

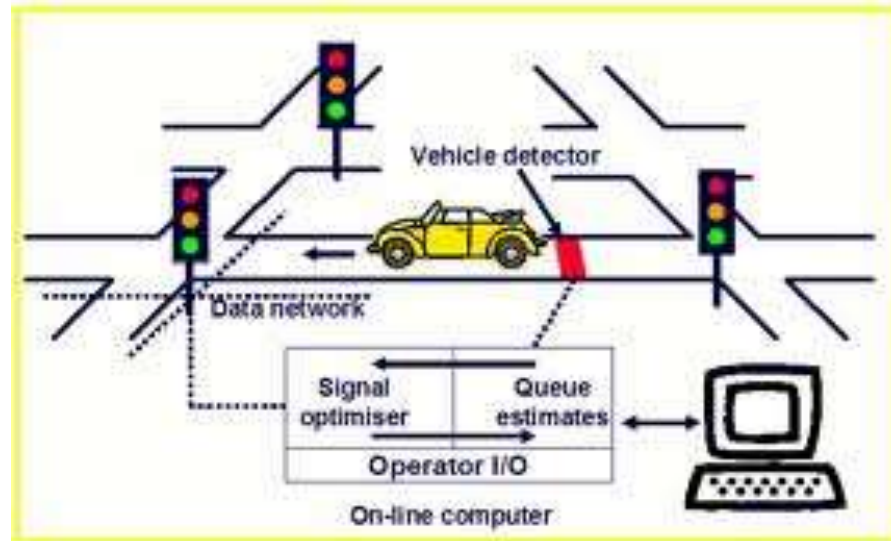
## Module V:

Traffic Management: Regulatory Measures, Travel Demand Management System, Traffic System Management (TSM) with IRC standards, Traffic and Management (TDM), Direct and indirect methods, Congestion and parking pricing, All segregation methods-Coordination among different agencies, Intelligent Transport System for traffic management, enforcement and education.

# **Area traffic Control (ATC)**

# Area Traffic Control System

- ATC systems are intelligent real-time dynamic traffic control systems which are designed to effectively respond to rapid variations in dynamic traffic conditions.
- It is a traffic responsive system that use data from vehicle detectors and optimize traffic signal time in real time.
- The timing plan of traffic controllers changed automatically.
- The technique employs digital computers for achieving the desired objective.



## Comparison over earlier systems

- **Ability to update signals from a Central Location**
- **Ability to have multiple plans and special plans**
- **Information on equipment failures**
- **Performance data on contractor or service personnel**

Advantages	Disadvantages
Minimizing journey time for vehicles	Very costly
Reducing accidents	Very complex
Increasing average saving in fuel	Suitable only for lane following traffic

# Components of Area traffic control (ATC)

In area traffic control system we use **vehicle detector to collect the data to find the actual flow and to get signal timing according to the present condition of traffic.**

Area traffic control system is a very big system which includes the following components

- 1.Vehicle Detectors
- 2.Intersection Controller
- 3.Communication Network
4. Application Software
5. Central (Regional) Control System.

These unit is use to perform different-different task for the system.

# Components of Area traffic control

## 1.Vehicle Detectors:

Commonly used vehicle detectors are

- Ultrasonic
- Microwave radar
- Infrared laser radar
- Non-imaging passive infrared,
- Video imaging
- Acoustic array
- Magnetic loop
- Inductive loop

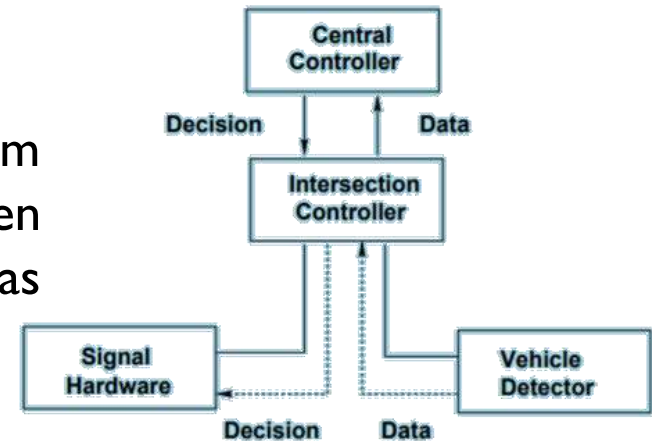
## 2.Intersection Controller:

It placed at intersection for temporary storage of data. It collects the data from vehicle detector and sends it to the central control. Central control processed the data and sends it back to the intersection controller which then implements the signal timings as instructed at the intersection.

# Components of Area traffic control

## 3. Communication Network:

It transfers the data obtained from detectors to central control which then implements the signal timings as instructed at the intersection.



Communication Network (Source: Muralidharan, 2006)

## 4. Application Software:

Application software is the software used behind the whole ATC system which performs the entire task.

## 5. Central (Regional) Control System:

It is the main unit of ATC. In this unit collected traffic data is processed to optimize various traffic parameters like-signal timing, phase change, delay. It supervises all the units of ATC.

# Area traffic control

## **Advantages:**

- 1) Minimizing journey time for vehicles
- 2) Reducing accidents
- 3) Increasing average saving in fuel

## **Disadvantages:**

- 1) Very costly
- 2) Very complex
- 3) Suitable only for lane following traffic



# SCOOT (Split Cycle Offset Optimization Technique)

- The Split Cycle Offset Optimization Technique (SCOOT) is an urban traffic control system developed by the Transport Research Laboratory (TRL) in collaboration with the UK traffic systems industry.
- Prime objective of this is to minimize the sum of the average queues in the area.
- Continuously measures traffic volumes on all approaches of intersections in the network and changes the signal timings to minimize a Performance Index (PI) which is a composite measure of delay, **queue length** and stops in the network.
- Each SCOOT cell is able to control up to 60 junctions.

SCOOT involves split optimizer (split of red and green times, cycle time optimizer, offset optimizer)

# SCAT (Sydney Coordinated Adaptive Traffic)

- Timing of signals is governed by computer-based control logic.
- It has ability to modify signal timings on a cycle-by-cycle basis using traffic flow information collected at the intersection approach stop lines.
- It is not model based but has a library of plans that it selects from and therefore banks extensively on available traffic data.

Advantages	Disadvantages
Travel time reduction, accident protection, prevention of air pollution and	Very costly
Replaced manual method of traffic volume data collection with automated means	Very complex and lacks user friendly interface
Provide accurate data at good accuracy	Error messages do not provide opportunity for corrective measures

# Travel Demand Management (TDM)

TDM techniques are aimed at **reducing the traffic flows**, especially during the **peak hour**.

**Direct methods** are the methods that can be directly quantified/ visible by the road user itself.

**Indirect methods** are the methods which cannot be directly measured. Among the different techniques enlisted below, **except road pricing all are direct methods**.

The different techniques adopted are

## **Direct Methods**

1. Car pooling and other ride-sharing programmes
2. Peripheral parking
3. Chartered buses
4. Staggering of office hours
5. Internal shuttle service in CBD
6. Parking restraint
7. Entry fee
8. Priority for buses in traffic
9. Restrictions on entry of trucks during day-time.

## **Indirect Method**

1. Road pricing

# Concept of Road Pricing

This is a method of road **user taxation, charging the users of congested roads** according to the time spent or distance travelled on those. The **principle** behind road pricing is that those who cause **congestion** or use the road in the congested period should be charged, thus giving the **road user the choice of whether to make a journey or not.**

## ***Economic principles behind road pricing:***

Journey costs include private journey cost, congestion cost, environmental cost, and road maintenance cost.

The benefit a road user obtained from the journey is the price he prepared to pay in order to make the journey. As the **price gradually increases, a point will be reached when the trip maker considers it not worth performing or it is worth performing by other means.** This is known as the **critical price.**

# Concept of Road Pricing

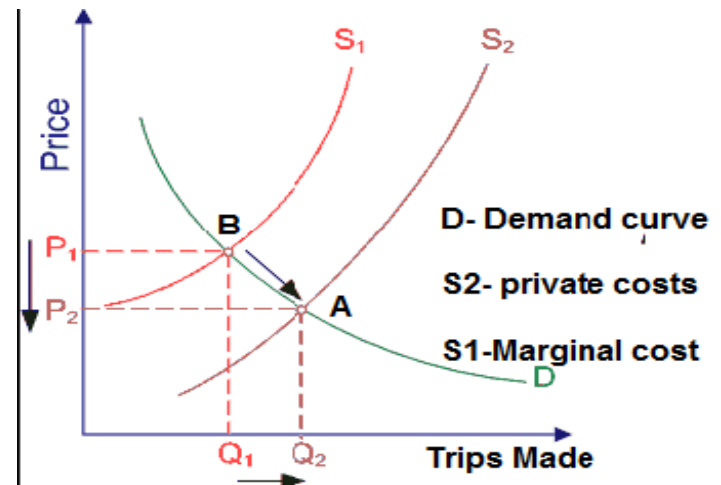
❑ At a cost less than this critical price, he enjoys a **net benefit called as consumer surplus(es)** and is given by:

$$S = X - Y$$

where, X is the amount the consumer is prepared to pay, and Y is the amount he actually pays.

❑ The basics of congestion pricing involves demand function, private cost function as well as marginal cost function.

❑ Similarly the **cost** incurred in making **the trip increases with the traffic volume** which is called as private costs. On making any trip each road user creates an additional cost (marginal cost) in terms of **congestion, parking** etc. All these costs are shown in the figure below. Shift from A to B indicates road pricing.



# Transport Systems Management (TSM)

**Transport System Management** is the planning, monitoring, and controlling or influencing of traffic modes. It aims to:

- ☐ Maximise the **effectiveness** of the use of **existing infrastructure**;
- ☐ Ensure **reliable and safe** operation of transport;
- ☐ Address environmental goals;
- ☐ Ensure **fair allocation of infrastructure space** (road space, rail slots, etc.) among competing users.

Transport System Management (TSM) **maximises the capacity of the street system** and reduces the demand on it.

Although some of them may be expensive to implement, TSM measures are typically **low cost localized improvements** that attempt to take full advantage of the existing street infrastructure thereby increasing the efficiency of the street system.

# Transport Systems Management

The spectrum of TSM measures is wide; the measures that are applicable will generally fall into one of **six categories** listed below:

- 1) **Regulatory Techniques** : This include One way Streets, Reversible Streets, Reversible lanes, Turning Movement Restrictions, Closing Streets
- 2) **Traffic Control Devices**: The various traffic control devices used for the traffic management are: Traffic Signs, Traffic Signals, Road Markings, Computerised Signal Control device, Traffic Cone and Drums, Speed Breakers
- 3) **Traffic Segregation Techniques**: The various traffic segregation techniques used are Vehicle-Vehicle Segregation, Pedestrian-Vehicle Segregation, Time Segregation



# Transport Systems Management

4) **Demand Management Techniques:** The various demand management techniques used are Parking Restriction, Parking Pricing, Off Street Parking and Pay Area, On street parking meters, Park and ride systems

5) **Bus Priority Techniques:** The various bus priority techniques used are: Bus Priority Manoeuvres, Bus Lanes, Bus Priority Signal system

6) **Self-Enforcing Techniques:** The various techniques used are Central Divider, Railing, Channelisers



# Traffic Management

The different methods of traffic management are

- (i) **Restrictions on turning movements:** Turning movements always create chaos at intersections. Among the turning movements, right turns are more crucial. In such cases providing an exclusive right turning phase in signal schemes or providing an early cut-off or late start in signal timings can eliminate such traffic problems.
  
- (ii) **One-way streets:** since the traffic flows only in one direction, capacity of the stretch increases and delays also will be reduced (Based on the marks this can be elaborated). Proper signing is important as far as one way streets are concerned to ensure smooth and efficient traffic.

# Traffic Management

(iii) **Tidal flow operations:** morning peak hours witness a huge traffic towards city centre, whereas in the evening it will be vice versa. Use of barricades such that more width of lane is available towards direction of movement is called as tidal flow/ reverse flow operation.

(iv) **Exclusive bus-lanes:** stoppage of public transport at mid block sections can create long queue. Hence, reservation of an exclusive lane for buses provides convenience and safety to embarking and alighting passengers without interrupting traffic flow.

(v) **Closing side streets:** If there are many minor roads opening on main streets, it will cause interference to the main stream traffic. Hence, closing side streets, will reduce/ eliminate that traffic chaos.

# One-way streets

One-way streets are those where traffic movement is permitted only in one direction.

## **Advantages:**

1. **A reduction in the points of conflict:** since opposing traffic flow is not there, head on collisions can be avoided and the number of conflict points is reduced.
2. **Increased capacity:** entire traffic in one direction, hence high capacity.
3. **Increased speed:** No opposing traffic, hence high speed.
4. **Ensure smooth and safe traffic**
5. **Improvement in parking facilities:** Only one-side parking. This ensures more space for traffic movement.
6. **Elimination of dazzle and head-on-collision**

# One-way streets

## Disadvantages:

1. Though journey time decrease, actual **distance to be covered increase**.
2. The **relocation of bus-stops** due to one-way street regulation may cause the passengers to travel extra distance.
3. **Excessive speed** of vehicles may be a hazard to residential areas
4. One-way street regulation may become beneficial for some **business** and impart **adverse effect** to others **based on accessibility**.
5. Heavy traffic on one-way streets may affect the peace and tranquillity of the area.
6. **Initially confusion** may set in during traffic operation.
7. **Emergency vehicles** may find it difficult to find gap in other lanes, since there is no traffic flow in opposite direction.

# CO-ORDINATED CONTROL OF SIGNALS

## Co-ordinated signal system

- Co-ordinated signal system on a road net-work of an area is a very complex problem.
- Area traffic control system with co-ordinated signal network is to be implemented with the help of advanced technology.

## Need for co-ordinated control

- ✓ Need for co-ordinated control of signals arises on a main traffic route when it is desirable to reduce delays and avoid main traffic from having to stop at every junction.
- ✓ When a signal indicates a stop aspect at a junction, a queue of vehicles is formed behind the stop line.
- ✓ When the signal changes to green, the vehicles start moving in a platoon.
- ✓ If this platoon is made to meet a green aspect at the next junction no delay is caused to the vehicles.

**This principle of linking adjacent signals so as to secure maximum benefits to the flow of traffic is called co-ordinated control of signals.**

The co-ordination of signals is sought for with the following objectives in view:

- To pass the maximum amount of traffic without enforced halts.
- To have minimum overall delay to traffic streams, both in the main and side roads.
- To prevent the queue of vehicles at one intersection from extending and reaching the next intersection.

# Coordinated control of signals

**There are 4 types of signal coordination system**

1. Simultaneous system
2. Alternate system
3. Simple progressive system
4. Flexible progressive system

## **Simultaneous system**

All the signals along a given street will display the **same indication** to the same traffic stream at the same time.

Division of **cycle time is same** at all intersections

A master controller is employed to keep the series of signals in step.

## **Disadvantages:**

1. It's not conducive to give continuous movement of all vehicles
2. It **encourages speeding** of drivers between stops
3. Since division of cycle time is same at all intersections, **inefficiency** is inevitable at some intersection
4. **Simultaneous stopping** of vehicles at all intersection cause **difficulty** for the side street vehicles while turning.

# Coordinated control of signals

## Alternate system

Consecutive traffic signal installations along a given road show **contrary indications at the same time.**

This permits the vehicles to travel one block in one half of the cycle time.

It brings about a certain measure of **speed control** since speeding drivers are stopped at each signal.

### Disadvantages:

1. Green times for both major and minor streets have to substantially equal. Hence, more wastage of time.
2. If the block length is not equal, it's not well suited.
3. Adjustments are difficult for changing traffic conditions.

# CO-ORDINATED CONTROL OF SIGNALS

## SIMPLE PROGRESSIVE SYSTEM

- ❖ In 'simple progressive system' a time schedule is made to permit, **as nearly as possible, a continuous operation of groups of vehicles** along the main road at a **reasonable pre-decided speed**.
- ❖ The signals controlling green phases of the traffic signals along this road are scheduled to work at the predetermined time schedule
- ❖ Though each signal unit may work as fixed time signals, they have **equal signal cycle length** and **are interlinked** so as to operate with the required time off-sets.
- ❖ The **principle of this simple progressive system** is that if a group of vehicles get released during the green phase at a signalized intersection of the main road, by the time the first vehicle of this vehicle group travelling at the recommended speed reaches the next junction, the green phase of this signal would just get started to allow non-stop movement to the next intersection.

## **Disadvantages**

- However on urban roads the traffic volume at each intersection may vary considerably; the number of intersecting roads may also vary at different junctions.
- Therefore practically it may not be always possible to provide equal signal cycles at all the intersections along the selected stretch of the main road and so the simple progressive system may not function effectively.



# CO-ORDINATED CONTROL OF SIGNALS

## FLEXIBLE PROGRESSIVE SYSTEM

- It is possible **to automatically vary the length of signal cycle** and **signal phase** at each signalized intersection with the help of sensors to detect vehicle arrival and connecting to a master computer.
- This is the **most efficient system** of all the four types of traffic signal system.
- This system can function satisfactorily on selected stretches of urban roads with divided carriageway or on roads with one-way traffic.
- This system is an improvement over the simple progressive system with the following provisions.
  - (i) It is possible to vary the cycle time and division at each signal depending upon traffic.
  - (ii) It is possible to vary the offset, thus enabling two or more completely different plans.
  - (iii) It is possible to introduce flashing or shut down during off-peak hours

# **Intelligent Transport System (ITS)**

# Intelligent transport System

**Intelligent Transportation Systems (ITS):** is the application of computer, electronics, and communication technologies and management strategies in an integrated manner to provide traveler information **to increase the safety and efficiency of the road transportation systems.**

3 components of ITS

- ITS user services
- ITS architecture
- ITS planning

# Intelligent transport System

## ➤ ITS user services:

A framework is developed highlighting various services the ITS can offer to the users. A list of 33 user services have been provided in the National ITS Program Plan.

The number of user services, keep changing over time when a new service is added.

1. Travel and traffic management
2. Public transportation operations
3. Electronic payment
4. Commercial vehicle operations
5. Advance vehicle control and safety systems
6. Emergency management
7. Information management
8. Maintenance and construction management

# Intelligent transport System

## ➤ ITS architecture

The ITS Architecture provides a common framework for **planning, defining, and integrating** intelligent transportation systems. It specifies how the different ITS components would interact with each other to help solving transportation problems.

**Interoperability** - The ITS architecture should be such that the information collected, function implemented or any equipment installed be interoperable by various agencies in different state and regions.

**Capable of sharing and exchanging information** - The information by traffic operations may be useful to the emergency services.

**Resource sharing** - regional communication towers constructed by various private agencies are required to be shared by ITS operations

# Intelligent transport System

## ➤ ITS planning

The ITS planning is to **integrate ITS into the transportation** planning process.

Transportation planning is an iterative process which include **problem identification, solution generation, analysis, evaluation and implementation.**

This can be **integrated with ITS using computers, communication systems and software.**

As planning is normally made for long period, installing ITS facilities needs to be updated and one should ensure that the equipments and technologies are compatible for future improvement and expansion.

# Traffic regulation

# TRAFFIC REGULATION AND CONTROL

❑ In order to have safe traffic on roads, it is desirable to impose adequate traffic regulations and traffic control with the help of standard traffic control devices.

❑ The traffic regulations and control are implemented with the help of suitable regulatory signs, signals, marking, traffic islands and other devices.

The various regulations imposed through the traffic control devices should fulfill the requirements such as:

- (i) Clear visibility during the day and night
- (ii) Easy to recognize and understand
- (iii) Sufficient time for the driver driving at the design speed or within the legal speed limit to react and follow the regulation.
- (iv) To ensure safety in general.

Traffic regulations and laws cover the following four phase. –

- I. Driver controls
- II. Vehicle controls
- III. Traffic flow regulations
- IV. General controls



# REGULATIONS AND CONTROLS ON DRIVERS

- ✓ The controls on drivers include eligibility for driving motor vehicles, issue of driving license and other regulations on the drivers during the act of driving.
- ✓ As per the Motor Vehicle Act, the minimum age for getting a driving license to drive a non-geared two-wheeler is 16 years and the minimum age for driving a geared two-wheeler or a four wheeler is 18 years.
- ✓ Driving a motor vehicle without a valid driving license is an offence.
- ✓ Before the issue of driving license for a specified category of vehicle, one has to undergo specified tests.
- ✓ The driver is expected to demonstrate his ability to drive the vehicle safely and he should be conversant with the motor vehicle rules and regulations.
- ✓ Separate requirements and tests have been specified for driving different categories of motor vehicles such as two-wheeler automobiles, light motor vehicles, public transport vehicles, heavy commercial vehicles, etc.
- ✓ There are regulations prohibiting driving under the influence of alcohol or 'drunken driving'.
- ✓ Dangerous driving including exceeding the specified speed limits, etc., which may render a driver to pay specified penalty or to suspend the driving license for a specified period or to permanently disqualify from driving a vehicle in the country.
- ✓ The Regional Transport Officer has the powers to endorse upon the driving license the particulars of the traffic violations and when the number and severity of the violations exceed the permissible limit, the license can be suspended or even cancelled.

# REGULATIONS AND CONTROLS ON VEHICLES

- ❑ Regulations and controls on vehicles include vehicle registration, requirements of equipment and accessories of motor vehicles, maximum permissible dimensions and weight, vehicle fitness, inspections, emission etc.
- ❑ The registration is essential for any new motor vehicle.
- ❑ The information about the details of the vehicle such as the type, make, capacity of engine, manufacture's serial number, details of the owner, license plate number, etc. are registered in the transport department and police records.
- ❑ There are different specifications for public transport vehicles, hired vehicles and private vehicles for displaying the registration number.
- ❑ For example private vehicles have to display the registration numbers of specified size letters and numerals written in black colour on plate with white back-ground. ❑ The specified colour of the registration plate is yellow for public transport vehicles including hired vehicles.
- ❑ The regulation covers the length, width, height, type and condition of tyres, maximum weights of commercial vehicles seating arrangements and number of seats in public service vehicles, lamps and signaling appliances, emission, noise, use of horn, speed governors , safety glasses, etc.
- ❑ At least a third party insurance policy is mandatory for all vehicles.

# GENERAL REGULATIONS AND CONTROLS

Some other general regulations and provisions are made.

They include reporting of accidents, recording and disposing traffic violation cases, etc.

## IMPLEMENTATION OF REGULATIONS

- ❖ The traffic regulations have been enacted and implemented in India with the help of the Motor Vehicle Act of 1939, The revised Motor Vehicle Act of 1988.
- ❖ These have covered various traffic regulatory measures in three major phases, namely control on the
  - (i) drivers
  - (ii) vehicle ownership and
  - (iii) vehicle operation on roads and in traffic stream.
- ❖ The various items covered are issue of driving license, registration of vehicles, transfer of ownerships, distinction between private and public vehicles, transport authorities and inter-state commission, limits of speed, weight, restrictions on parking and halting places, vehicle insurance and fees, signs, signals and general provisions for punishment of violations and offences.
- ❖ Some of the most common traffic flow regulations such as
  - (i) one-way regulation and (ii) turning restrictions at junctions
- ❖ Various other regulations such as Stop, Speed limit, Restrictions on overtaking, parking, stopping, etc. are implemented by appropriate regulatory signs.