9th Urban Mobility India Conference & Expo 2016
Planning Mobility for City's Sustainability

ADVANCED TRAFFIC SIGNAL CONTROL SYSTEM IN INDIAN CITIES

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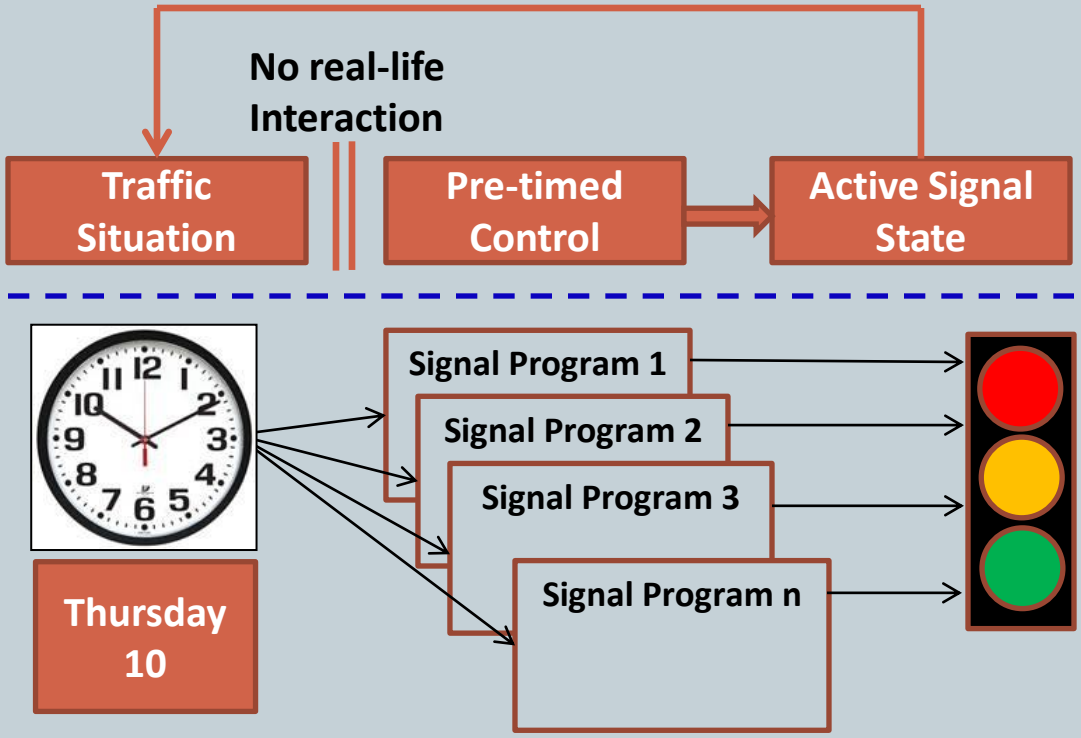
Traffic Signal Controllers in India

- **Most of them are Pre-timed**
  - Simple and inexpensive
  - Signal timings derived from the statistical data
  - Duration and order of all green phases are fixed
  - Cannot respond to real-time demand
- **Few Vehicle Actuated Signal Controllers**
  - Signal timings based on real-time traffic demand
- **Very few Adaptive Traffic Control Systems**
  - Real-time signal control applied to a network of traffic junctions

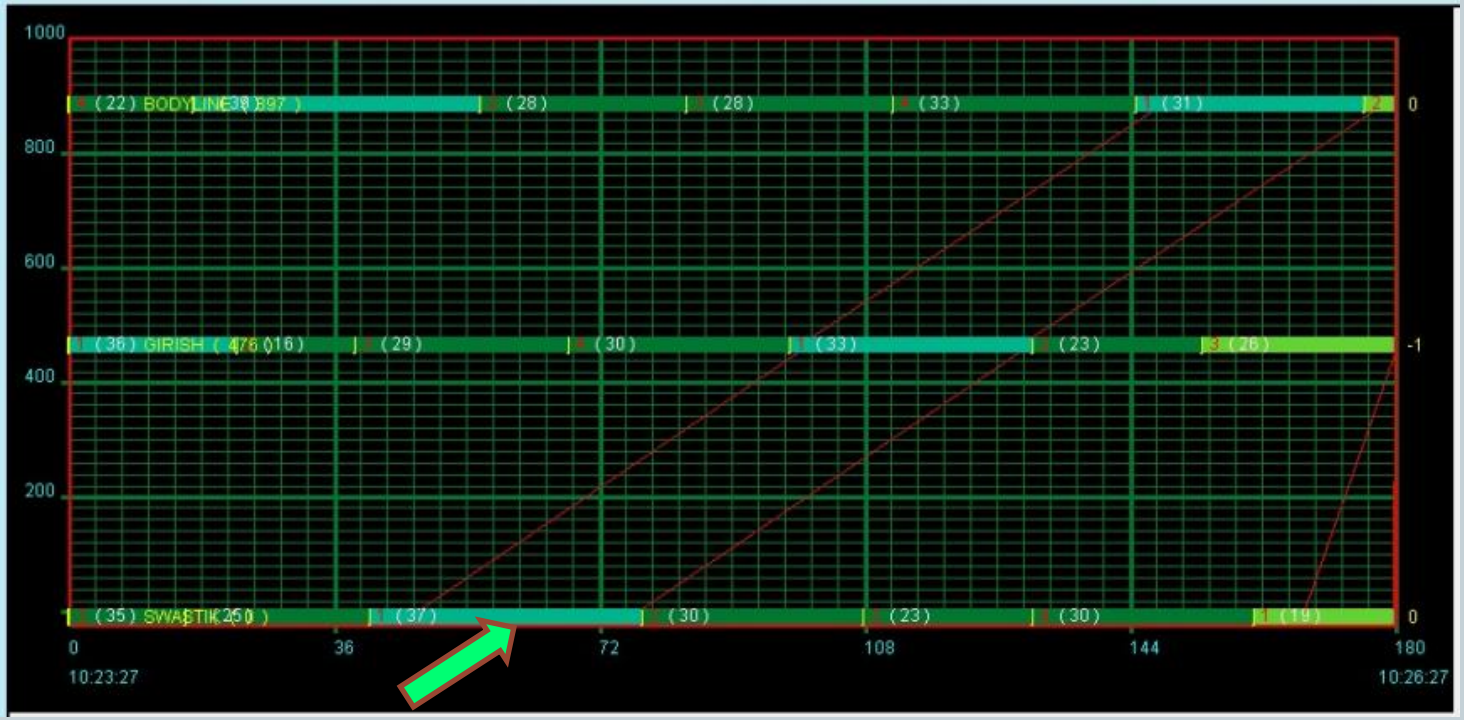
Pre-timed Traffic Signal Controller

(Isolated / Coordinated)



Coordinated Signal Control

- A technique to reduce stopped delay and improve travel time
- Provides progressive green signal at consecutive intersections when travelled at specified speed

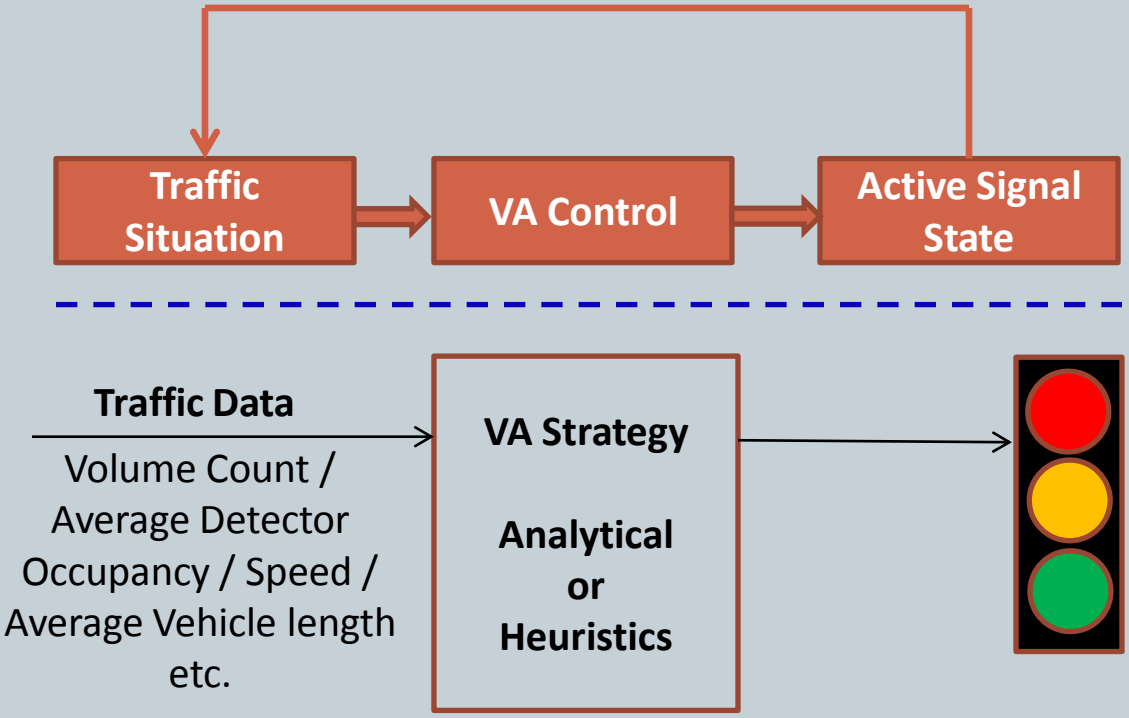


Myth about Signal Coordination

- Any type of junctions can be coordinated ….
  - Junctions of similar characteristics only can be coordinated (e.g. junctions requiring more or less same cycle lengths)
- All vehicles in the platoon get green signal at all consecutive junctions ….
  - Signal coordination can be assumed for 70-80% vehicles in the platoon
- The signals can be coordinated in all direction ….
  - Generally the direction of maximum flow only is coordinated

Vehicle Actuated Traffic Signal Controller

(Isolated / Coordinated)



Vehicle Detection

- Inductive Loop
- Camera
- Microwave Radar
- Thermal Camera
- Piezoelectric
- Magnetic
- ----

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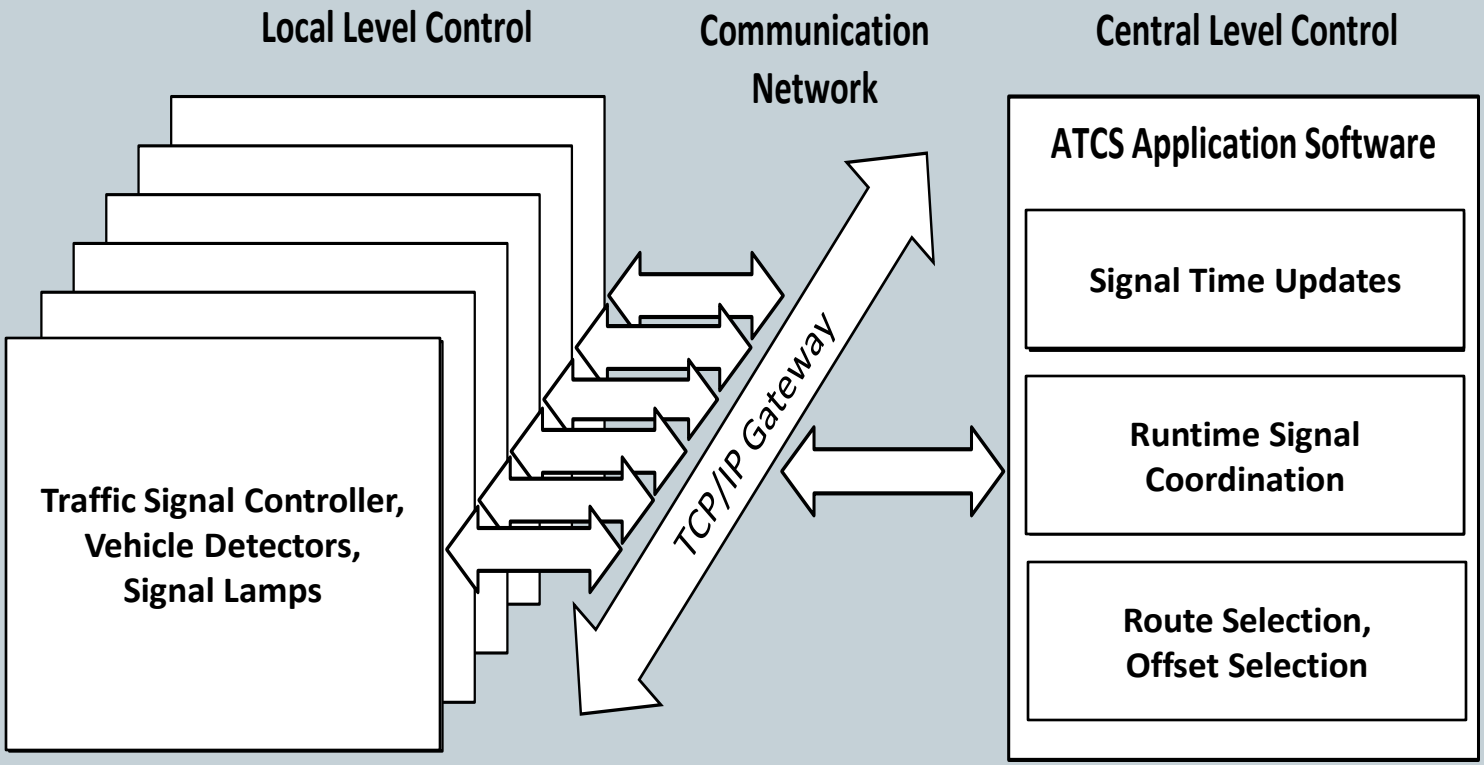
Advanced Traffic Signal Control System

- Provides real-time signal coordination for a group of traffic signals based on real-time traffic demand
  - Phase timings, Cycle lengths
  - Signal coordination route
- Operates in two levels
  - Local level : Traffic Signal Controller and other field equipment
  - Central level : ATCS application software running on a computer
  - Both levels are networked on a robust communication backbone
- Generates decision support reports and logs
- Supports remote Monitoring and Administration

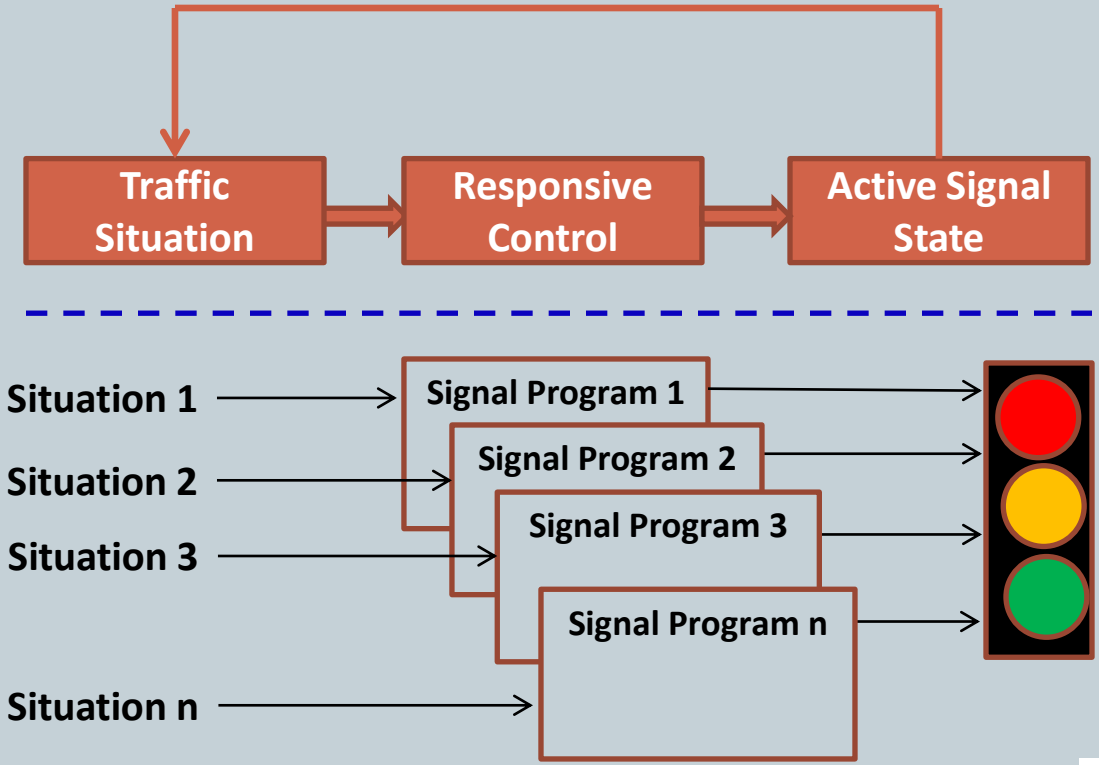
ATCS Overall Block diagram



Traffic Responsive Signal Controller

(Traffic Network – Real time signal coordination)

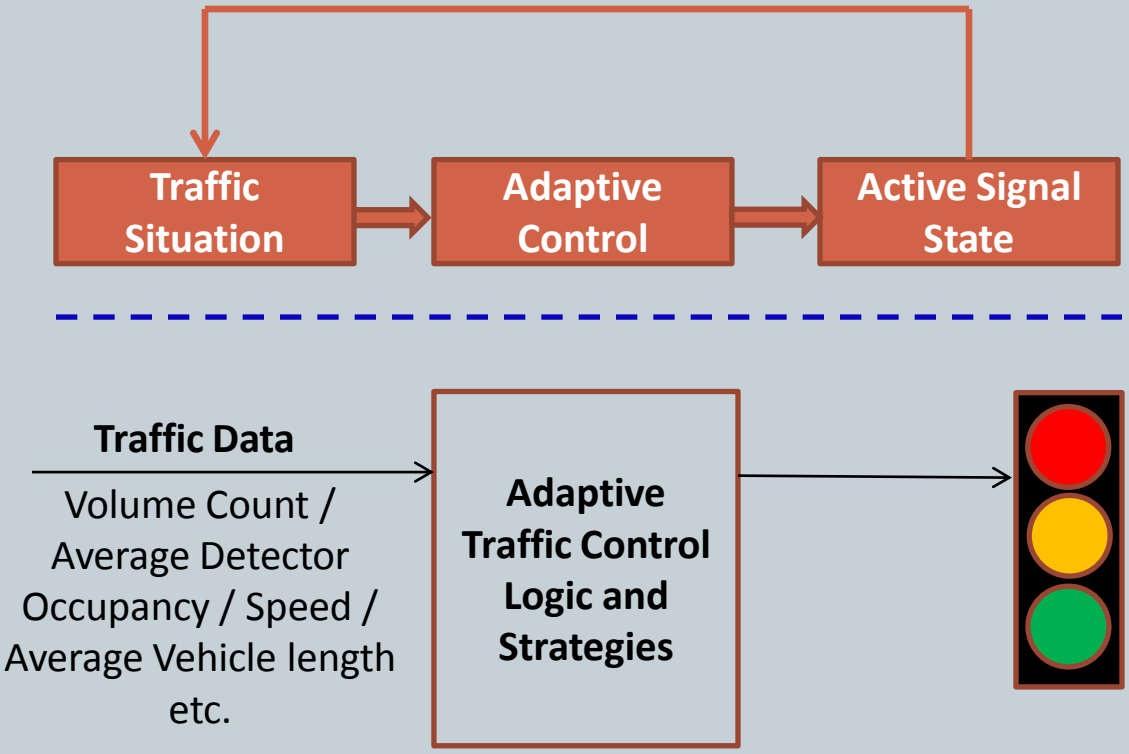
- Appropriate signal plan selected from a library of coordinated signal plans based on the real-time traffic demand



Adaptive Signal Controller

(Traffic Network – Real time signal coordination)

- Appropriate signal plan generated based on the real-time traffic demand



Operational Categorization of ATCS

ATCS	Detection	Action	Time Frame	Model	Timings
ACS Lite	SL, MB, US	P & R	5-10 Mins	No	S.O
Balance	NSL	P & R	5 Mins	Yes	S.Cl.O.PS
InSync	NSL	P & R	Phase / Cycle / 15 Mins	Yes	S.Cl.O.PS
LA ATCS	SL , US	P & R	Cycle	Yes	S.Cl.O
MOTION	NSL	P & R	5-15 Mins	Yes	S.Cl.O.PS
OPAC	MB , SL	P	Phase / Cycle / 5 Mins	Yes	S.Cl.O
RHODES	MB , SL	P	Sec-by-Sec	Yes	S
SCATS	SL, NSL, MB	R	Cycle	No	S.Cl.O
SCOOT	US , SL	P & R	Cycle / 5 Mins	Yes	S.Cl.O.PS
UTOPIA	US, SL	P	3Sec / 5 Mins	Yes	S.PS
CoSiCoSt	SL , NSL	R	Cycle	No	S.Cl.O

- **Model based**
  - Use macroscopic, mesoscopic, or microscopic models to estimate the current state of traffic
  - The estimated value is further used as an input to adjust signal timings
  - Most of the currently operational ATCS are Model based
- **Non-model based**
  - Based on functional relationship between parameters that describe change of traffic conditions
  - Use feedback of the traffic measured during the previous interval

Myth about ATCS

- **ATCS Solves all urban traffic problems……**
  - In reality it helps in improving the traffic conditions
    - Increased lane carrying capacity and travel speeds
    - Reduction in delay, stops, queue, fuel consumption, emissions and drop in accident rate
    - Better Traffic Management - Green Wave Routes, Diversions, Incidents Detection

Myth about ATCS

- **All ATCS Optimizes all timing parameters……**
  - The reality is that some of them perform some kind of optimization, which is usually constrained by its domain or time allowed to conduct the optimization process
  - Some of these optimizations use heuristic techniques, whereas others use extensive search techniques, to find solutions
  - Others do not formally optimize (no search process and no objective function); instead, they adjust signal timings by using some heuristic methods and common traffic engineering concepts.

ATCS Philosophy

- An area is divided into corridors of closely spaced traffic junctions having similar flow characteristics and, synchronize them independently based on real-time demand
- Signal Coordination is achieved by
  - **Phase Sequencing:** Not used widely because of the negative impacts due to frequent transitions. Not permitted in many countries
  - **Common Cycle time method:** Consider Cycle length, Phase length and Offset as the fundamental parameters for signal synchronization

Advanced Traffic Signal Control Systems in India

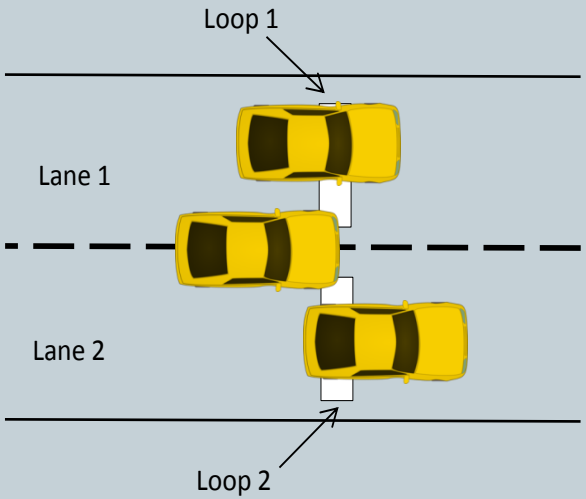
- Delhi – SCOOT — Model based
- Mumbai – ITACA — Proactive and Reactive

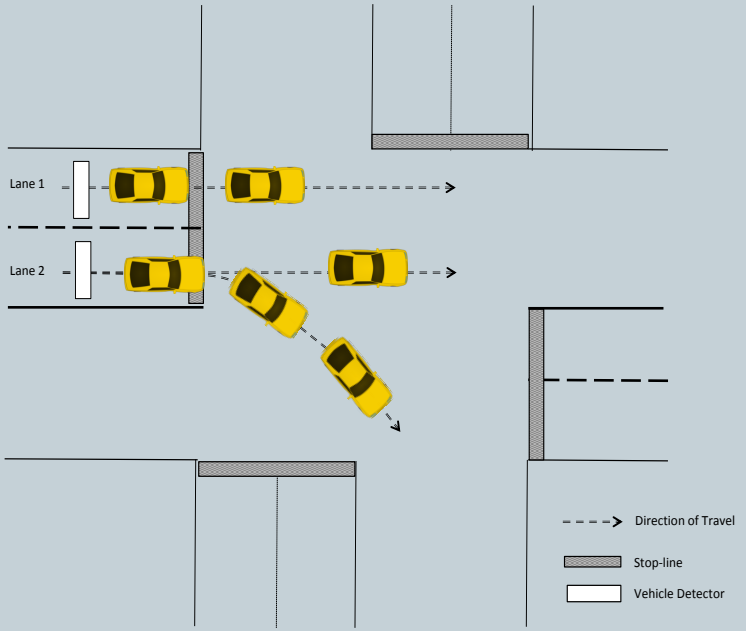
- Jaipur – CoSiCoSt — Non-model based; Reactive

How Adaptive are the Adaptive Traffic Control Systems on our Road…

- **The analytical models are constrained by inadequate input data**
  - Low level of lane discipline
  - High mix of traffic
  - Higher percentage of two wheeler population
  - Poor junction geometry
- **And we are constrained by**
  - Lack of expertise
  - Power and Network connectivity interruptions

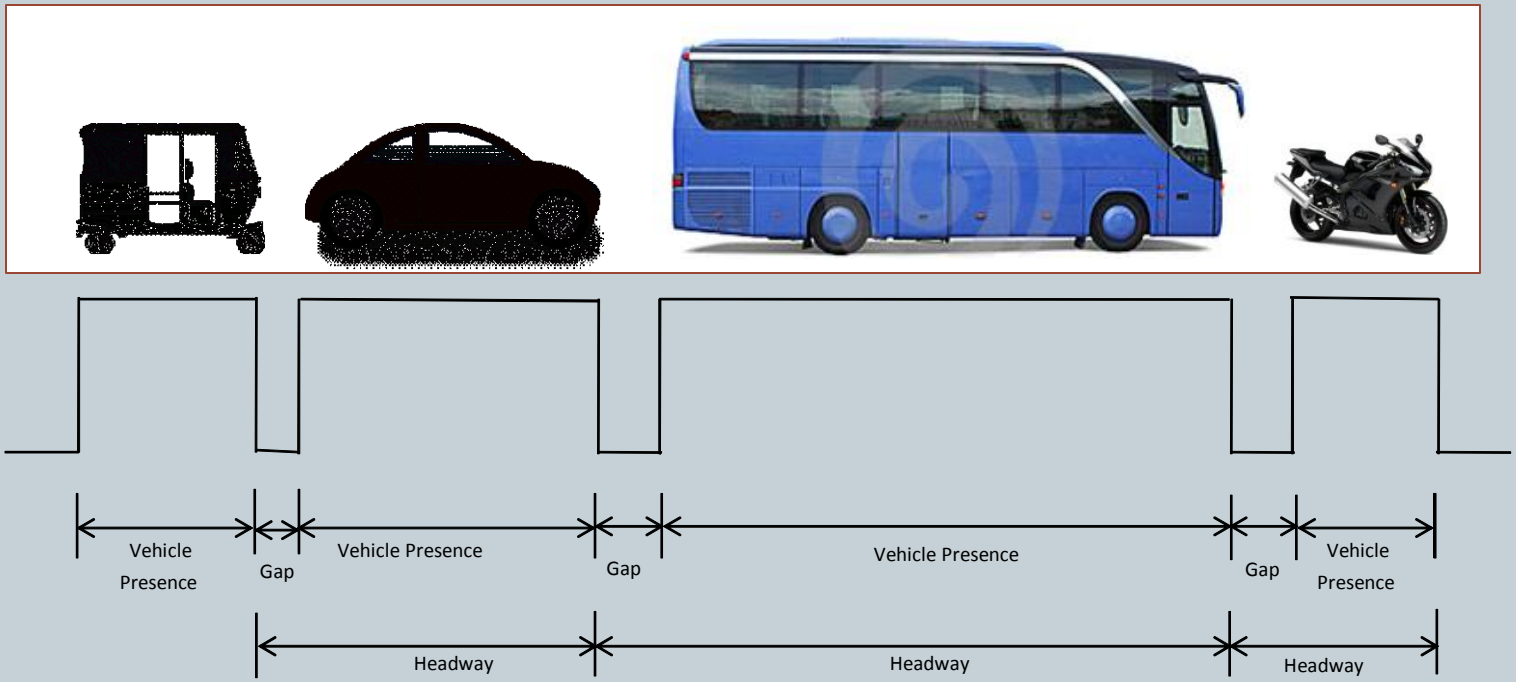
Non-lane based driving





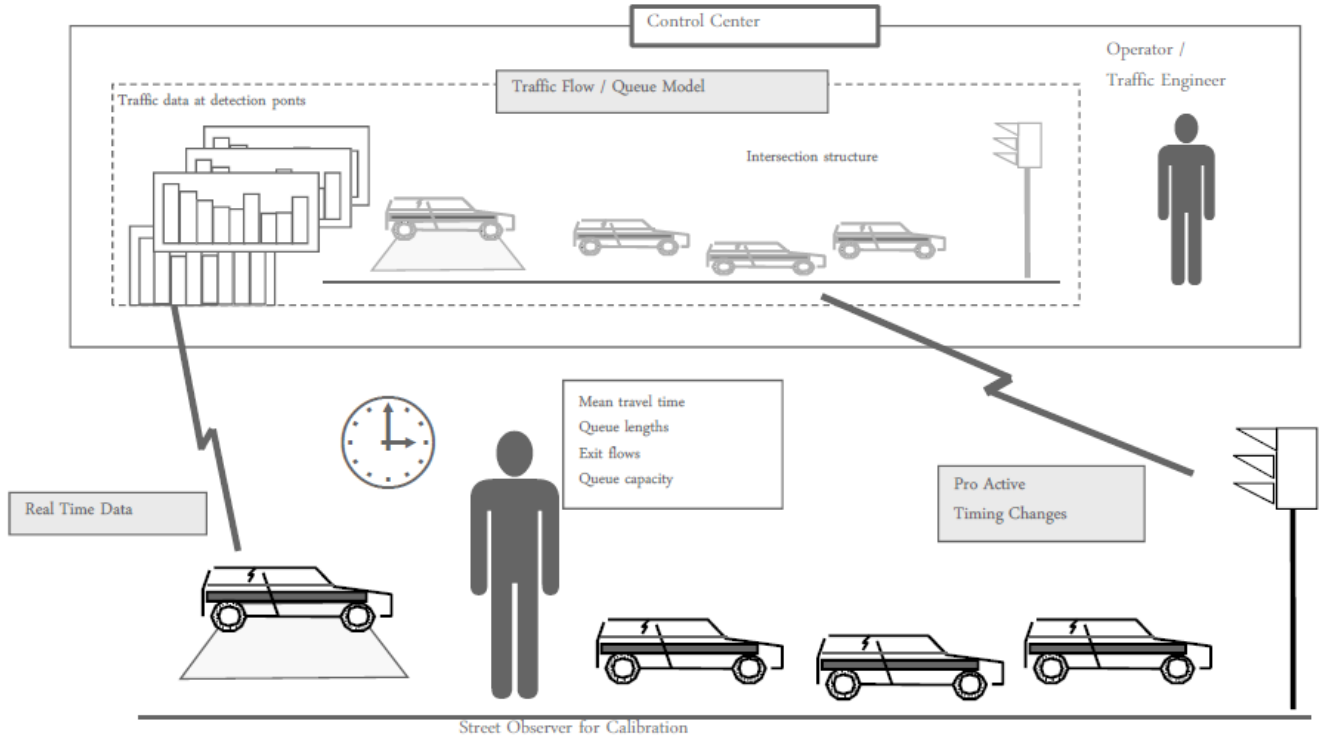
- Deriving the critical parameters in real-time for vehicle actuated signal control is highly complex
  - volume counts, turning proportion, headways and gaps

Mixed Traffic Flow Conditions



- Data collection is more complex in mixed traffic flow conditions

Calibration is much more complex



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What is required…

- Handle non-lane based mixed traffic flow conditions
- Implementation of Complex Phasing Schemes
- Self-calibrating for Phase lengths and Cycle lengths
- Dynamic Route Selection
- Real-time Signal Coordination
- Fallback operation in Vehicle Actuated mode
- Remote Monitoring and Administration
- Scalable
- Decision Support Reports
- Local Expertise
- Simulator interface

Relevance of the topic

- Adaptive Traffic Signal Control (ATCS) is one of the major components of all Smart City Mission Projects

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END OF PRESENTATION

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