

**AN INTRODUCTION TO**  
**INTELLIGENT TRANSPORTATION SYSTEMS**

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**1.212**  
**SPRING 2003**

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**Professor Joseph M. Sussman**

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**Mon/Wed 1-2:30**

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**LECTURE 12**

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**COMMERCIAL VEHICLE  
OPERATIONS (CVO)**

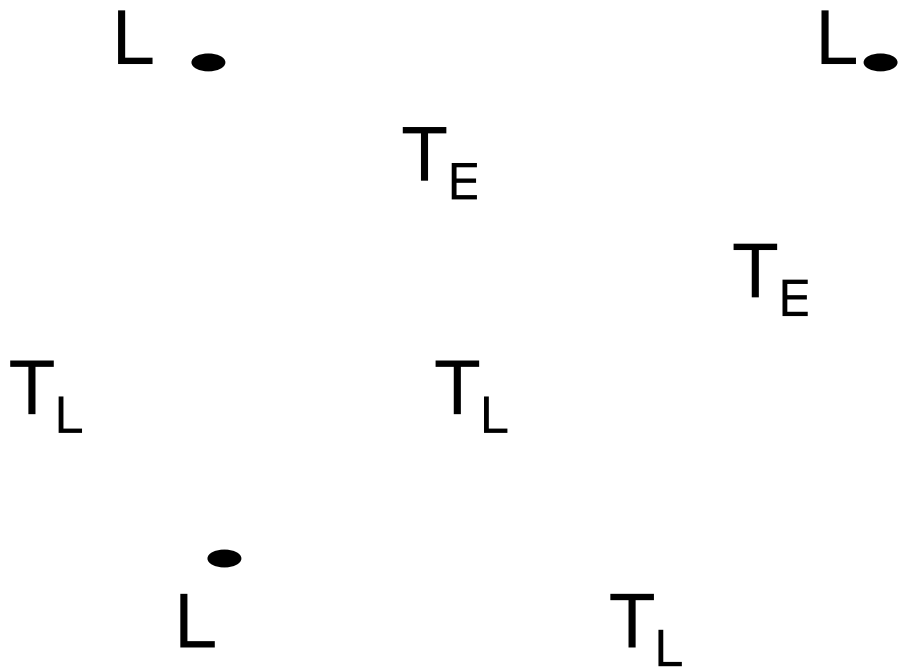
**SPEAKER: Joseph M. Sussman**  
**MIT**

**March 19, 2003**

- ◆ WHY IS CVO ESPECIALLY VALUABLE IN AN INTERMODAL SITUATION?
  - ◆ TRUCK
  - ◆ RAIL
  - ◆ SHIP

CLASS DISCUSSION

What can a trucking company do with real-time information about location of its vehicles and network state?



Loads are generated randomly in time with an origin and a destination and a time window.  
“Tours” are generated for trucks.

“On-Line Algorithms for Truck Fleet Assignment and Scheduling Under Real-Time Information”, Jian Yang, Patrick Jaillet, and Hani S. Mahmassani, *Transportation Research Record 1667*, Transportation Research Board, Washington, DC, 1999.

Our 1.212 question:

How does ITS help?

-- Yang, Jaillet, Mahmassani

- ◆ Strategies
  - ◆ Assign
  - ◆ Divert -- to a different load
  - ◆ Resequence
- ◆ Reassignment -- load to different trucks
- ◆ Value of advance information
- ◆ Value of truck location information
- ◆ Empty mileage vs. waiting time trade-offs

-- Yang, Jaillet, Mahmassani

- ◆ Dynamic assignment and sequencing of trucks to jobs consisting of picking up and delivering full truckloads when requests for service arise on a continuous basis.
- ◆ Dynamic reassignment of trucks to loads
  - ◆ Including diversion to a new load of a truck already en route to pick up another load
  - ◆ As well as for the dynamic resequencing of the order in which loads are to be served as new loads arrive and conditions unfold.

-- Yang, Jaillet, Mahmassani



- ◆ Time windows for pick-up and delivery
- ◆ Penalties for failure to pick up a load

-- Yang, Jaillet, Mahmassani

- ◆ Simulation experiments conducted to compare the performance of the OPTIMAL strategy with that of less computationally demanding local assignment rules provided valuable insights concerning the value of additional information and trade-offs between empty distance and waiting time to serve a demand.
- ◆ The results suggested that strategies that allow the reassignment of previous loads to vehicles can profit from advance information to reduce both the waiting time and the empty distance.
- ◆ However, there appears to be a threshold above which additional advance information may not be beneficial and might even be counterproductive. The threshold also depends on overall congestion in the system.

-- Yang, Jaillet, Mahmassani

# QUESTIONS

- ◆ How do you develop optimal vehicle tours?
- ◆ What does “optimal” mean in this context?

## CLASS DISCUSSION

“Benefit-Cost Analysis of the Commercial Vehicle Information Systems and Networks Program”, Daniel Brand, Thomas E. Parody, John E. Orban, and Vincent J. Brown, *Transportation Research Record 1800*, Transportation Research Board, Washington, DC, 2002.

# COMMERCIAL VEHICLE INFORMATION SYSTEMS AND NETWORKS (CVISN) PROGRAM

- ◆ The CVISN Model Deployment Initiative (MDI) began in 1996 in Maryland and Virginia and was later extended to eight additional states (California, Colorado, Connecticut, Kentucky, Michigan, Minnesota, Oregon, and Washington).
- ◆ The objective of the MDI was to demonstrate the technical and institutional feasibility, costs, and benefits of intelligent transportation system(ITS) programs aimed at improving the safety and operational characteristics of commercial vehicle operations.

--Brand, Parody, Orban, Brown

# CVISN FUNCTIONS

- ◆ Safety information exchange -- technologies that permit the collection, rapid dissemination, and easy review of motor carrier safety information at the roadside;
- ◆ Electronic credentialing -- the capability to allow motor carriers to apply for, pay for, and receive credentials electronically, as well as the provision for electronic tax filing and payment of certain taxes and fees; and
- ◆ Electronic screening -- the ability to detect, identify, and weigh commercial vehicles at highway speeds and, if all certificates and weights are in order, give the vehicles a green light to bypass static weigh and inspection stations.

--Brand, Parody, Orban, Brown

# CVISN BENEFITS

- ◆ Roadside enforcement including safety information exchange and electronic screening:
  - ◆ Truck crashes avoided,
  - ◆ Transit time savings, and
  - ◆ Air and noise pollution reductions from trucks bypassing inspection stations at highway speeds; and
- ◆ Electronic credentialing:
  - ◆ Operating cost savings to states,
  - ◆ Operating cost savings to carriers, and
  - ◆ Inventory cost savings to carriers.

--Brand, Parody, Orban, Brown

# CVISN COSTS

- ◆ Roadside enforcement:
  - ◆ One-time startup cost to states,
  - ◆ Replacement capital costs to states,
  - ◆ Increased operating costs to states,
  - ◆ Increased operating costs to carriers, and
  - ◆ Increased out-of-service costs to carriers; and
- ◆ Electronic credentialing:
  - ◆ One-time startup cost to states, and
  - ◆ Replacement capital costs to states in future years.

--Brand, Parody, Orban, Brown

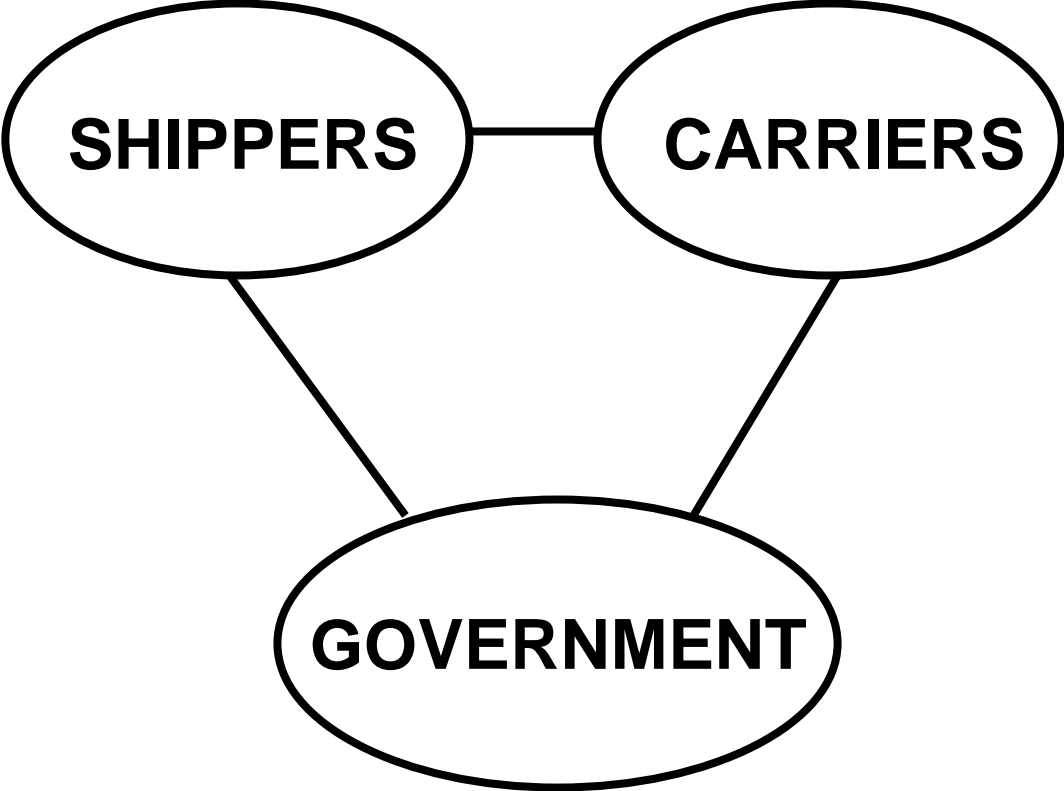


# RESULTS

- ◆ On the basis of the benefit-cost analyses undertaken, it is clear that the deployment of CVISN will yield significant benefits to all stakeholders -  
- the states, motor carriers, and the public.
- ◆ Benefit-cost ratios were found to be the highest for those applications that involved more complete CVISN systems for roadside enforcement.
- ◆ Both electronic credentialing scenarios had very high benefit-cost ratios and thus easily passed the important benefit-cost ratio criterion for determining whether such systems are economically justified.

--Brand, Parody, Orban, Brown

**INSTITUTIONAL  
STRUCTURE  
AND  
CVO SERVICES**



“Commercial Vehicle Operations and Freight Movement”, Kim Richeson and Valerie B. Barnes (Applied Physics Labs, Johns Hopkins University), Chapter 9 in *Intelligent Transportation Primer*, Institute of Transportation Engineers, Washington, DC, 2000.

# CVO FUNCTIONS

- ◆ Freight Movement
- ◆ Carrier Operations
- ◆ Vehicle Operations
- ◆ Safety Assurance
- ◆ Credentials Administration
- ◆ Electronic Screening

-- Richeson & Barnes

# **KEY ITS/CVO OPERATIONAL CHANGES**

- ◆ Integrated logistics management
- ◆ Just-in-time manufacturing
- ◆ Enterprise resource planning

-- Richeson & Barnes

# KEY ITS/CVO OPERATIONAL CONCEPTS FOR CARRIER OPERATIONS

- ◆ Total asset visibility
- ◆ Automated identification and tracking
- ◆ Automated routing and dispatch
- ◆ Maximizing equipment readiness and utilization
- ◆ Automated finding and bidding on loads
- ◆ Interoperability with customer systems
- ◆ Specialized load handling and logistics services

-- Richeson & Barnes

# **KEY ITS/CVO OPERATIONAL CONCEPTS FOR VEHICLE OPERATIONS**

- ◆ On-board location and navigation
- ◆ Real-time monitoring of equipment, load and driver
- ◆ Communication between vehicle and dispatch
- ◆ Communication between vehicle and roadside

-- Richeson & Barnes



# **KEY ITS/CVO OPERATIONAL CONCEPTS FOR ELECTRONIC SCREENING**

- ◆ Interoperability among screening systems
- ◆ Widespread participation encouraged
- ◆ Up-to-date electronic information at the roadside
- ◆ Credential and safety checks at the roadside
- ◆ ...

-- Richeson & Barnes

# CVO VISION

- ◆ Interoperable system
- ◆ Smooth regulatory compliance
- ◆ Improved productivity through fleet management
- ◆ Integration with shippers -- supply-chain management
- ◆ International scale

# **MARYLAND'S CVO PROGRAM**

# PLAYERS IN MARYLAND'S CVO PROGRAM

- ◆ Public Sector
  - ◆ State agencies (MDOT, MSP, Comptroller, MDE)
  - ◆ Port of Baltimore and BWI Airport
  - ◆ FHWA (Headquarters, Regional, and Division levels)
  - ◆ Public and public/private entities with related ITS programs (e.g., VDOT, I-95 Corridor Coalition)
- ◆ Private Sector
  - ◆ Regional trucking industry
    - ◆ Maryland Trucking Association
    - ◆ Individual firms and drivers
  - ◆ Shippers using Maryland transportation system

# TRENDS IN FREIGHT -- RELATED ACTIVITIES BY STATE AGENCIES

- ◆ More stringent financial environment
- ◆ Mandate to become more supportive of private enterprise
- ◆ Thrust to integrate motor carrier administration across state agencies

# **SPECIAL CONSIDERATIONS IN MARYLAND'S STRATEGIC PLANNING PROCESS**

- ◆ Maryland's role in the Mid-Atlantic coast transportation network
- ◆ Regional economic importance of Port of Baltimore and BWI Airport
- ◆ Challenges faced by the freight transportation industry in Maryland
- ◆ Virginia's role as a regional competitor and CVO collaborator
- ◆ Organizational issues

# CVO TECHNOLOGIES

- ◆ Automated Vehicle Identification
- ◆ Automated Vehicle Classification
- ◆ Automated Vehicle Location
- ◆ On-board Computer/Transponder
- ◆ Roadside-Vehicle Communication
- ◆ Dedicated Short Range Communication
- ◆ Dynamic Routing and Scheduling
- ◆ Weigh-In-Motion
- ◆ Smart Cards
- ◆ Collision-Warning Systems
- ◆ Vehicle Condition Sensing
- ◆ May-Day

Refer to hard copy hand-outs (2):

“Motor Carrier Administration in Maryland”

“Maryland Needs to Consider Other ITS Programs in Developing Its CVO Program”



