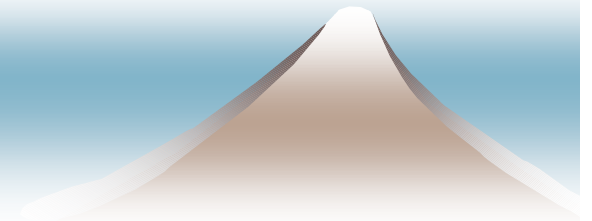


*Sustainable **ITS** for Transportation Management*

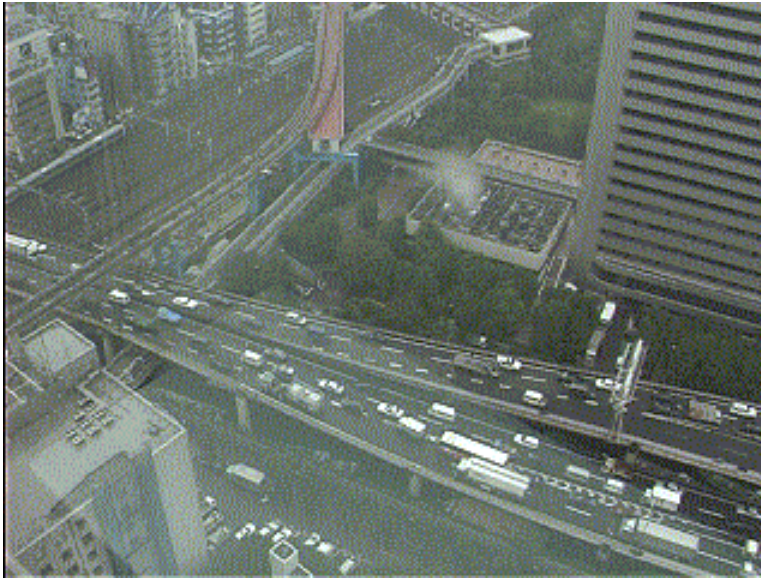
6th of August, 2009

One-day International Workshop on Sustainable Transportation and Energy
-Leading-edge Technologies and Policies –

Institute of Industrial Science,
University of Tokyo
Masao Kuwahara (Professor)



Characteristics of Traffic Congestion



Time Loss = 100 billion EURO/Yr (年間損失 12 兆円程度)

Environmental Loss

Accident Loss = 40 billion EURO/Yr (年間 5 兆円程度)

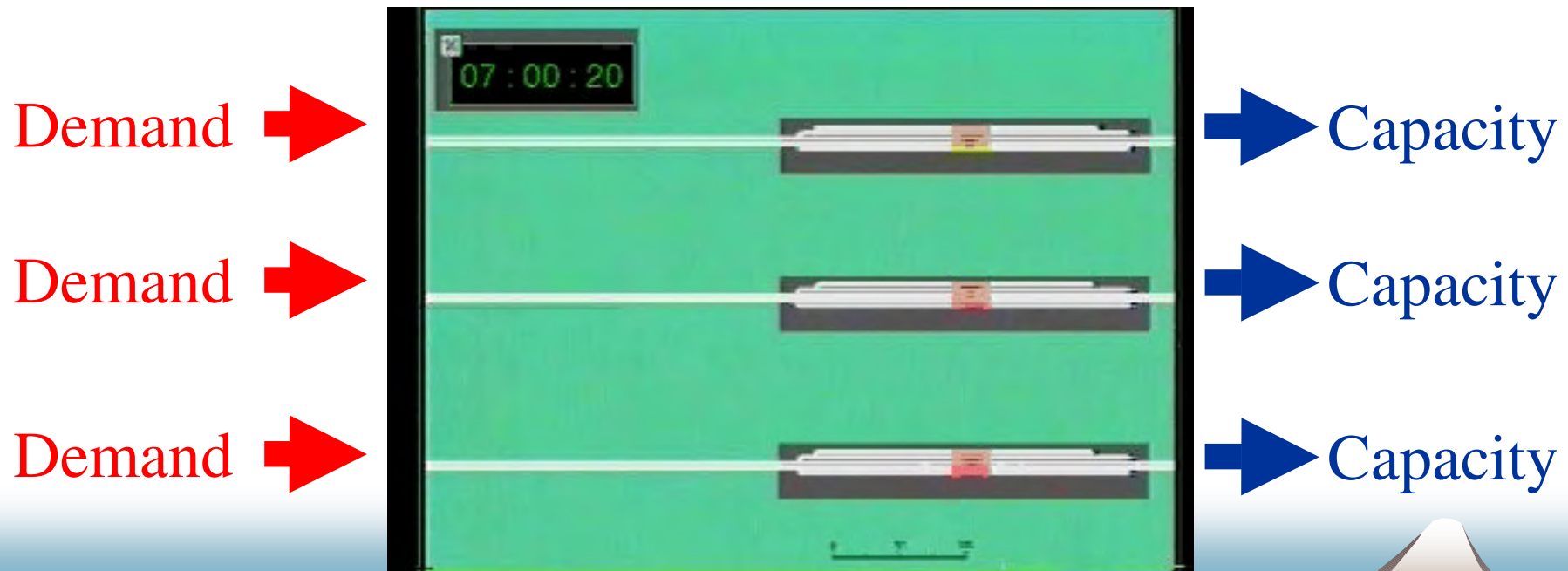
Traffic Congestion: Demand > Capacity

Demand – Capacity = Excess demand (surprisingly small)

Surprisingly small amount of Excess Demand : about 10 % even during peak

Period of Excess Demand << Period of Congestion

Large possibility to substantially alleviate congestion by traffic management



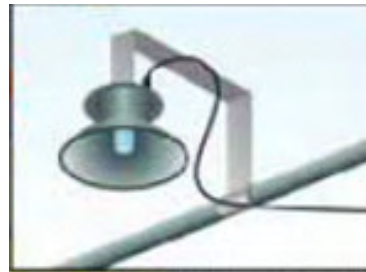
Data Driven Approach

Loop Detector (Intercity Motorways)



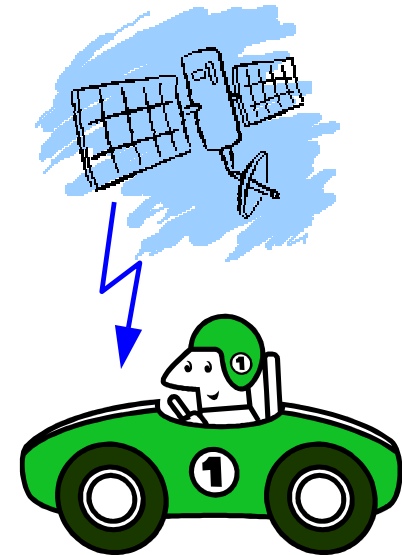
e.g. One loop detector between interchanges
(approximately one in every 10 km)

Ultra-sonic Detector (Urban Expressway, Local Streets)



e.g. Metropolitan expressway (300km length)
Ultra-sonic detectors installed at every 300 m

Probe data

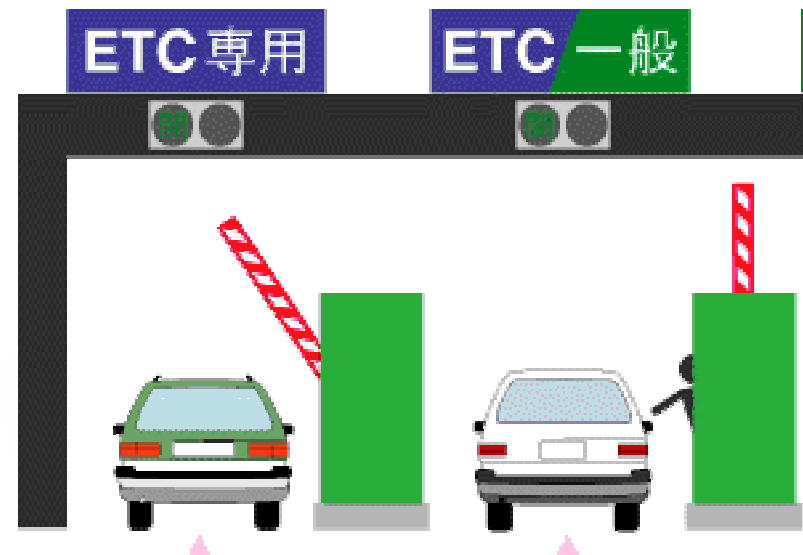


ETC (*E*lectronic *T*oll *C*ollection)

On-board unit



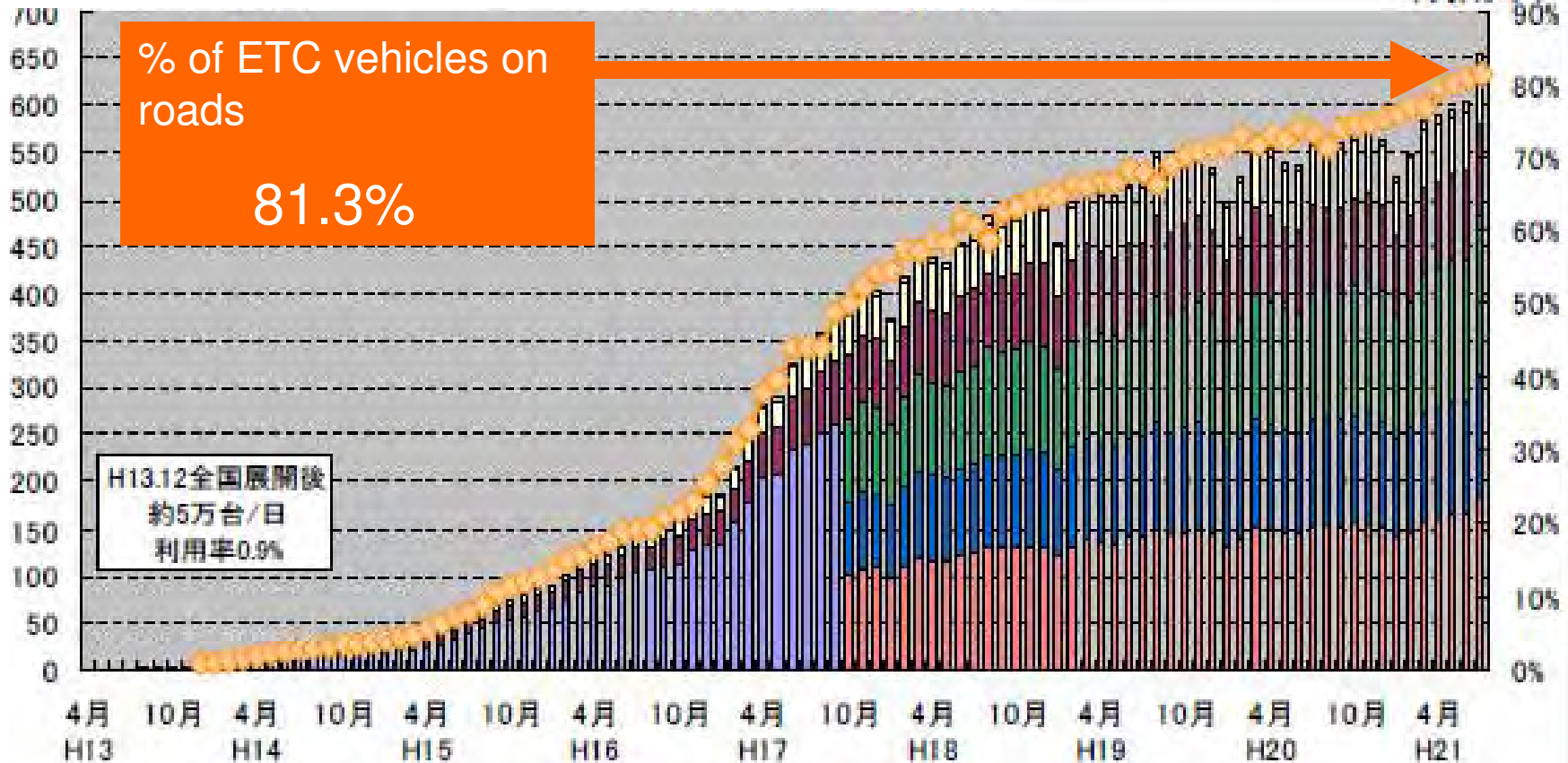
ETC and Mixed lanes



ETC Utilization

July, 2009

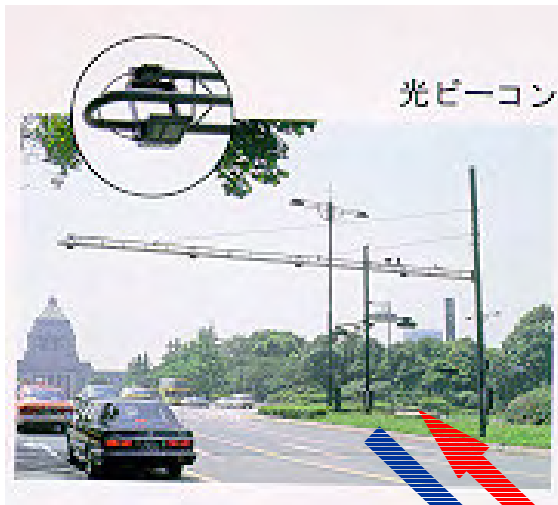
ETC Trips per Day [10⁴]



Over 80% of trips are made using ETC,
but only 30% of vehicles carry on-board ETC units.

VICS

(Vehicle Information and Communication System)



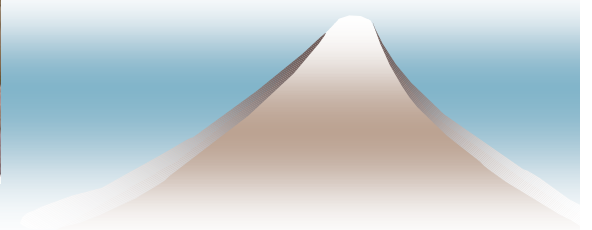
Infrared Beacon
(bi-directional)
(Local street information)



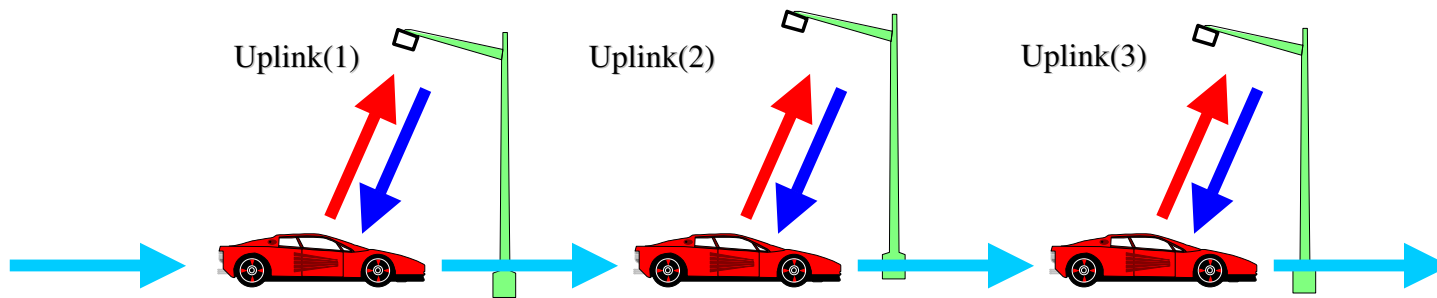
Microwave Beacon
(Motorway information)



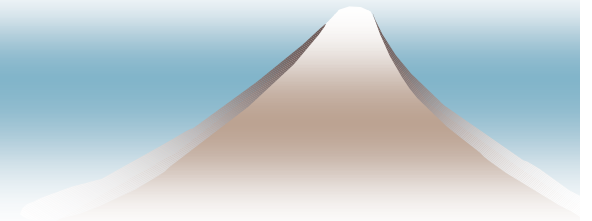
FM Broadcast
(within a prefecture)



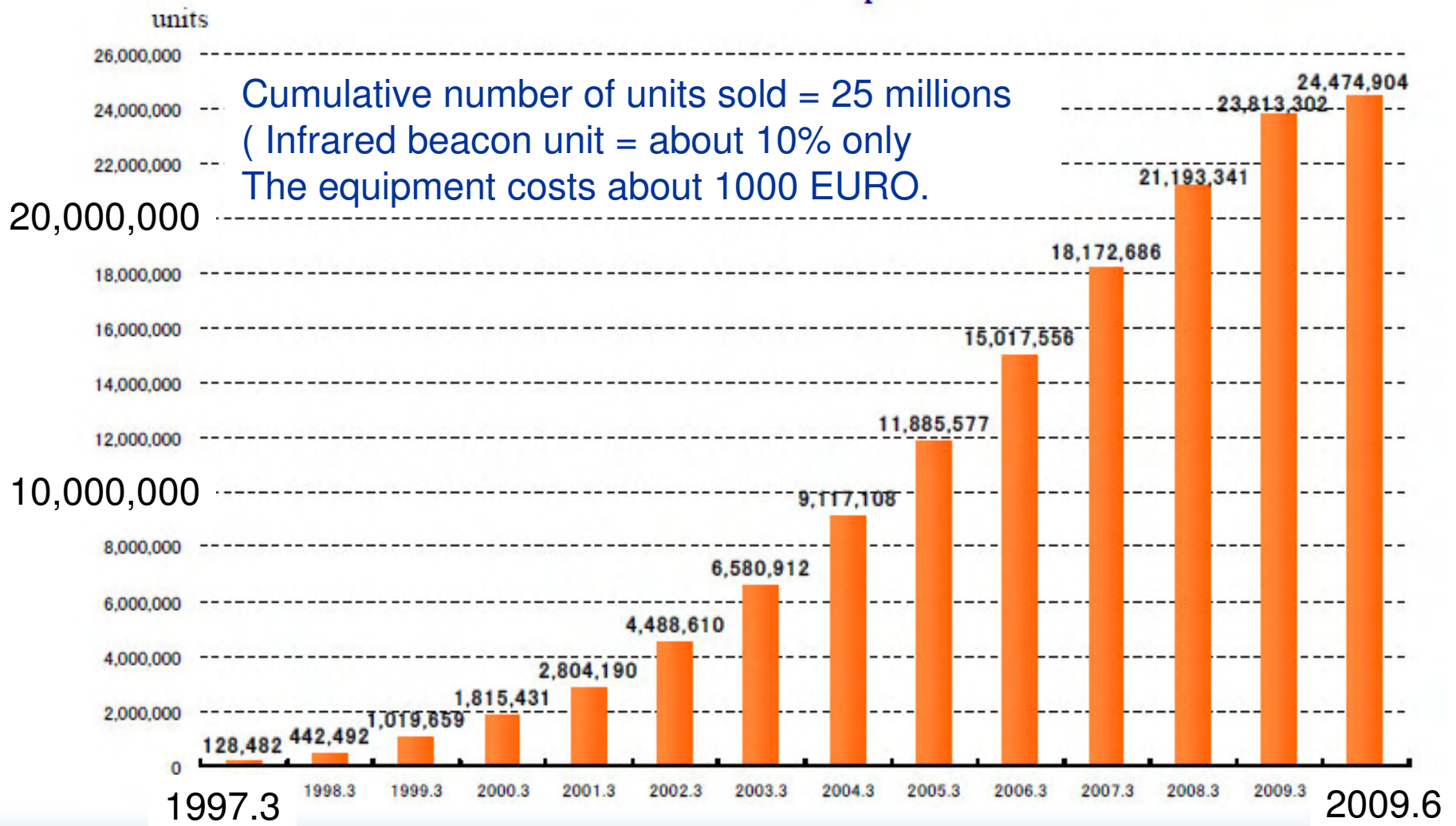
Bi-directional Communication by Infrared Beacons



ID is randomly generated when you start the engine.
Travel time, Route, OD etc



Cumulative Number of VICS Units Sold (June, 2009)



OD Variability using ETC data

Metropolitan Expressway

Length = 283.3 km

Ramps = about 150 on-ramps
about 150 off-ramps

Daily trips = 1.16 millions

% of ETC vehicles on MEX = 70%

Huge amount of data have been
accumulated.

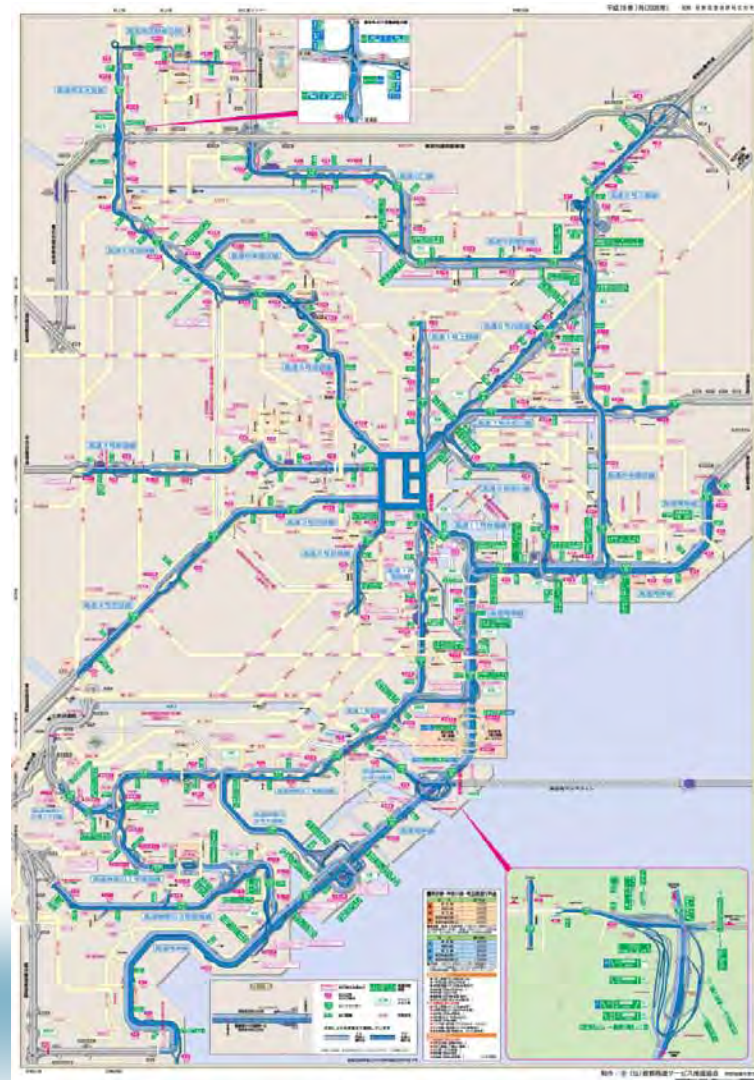
Card ID → card holder

Vehicle ID → vehicle

(Keep the same ID!)

Ramp ID

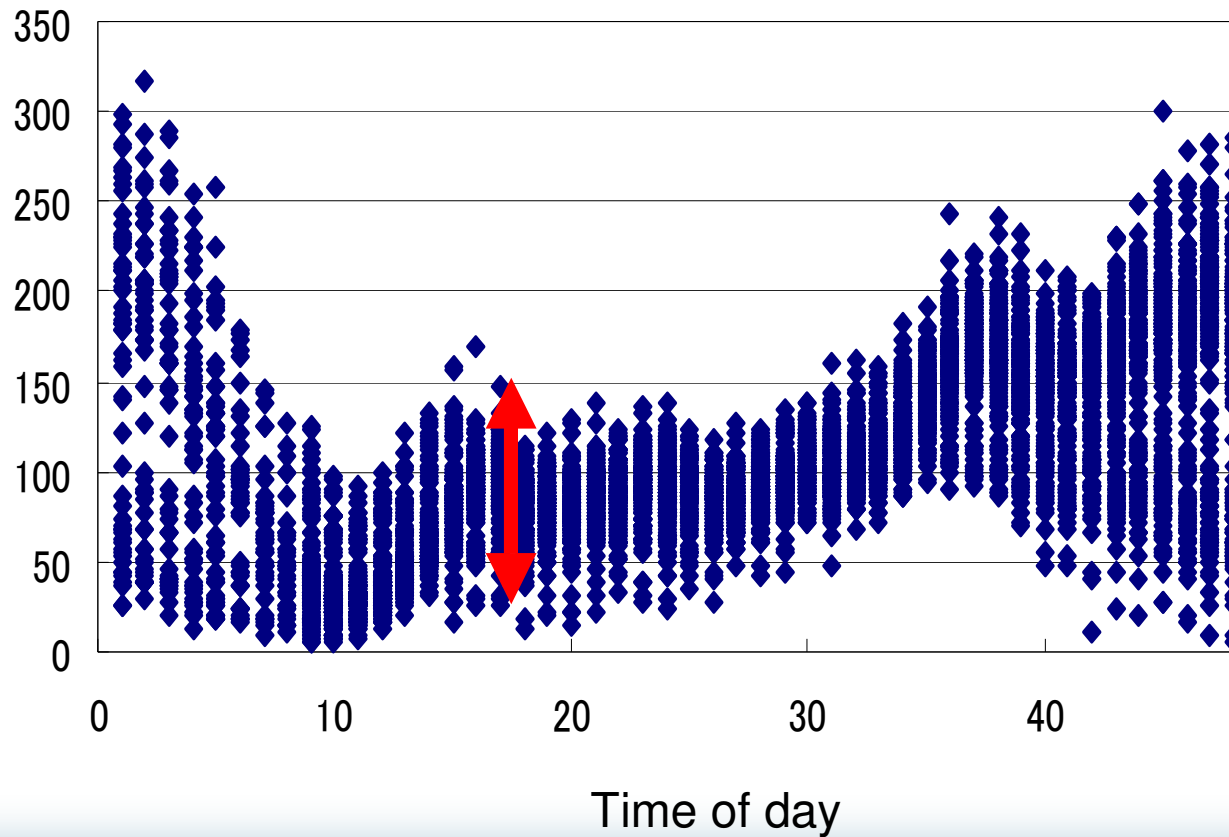
Passing Time



OD Variability using ETC data

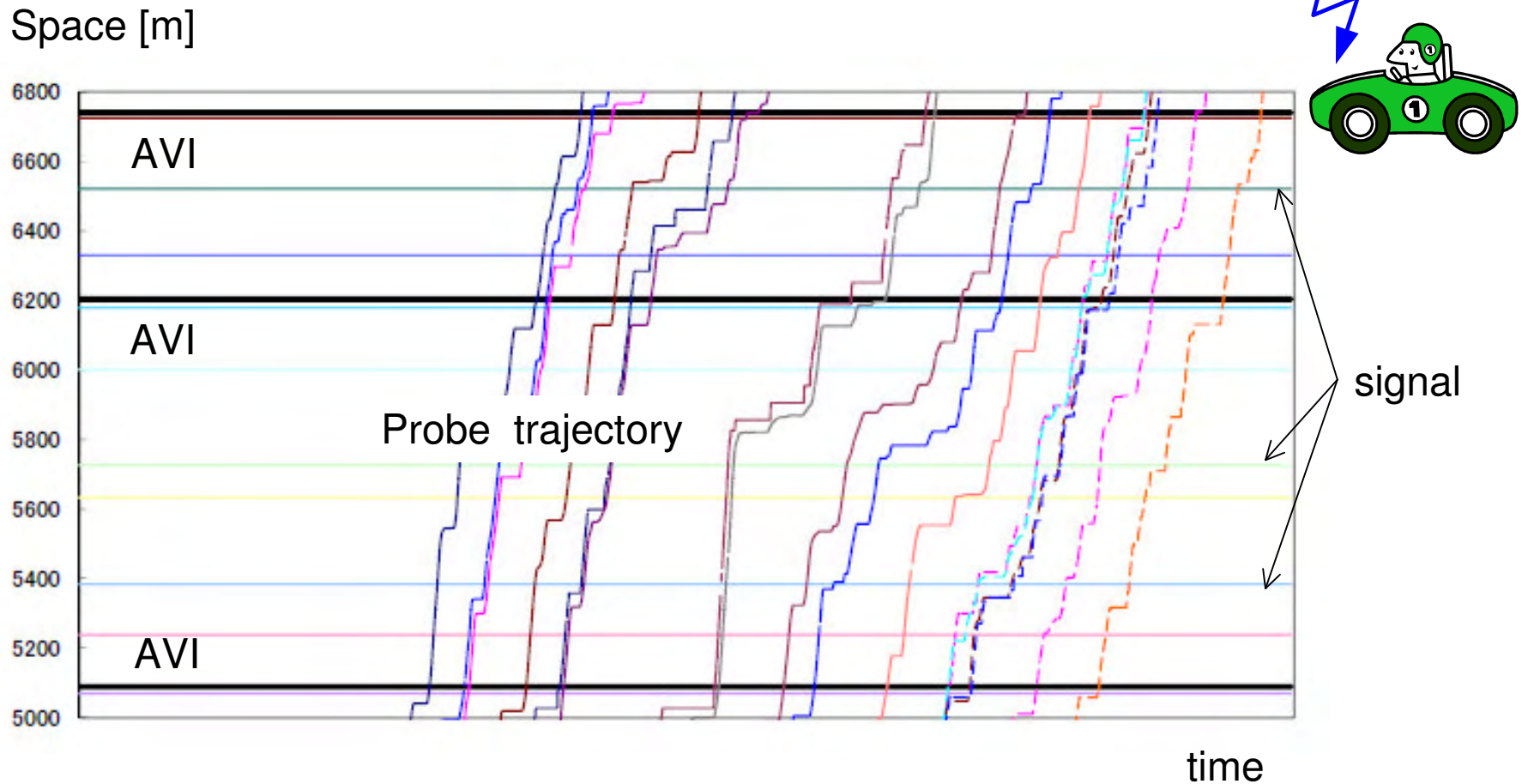
(June to December, 2006)

trips /
30 minutes



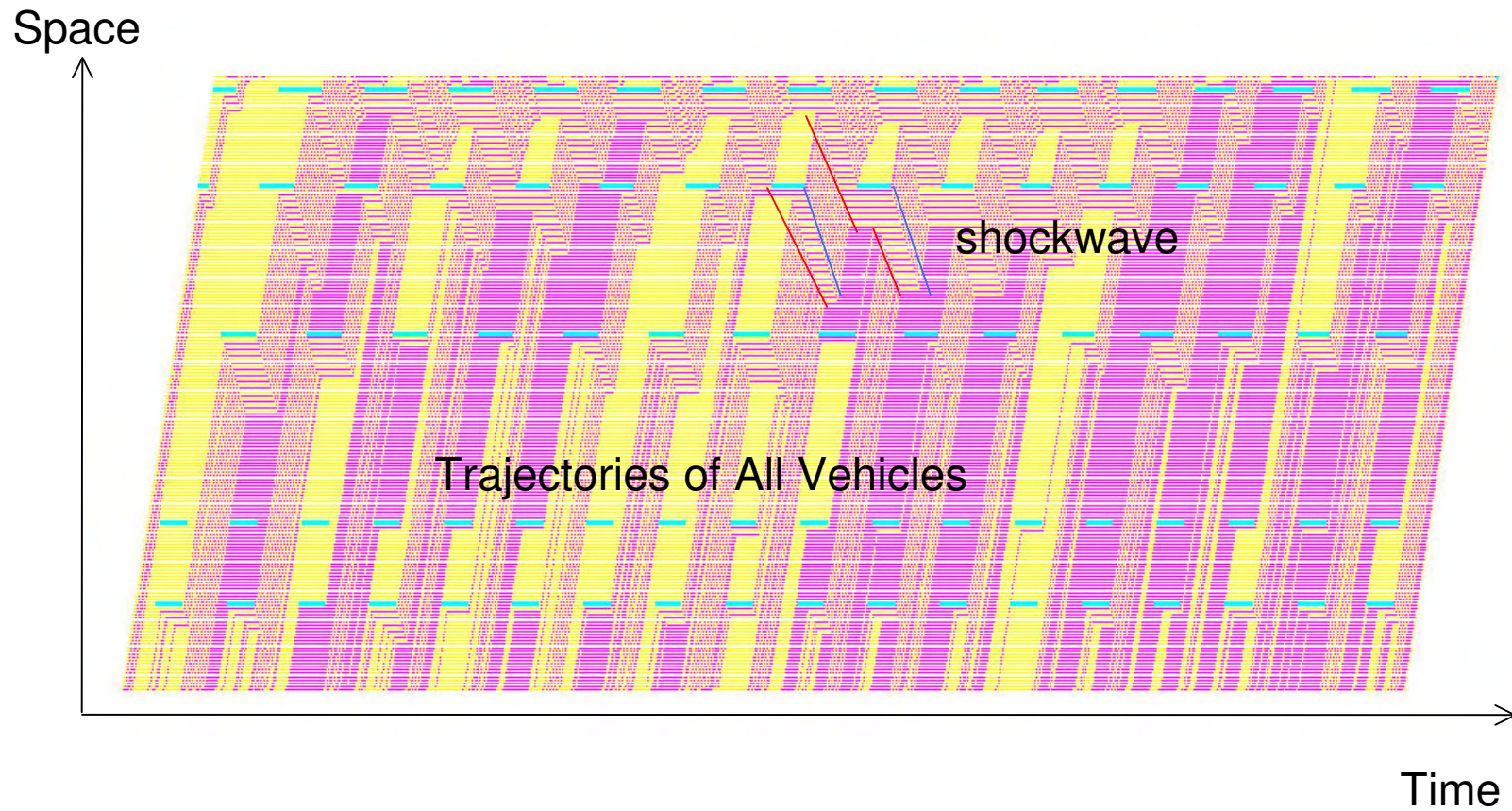
30-minute OD from Ikejiri to Yoga, Weekday

Probe Data Analysis

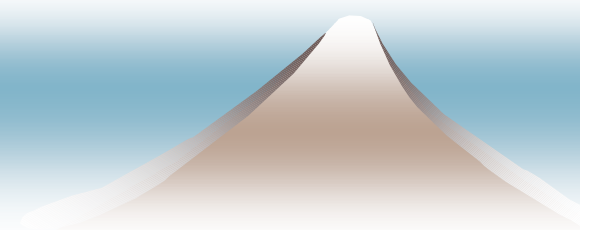


Probe data have very rich information, not just travel time. From probe trajectories, we can draw a complete picture of traffic condition in the study area.

Complete Trajectories based on Kinematic Wave Theory

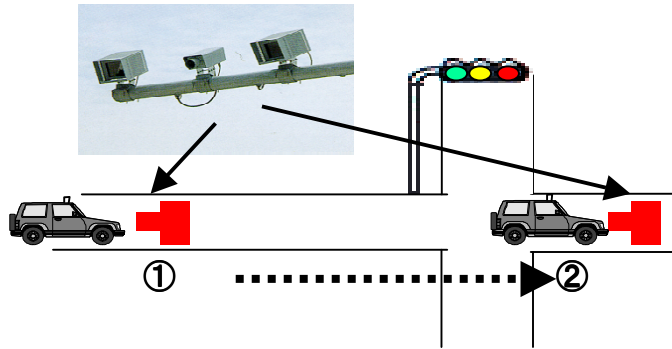


Trajectories of All Vehicles → Travel Time
→ Queue Length



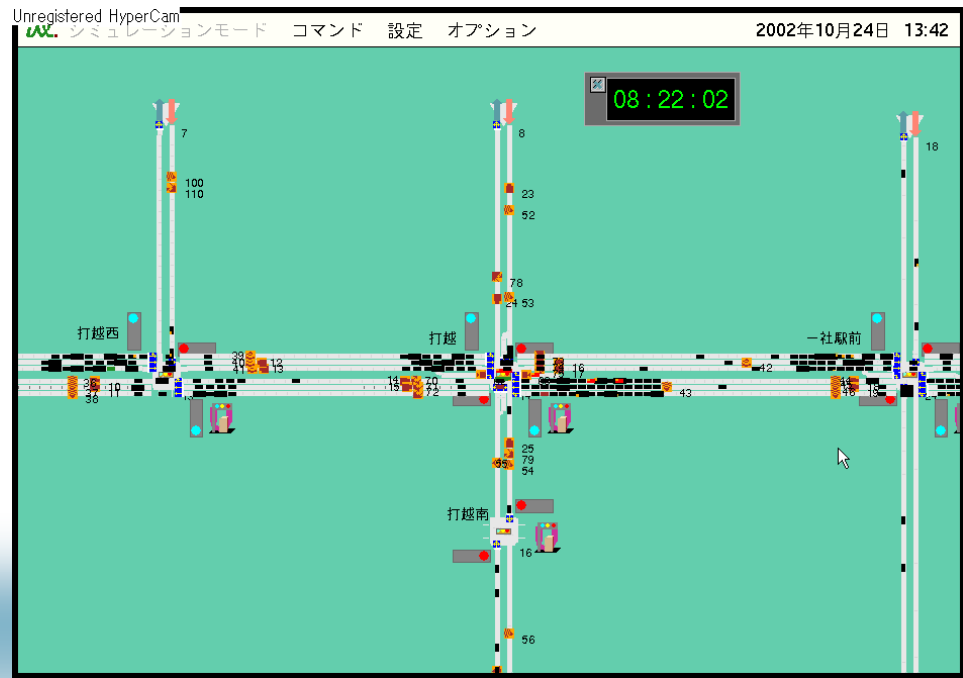
Traffic Signal Control

AVI: Automatic Vehicle Identification
Probe Vehicle Information

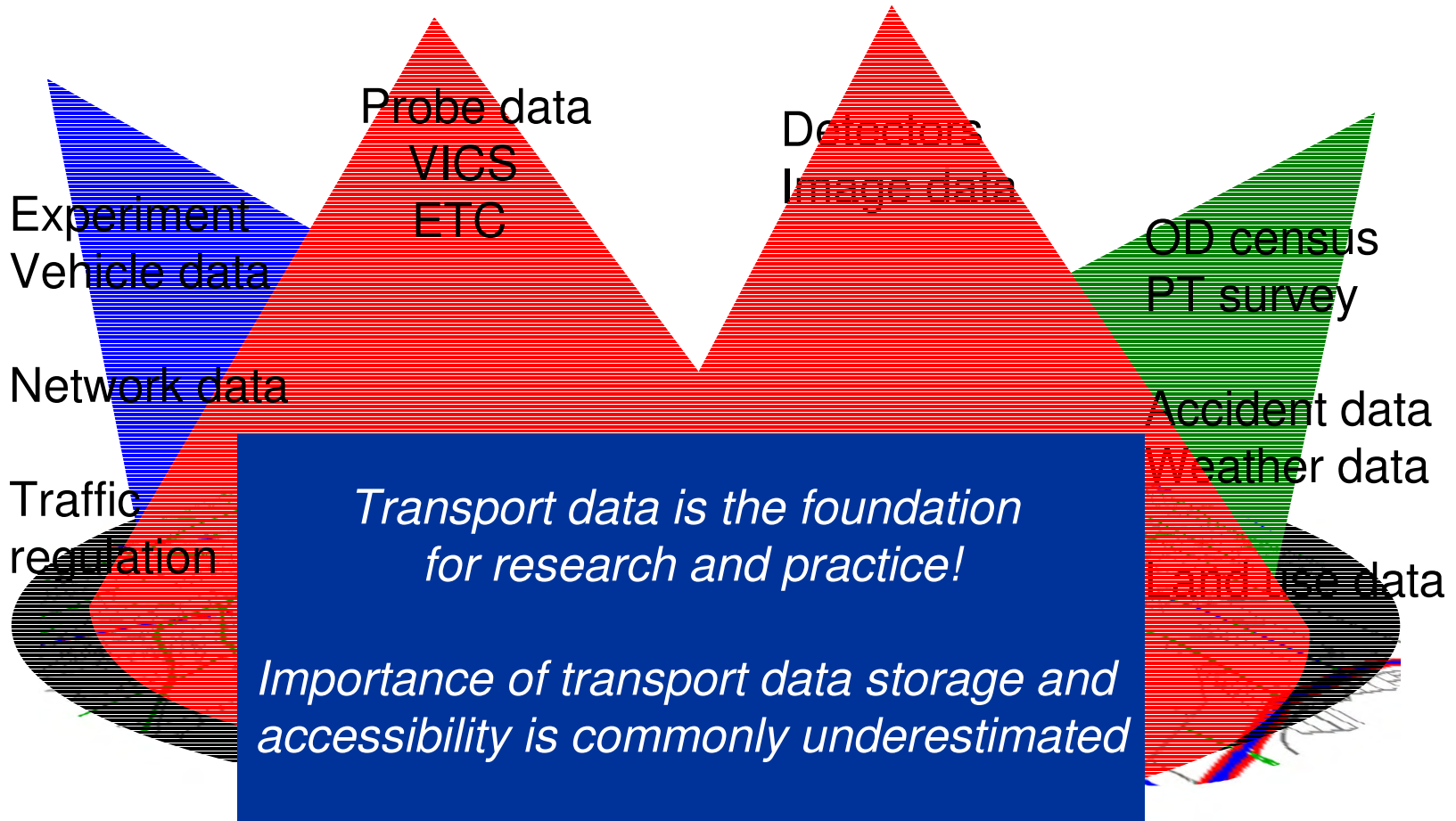


Field Demonstration in Nagoya

CARREN
*Control Algorithm Retuning parameters
with self performance Evaluation*



International Traffic Database



Land Use Planning

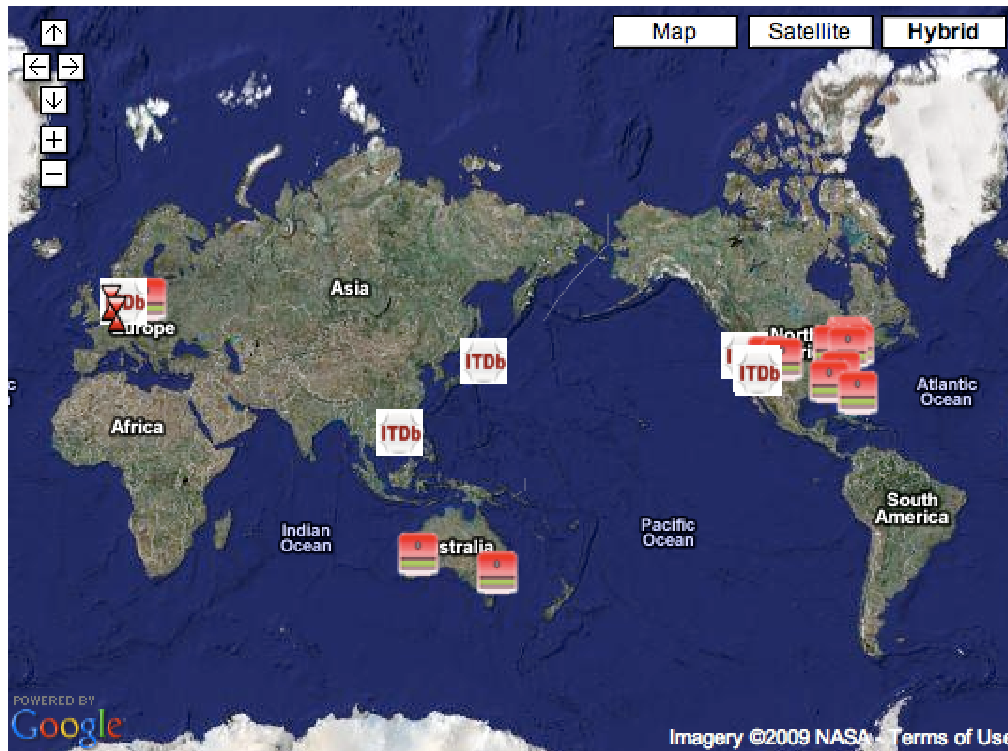
Traffic Management

Strategic Planning

Transport Operation

International Traffic Database (ITDb)

<http://www.trafficdata.info/>



Sources:

- Detector Data
- Video Image Data
- Signal Parameters
- Network Data
- Project Information
- Environmental Data
- Accident Data
- etc.

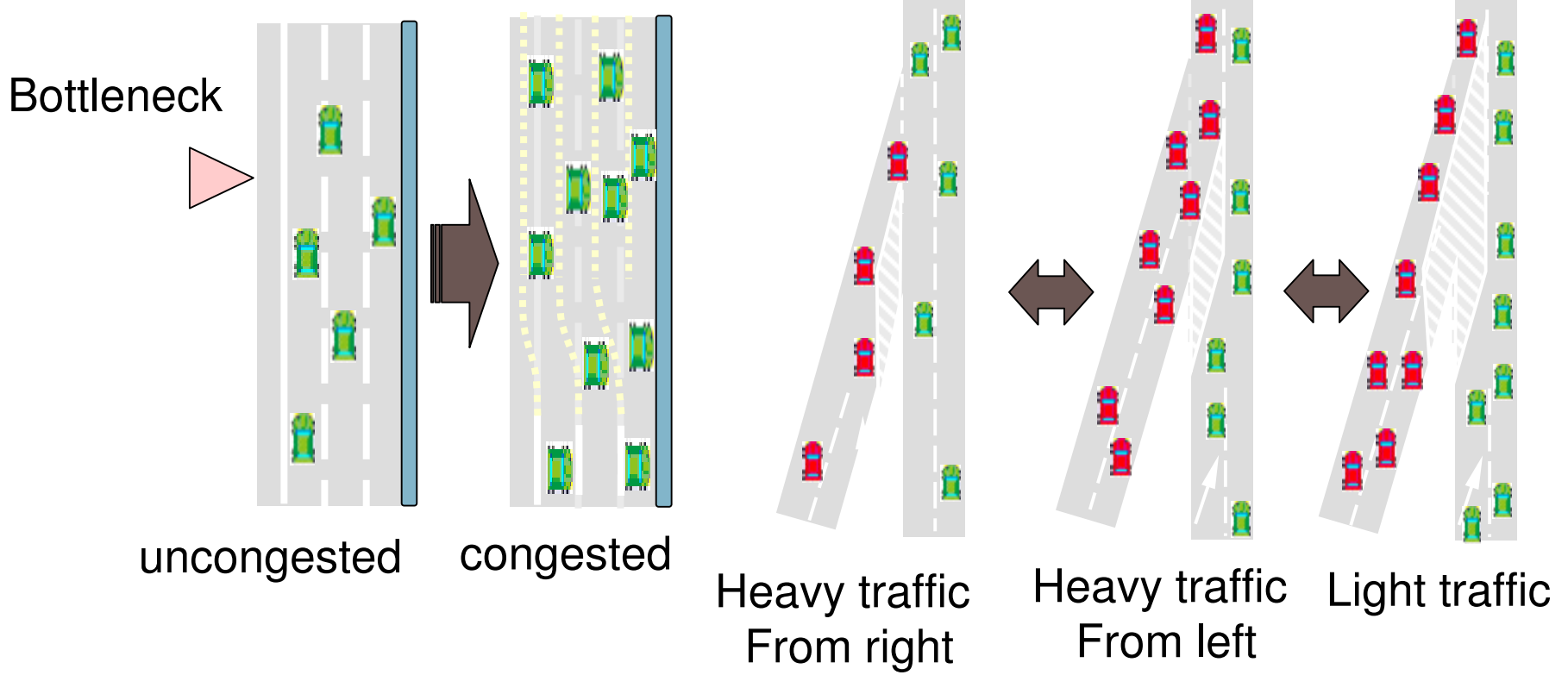
ITDb data: Meta information and actual data stored on ITDb server

External data: Meta information stored on ITDb server, while actual data is accessed via an external database

Connections - worldwide



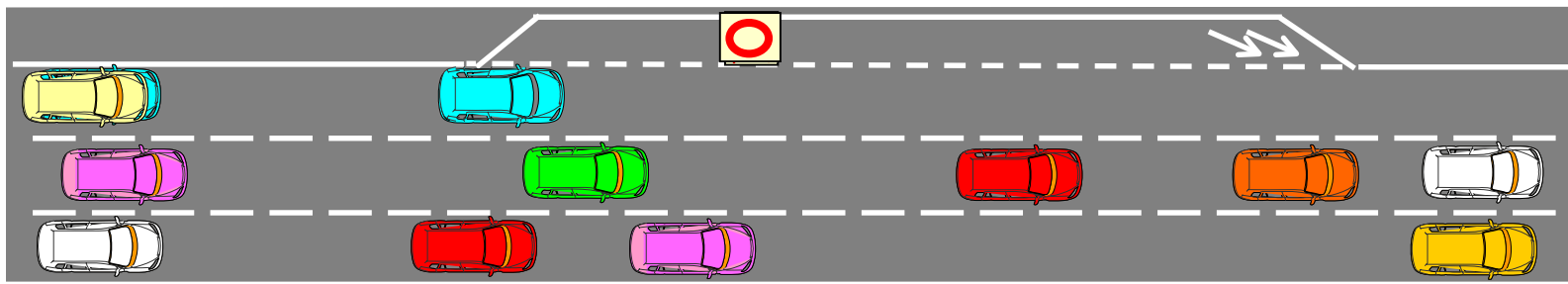
Dynamic Infrastructure



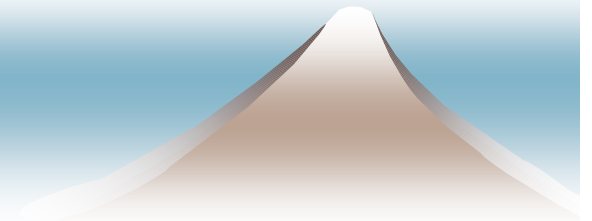
Safety and Efficiency Improvement



Shoulder Lane Utilization



We could expect substantial capacity improvement by the shoulder lane utilization.

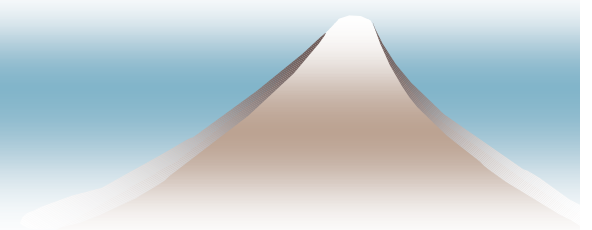
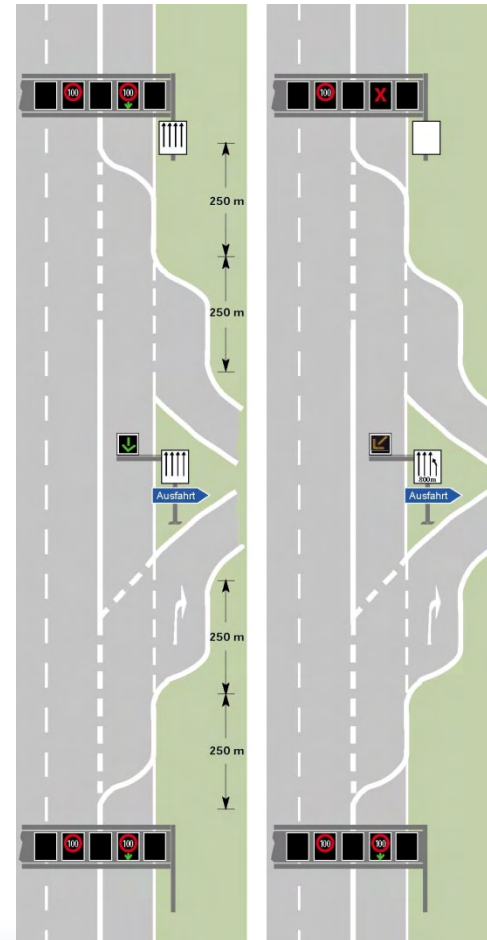


Autobahn A5



(車線別の表示によって車線別の利用可否、速度規制)

Autobahn in Munchen





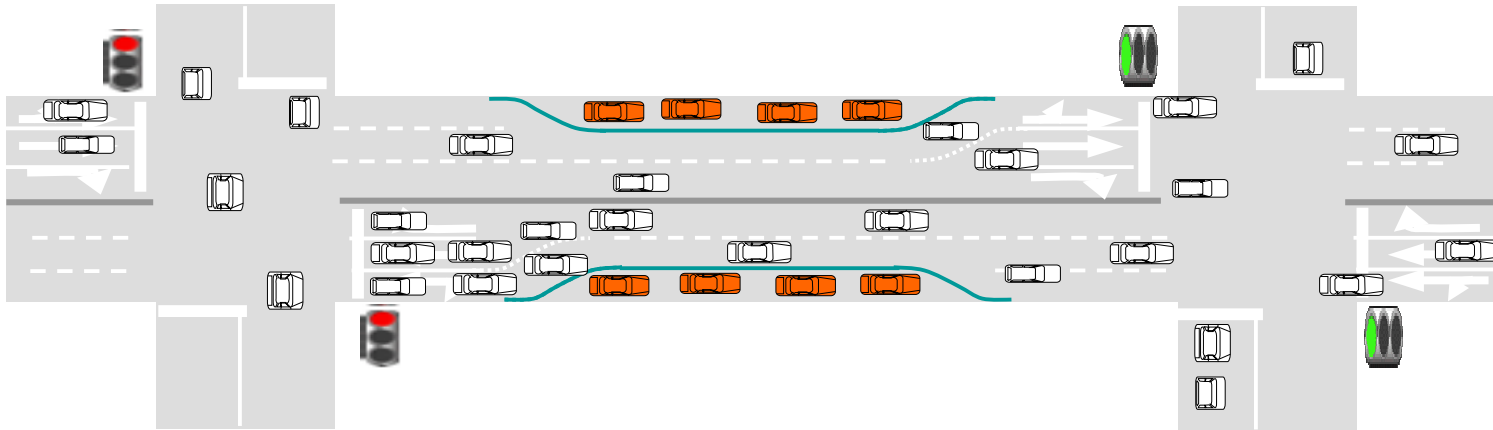
German Autobahn

On-Street Parking Management



Flexible Parking Regulation

- ◆ Dynamic Parking Regulation for Short-time Parking
- ◆ Flexible Parking Charge



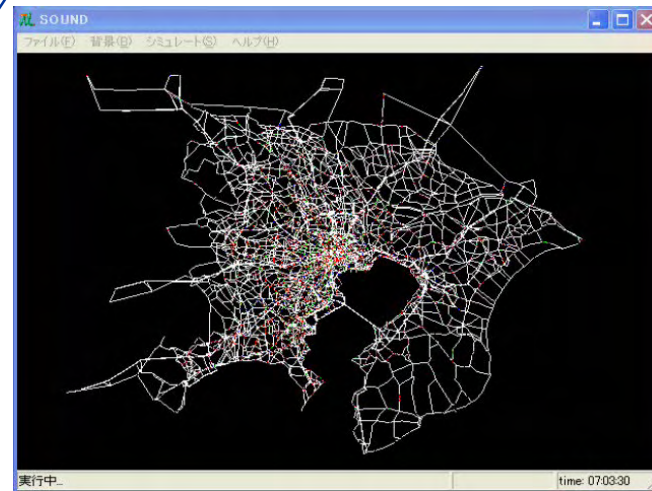
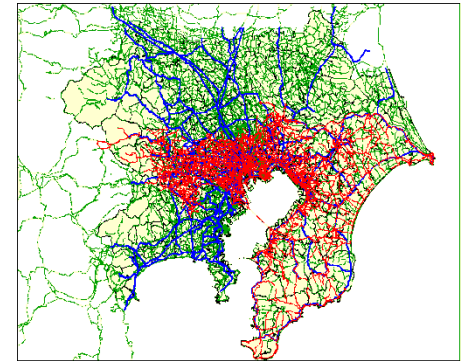
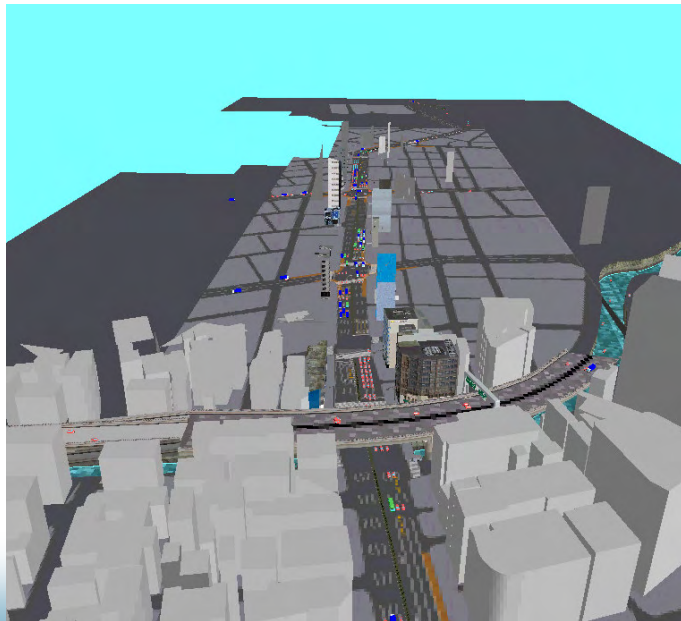
Safety Evaluation



Evaluation using Simulator

AVENUE

Advanced & Visual Evaluator for road Networks in Urban arEas



SOUND

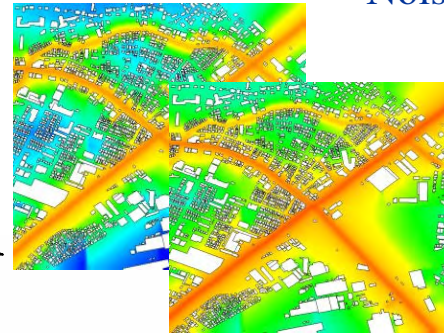
Simulation On Urban road Networks with Dynamic route guidance

Evaluation of Environmental Impact

NO_x, CO₂
Concentration
Model



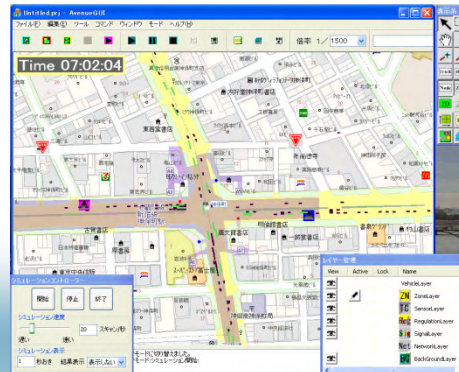
Noise



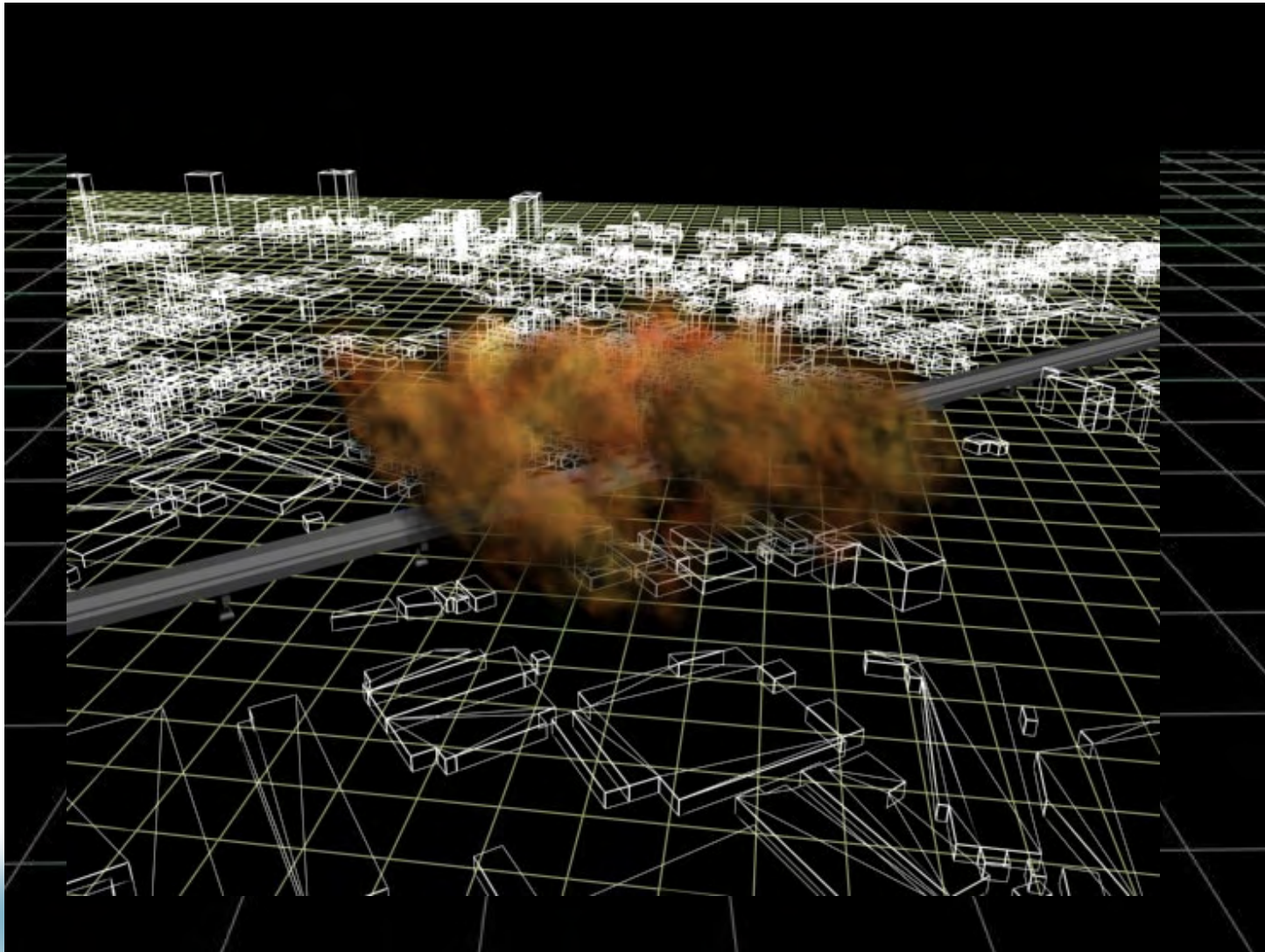
3-Dim
Urban Model



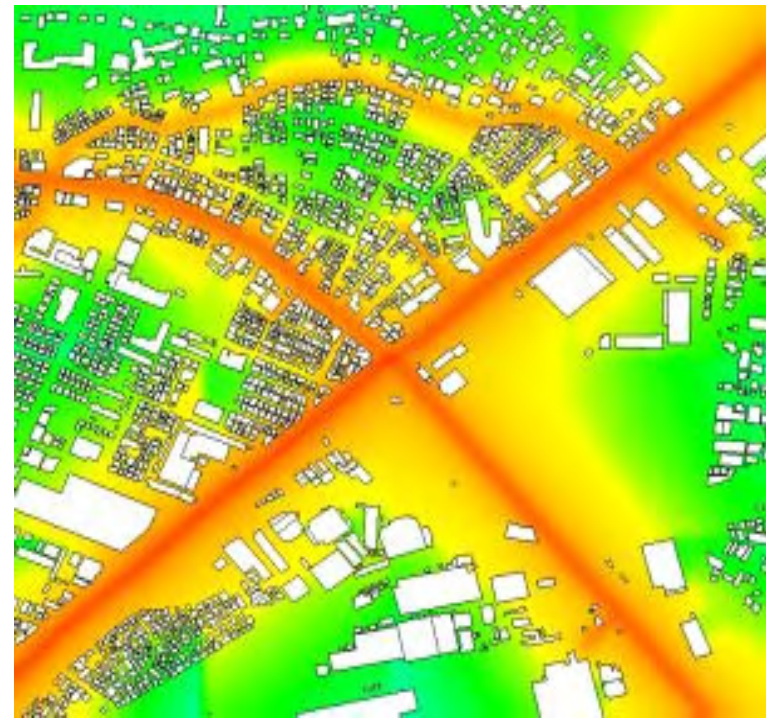
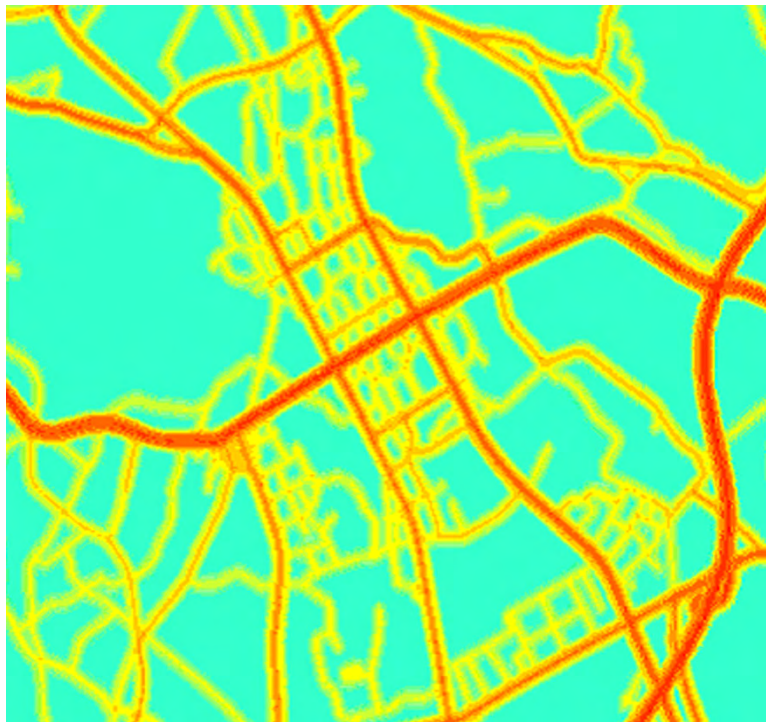
Emission Model
Traffic Simulation



Visualization (Nox Concentration)



Road Noise Contour



Advanced Mobility Research Centre



2005.4 Collaborative Centre for Advanced Mobility



Centre directly under University of Tokyo

2009.4 Advanced Mobility Research Centre

専任メンバー Core Members



センター長・教授 Director, Professor
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交通工学
Traffic Engineering
●道路指向構造および容量 ●交通需要マネジメント
●道路交通シミュレーション ●道路環境の評価
●Highway geometric design
●Traffic demand management
●Traffic simulation model
●Evaluation of road traffic environment



教授 Professor
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Vehicle System Dynamics and Control
●車両運動力学と制御 ●コネクター/ドライブシャフト
●タイヤ・サスペンションの接点力学 ●バーソナルモビリティ、
先進交通システム ●快適性の工学的評価
●Multibody dynamics and control for vehicle systems ●International driving
simulator for human, vehicle, and traffic research ●Contact mechanics for
tire/road and wheel/rail interactions ●Personal mobility and advanced
transportation systems ●Human machine interface and comfort analysis



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Computer Vision
●広域実空間情報の獲得と仮想都市空間の構築 ●有形・
無形文化遺産のデジタルアーカイブ ●入地行動経路学習
ロボット ●物理ベースシミュレーションによる力学分析
●Digital archiving of tangible and intangible cultural heritage
●Mission learning of human behaviors by robots
●Stochastic analysis by physics-based vision



客員教授 Visiting Professor
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ITS分野の事業化
デジタル道路地図技術
Commercialization of ITS
Digital Road Map



客員教授 Visiting Professor
坂本 慎一 Shinichi SAKAMOTO
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17 Core members



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ロボティクス
Robotics
●人間運転モデルの推定と検証 ●視覚的運転モデル
●混在交通流における挙動解析と制御
●非線形ロボティクス
●Identification and estimation of human driver model
●Radical driver models
●Analysis and control of nonlinear behavior in mixed traffic flow
●Nonlinear robotics



准教授 Associate Professor
中野 公彦 Kimihiko NAKANO
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機械生体システム制御工学
Mechanical and Biological Systems Control
●セルフワード/アクティブ振動制御
●独立成分分析系の機械系への適用
●トライブリグシミュレータを構築している運転者の脳波解析
●Self-powered active vibration control
●Active vibration control without sensors and power sources
●Active control of both structural vibration and sound
●Automatic local cooling system to suppress epileptic discharges



准教授 Associate Professor
橋本 秀紀 Hideki HASHIMOTO
生産技術研究所 IIS-3
空間知能化及び制御工学
Intelligent Space
●空間知能化 ●ネットワークロボティクス ●分散知能セン
サネットワーク (DND) ●ハプティクス・インタフェース ●空
間認識 ●空間知能化ユーザインタフェース
●Intelligent Space ●Network robotics ●Distributed Intelligent Networked
Devices (DIND) ●Haptic interface ●Context recognition in a space ●Spatial
Human Interface in Intelligent Space



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Applied Acoustic Engineering
●都市環境騒音の予測・対策・評価
●室内音響設計 ●心理音響
●音場シミュレーション手法の開発と応用
●Prediction and evaluation of urban environmental noise
●Room acoustics
●Psychoacoustics
●Development and application of sound field simulation technique

客員教授
塚本 修
Visiting Professor
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生産技術研究所 IIS-2
経済産業省 政策評価課 課長
Ministry of Economy, Trade and Industry
産業技術政策
Industrial Technology Policy

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Visiting Professor
Akihiro FUJITA
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内閣府 政策評価課 Cabinet Office
科学技術政策
Science & Technology Policy



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●Control engineering



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●エネルギー・ITS ●エコドライブ
●タイヤ特性
●Energy/ITS ●Eco drive ●Tire characteristics



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●Vehicle recognition ●ITS education



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●Virtual city modeling ●Image-based rendering
●Development of ITS sensing vehicle



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●交通流モデル構築 ●交通流および交
通容量 ●混雑交通における天候の影響
●Highway geometric design ●Traffic flow and
capacity ●Weather effect on traffic flow



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●心理音響 ●音場シミュレーション
●Psychoacoustics ●Sound field simulation

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Nonlinear
プラスチック成形加工工
Polymer processing



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建設
Build



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空間情報工学
Spatial Information Technology, GIS



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生産技術研究所 IIS-2
準静電界を応用したモビリティ通信、
センシング
Sensing and communication on the Mobility,
based on Quasi-Electrostatic field



准教授 Associate Professor
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Visual Media Engineering, HCI



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Concrete Engineering
Circular Engineering



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都市交通マネジメント
Urban Traffic Management



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Grad. School of Frontier Sciences, Dept. of
Human and Engineered Environmental Studies
産業環境学
Industrial Information Systems




教授 Professor
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Grad. School of Engineering,
Dept. of Aeronautics and Astronautics
数理物理学、流体力学
Mathematical Physics and Jamology

学外協力メンバー(学) External Support Members (Academia)



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千葉大学
Chiba Univ.
交通
Traffic
交通工学
Engineering



教授 Professor
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Tsukuba Univ.
工学系研究科
Department of Engineering



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埼玉大学
Saitama Univ.
時空間データベース
Spatio-temporal Database



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日本大学
Nippon Univ.
ビー
Be
コン
Cont



准教授 Associate Professor
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Saitama Univ.
3次元ビジョン
コンピュータ・グラフィクス
3-D Vision and Graphics



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ITS創成情報学
Intelligent Transport Systems Innovation
Informatics



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交通工学、道路計画
Traffic Engineering, Highway Planning



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川崎 洋 Hiroshi KAWASAKI
埼玉大学
Saitama Univ.
3次元ビジョン
コンピュータ・グラフィクス
3-D Vision and Graphics



准教授 Associate Professor
高橋 良至 Yoshiyuki TAKAHASHI
東洋大学
Toyo Univ.
生活支援ロボティクス
Assistive Robotics

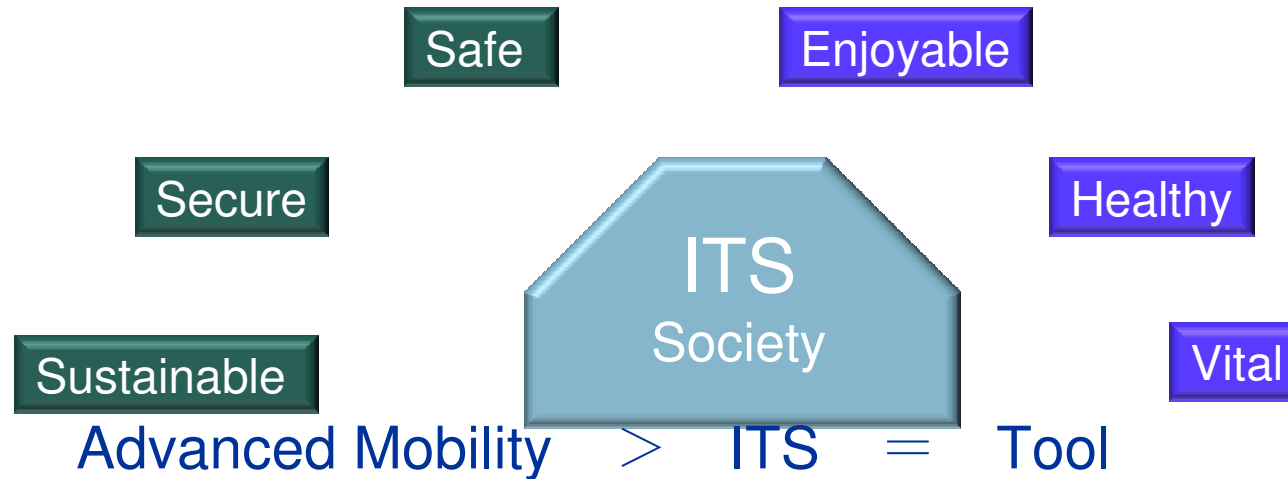
学外協力メンバー(官・産) External Support Members (Government / Industry)

橋本 晃 Akira H
渋谷 秀悦 Shuetsu
井出 真司 Shinji I
細田 俊之 Toshiy
金澤 文彦 Fumihiko
宮原 哲郎 Tetsuro

13 External Support members From Public and Private Sectors

天野 肇 Hajime AMANO トヨタ自動車(株) 専務
Toyota Motor Corporation

ITS Vision in 2025



- Enjoyable and Healthy Society → Reduce Mobility Gap (Age, Area)
- Fatality Free Society → Zero fatality
- Environment Friendly Society → CO₂ -10% (compared to 1990)

Advanced Mobility Research Centre Vision and Mission

1. Education

2. Needs Oriented ITS Feedback to Society

R&D in Advanced Mobility Res Center

Record
Time & Space
4-Dim Information
Infrastructure
Ikeuchi, Hashimoto

Read
Time & Space
Mobility for Next Generation
Suda, Suzuki, Nakano

Manipulate
Time & Space

Measure
Time & Space
Environmental Evaluation
Sakamoto

Utilize
Time & Space
Dynamic Traffic Management
Kuwahara, Tanaka

3. Networking and Dissemination

Society

enjoyable

Healthy

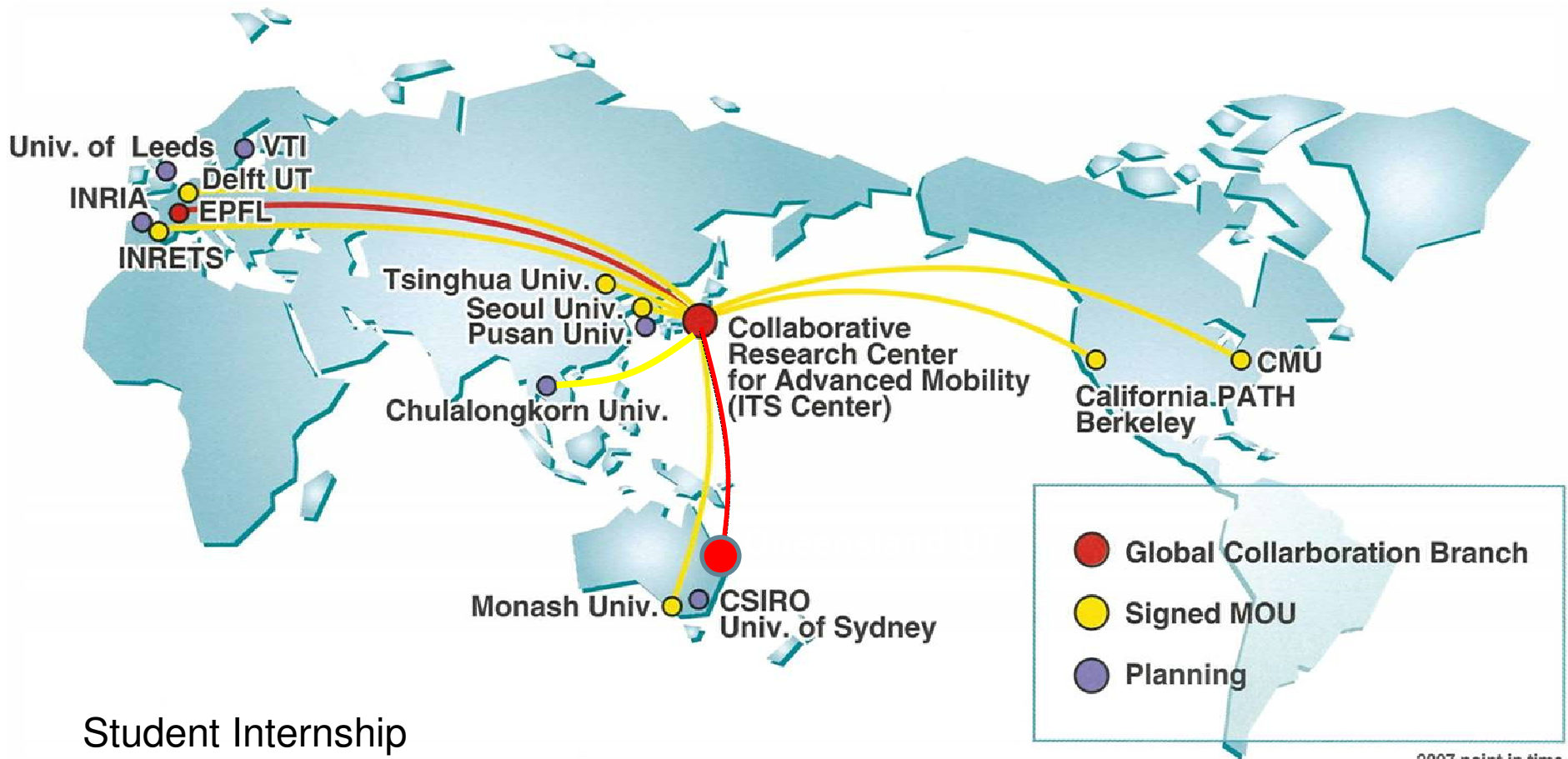
Safe

Secure

Sustainable

Vital

International Collaboration



Student Internship
Staff Exchange
International Symposium
Collaborative Research