Toward the Autonet Vision

Will Recker
Institute of Transportation Studies
University of California, Irvine
wwrecker@uci.edu

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Institute Scope

- Restructuring Traffic Flows by Sharing Information

- Sensor-based real-time monitoring of traffic & cars
- Peer-to-peer ad hoc communication and control
- Extension of the Internet Into automobiles
- Creating intelligent vehicles
- Autonomous transportation agents and systems
- Visual context capture & microphone arrays
- Wireless mobile multimedia systems
- Driver distraction/attention assessment
- Fostering intelligent management

Mobile interactive Avatars
- Televiewing using omni-directional cameras
- Semantic databases and architecture
• **UC Multi-campus Research Unit**
  – 20 – 25 faculty, 40 – 50 graduate students
  – $3 million annual C&G research expenditures

• **Research Centers within ITS**
  – UC Transportation Center
  – PATH ATMS Center
  – Center for Activity Systems Analysis
  – Advanced Transportation Systems Testbed

• **Testbed**
  – Integrated R & D program in Intelligent Transportation
  – Fully-instrumented operations environment
  – Real-time links to research laboratories
  – Testing ground for national ITS efforts
Testbed Wireless Elements: Mobile Surveillance

• Wireless Communication
• Acoustic detector system for wireless ramp metering
• RTMS detector system for collecting mainline traffic data
• Low Voltage LED signal head
• Solar Powered system
Testbed Wireless Elements: Mobile Transportation Management Center

• Wireless Communication
• Receive & transmit compressed video to TMC
• Voice & video conference with TMC
• Operate TMC ATMS from within MTMC
• Acoustic detector system for wireless ramp metering
• RTMS detector system for collecting ramp and mainline traffic data
Testbed Wireless Elements: Real-time Vehicle Tracking (TRACER)

- Web-based CDPD 2-way Wireless Communication
- Receive & transmit data via web-based interface
- PC 104 Pentium Processor, Linux OS, Compact flash RAM
- 12-channel Garmin GPS 35 TracPak
- Vibration sensor for auto on/off
- OpenMap GIS Analysis and Display
Testbed Wireless Elements: OpenMap GIS – GPS Tracings
Testbed Wireless Elements: Web-based Travel/Activity Diaries (REACT!)

- Web-based household level processing of travel and activity
- Integrated GIS facilitator
- Integration with TRACER
Vision: Evolution of Transportation Systems

• Evolution of traffic information
  – From pavement to vehicle
  – From centralized to distributed
  – From uni-directional to pervasive
  – From sparse & rudimentary to continuous & rich
  – From static to dynamic
  – Toward enabling real-time management, communication & control

• Evolution of traffic data processing
  – From TMCs to the vehicle
  – From centralized to distributed
Vision: Evolution of Transportation Systems

• Evolution of traffic decision making
  – From historical to real-time
  – From locomotion toward mobile computer
  – From control-based to information-based
  – From managed to self-organizing
  – Toward a wireless distributed traffic computer
Vision: Intelligent Transportation - AUTONET

- **Concept**
  - Mobile, ad-hoc, wireless, peer-to-peer platform
  - Distributed sensing, computation, and control
  - User-control, system benefits

- **Applications**
  - Autonomous distributed traffic control
  - Intelligent agents for route choice
  - Multi-level state estimation/prediction
  - Decentralized databases
  - Distributed processing
  - Mobile software agents
Intelligent Transportation - ZEV•NET

• AUTONET - Path to Implementation
  – Caltrans ATMS Testbed + Cal-(IT)$^2$ = Wireless Testbed
  – UCI Station Car Initiative - ZEV•NET

• ZEV•NET – Goals and Objectives
  – Fulfill intent of CARB ZEV Clean Air Mandate
  – Accommodate urban growth/sprawl
  – Initial testing ground for AUTONET components
ZEV•NET Communications

- **User to vehicle (PDA or cellphone)**
  - Vehicle authorization, range warnings & charging locations, en-route navigation, walk-up rentals

- **Vehicle to network (wide area wireless)**
  - User authentication & theft prevention
  - Monitoring
    - charge status, location, environmental
    - Traffic updates

- **User to network (wireless & wireline)**
  - Reservations/cancellations, billing
  - Vehicle availability
ZEV•NET Implementation

- Current implementation
  - Irvine Transportation Center
  - Charging stations & Photo-voltaic canopy
  - Corporate shared-use model
  - 50 vehicles (Toyota)
  - 10 E-Coms
  - 30 Rav-4 Evs
  - 10 Prius Hybrids
  - Rudimentary wireless tracking & communications
  - On-line behavioral survey
  - Additional stations (Riverside, San Diego)
  - Stationary fuel cells for power generation

- Next-steps (Dec 2001)
  - Additional vehicles
    - Nissan Hyper Minis?
    - Ford Think?
  - Additional stations (Riverside, San Diego)
  - On-line Survey

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Research Issues: Realizing AUTONET

• **Sensor Technology**
  – Smart Sensors, Small Sensors, Distributed Sensors
  – Self-powered Sensors, Traffic-powered Sensors

• **Data Management**
  – Data Fusion of Multiple Sensor Sources from Multiple Processors
  – Network Abstractions & Synchronization

• **Computing**
  – Distributed Processing, Grid Computing
  – Dynamic Networking of Mobile Computers

• **Algorithms**
  – Dynamic Network Optimization in Real Time