Intelligent Transportation Systems (ITS)

Application to Urban Transport
Common Urban Transport Challenges

- Increasing transport demand
- Insufficient or poor transport infrastructure
- Inefficient use of existing infrastructure
- Conflicting demand from people and fright transport
- Low performance of public transport
- Poor traffic management and Low performance of traffic control system
- Poor parking management
- Poor information to users
What is Intelligent Transportation Systems (ITS)?

- (wikipedia) adding information and communications technology to transport infrastructure and vehicles so to manage factors that typically are at odds with each other, such as vehicles, loads, and routes to improve safety and environment and reduce congestion, vehicle wear, and fuel consumption:
  - A variety of advanced technologies to collect, process, and disseminate real-time data from/to vehicle and/or roadway sensors
  - Communications and computing power used to transform the data into useful information for drivers, operators, and customers
ITS in Managing Demand and Supply

End User (Traveler) goals
Comfort, speed, value for money

Policy goals
Reliable, efficient, safe, clean, etc.

Commercial goals
Added value, costs, profits, etc.

Demand management
Information, route guidance, pricing, slot allocation, etc.

Traffic management
Intersection control, ramp metering, lane control, dynamic speed limits, route guidance, etc.

Monitor
(measure, check, interpret, predict)

Source: ITS lecture notes, Hans van Lint, Delft University
Potential Benefits of ITS

- Reduce congestion and travel time
- Shorter routes
- Optimize usage of available infrastructure
- Improve reliability and operational control, thereby impacting quality of service
- Reduce travel and dwell times for public transport
- Improve service information for customers and increase user satisfaction
- Improve safety and security
- Improve environment
Fields of Application

- Traffic Management
- Public Transport Management
- Parking Management
- Commercial Vehicle Management
- Traveler Information
- Asset Management
- Electronic Financial Transactions
- Incident and Hazard Response
- Advanced Driver Assistance
Traffic Management: Traffic Signal Control - Operator Level

- Map of conflicts
- Traffic signals
- Signal plans
- Time-distance diagrams

Fixed time
Zone based
Network wide adaptive
Traffic Management: Dynamic Speed Limit Control

- Speed limits and information to drivers
- Maximal speed limit usually set
- Reduced stepwise if congestion or accident in front, adverse weather conditions, etc.
- Increases driver alertness
- Postpone congestion occurrence
Traffic Management: Traffic Control Center

- Equipment in the control center
  - Command desk
  - Central traffic control
  - Technical service room
  - Road map
  - Video observation
  - Emergency phone
  - Engineering tools
Parking Management

In highly motorized cities: during peak hours 80% of parking places occupied (research: 25% of traffic search for parking places)

- Parking management allows:
  - Reduced congestions and emissions
  - Increased user satisfaction
  - Better usage of available spaces and data for urban planning

- Parking guidance system benefits (from research studies):
  - Japan – reduction of waiting times of 50%, reduction of kilometers travelled for 47%
  - Southampton – reduction of emissions up to 15%
  - USA – travel time reduction 9%
  - In all cases – high user satisfaction and approval
Components of Parking Management

- Garages and closed parking spaces
  - Navigation in garages

- Parking management systems
  - One space pay mechanisms
Commercial Vehicle Management

- Taxi vehicles, trucks, private fleets, etc.
- Main functions
  - Optimization of fleet performance
  - Monitoring vehicle operation (fuel consumption, axel loads, engine operation...)
  - Vehicle positioning
  - Distribution of working tasks
  - Route tracking
  - Alarms in case of exceptional events (e.g. changing of route, stopping, problem with a vehicle, etc.)
  - Arrival and departure announcements
  - Navigation
  - Service charges
Public Transport: Examples of Application

- Automatic Vehicle Location (AVL)
- Advanced Communication Systems (ACS)
- Traveler Information
- Collision Warning
- Precision docking, etc.
- Traveler information
  - At stations
  - On vehicle
  - On person/home/office
- Trip Itinerary Planning
Public Transport: Automatic Vehicle Location (AVL)

- AVL is at the root of virtually all ITS applications
- Primary types of AVL:

  - Sign Posts with Radio or infrared
  - Pavement Loops
  - Global Positioning Systems (GPS)
Public Transport: Advanced Communication System (ACS)

- Creates backbone upon which other applications function
- Utilization of voice and data communication to allow for operation of ITS applications
- ITS technologies require the utilization of a robust communication system capable of near instantaneous transmittal of a large amount of data
Public Transport: Traveler Information at Stations

- Information on schedules, next bus, and delays via dynamic message signs
- Requires system to predict (model) arrival times and appropriate signage

MetroRapid, Los Angeles, CA

Brisbane, Australia
Public Transport: Traveler Information on Vehicle

- Display and announce information to customers on vehicles
- Includes next stop and transfer information as well as dynamic messages on delays or other special conditions
- Requires underlying vehicle location system
Public Transport: Traveler Information on Person / Home / Office

- Information about schedule, next bus, or delays available via PDA, cell phone, or other device
- Information available on internet or mobile communications
Public Transport: Trip Itinerary Planning

- Request trip information by specifying trip origin and destination, time and date

- Ability to specify special equipment or handling requirements
Public Transport: Passenger Information Advantages

- **Pre-trip:** Affects mode choice, when to make trip, how to get to destination
- **En route:** Decreases anxiety, directs passengers to correct platforms/bays, advises on delays/disruptions, improves wait time experience
- **On board:** Reassures passengers that they are on right vehicle/route, reduces navigation mistakes
- **In general:** Ridership, customer satisfaction, visibility, image
Public Transport: Passenger Security

- Actual or perceived insecurity is a big impediment to public transport use, especially by women and the elderly.
- ITS technologies, ranging from closed circuit TV in stations and on-board vehicles, to “panic buttons” on vehicles and at stations can address this issue.
- ITS technologies do not eliminate need for security personnel but can make them much more efficient and effective.
ITS

Developing Country Advantages

- Developing and transition economies are still building much of their basic infrastructure
- Major advantages for adopting ITS:
  - Cheaper to include than with retrofitting
  - Often little legacy infrastructure
  - Can take advantage of proven/mature technologies which often cost less
  - Can use experiences from countries that already have extensive practice of ITS
  - Often high acceptance of new technologies
ITS Deployment Limitations in developing and transition countries

- Introducing ITS is a complex undertaking
- ITS requires consideration of:
  - General factors
    - Underdeveloped road network
    - Limited budget
    - Fast urbanization and expansion
  - Institutional factors
    - Staff with adequate skill sets
    - Appropriate legal framework
    - Procurement systems able to handle ITS
  - Technological factors
    - Standards to provide consistency
    - Communications infrastructure
    - Data models
ITS Deployment must be based on real needs

- Choose a system based on real country needs and situation
- Introduce the system that shows to be robust and cost effective: costs and benefits must be transparently assessed
- Develop ITS in parallel to building of infrastructure and introduction of IT
- Plan technology change
  - Development plan that takes into account technology change
  - Develop system so that maximum number of hardware and software components can be used for a longer period
  - Ensure technology can be acquired from more than one sources
Steps for successful introduction of ITS

- Establish ITS advisory group
- Establish organization to promote ITS
- Develop sustainable ITS architecture
- Introduce ITS standards
- Include ITS planning and application in regular transportation planning
- Encourage cooperation between different institutions
- Encourage involvement of private sector in development of ITS
Summary

- Introduction of ITS has a significant potential to make better use of existing urban transport infrastructure and can help make better decisions on future investments
- ITS cover a large spectrum of applications
- ITS should be part of normal transport planning process
- Developing ITS should be done based on needs and should pass cost-effectiveness test
- ITS is no panacea:
  - Need capable institution
  - Need human capacity
  - Need good infrastructure and services