



IBM Zurich Research Laboratory

Scaling Real-Time Telematics Applications using Programmable Middleboxes: A Case Study in Traffic Prediction

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IEEE 2004 Consumer Communications and Networking Conference
7 January, 2004

Outline

- ◆ **Introduction**
- ◆ **Architecture**
 - ◆ City Simulator
 - ◆ Booster Box
 - ◆ Route Finder
 - ◆ Traffic Prediction
- ◆ **Prototype Implementation**
- ◆ **Conclusions**

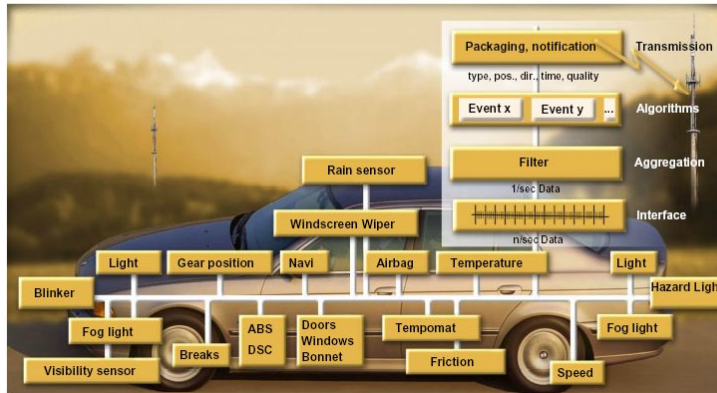
Introduction

- **Emerging applications – sensor networks**
 - Floating Car Data
 - Traffic Prediction
 - Pay as you drive
 - RFID tags
 - Supply chain management
 - Inventory control
 - Passive monitoring (cell phones)
 - Traffic Prediction

Telematics with Car Based Sensors



XFCD In-Vehicle Data Processing

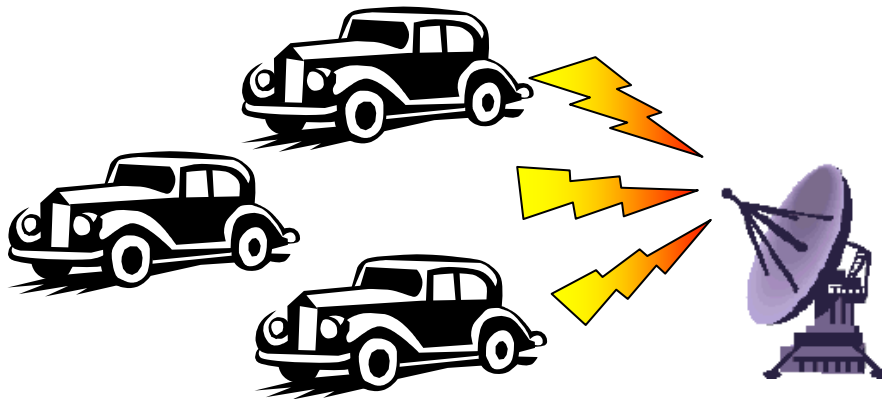


W. Huber, BMW, EW Sciences and Research
H. Kirschfink, H/B, Information Management

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Applications

- ✓ Traffic & Travel Information
- ✓ Payment (road-pricing)
- ✓ Insurance (pay-as-you-drive)
- ✓ Security & Emergency Management
- ✓

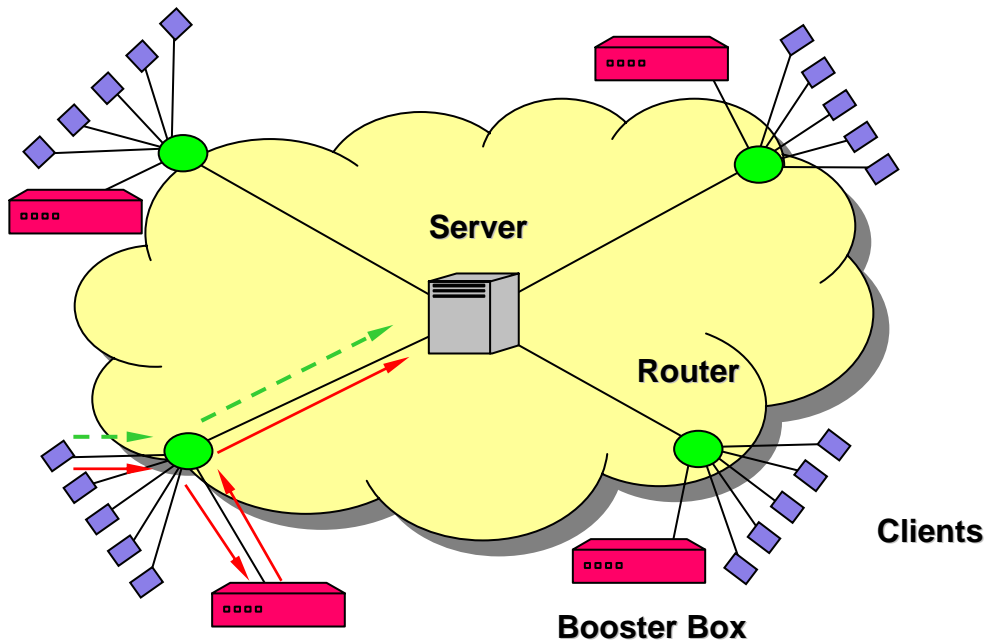


Key features

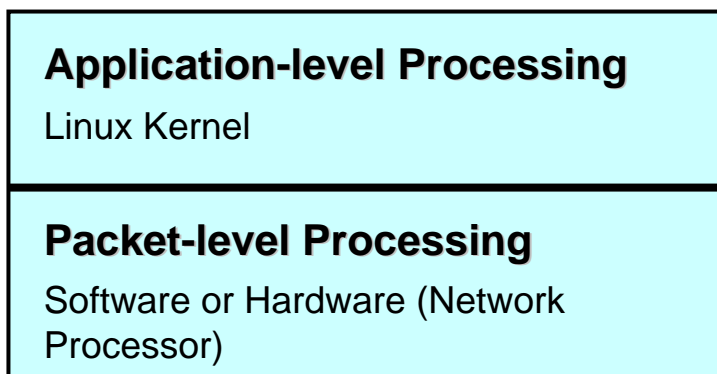
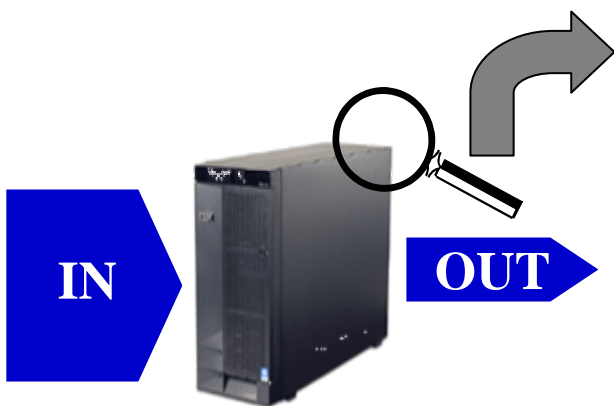
- ✓ Real Time Data
- ✓ High Number of Clients
- ✓ Very Short Response Times

Many cars → **Lots of data** → **It doesn't scale !!!**

The Booster Box - Middlebox

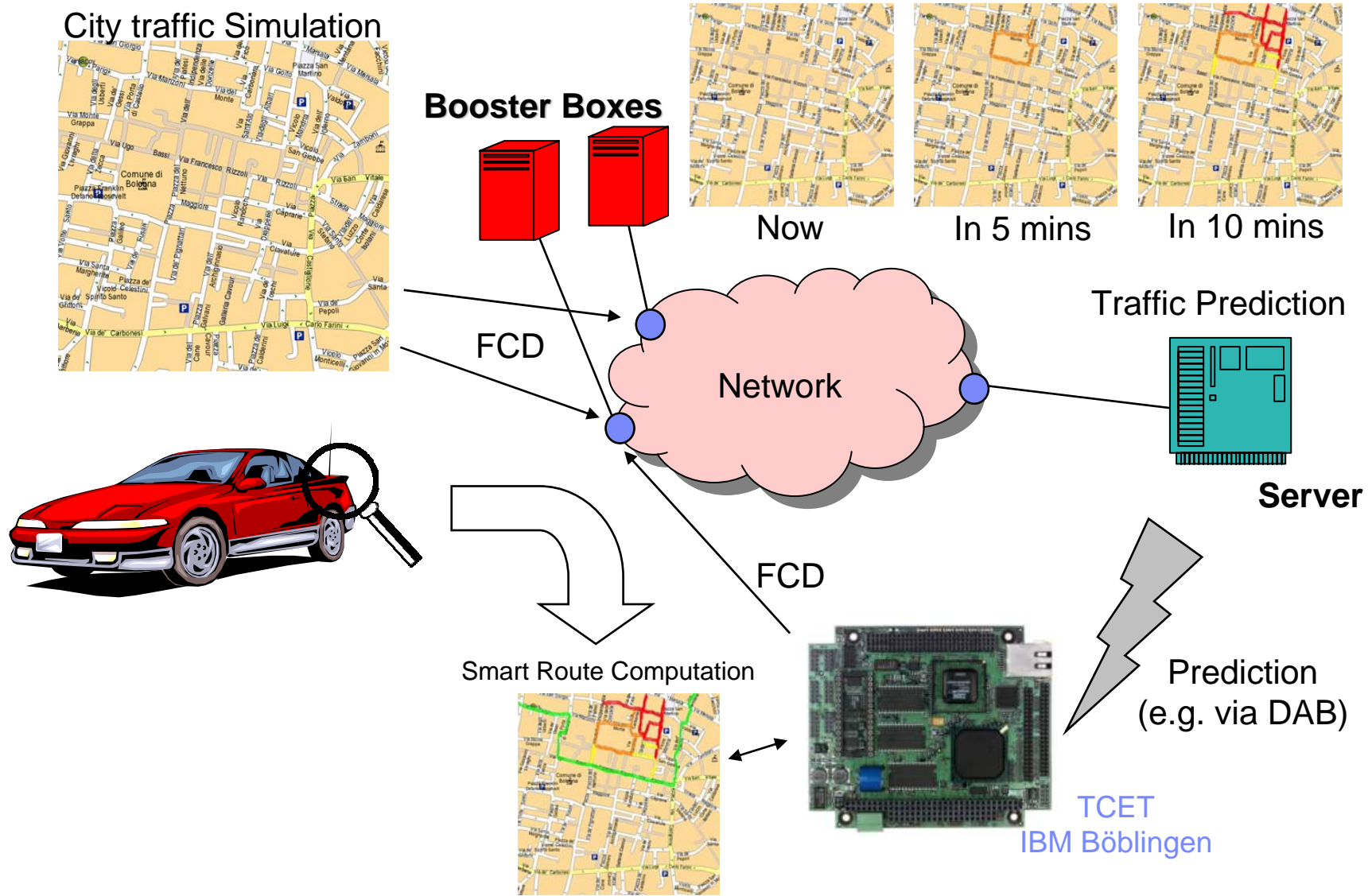


Where
(location)



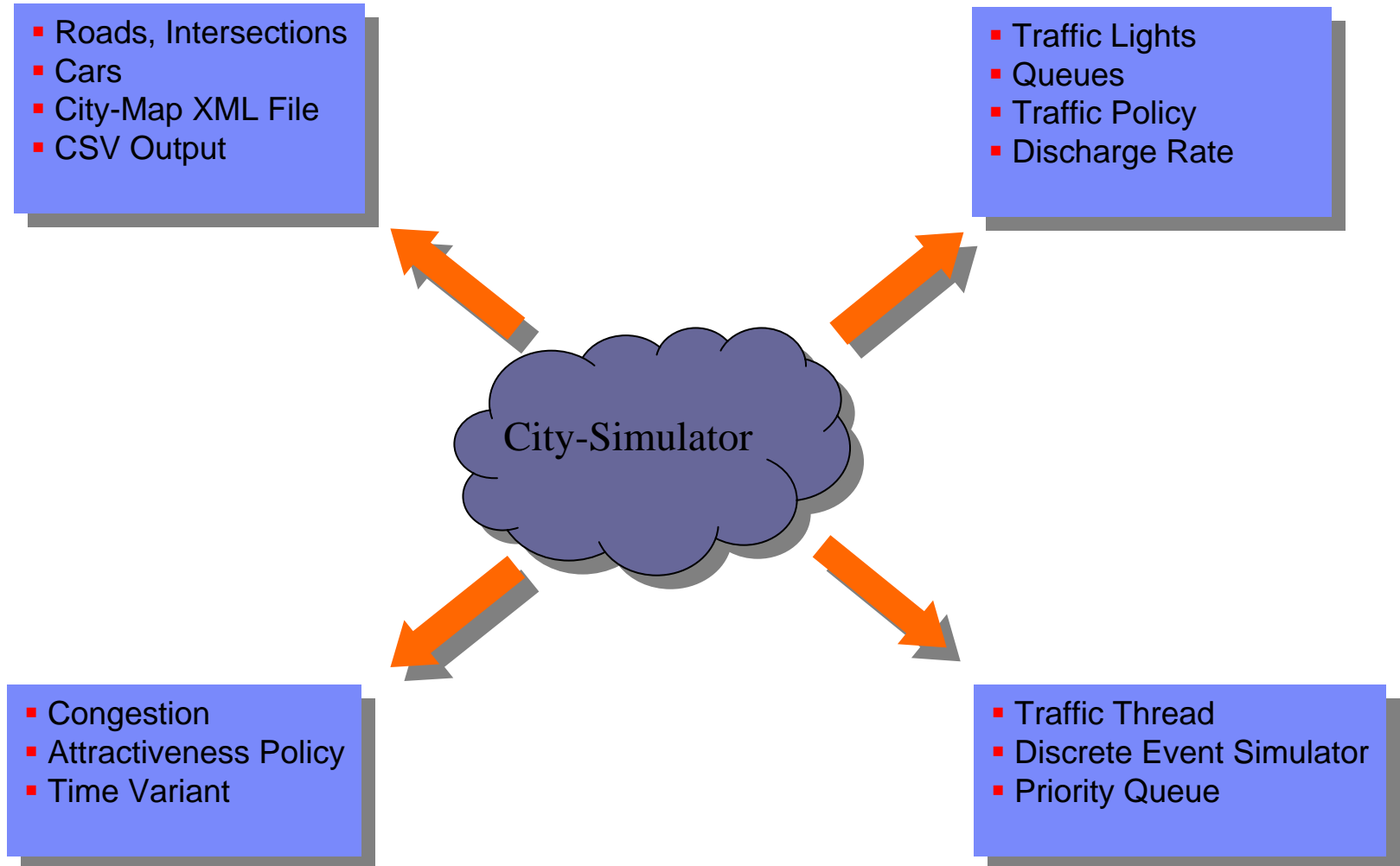
How
(architecture)

System Overview



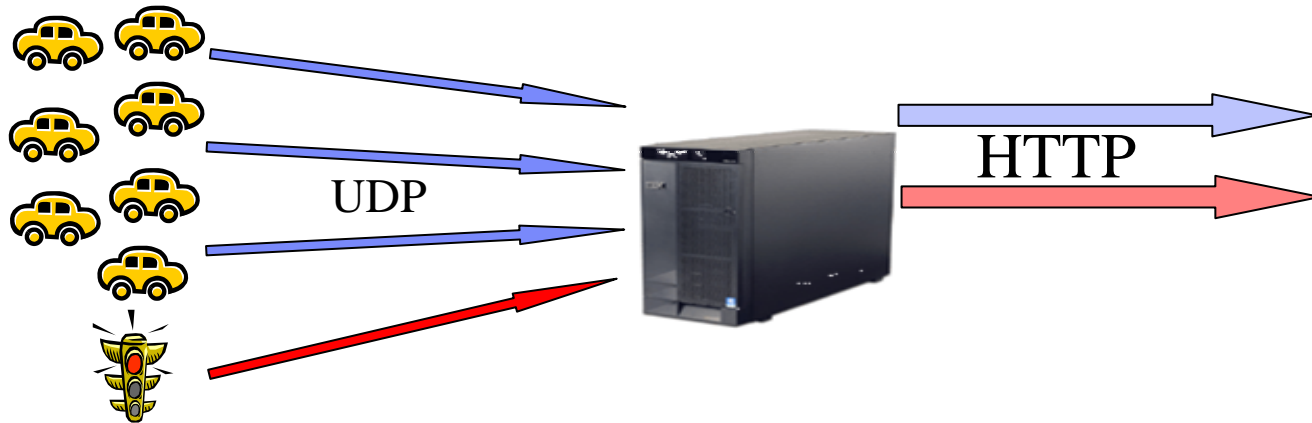
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City Simulator



Booster Box for Traffic Prediction

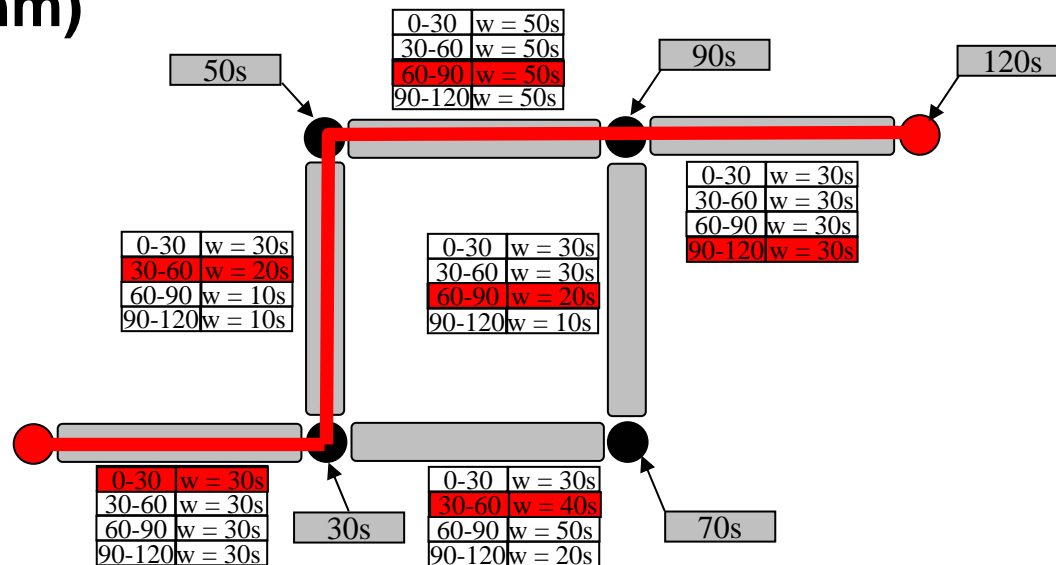
- ✓ Software based
 - **Java Application**
 - **Software solution for diverting packets**



- ✓ Data aggregation
 - **Sends information about road traffic, not individual cars**
- ✓ Transcoding
 - **UDP -> HTTP**

Route Finder

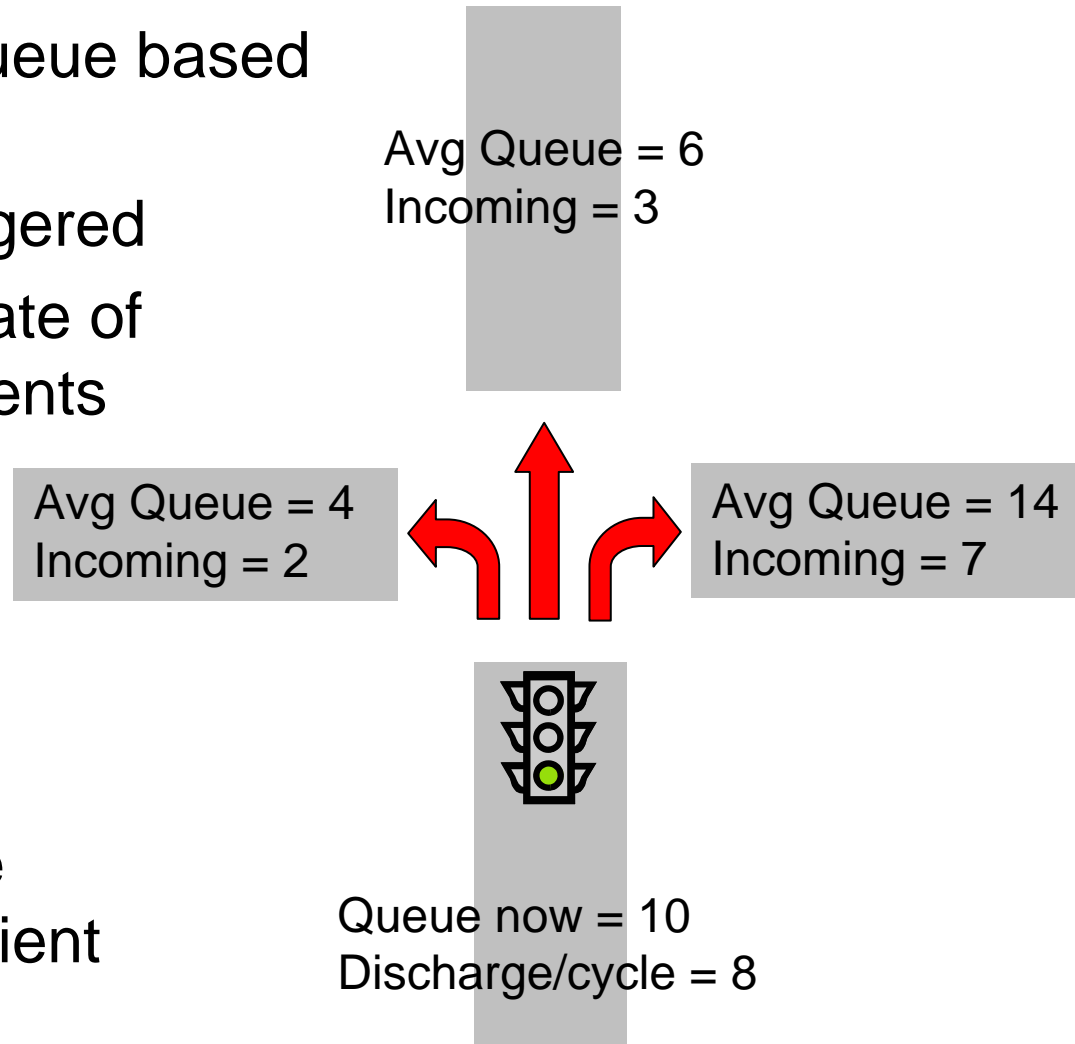
- ✓ Based on current traffic as well as predictions
- ✓ Minimizes traveling time (Dijkstra shortest path algorithm)



- ✓ Receives data from DAB (prototype - TSpaces)

Traffic Prediction

- ✓ Macroscopic queue based approach
- ✓ Traffic light triggered
- ✓ Adaptive estimate of turning movements



Factors

- ✓ Queue Length
- ✓ Discharge Rate
- ✓ Turning Coefficient

◆ Introduction

◆ Architecture

- ◆ City Simulator

- ◆ Booster Box

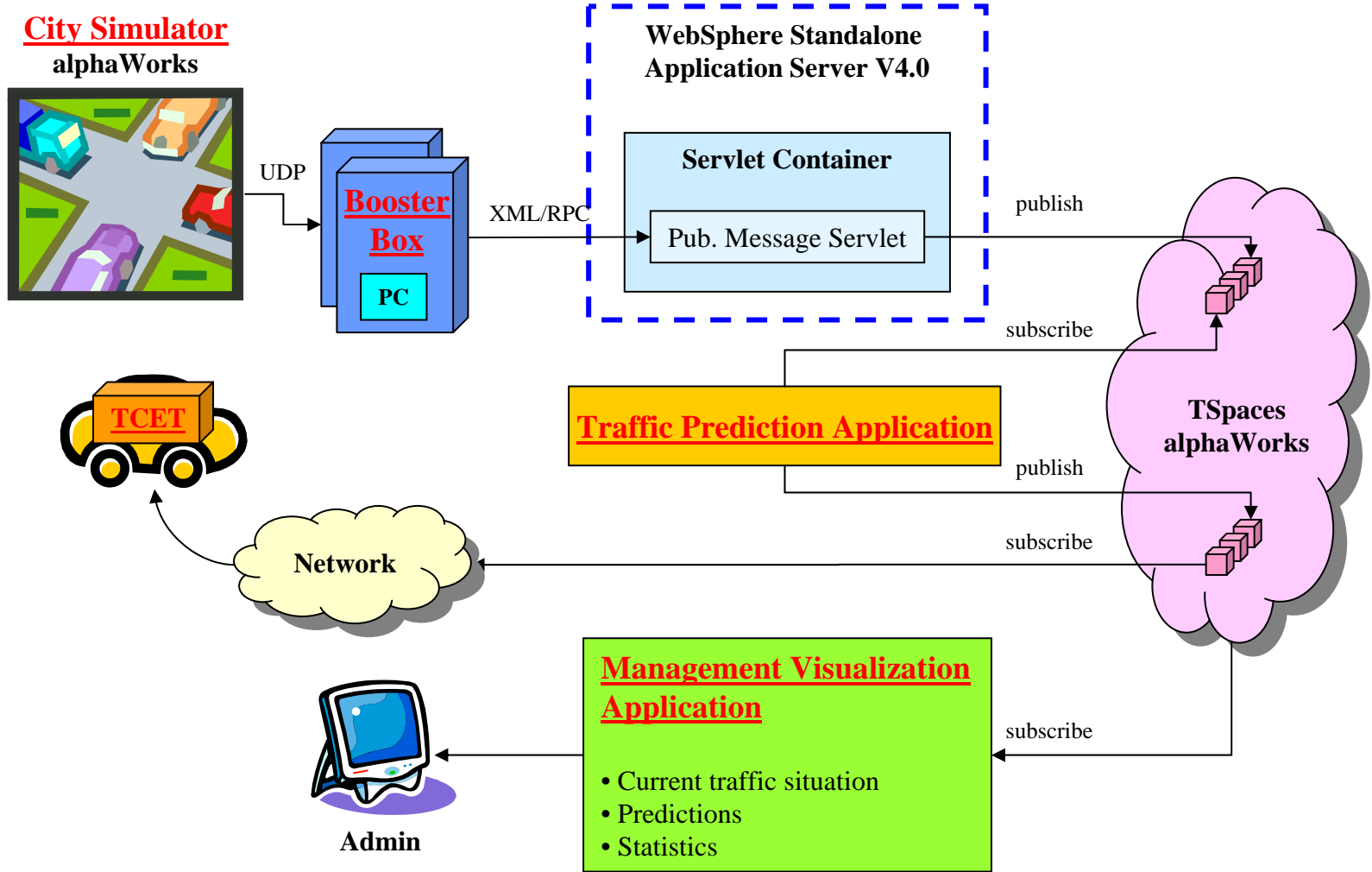
- ◆ Route Finder

- ◆ Traffic Prediction

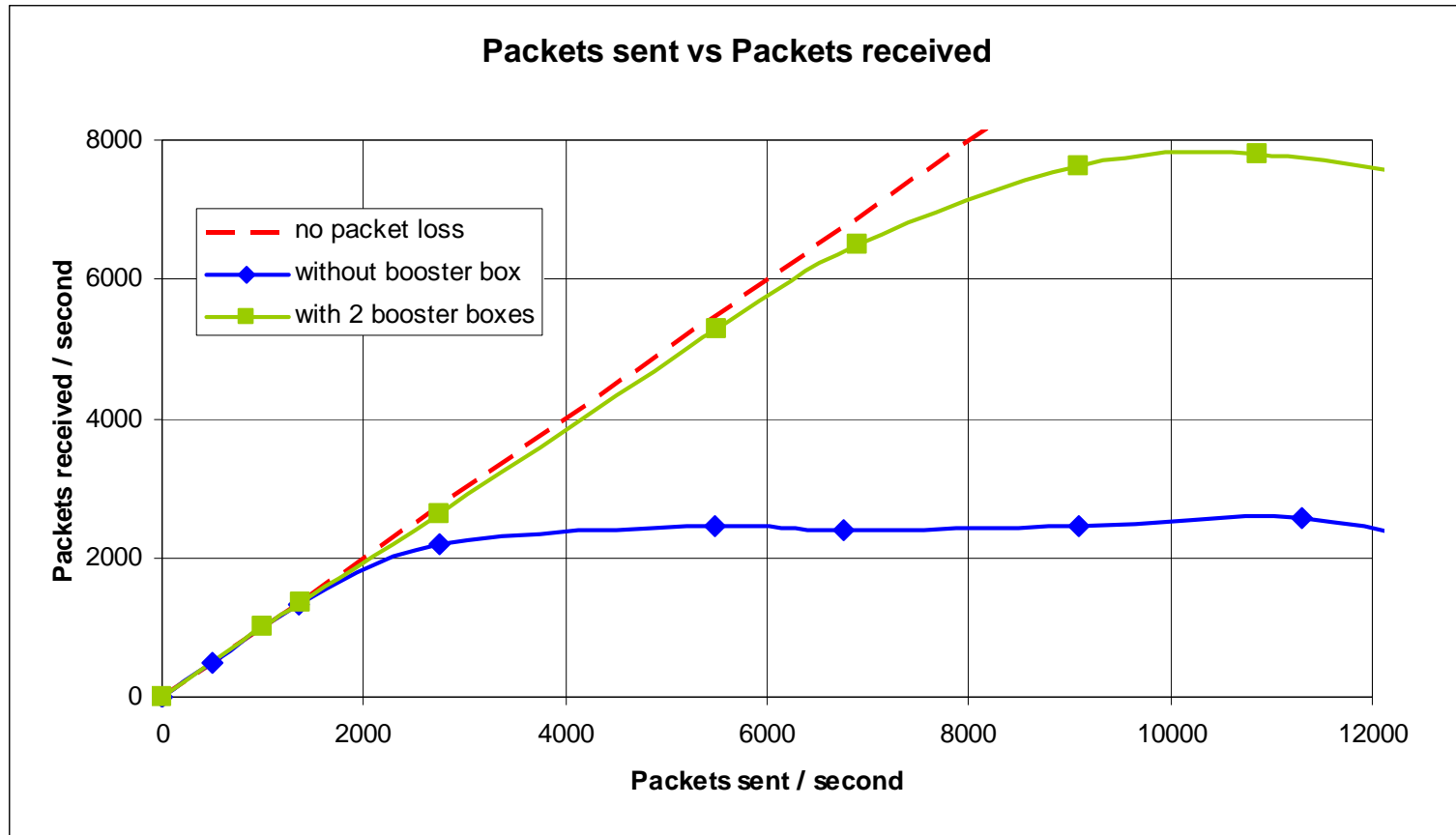
◆ Prototype Implementation

◆ Conclusions

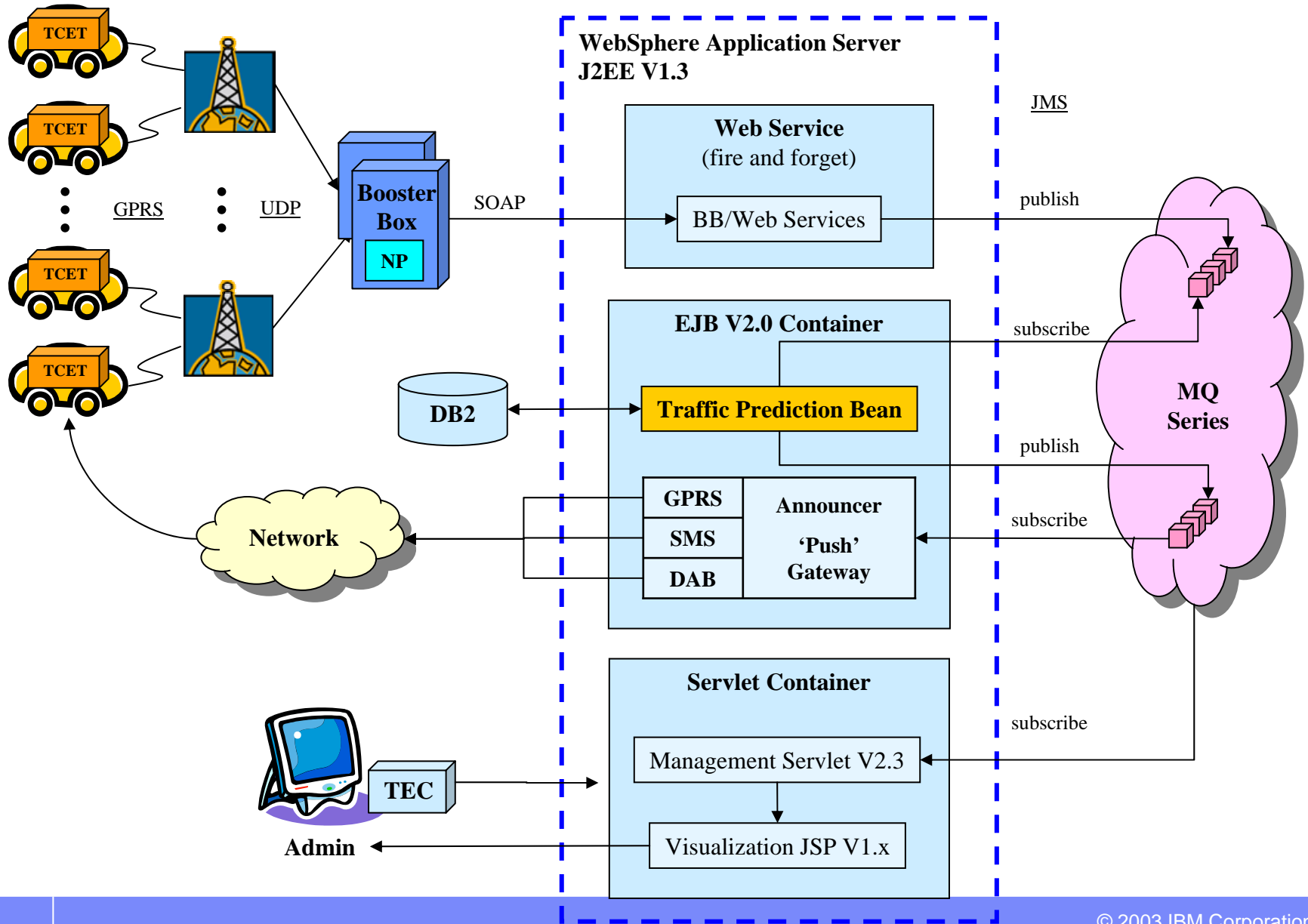
Prototype Architecture



Performance Comparisons



IBM Architecture



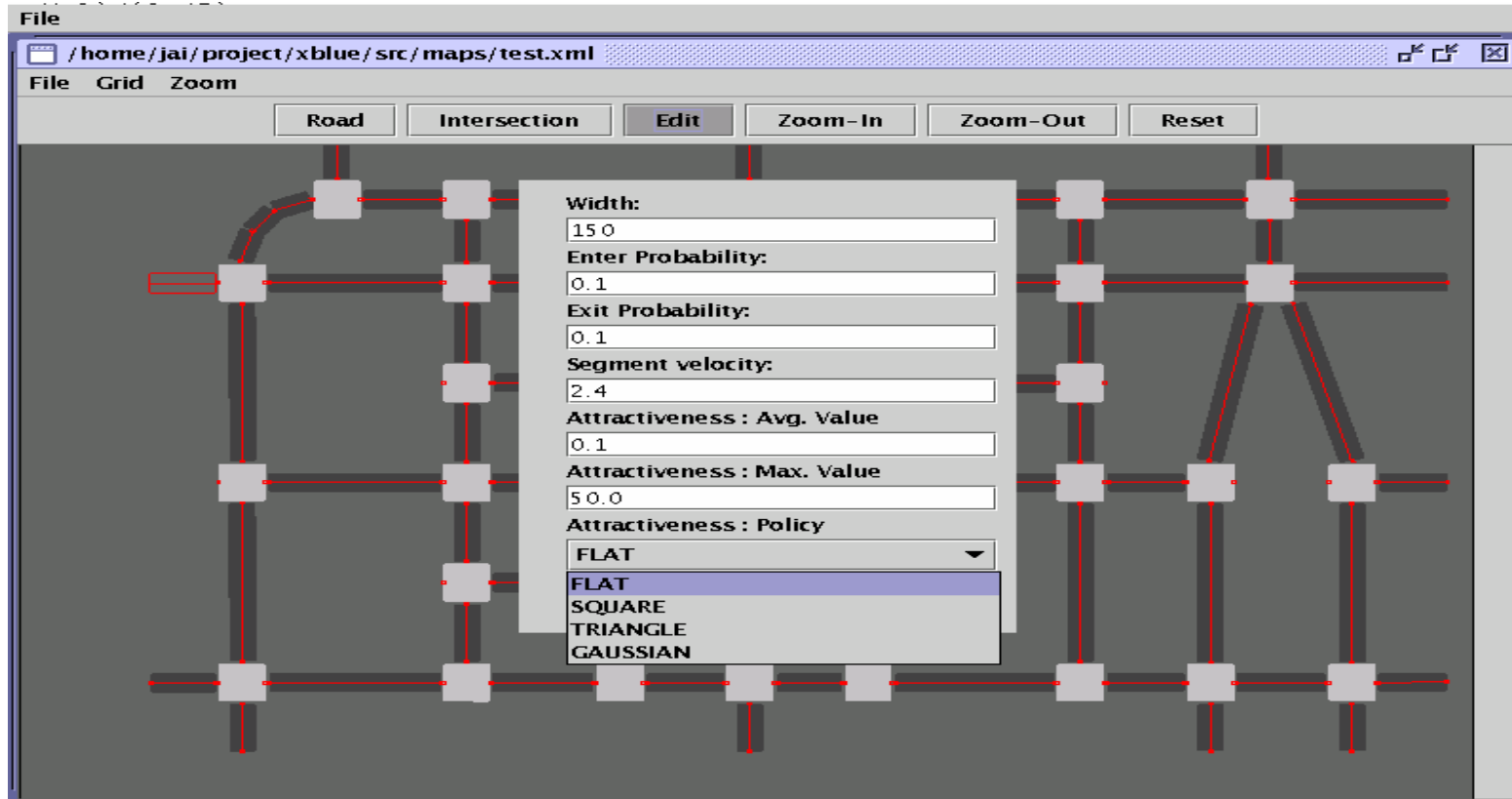
Conclusions

- ◆ **Floating Car Data is one example of sensor networks**
- ◆ **Concept of distributed processing - distribute code close to where the data originates**
- ◆ **The use of standard components. Current work more oriented towards: loosely coupled architectures, publish-subscribe mechanisms.**
- ◆ **Proof of concept – showed to manufacturers**
- ◆ **Problem: who's going to pay for it? (alternatives: passive monitoring for highways)**

Questions?



City-Map Editor



Demo Setup

