Intelligent Transport Systems (ITS) For Indian Cities

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Infrastructure growth is lagging behind growth in vehicle volumes.
Better traffic management and more information to commuters can alleviate traffic woes, though cannot obliterate them.
Technology to do this is called ITS.

Intelligent Transport Systems (ITS)

Traffic Management

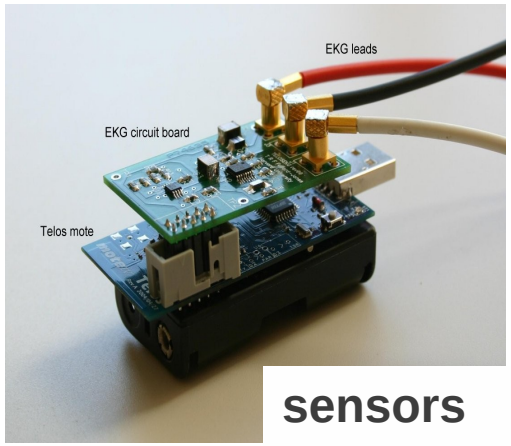
- Intersection control
  - adaptive/static
  - isolated/co-ordinated
- Infrastructure planning
- Incident handling
  - detection
  - fine imposition
- Revenue collection
- Pollution control
- Infrastructure maintenance

And many more .....

Commuter Information

- Congestion map
  - historical/real-time
- Travel time
  - historical/real-time
- Transit tracking
  - bus/train/metro
  - arrival time prediction
- Cab services
  - locate nearest
  - trip fare/duration prediction
- Personal vehicle services
  - parking spaces
  - carbon footprint

Interdisciplinary Problem Space

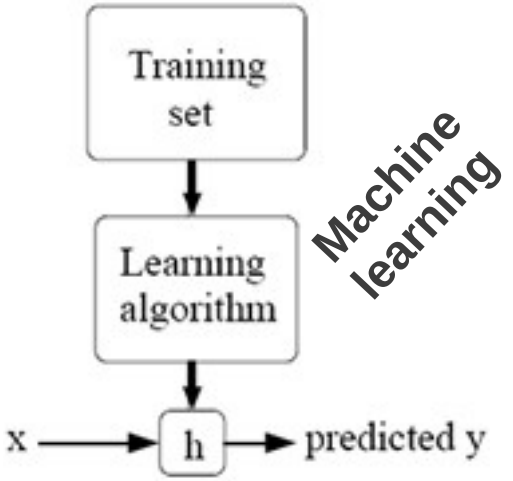


smartphones

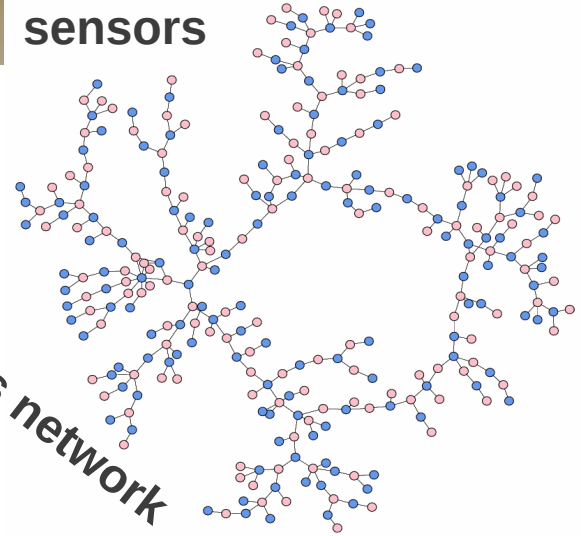


Image/ signal processing





sensors



Wired/ wireless network



Transportation engineering

Papers in diverse Venues!

**Transportation Research Board Journals,
Conferences on Image Processing,
Artificial Intelligence, Machine Learning, Mobility, Sensing,
Embedded Systems, ICT .....**

Road Sensors

Static

- Magnetic sensor
- Camera
- Infrared sensor
  [TIRTL]
- Radar
- Acoustic sensor
  [HornOkPlease]
- RF sensor
  [WirelessAcrossRoad]

Mobile

- GPS
  [SurfaceStreet, EasyTracker, Balan]
- Phone sensors
  [Nericell, PhoneAstra, Melos]
  - accelerometer, microphone
  - magnetometer, gyroscope
  - compass
- Phone radios
  - Wi-Fi *[VTrack]*
  - GSM *[CTrack]*
- Specialized hardware
  [Autowitness, GreenGPS,Parknet]

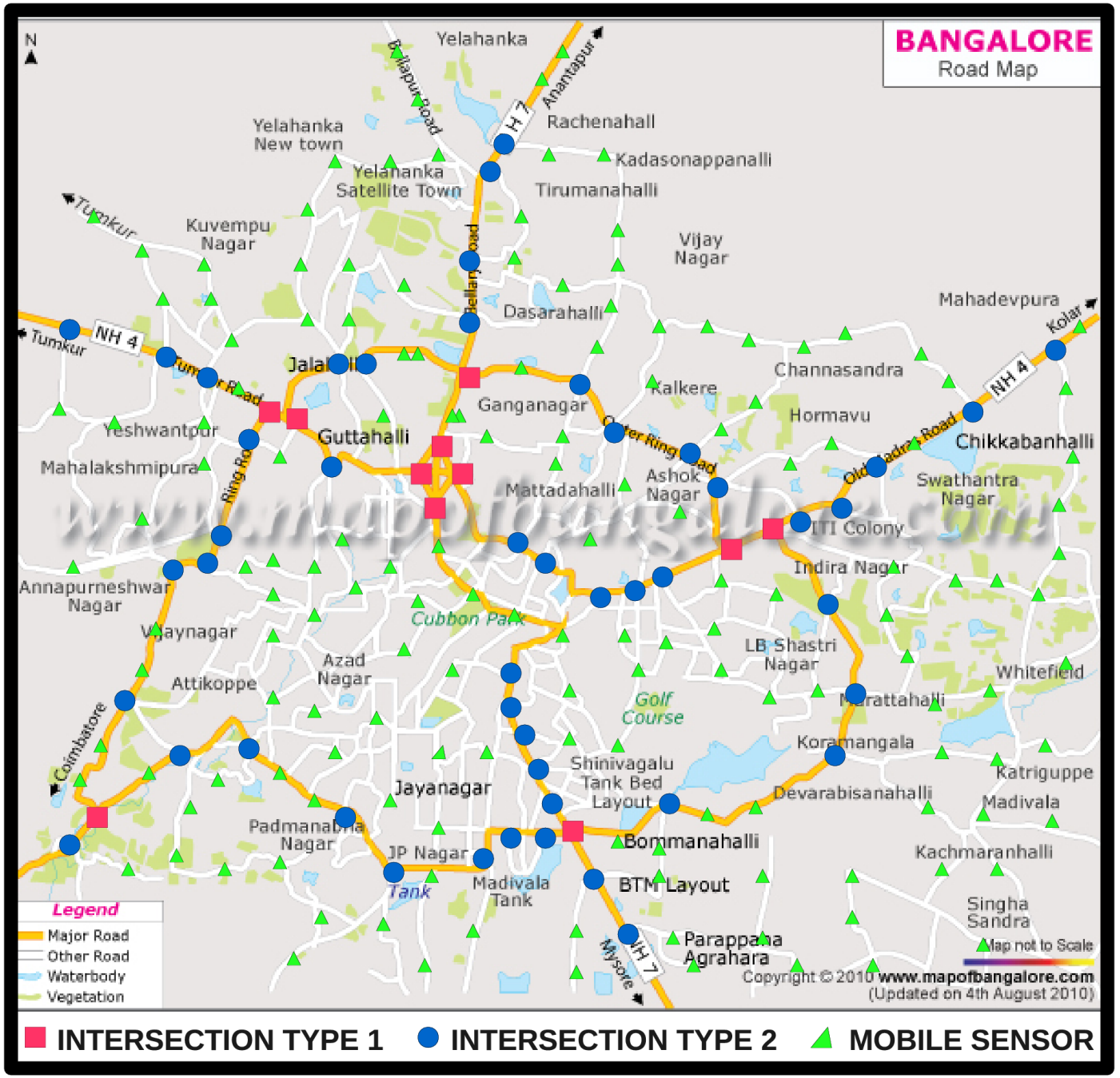
Hybrid

- Teledensity
- Bluetooth
- RFID

Any ITS application would need information from the road.
Hence the need for "*road sensors*".

Wait ....

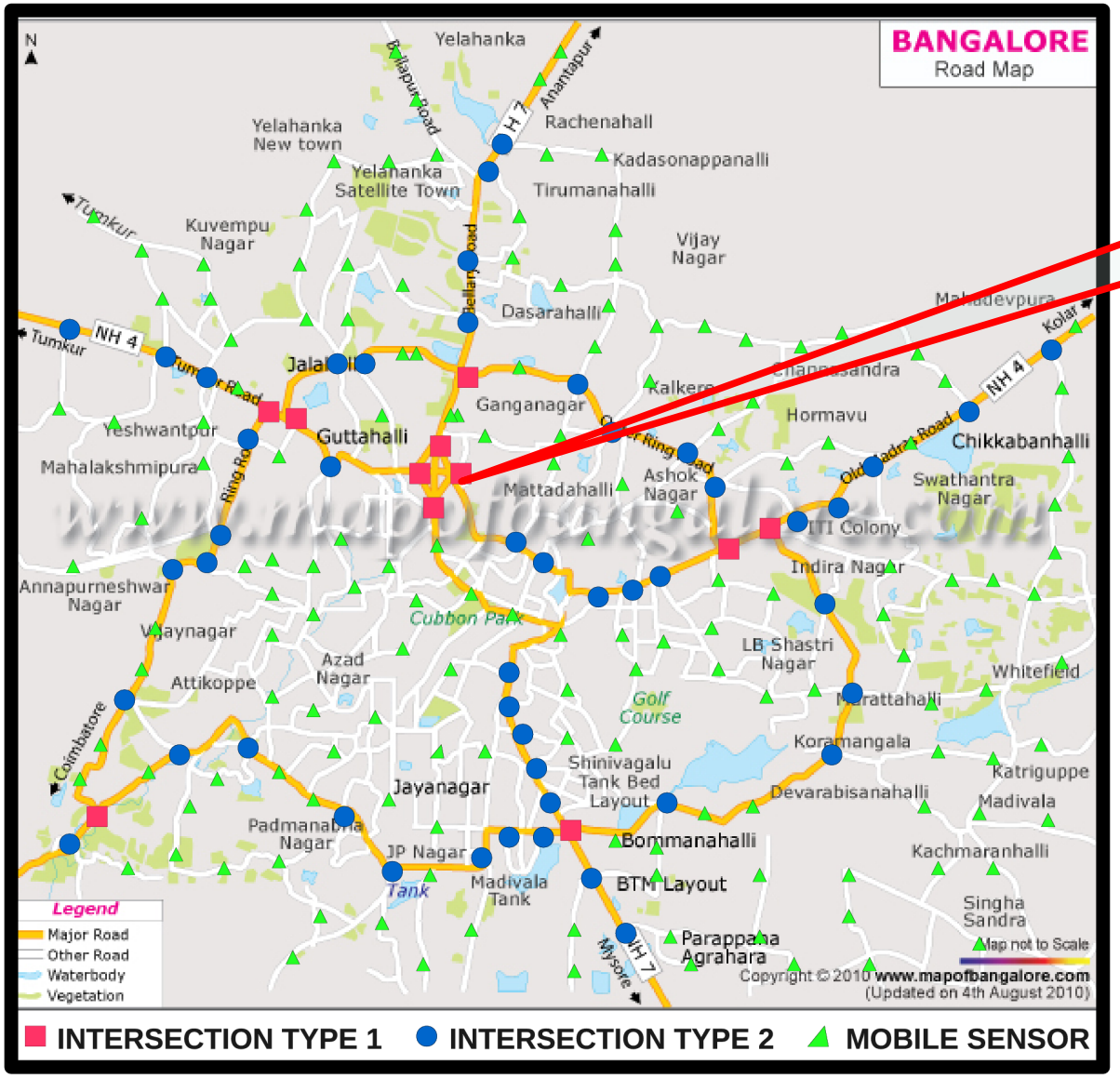
do we need all sensor types?



Let's take a road map of Bengaluru and try to design a bunch of ITS applications for it

Wait ....

do we need all sensor types?

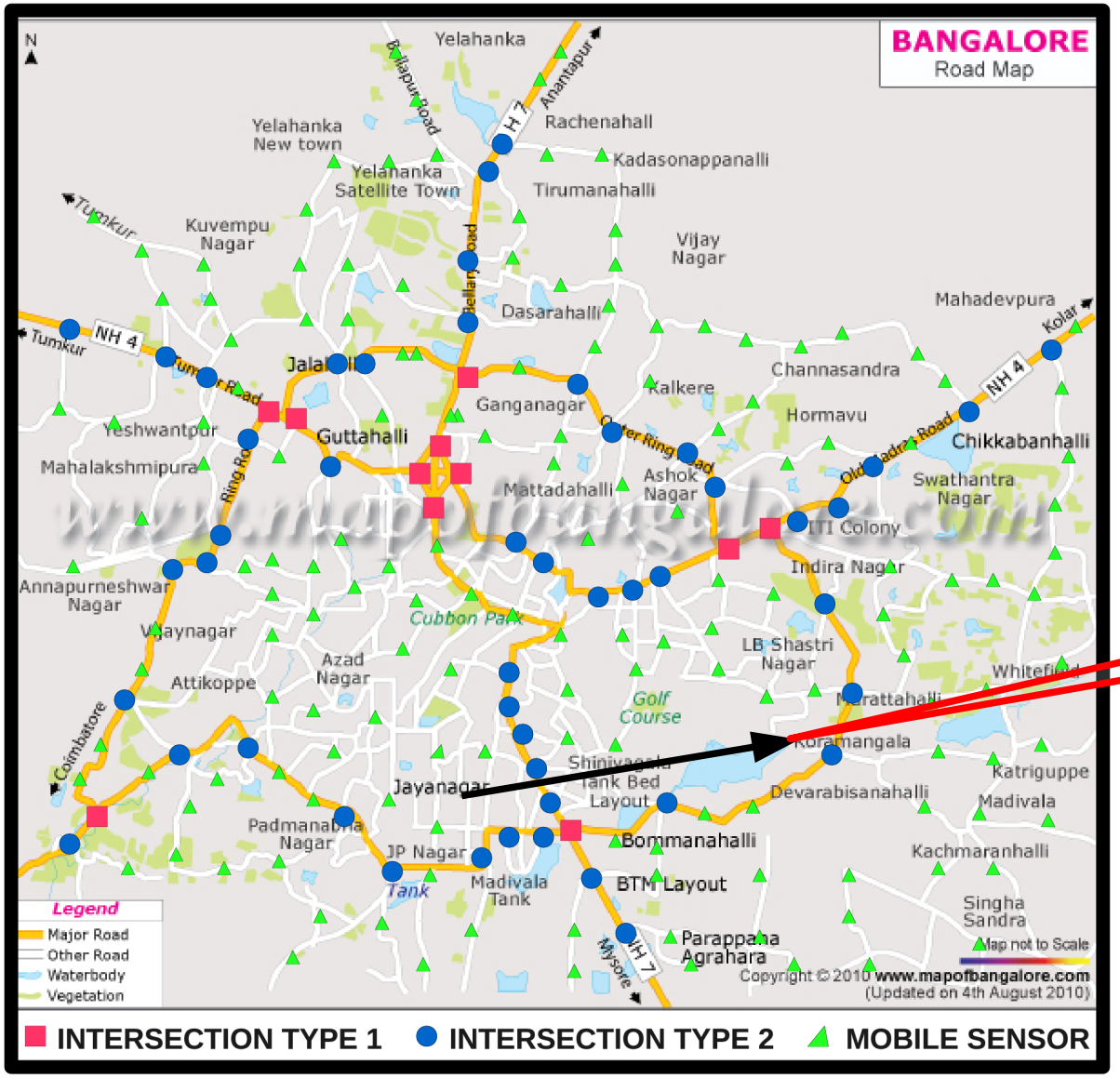


Adaptive control of traffic lights based on current queue length

- strictly periodic
- accurate
- from few important intersections
- queue length

Wait ....

do we need all sensor types?

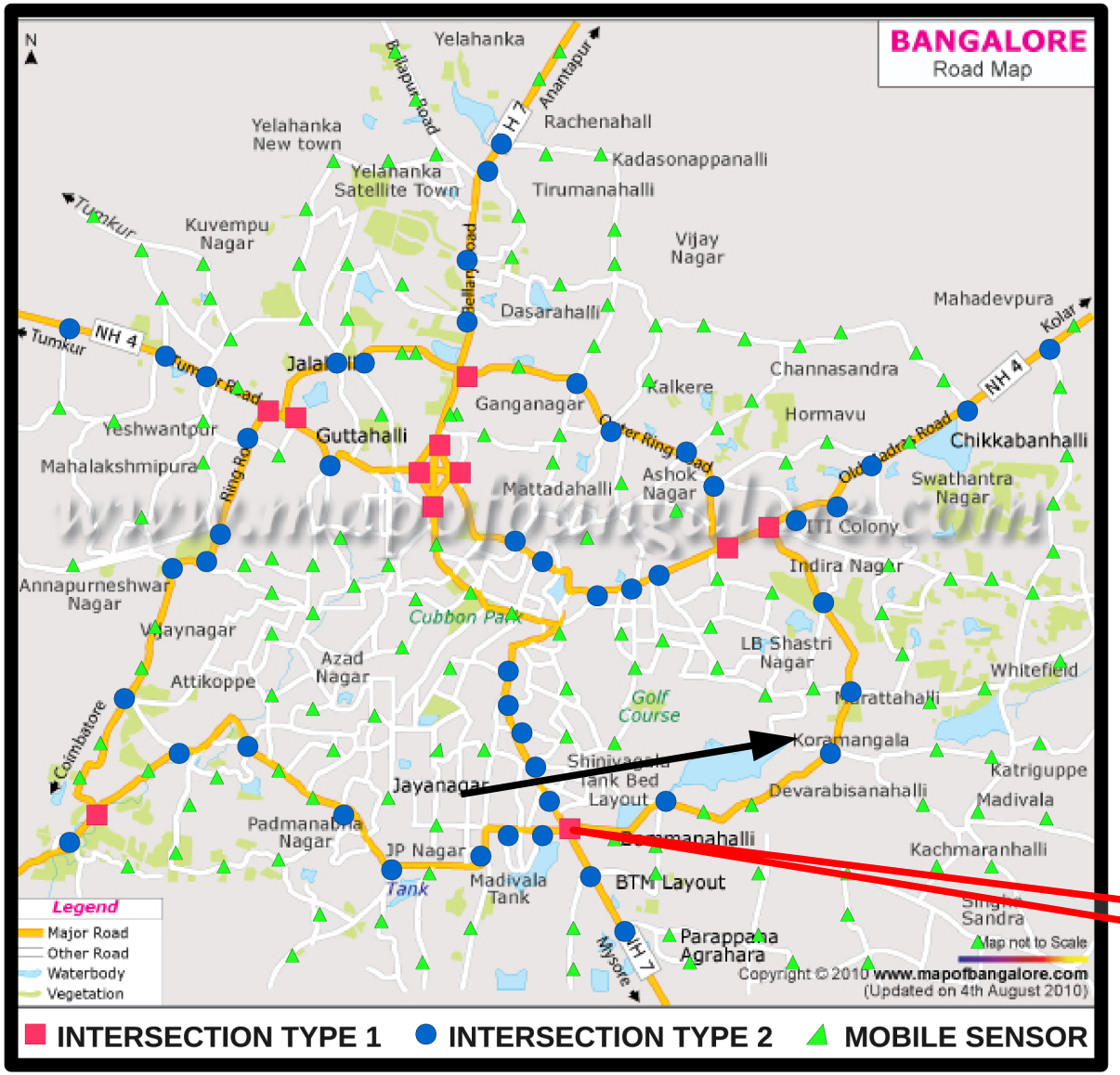


Travel time from Jayanagar to Koramangla

- historical/ delayed
- within error of few minutes
- from all over the city
- travel time

Wait ....

do we need all sensor types?

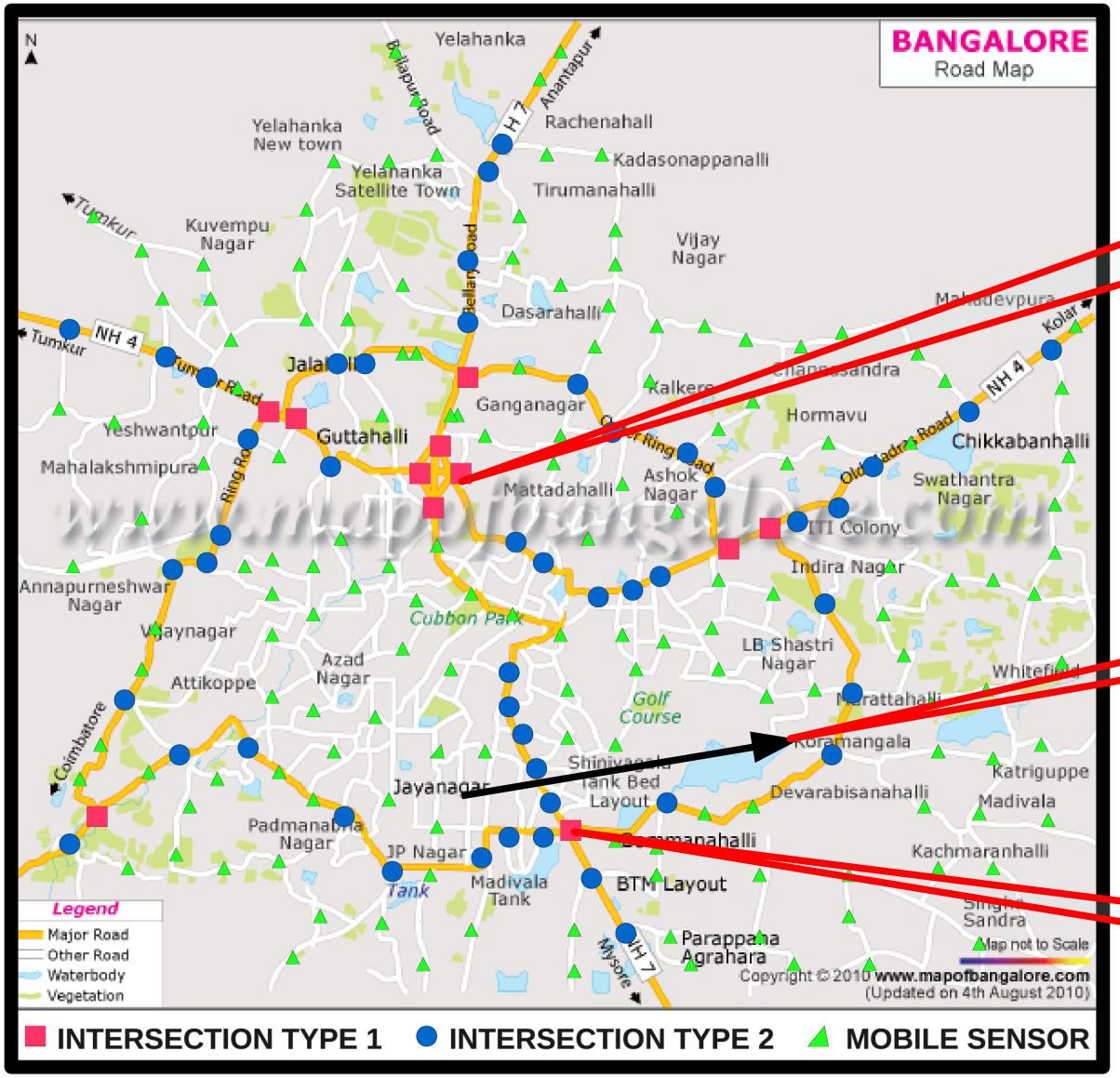


Red light violation detection

- immediate
- accurate
- intersections
- number plate of vehicle

Wait ....

do we need all sensor types?



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Red light violation detection

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1. Timeliness 2. Accuracy
3. Spatial coverage 4. Nature of Information
5. Cost 6. Deployment overhead

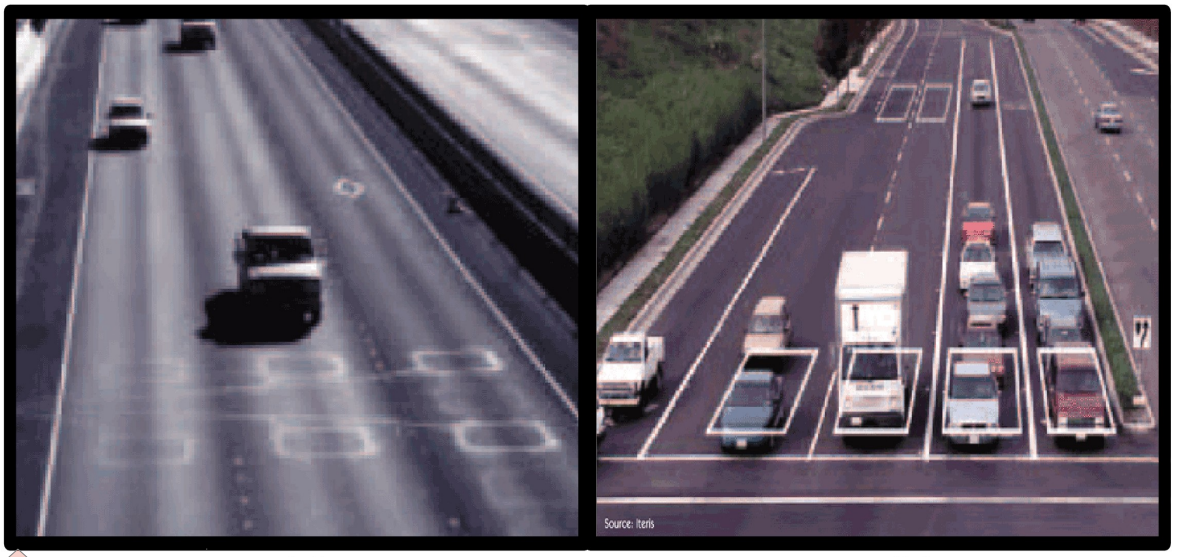
→ ***Should decide sensor type for the intended application***

Open Problems

Static road sensors

- Magnetic sensor
- Camera
- Infrared sensor
  [TIRTL]

Adapting existing techniques for non-laned traffic





Open Problems

Static road sensors

- Acoustic sensor
  [HornOkPlease]
- RF sensor
  [WirelessAcrossRoad]

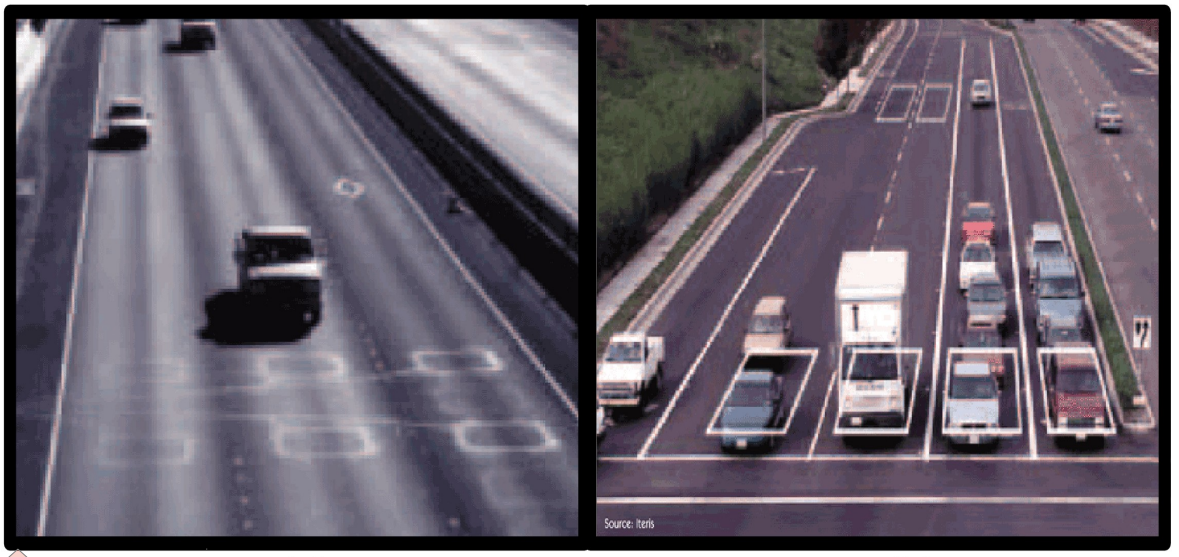
Designing new techniques for non-laned traffic



Open Problems

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Adapting existing techniques for non-laned traffic

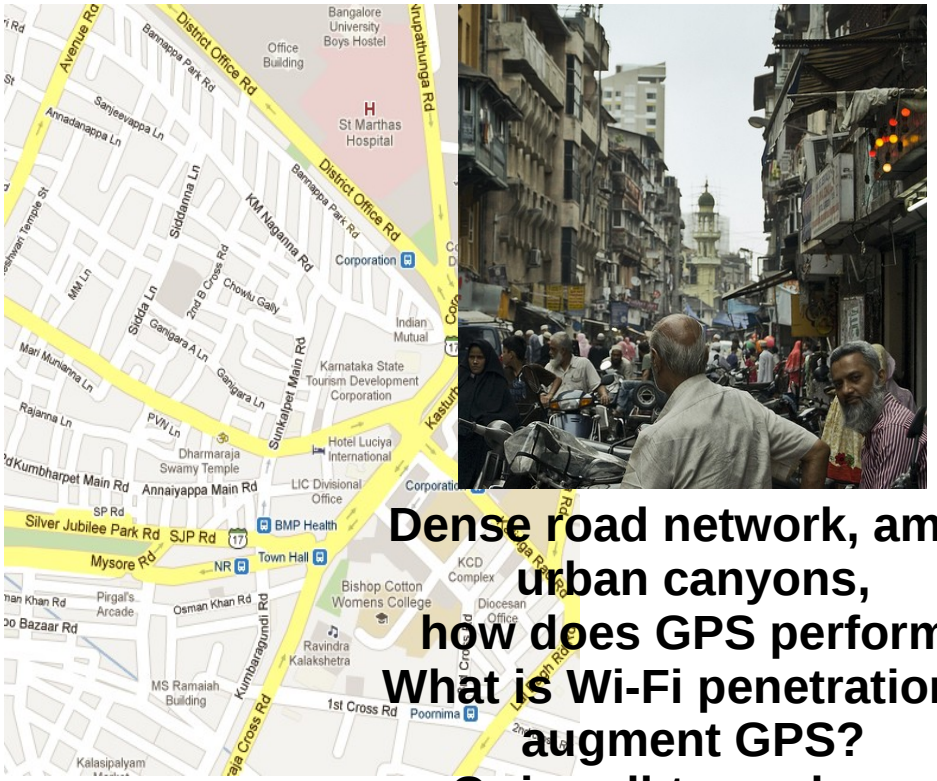


- Acoustic sensor
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Designing new techniques for non-laned traffic

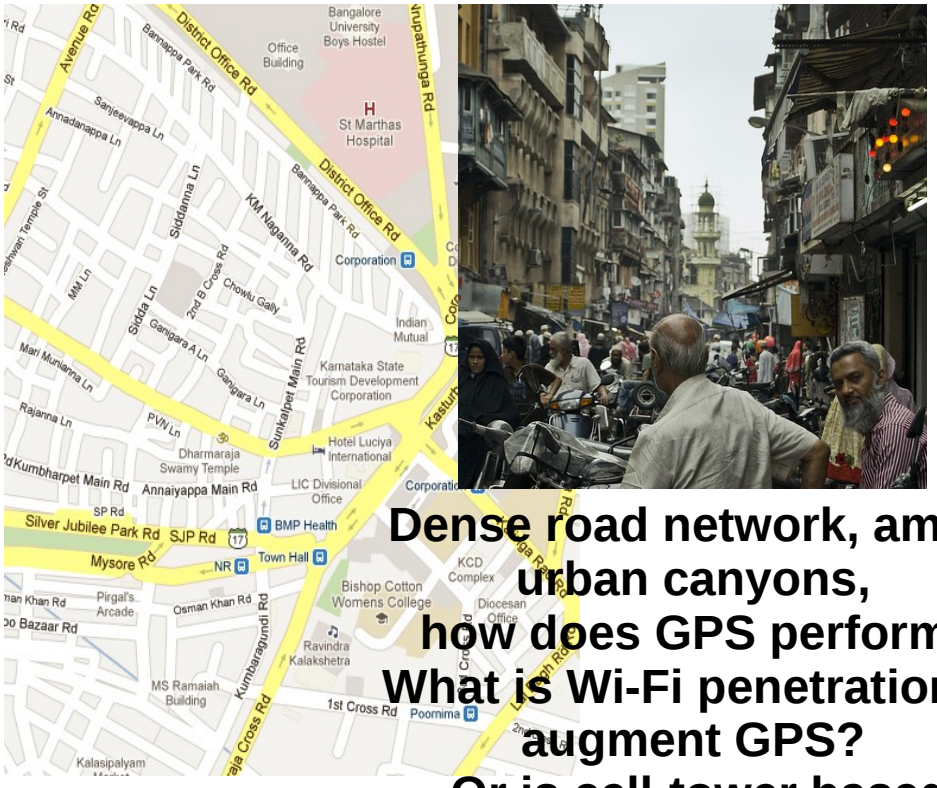
What to sense? How long to sense?
How to train sensors for different road types?

Open Problems



Dense road network, ample urban canyons, how does GPS perform? What is Wi-Fi penetration to augment GPS? Or is cell-tower based localization the optimal choice?

Open Problems

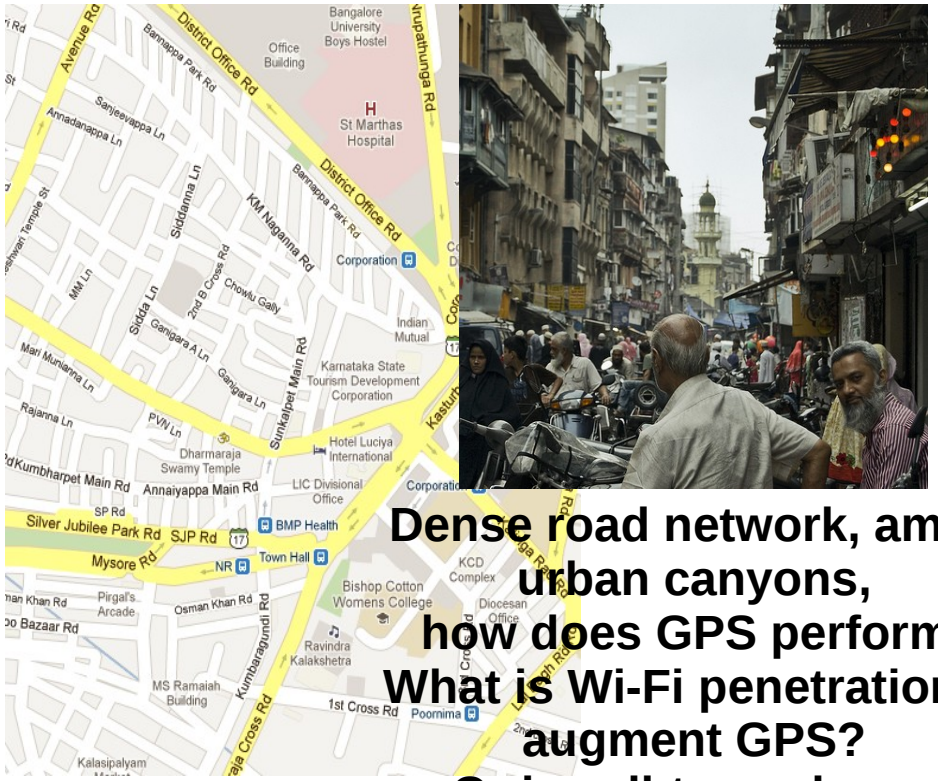


Dense road network, ample urban canyons, how does GPS perform? What is Wi-Fi penetration to augment GPS? Or is cell-tower based localization the optimal choice?

In non-laned traffic, how does surrounding traffic density affect driving behavior? Lane change – gyroscope Braking – accelerometer Honking – microphone Build realistic traffic simulators with the results.



Open Problems



Dense road network, ample urban canyons, how does GPS perform? What is Wi-Fi penetration to augment GPS? Or is cell-tower based localization the optimal choice?



How many vehicles of what type – defines Passenger Car Unit (PCU) for a road. PCU is used in planning infrastructure. Current method involves manual counting on road.

In non-laned traffic, how does surrounding traffic density affect driving behavior? Lane change – gyroscope Braking – accelerometer Honking – microphone Build realistic traffic simulators with the results.





amazon mechanical turk beta

Shoot the trucks & score!

Will gaming or paid incentives help this application? How to handle label noise?

Logistic Assistance

<gps & image data, deployment permissions ... >

Organization type	Website
Academic institutions	IISC - http://cistup.iisc.ernet.in/index.html IIT Delhi - http://tripp.iitd.ernet.in/ IIT Chennai - http://coeut.iitm.ac.in/ IIT Bombay, Civil - http://www.civil.iitb.ac.in/~gpatil/research.html IIT Bombay, CSE - http://www.cse.iitb.ac.in/silmaril/br/doku.php?id=proj:carts IIT KGP - http://www.iitkgp.ac.in/fac-profiles/showprofile.php?empcode=bSmUS IIIT Delhi - http://www.iiitd.edu.in/muc/
Private Organizations	Mapunity - http://www.mapunity.in/ Logica - http://www.logica.in/we-do/innovation/ KritiKal - http://www.kritikalsolutions.com/products/traffic-analyzer.html Embarq - http://www.embarq.org/en/about/about-embarq iTrans - http://www.itrans.co.in/aboutus.html Traffline - http://www.traffline.com/default.aspx
Some city traffic control authorities	Mumbai - http://www.trafficpolicemumbai.org/ Bengaluru - http://www.bangaloretrafficpolice.gov.in/ Chennai - http://www.chennaitrafficpolice.in/ Delhi - http://delhitrafficpolice.nic.in/
Government R&D lab Center for Development of Advanced Computing (C-DAC)	http://www.intranse.in/its1/
City bus authorities with GPS installed in buses	Bengaluru - http://www.bmtcinfo.com/site/index.jsp Chennai - http://www.mtcbus.org/
Research labs	Microsoft [28], IBM [15], Alcatel Lucent [55], Infosys [60]

Logistic Assistance

<gps & image data, deployment permissions ... >

Organization type	Website
Academic institutions	IISC - http://cistup.iisc.ernet.in/index.html IIT Delhi - http://tripp.iitd.ernet.in/ IIT Chennai - http://coeut.iitm.ac.in/ IIT Bombay, Civil - http://www.civil.iitb.ac.in/gpatil/research.html IIT Bombay, CSE - http://www.cse.iitb.ac.in/silmaril/br/doku.php?id=proj:carts IIT KGP - http://www.iitkgp.ac.in/fac-profiles/showprofile.php?empcode=bSmUS IIIT Delhi - http://www.iiitd.edu.in/muc/
Private Organizations	Mapunity - http://www.mapunity.in/ Logica - http://www.logica.in/we-do/innovation/ KritiKal - http://www.kritikalsolutions.com/products/traffic-analyzer.html Embarq - http://www.embarq.org/en/about/about-embarq iTrans - http://www.itrans.co.in/aboutus.html Traffline - http://www.traffline.com/default.aspx
Some city traffic control authorities	Mumbai - http://www.trafficpolicemumbai.org/ Bengaluru - http://www.bangaloretrafficpolice.gov.in/ Chennai - http://www.chennaitrafficpolice.in/ Delhi - http://delhitrafficpolice.nic.in/
Government R&D lab Center for Development of Advanced Computing (C-DAC)	http://www.intranse.in/its1/
City bus authorities with GPS installed in buses	Bengaluru - http://www.bmtcinfo.com/site/index.jsp Chennai - http://www.mtcbus.org/
Research labs	Microsoft [28], IBM [15], Alcatel Lucent [55], Infosys [60]



Meaningful collaborations with the public sector are necessary, to implement and test our ITS systems at scale.

Thank You

For questions: please write to

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br@cse.iitb.ac.in