

AN INTRODUCTION TO
INTELLIGENT TRANSPORTATION SYSTEMS

1.212
SPRING 2005

Professor Joseph M. Sussman

Mon/Wed 2:30-4

BLOCK 1

(Lectures 1, 2)

INTRODUCTION TO ITS

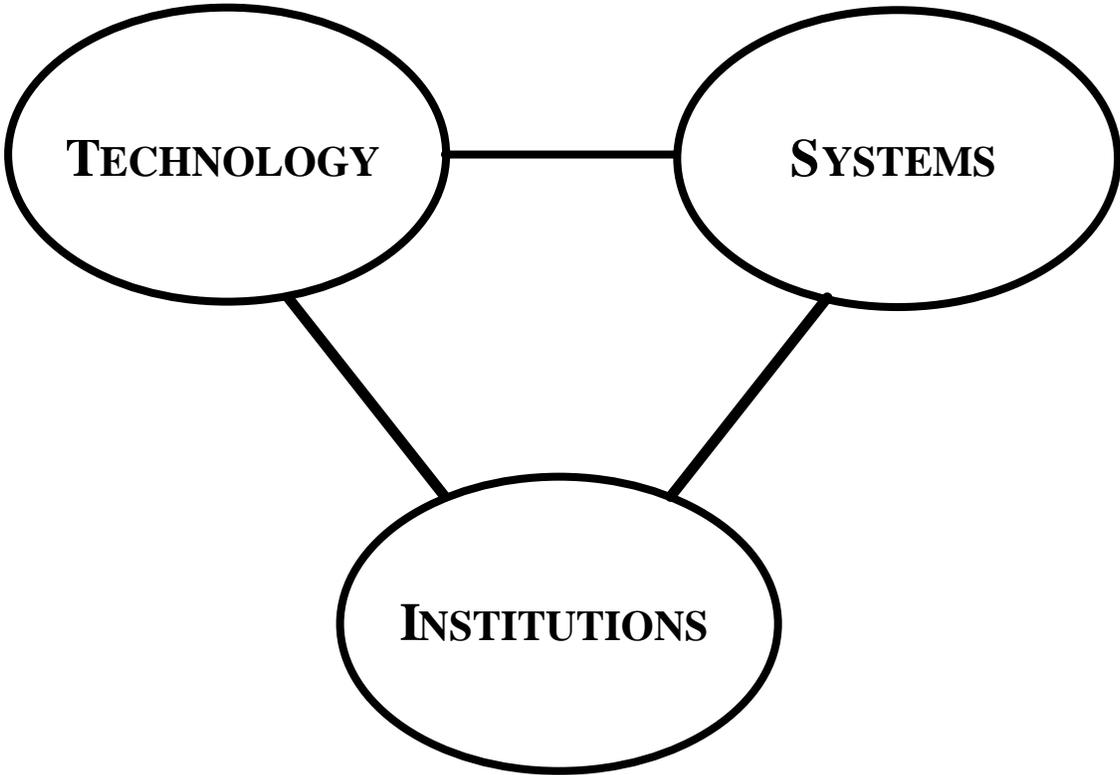
Basic Concepts

SPEAKER: Joseph M. Sussman
MIT

February 2, 2005

DEFINITION OF ITS

- ◆ Intelligent Transportation Systems (ITS) apply well-established technologies of communications, control, electronics and computer hardware and software to the surface transportation system.



WHAT 1.212 IS ABOUT

- ◆ It's a *transportation* class, with all that implies
- ◆ It's a policy class -- how transportation relates to major societal goals
- ◆ It's a technology development and deployment class
- ◆ It's a complex system (CLIOS) class
- ◆ It's a "Regions" class
 - ◆ Planning
 - ◆ Architecture
- ◆ It's an organizations/institutions class
- ◆ It's an advanced research ideas class

1.212 CLASS SYLLABUS

Spring 2005

Block	Topic	Lectures
1	Introduction to ITS, including where ITS fits; roles and responsibilities	2
2	Advanced Traveler Information Systems (ATIS), including functionality; business models; field trip to SmartRoute Systems	3
3	Advanced Transportation Management Systems (ATMS), including network operations; incident detection; congestion pricing, tolling, HOT lanes, example deployments	3
4	Fleet-oriented ITS services, including Advanced Public Transportation Systems (APTS); BRT; Commercial Vehicle Operations (CVO); Intermodal Freight, including International Operations and Supply Chains	3
5	ITS and Technology, including automated highway systems (AHS); sensors, electronic toll collection (ETC); dedicated short range communication; standards	2
6	Regionally-scaled ITS deployment, including regional architecture; organizational and institutional issues; standards; developed vs. developing countries; ITS and strategic regional transportation planning; Integrating in infrastructure and operations planning	6
7	Critical ITS Issues, including (as time permits) ITS and security; safety; human factors; privacy; sustainability; funding (as contrasted with conventional infrastructure); technology deployment/R &D/p olicy; other institutional issues	4
8	Conclusion, including regional ITS planning and architecture presentation; the future of ITS	3

STUDENT REQUIREMENTS

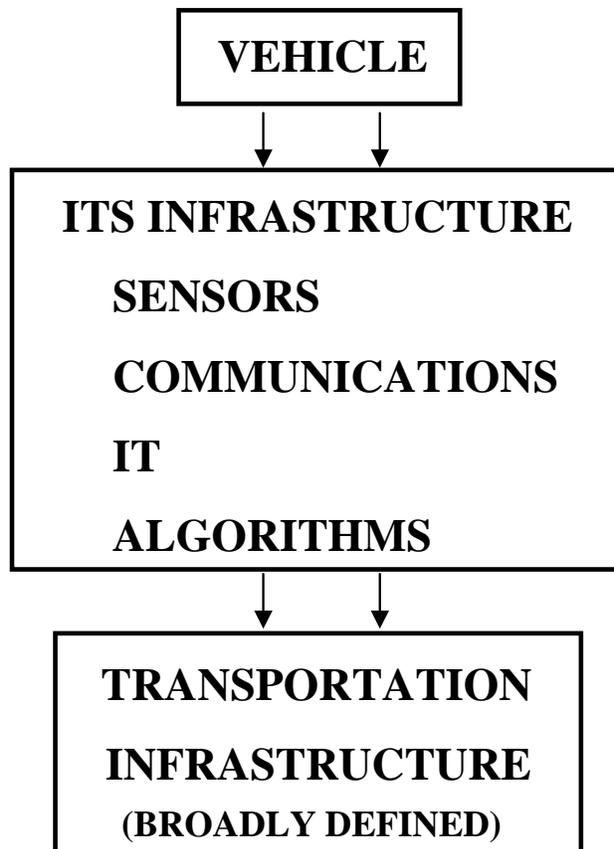
1. One short (7 pages) assignment.
2. “Mini” Term Paper (about 10 pages -- topic to be “negotiated” with Professor Sussman); submitted right after Spring Break.
 - A. Critical review of selected ITS literature
 - B. A paper or analysis on some topic of interest to you.
3. Readings
4. Group Regional ITS Planning and Architecture Project (second half of semester)
5. Discussion Articles -- We will distribute several articles that will be discussed (interactively) at the next lecture. We will ask you to write a brief summary of the article to be submitted before the discussion.
6. Class Participation

BIG ITS IDEAS

- ◆ The ITS-4 Technologies
- ◆ The ITS Insight: Linkage of Vehicle and Infrastructure
- ◆ Regionalism
- ◆ Intermodalism
- ◆ Information
- ◆ Mobility
- ◆ The Potential of Pricing
- ◆ Institution Building
and
- ◆ Institutional Change
- ◆ Nationally-Consistent System
- ◆ Internationally-Consistent System

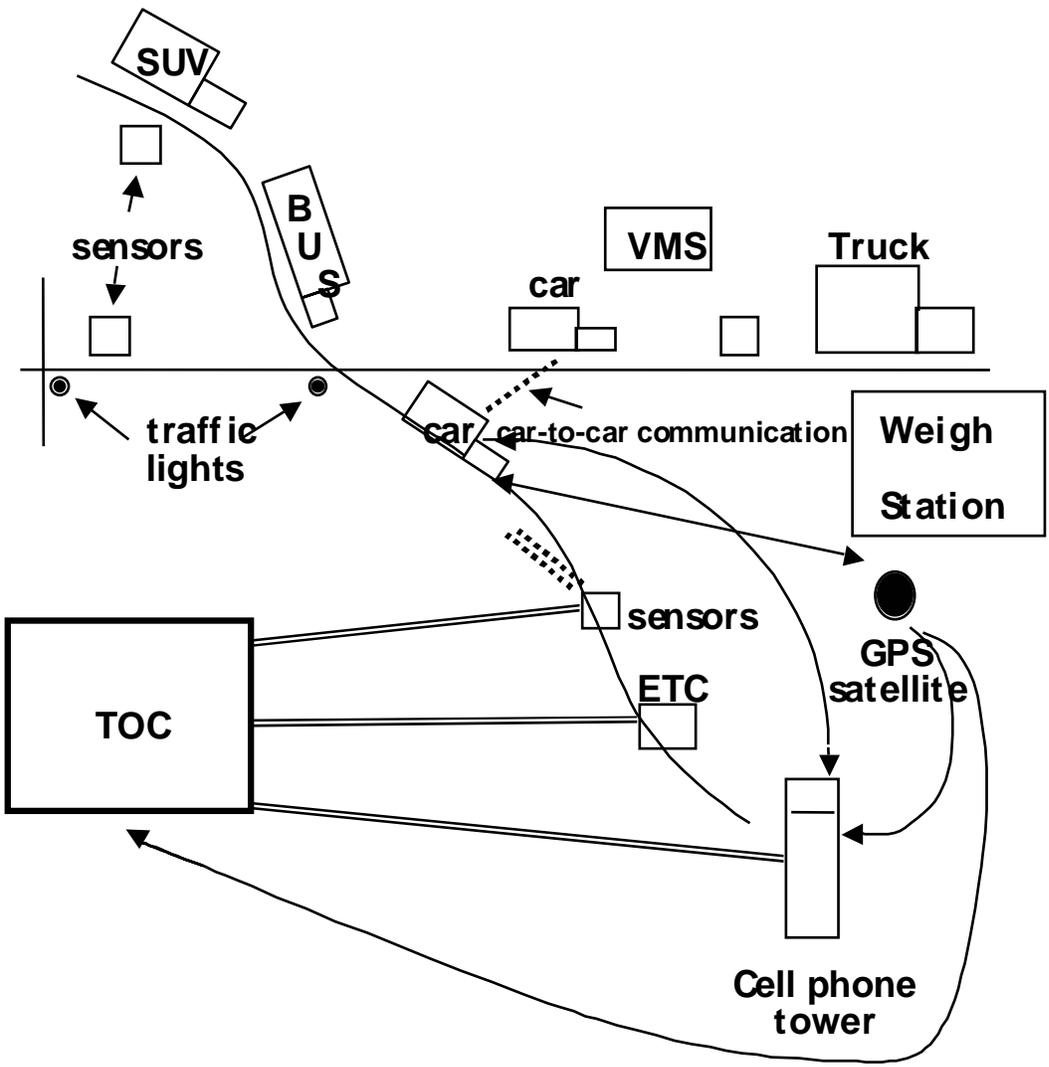
THE FUNDAMENTAL ITS INSIGHT

- ◆ Linkage of vehicle and transportation infrastructure through ITS infrastructure.

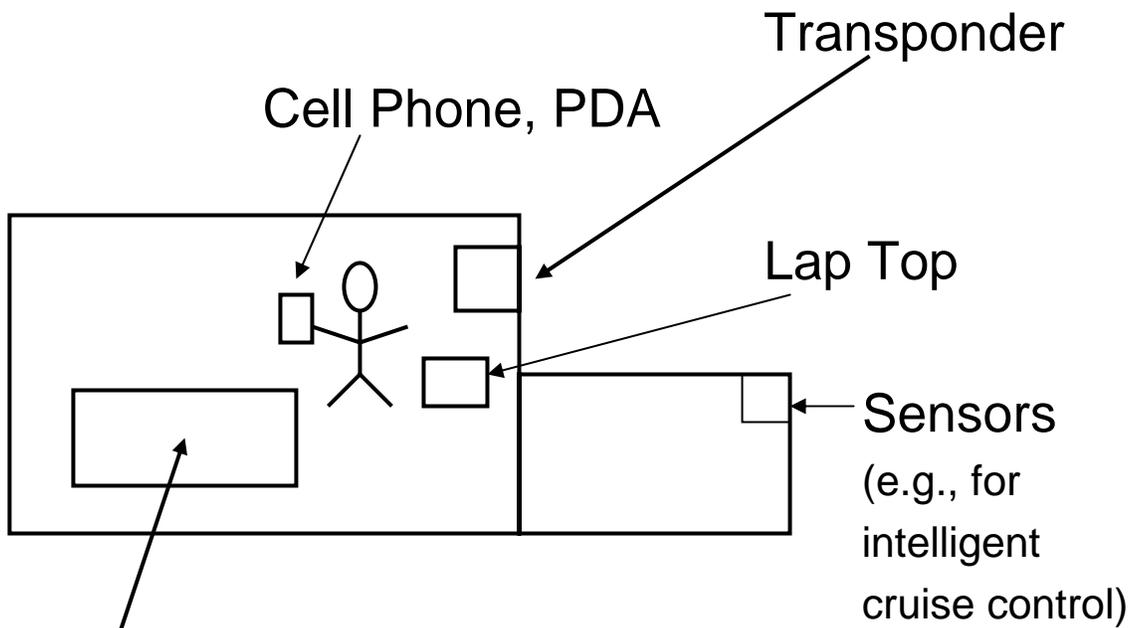


THE ITS-4 TECHNOLOGIES

- ◆ Sensing
- ◆ Communications
- ◆ Computing
- ◆ Algorithms

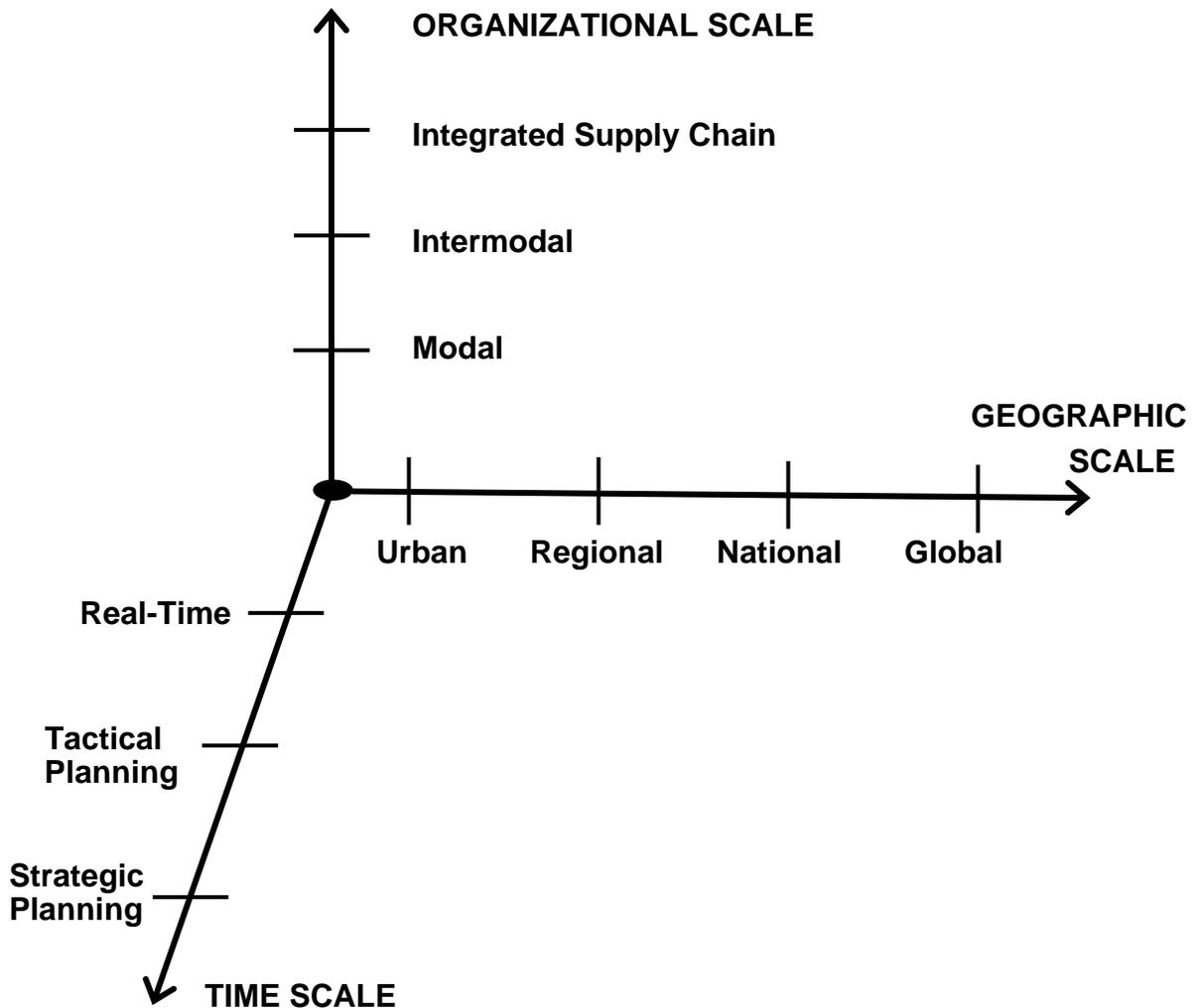


SOME VEHICLE FEATURES



Telematics: In-vehicle equipment

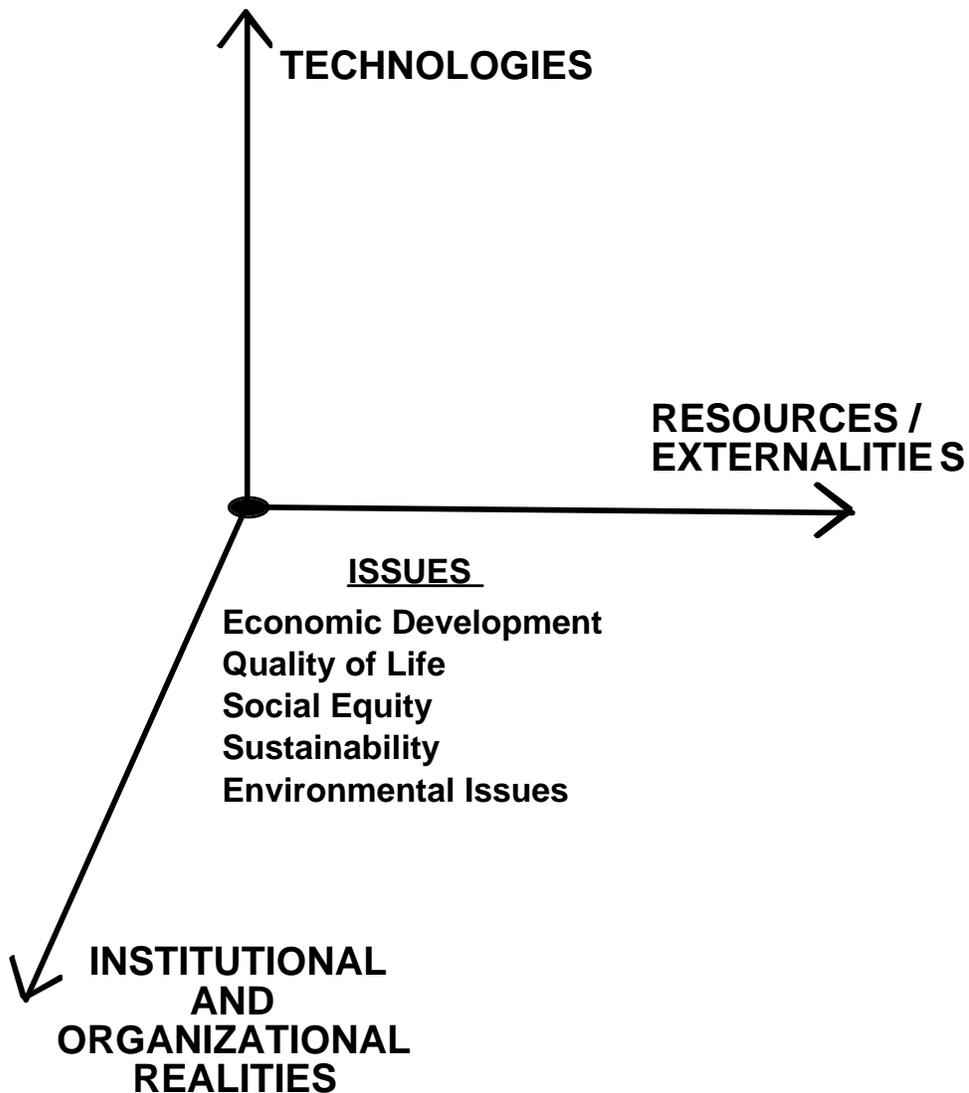
TRANSPORTATION SYSTEM DIMENSIONS



APPROACHES

Quantitative Models (OR, Simulation, ...)
Qualitative Frameworks for Analysis
Transportation Domain Knowledge

DRIVING FACTORS IN TRANSPORTATION



ITS at the Nexus of Major Issues

- ◆ Congestion and the environment on the public agenda
- ◆ Financing of transportation infrastructure, with gas tax revenues under pressure
- ◆ Focus on operations in many fields including transportation
- ◆ The *region* as the unit of economic competition and environmental management - the concept of Regional Strategic Transportation Planning (RSTP)
- ◆ Architecture as a key idea in many kinds of large scale engineering systems

BIG, WORLD-WIDE CHANGES

Mid-1980s to the Present --

**WHERE DOES ITS (AND, MORE
BROADLY, TRANSPORTATION)
FIT?**

CONTEXT

(at the time of the 1991/2 strategic plan)

- ◆ Transportation at a “Crossroads”
(Congestion, Safety,
Environment, Energy and
Productivity)
Can't build our way out of it
- ◆ ITS Addresses All These Key
Issues
- ◆ Technology -- No Breakthrough
Needed
- ◆ Institutions -- Partnerships
- ◆ Transportation -- Information
Infrastructure
- ◆ Broad-based Set of Benefits

GOALS FOR ITS IN THE U.S. (at the time of the 1991/2 strategic plan)

- ◆ Improved Safety
- ◆ Reduced Congestion
- ◆ Increased and Higher Quality Mobility
- ◆ Reduced Environmental Impact
- ◆ Improved Energy Efficiency
- ◆ Improved Economic Productivity
- ◆ A Viable U.S.ITS Industry

VISION

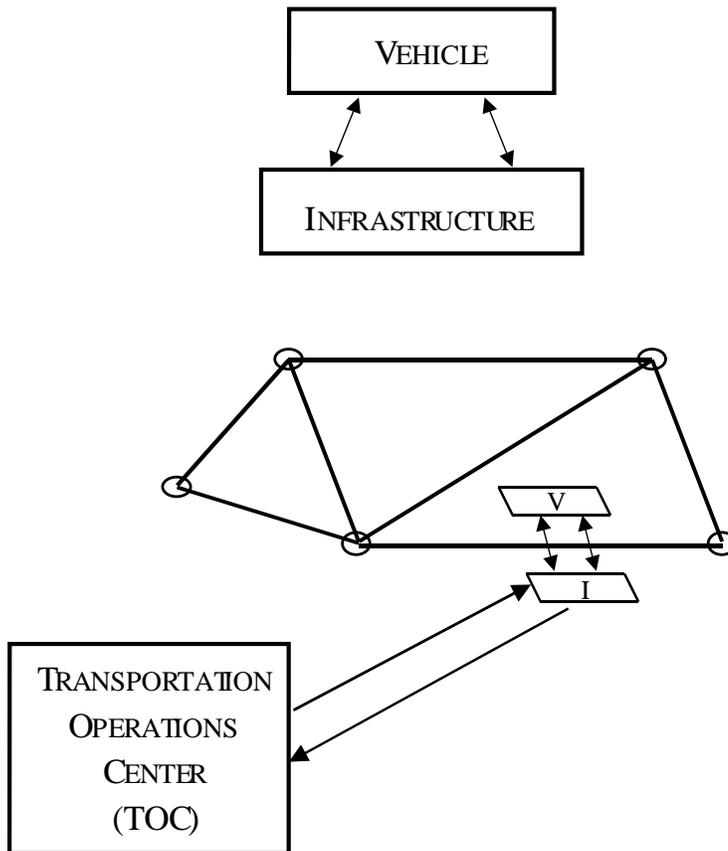
(at the time of the 1991/2 strategic plan)

- ◆ A national system that operates consistently and efficiently across the U.S. to promote the safe, orderly and expeditious movement of people and goods.
- ◆ An efficient public system that interacts smoothly with improved highway operations.
- ◆ A vigorous U.S. ITS industry supplying both domestic and international needs.

ITS “RECENT” U.S. HISTORY

Early 1970s	Electronic Route Guidance (ERGS)
1986	California (CALTRANS)
1987	Federal government (FHWA)
1990	Mobility 2000
1991	Formation of ITS America
1991-2	Strategic Plan Development
1991	ISTEA (Intermodal Surface Transportation Efficiency Act)
1994	ITS Architecture Contracts
1996	Major Regional Initiatives
1997	Automated Highway Demonstration in San Diego
1998	TEA-21
2002/3	Ten-Year ITS Plan
2003/4	TEA-21 Reauthorization

FUNDAMENTAL ATMS/ATIS SYSTEMS



ATMS -- ADVANCED TRANSPORTATION MANAGEMENT
SYSTEM
(OPERATOR)

ATIS -- ADVANCED TRAVELER INFORMATION SYSTEM
(CUSTOMER)

SOME FUNCTIONS

- ◆ Manage and monitor the network traffic flows
- ◆ Provide information on the state of the network
- ◆ Fleet management (vehicle location)
 - ◆ Trucks
 - ◆ Buses
- ◆ Monitoring vehicle condition and status
 - ◆ Trucks
 - ◆ Buses
- ◆ Autonomous systems
 - ◆ Vehicle status
 - ◆ Intelligent cruise control
 - ◆ Obstacle detection

SOME KEY ITS CONCEPTS (I)

- ◆ The Need for Organization Innovation
 - ◆ Public/Private Partnership
 - ◆ All Levels of Government
 - ◆ Changes in the Definition of a “Transportation Professional”
 - ◆ Academic/Research Role
- ◆ Building a U.S. ITS Industry/Test of the Marketplace
 - ◆ International Competition for the ITS Market
 - ◆ The Role of the Auto Manufacturer
 - ◆ The Role of the Information Service Providers
 - ◆ The Size of the Public and Private Markets
 - ◆ ITS as a National System
 - ◆ Standards and Protocols

SOME KEY ITS CONCEPTS (II)

- ◆ Productivity and International Competitiveness
 - ◆ Congestion
 - ◆ Safety
 - ◆ Sustainability
 - ◆ Environment
 - ◆ Energy
 - ◆ Mobility
- ◆ Limits on “Build More Highways” Option
- ◆ ITS as an Enabling Technology --
 - ◆ The TRANSPORTATION/ INFORMATION INFRASTRUCTURE
 - ◆ An Extended Definition of Infrastructure
 - ◆ Integration of IT, Communications, Sensors
- ◆ Spending on Infrastructure Works
 - ◆ Productivity Improvements
 - ◆ Examples:
 - ◆ Interstate System
 - ◆ Air System
- ◆ ITS and the Regional Scale