Shared-Use Station Car Initiative

August 7, 2001
- 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
Advanced Power and Energy Program (APEP)

- UCI Combustion Laboratory
  - Thirty Years
  - Gas Turbine Technologies
  - Largest University Program in World
- National Fuel Cell Research Center
  - Founded in 1997
  - U.S. DOE, California CEC, ARB
  - Single National Center Dedicated to Fuel Cell Development and Deployment
  - Members from industry and agencies
- Distributed Power Generation
  - Power Park
  - Shared-Use Station Car Initiative
Cal(IT)$^2$

Intelligent Transportation Systems Focus

- **Near-term Cross-cutting Project**
  - Establish a ZEV Shared-Use Station Car Program with the associated Information Technology infrastructure

- **Longer-term Basic Research and Deployment**
  - Adapt high-resolution GPS to vehicle tracking
  - Develop system architecture, software and devices to support development of Intelligent Transportation Systems
  - Develop and mature ZEV Station Car Program for California

- **Long-term Goal**
  - Apply information technology to guide “livable” urban development
  - Fully develop AUTONET concept
Autonet - **Overview**

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

- **Applications**
  - Autonomous distributed traffic control
  - Mobile, intelligent software agents
  - Multi-level state estimation/prediction
  - Decentralized databases
  - Distributed processing

- **Path to Implementation**
  - Caltrans ATMS Testbed + Cal-(IT)$^2$ = Wireless Testbed
  - Applications: incremental technological advances
  - ZEVNET “Living Laboratory”
Shared-Use Station Car Initiative

ZEV Mandate

SUSC Program
Implementation & Evaluation

An Autonet Laboratory
**Shared-Use Station Car Initiative**

**Purpose**
- Study transit-linked EV use
- Establish Irvine as a national laboratory for communications-based transport systems research
- Integrate Distributed Generation

**Program Description**
- Corporate commuter focused
- 15 to 50 to 200+ cars
- Depots linking stations to major places of employment
  - Irvine Transportation Center in the Irvine Spectrum
  - UCI’s University Research Park
  - Riverside, UCSD, northern California
Vehicle Example: E-Com

**Powertrain:**
19 kW / 25 hp
A permanent magnet motor is paired with a three-shaft single-speed reduction gear.

**Batteries:**
- 288 V
- Nickel-metal hydride
- 60 mile charge range

**Weight:** 1,742 lbs
**Seating Capacity:** 2
**Top Speed:** 62 mph

**Charger:**
- 110V current or 220V inductive charger
- Regenerative Braking
Vehicle Example: Th!nk

**Batteries:** 114V Nickel-Cadmium
53 mile charge range

**Weight:** 2,112 lbs
**Seating Capacity:** 2
**Top Speed:** 56 mph

**Powertrain:**
3-phase AC inductive motor
Front wheel drive
Vehicle Example: Hyper-Mini

**Batteries:**
Lithium-Ion
78 mile charge range

**Powertrain:**
Rear-Wheel 2WD
Neodymium Magnet

**Dimensions:**
- Length: 98 in
- Width: 58 in
- Height: 61 in

**Other Features:**
- Weight: XXXX lbs
- Seating Capacity: 2
- Top Speed: 60 mph

Vehicle Example: Hyper-Mini
Path to Implementation

- **Phase 1: Private Driver (Completed December 2000)**
  - Determine viability as second vehicle
  - Determine customer acceptance
  - Determine use of urban “non-freeway” vehicle

- **Phase 2: Shared Use (Current)**
  - Prototype corporate model
  - Develop IT management system
  - Track use and survey drivers

- **Phase 3: Shared-Use Station Car Initiative**
  - Link to ZEV Mandate and associated credits
  - Integrate stakeholders
  - Develop and implement infrastructure
  - Utilize Irvine as test bed, deploy as technologies mature
  - Integrate with distributed power generation
  - Fulfill ARB goal for standardization
**ZEV NET - Phase 2 Implementation**

**Purpose**
- Evaluate concept of shared vehicles
- Develop initial methods and tools for information-based transport systems
- Integrate Distributed Generation

**Program Description**
- Spring-Fall 2001
- Participants: UCI, 5 Irvine Companies
- Develop IT management system
- GPS tracking & communications
- Irvine Transportation Center
  - Initial 5 e•com parking stalls with chargers
  - Expand to 40-car canopy with P/V
  - Link with fuel cell power generation
UCI ZEVNET
Shared-Use Station Car Initiative

Research and Development
Challenges Related to the Autonet Vision
Communications levels

- User to vehicle
  - PDA, Cell Phone
  - Local area wireless

- Vehicle to network
  - Wide area wireless
  - Power hookups

- User to network
  - Wide area wireless and wireline
User to vehicle communication

- “Keyless” interface (PDA, cell phone, Smart Card)
- Guarantee identity of user to authorize vehicle use
- Trip planning, charge status, charging locations
- En-route navigation aids, range warnings
Vehicle to network communication

- User authentication and theft prevention
- Charge status monitoring
- Location monitoring
- Performance monitoring
- Traffic updates
- Environmental monitoring
**User to network communication**

- Advance reservation and subscription services
- Same day reservations/cancellations
- Walk up reservations
- Instant updates on vehicle availability
- Error-free billing mechanisms
- Guaranteed return trip
**System logistics**

- Maximize vehicle use, VMT
- Match vehicles with users
- Maintain vehicle charge
- Guarantee “return trip”
- Currently unknown supply, demand
Shared-Use Station Car Initiative

Phase 2 Evaluation Tools:

- REACT! And Tracer
- Paramics Microsimulator
**Evaluation Approach**

- **Phase 2 Before Study [no EVs]**
  - REACT! for all adults in each driver’s household
  - TRACER on Household Vehicles for 1 week

- **Phase 2 During Studies [EVs in use]**
  - TRACER on all EVs for remainder of Phase 2
  - REACT! for all adults in each driver’s household
  - TRACER on Household Vehicles for 1 week

- **Phase 2 After Study [no EVs]**
  - REACT! for all adults in each driver’s household
  - TRACER on Household Vehicles for 1 week
TRACER System

- Extensible Data Collection Units (EDCU)
- 12-channel Garmin GPS 35 TracPak
- Web-based CDPD 2-way Wireless Data Transfer
- OpenMap GIS Analysis and Display
- Integration with REACT! CASI Instrument

Applications to:
- Traffic Monitoring / Vehicle Probes
- Route Choice Studies
- Travel Behavior Surveys with REACT!
- Extensions to Route Guidance
TRACER EDCU Hardware

- PC 104 Pentium Class Processor
- Linux OS
- Uninterrupted Power Supply / Battery Backup
- Vibration Sensor for Auto On/Off
- Compact Flash RAM
- CDPD 2-way Wireless Communication
- Web-based Interface for Data Transfer
TRACER EDCU: Outside View
TRACER EDCU: Interior View

- UPS, microcontroller and low level conditioning
- PC/104 Expansion
- Compact flash slot
- Backup Battery
- Vibration sensor
- Shock mount
OpenMap GIS: D12 Loops & GPS
OpenMap GIS: I-5 GPS Tracings
REACT!

- Web-based activity/travel survey instrument
  - web-based program access and data submission
  - household level processing of travel and activity
  - integrated GIS facilitates data entry & geo-coding
  - extensive on-line help in a graphic user interface

- Integration with GPS Units
  - as memory jogger
  - to ascertain routing behavior

- http://www.its.uci.edu/~react/
Initial Interview

Post-Travel Updating

Pre-Travel Planning
REACT! with TRACER

Activity diary

Mon 1/10/00
Major Grocery (10 items)
Start? End? Dur: 0
Woh
09:00 AM-05:00 PM Dur: 480

Tracing Records

Please update the activity at this allocation.
Web-based survey using Tracer system

Please answer the following questions about the trip shown in the map to the left, taken on August 1, 2000.

- **Travel start time**: 6:53 pm
- **Travel end time**: 7:14 pm
- **Activity end time**: 7:42 pm
- **Activity**: dinner at wahoo's fish tacles
- **Was there any traffic?**
  - [ ] no
  - [x] yes
- **Alternate routes**: campus to bristol
- **Alternate destinations**: the wahoo's at park place

Submit
Paramics Microsimulator Demonstration
Implication: There is the potential for a rail-city electric vehicle based system to satisfy the commuting needs of a large sector of workers.
By 2020

- 6.7 million more people (two more Chicago’s)
  - More planned communities in far suburbs

- 4 million new jobs
  - More job growth in suburbs
  - Not clustered with amenity-driven residential locations
  - Drive-alone commuting will continue as preferred mode

- Traffic conditions will worsen
  - Traffic will grow by more than 48%
  - Traffic delay will more than double
  - Travel speeds will slow to 20 mph
  - Average commute times will increase by 13 minutes

- Multiple-worker households will continue to dominate
  - Vehicles generally must be capable of meeting commuting needs
By 2020

Population Forecast (% Change 1994-2020)

- Los Angeles: 12,249,088 (32.7%)
- Riverside: 2,815,987 (104.5%)
- San Bernardino: 2,830,050 (81.6%)
- Orange: 3,244,602 (25.0%)

Entire Region: 22,352,394 (43.2%)

Implication: Growth in the outlying regions will produce even greater demand for "corridor" transportation systems and solutions.
Conclusions Drawn

- Range of current ZEV technology seriously limits its marketability as a “stand-alone” system.
- Rise in congestion levels and concomitant dissatisfaction with commuting will push solo drivers toward alternative solutions.
- Accelerated economic development in the service high-tech industries will continue to place a premium on mobility at the workplace.
- Regional commuting patterns support a demand for a regional transportation system that maintains the convenience and flexibility of solo driving.
Shared-Use Station Car Solution

- Clean Limited-Range Mobility
- Rigid Line-Haul Performance
- Urban Mobility
- Congestion-free flow
- Clean Limited-Range Mobility
- Urban Mobility