**
Scientific Consulting:	**ZIV - Center for Integrated Traffic and Transport Systems at Darmstadt University of Technology**
Promotion:	**German Ministry of Research and Education.**
Characteristics:	**• integration of existing know-how, • extensive Public Private Partnership, • field tests and evaluation of results, • optimisation according to the user needs, • practical realisation and durable operation, • compatibility with other regions and problems.**

WAYflow► Main Contents



MobiManagement

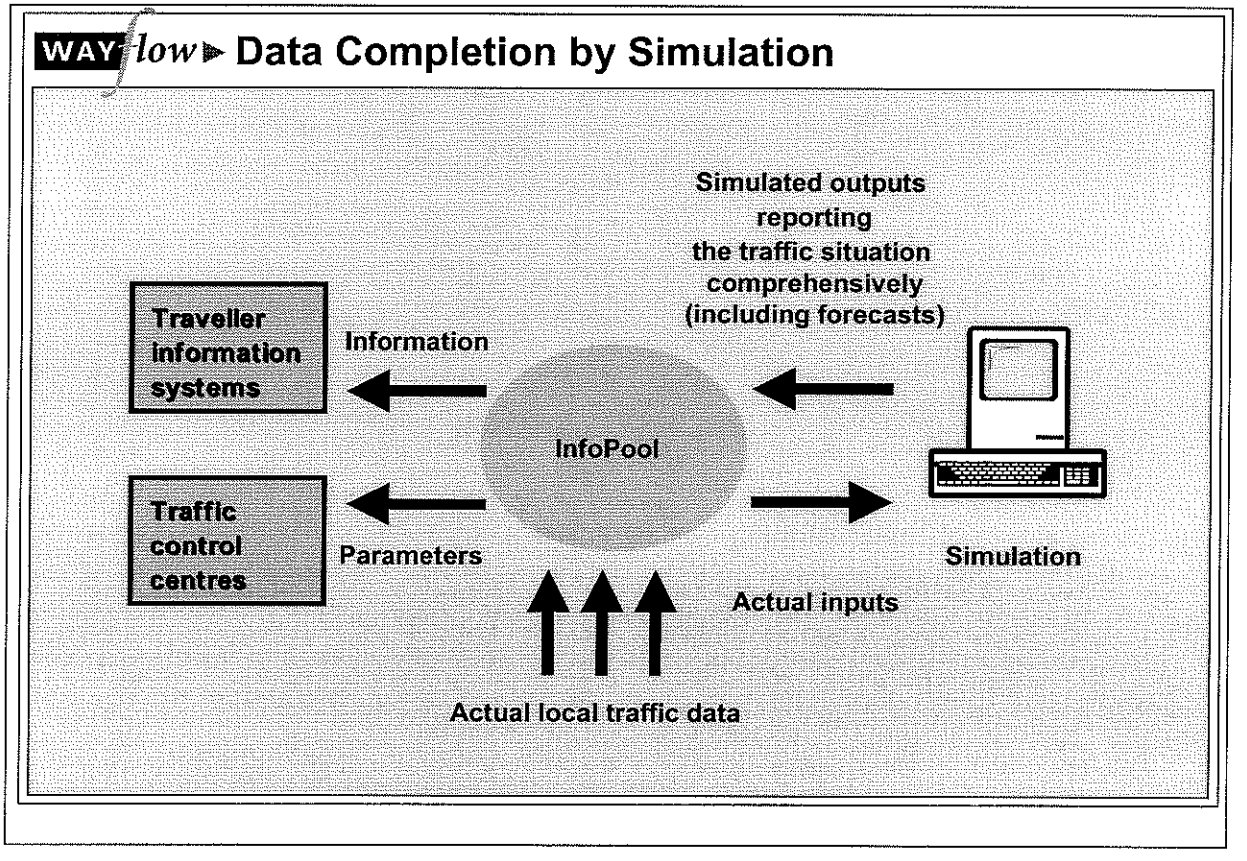
Initialisation of a regional traffic management including the development of intermodal traffic management strategies.

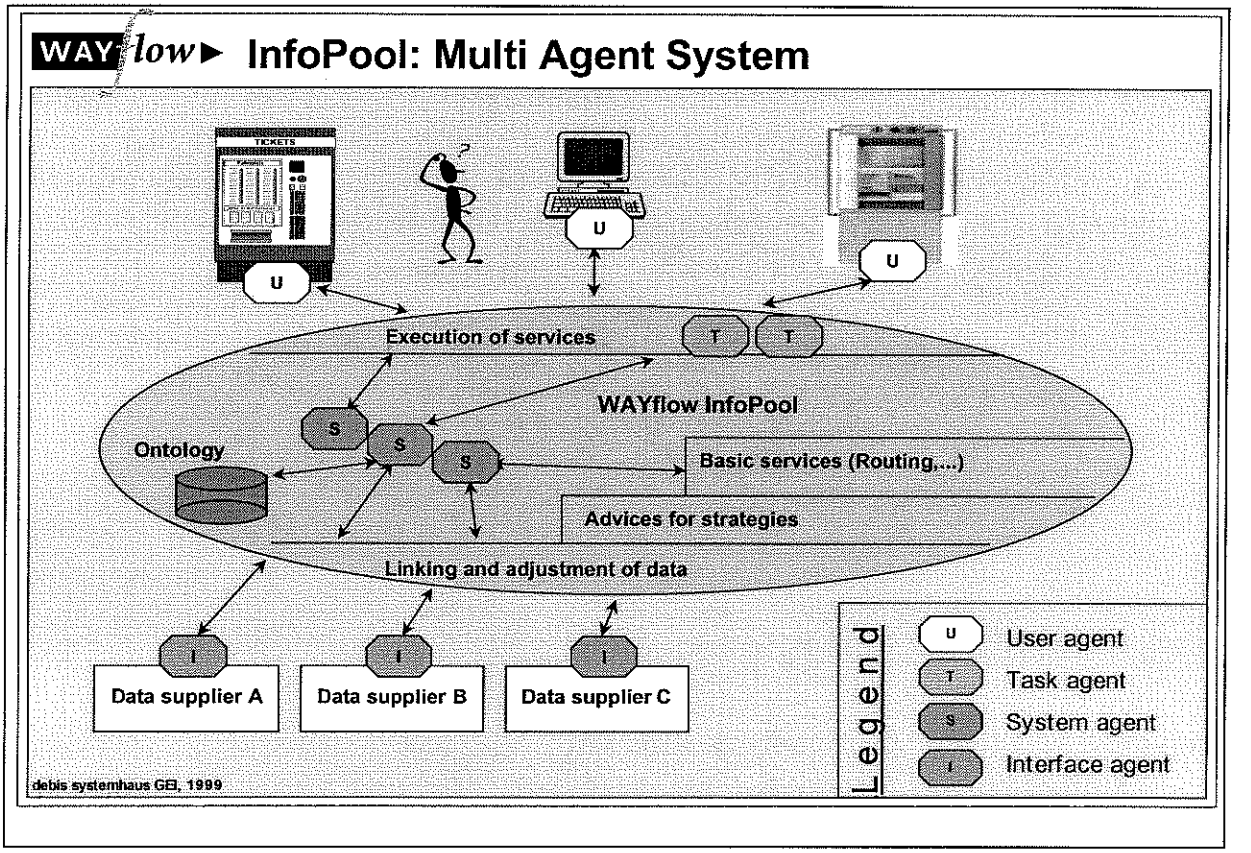
InfoPool

Development of an intermodal regional traffic data base with distributed data storage, based on a multi-agent system.

MobiChip

Development of the MobiChip for individualised personal travel assisstance.


WAYflow
Data Completion by Simulation
Simulated outputs
reporting
the traffic situation
comprehensively
(including forecasts)
Traveller
information
systems
Information
InfoPool
Traffic
control
centres
Parameters
Simulation
Actual inputs
Actual local traffic data


WAYflow
InfoPool: Multi Agent System
TICKETS
U
U
U
Execution of services
T
T
WAYflow InfoPool
Ontology
S
S
S
Basic services (Routing,...)
Advices for strategies
Linking and adjustment of data
I
I
I
Data supplier A
Data supplier B
Data supplier C
Legend
U User agent
T Task agent
S System agent
I Interface agent
debis systemhaus GEI, 1999

WAYflow► Intermodal and Comprehensive Routing

Planned improvements of the existing German Rail Service Platform:

1.) Door-to-door information:

- Giving addresses or locations as inquiry input instead of station names.
- Showing the footpaths to the relevant station on a map.

2.) Intermodal alternatives:

Considering and comparing private vehicle traffic, taxi and air traffic by communicating with the Router of the InfoPool.

3.) Comprehensive fare information:

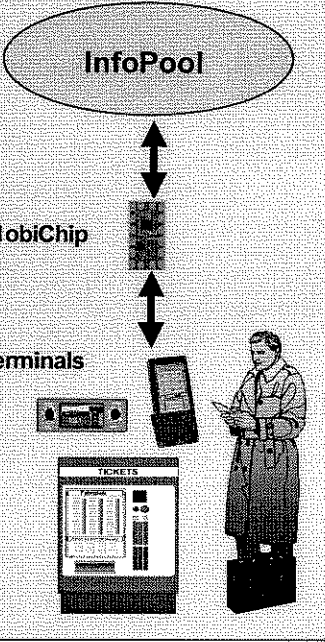
- Calculating all individual fares of the whole trip.
- Comparison with the costs of travelling by private car.

4.) Consideration of the actual traffic situation:

Actual delays and divergences from the timetable are considered in information services, even on-trip.

WAYflow► MobiChip: Personal Travel Assistance

Aim:	User-friendly interface between traveller and InfoPool.
Technical Characteristics:	Chip placed on contactless smart cards (telephone cards, credit cards,...), to be read by public terminals (for example ticket machines) or portable phones, laptops...
Advantages:	It supplies the user with individually relevant data and actualises automatically the profile of its user's traffic behaviour.
Outlook:	Future applications like electronic ticketing and e-purse can be integrated.



6. Conclusion and Outlook

Some Actual Problems in Traffic Management

Intermodality.

Intermodal, regional, decentralised organisation not yet established sufficiently.

Not enough participation and interest in traffic management at the regions smaller cities and districts.

Not enough financial resources and staff dedicated to trafficmanagement (partly no additional activities possible).

Problems in public-private cooperation, eg. conflicts of interest in data providing.

Aged technology (eg. for data transmission), missing standards to integrate such old equipment.

Data detection is not sufficient and data from many traffic detectors are not used.

No sufficient knowledge about impacts of measures and bundles of measures.

Some Aims for Future Activities

To integrate other cities and communities of the region in the ITS planning and implementation process.

To realise an improved organisational scheme for traffic management in the region.

To develop comprehensively strategies for dynamic traffic management.

To elaborate an overall strategic ITS implementation plan for cities and region based on these strategies (including means of data detection).

To take advantage of new technologies, searching for simple solutions.

To learn more about useful bundles of measures and their impacts, highlighting intermodal aspects.

To exchange experiences with other cities and regions on an international level.

Critical Factors of Success

- **User acceptance**
- **Intention of partners to co-operate**
- **Working public-private partnerships**
- **Realisation of interfaces**