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

EFFECTS OF TRANSIT SIGNAL PRIORITY ON BUS RAPID TRANSIT SYSTEM

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PRESENTATION STRUCTURE

- INTRODUCTION
- AIM / OBJECTIVES
- STUDY APPROACH
- LITERATURE REVIEW
- MODEL DEVELOPMENT
- RESULTS EVALUATION
- CONCLUSIONS

- **INTRODUCTION**
- LITERATURE REVIEW
- MODEL DEVELOPMENT
- RESULTS EVALUATION AND CONCLUSIONS

- *Definition*
- *Need for study*
- *Aim / objectives*
- *Study approach*

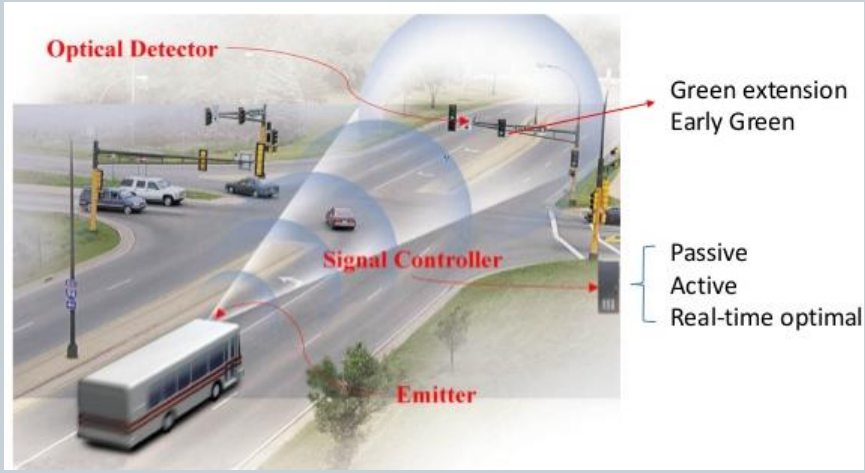
BUS PRIORITY SYSTEMS

"Systems" that gives priority to Bus movement in traffic

- Dedicated lane based priority systems
- Transit Signal Priority System
- Site/corridor specific priority systems

CENTRAL DEDICATED LANE FOR BUS, SEOUL

Source: http://www.septua.co.za/quo_vadis_brt.htm



TRANSIT SIGNAL PRIORITY

Source: kamila W. (2013) www.slideshare.net

NEED FOR RESEARCH

- multi-faceted problems as a result of rapid urbanization. . . . . **rapid motorization**
- Anticipated vehicle growth
- High public transit- BUS share
- Less road space and high vehicle density
- Alarming road fatality rate
- Deteriorating environmental quality
- Fuel consumption

"Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus"

"Introducing Intelligent Transport Systems for traffic management"

. . . . . .NUTP

AIM

The study aims at assessment of

effects Transit Signal Priority on Bus Rapid Transit System

RESEARCH OBJECTIVES

- Performance assessment of Bus Rapid Transit System in Indian context
- Defining indicators for quantitative assessment for performance evaluation
- Using micro simulation tool for BRTS performance assessment.

RESEARCH APPROACH

Review of literature and regulatory regime	• Trends of urbanization, traffic and public transport, Policies and programmes for UT sector • Indicators (evaluation parameters)
Primary and secondary data collection	• Primary surveys for base model development • Secondary data (bus services, traffic inputs etc.)
Base model development	• Model development using different inputs as per primary and secondary survey • Validation and calibration
Scenario generation and evaluation	• Development of alternate scenarios (using different priority measures) • Result evaluation
Conclusions and recommendations	• Comparison (indicators) and efficacy analysis • Recommendations (design based)

LITERATURE REVIEW

Impacts

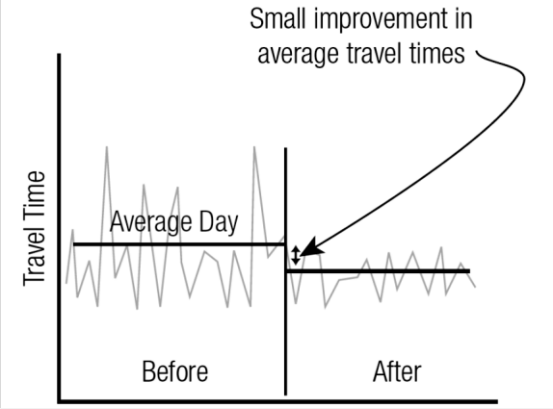
- **Rutherford S.(2010).** . . . . . "dedicated lane systems were always better than typical local busses running in mixed traffic"
  - **Improved level of service**
  - **Travel time saving**
- **Skabardonis A. (2010)** . . . . . "describes the formulation of both passive and active signal priority techniques for major roads" "examined the transit improvement strategies and identifies the major factors affecting transit priority"
  - **transit network improvements**
- **Zlatkovic et al (2013)** . . . . . "examined the independent and collective effects of queue jump lanes and signal priority system on performance of a Bus Rapid Transit system through Simulation"
  - **Bus TT improvement**
  - **Bus speed improvement**

Scale of projects

- STRATEGIC
- MESOSCOPIC
- MICROSCOPIC

Evaluation parameters

Variability indexing



Punctuality Index	$P_1 = \frac{S_1^2}{h_t^2}$
Variables	$S_1^2 = \frac{1}{I}\sum_{i=1}^{I}(t_i - \tau_i)^2$

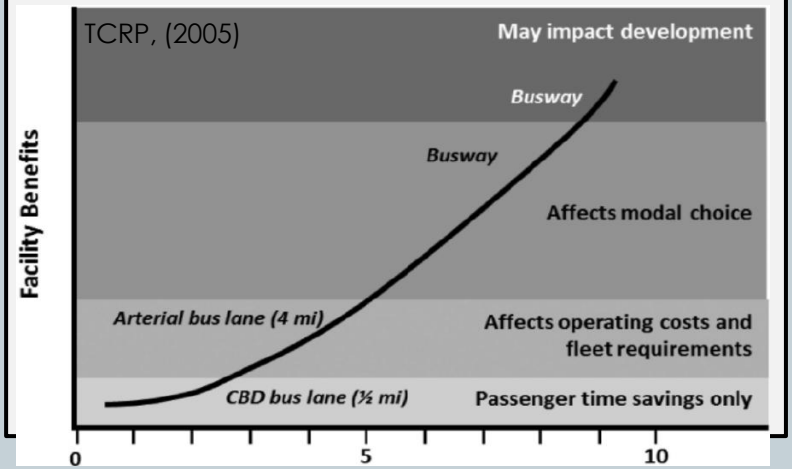
(Kho et al, 2005)

Travel time
Delay
Headway Variability
incidence

LITERATURE REVIEW

Dedicated lane based systems

- Inc. Operating speeds
  Graftieaux and Hildalgo (2008)
- Reduction in accidents and fatalities
  Hidalgo et al., 2012
- Pollution reduction
  Echeverry et al. (2005)
- User Comfort
  Cain et al., (2009)



Signal priority based systems

Portland bus service (10 junctions)

Green Ext, Red truncation

Reduction in bus TT by 1.4-6.4%
Reduction in Transit Delay (due to signal) by 20%

Toronto bus, street car (36 junctions)

Green Ext, Red truncation

Transit signal delay reduced 15-49%

LA, bus (211 junctions)

Actuated phasing

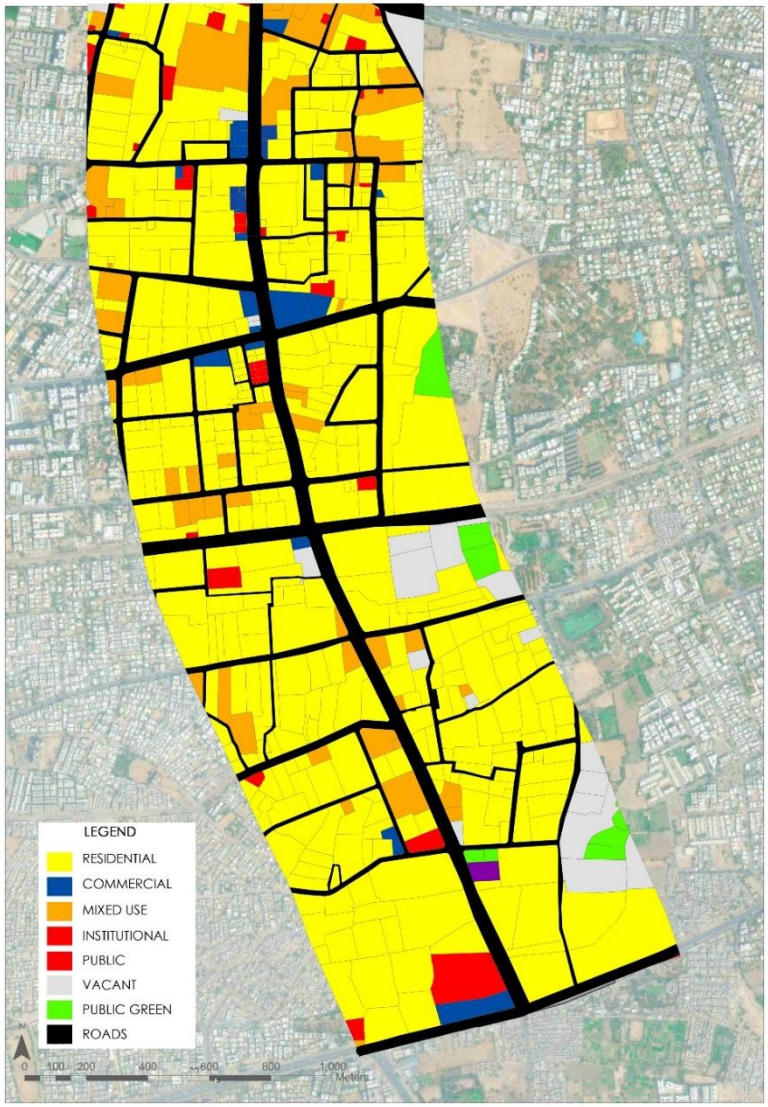
Reduction in bus travel time by 35%
Reduction in Transit Delay by 50%

TCRP, (2005)

- INTRODUCTION
- LITERATURE REVIEW
- **MODEL DEVELOPMENT**
- RESULTS EVALUATION AND CONCLUSIONS

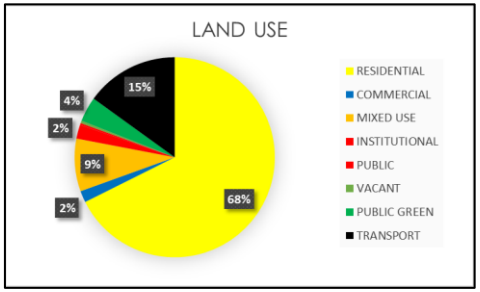
- *Test corridor and rationale*
- *Data collection and methodology*
- *Model development*
- *Calibration and validation*
- *Scenario development and sim-runs*

DESCRIPTION OF TEST CORRIDOR AND RATIONALE

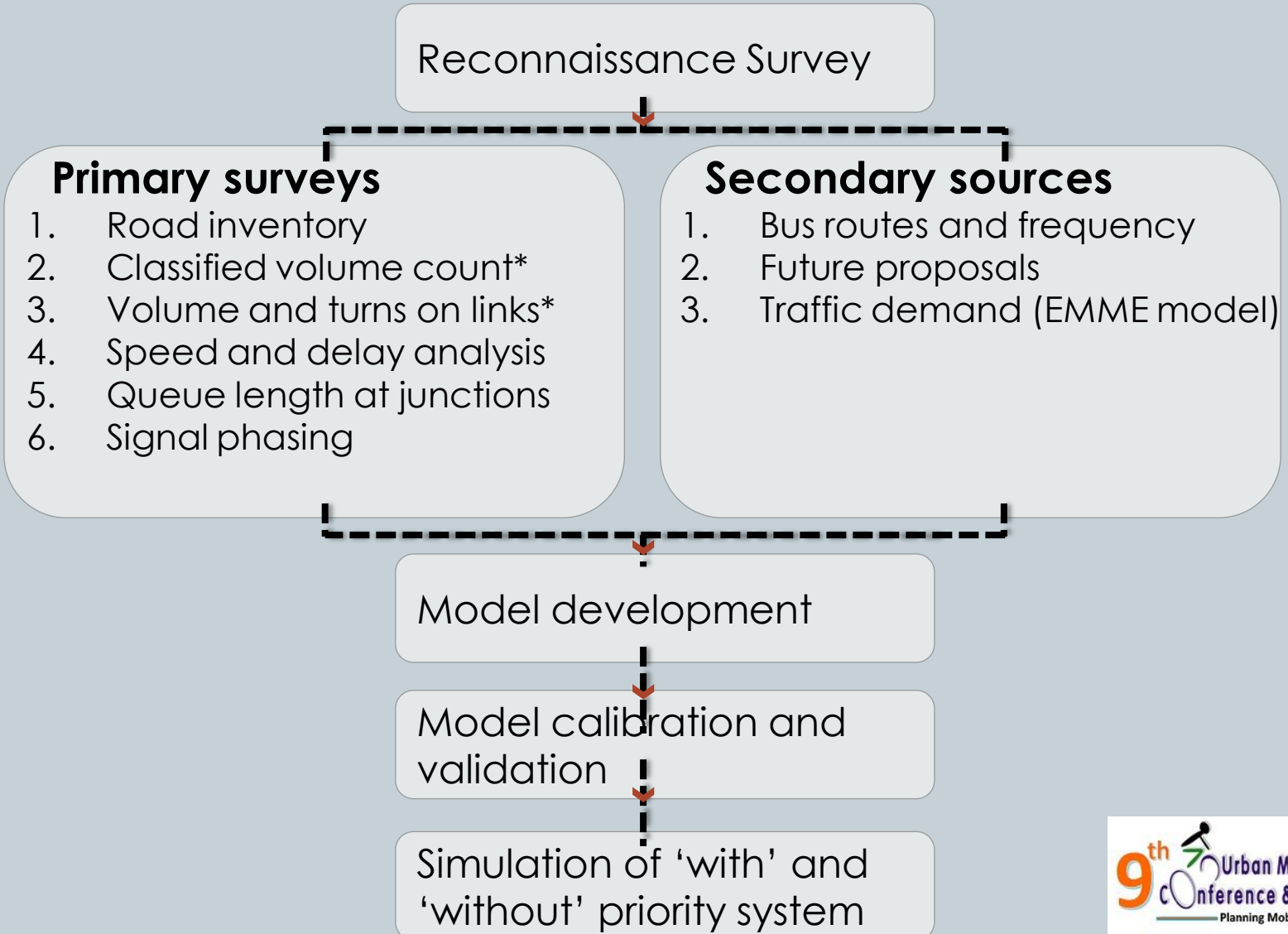


- The stretch from **Shivranjani to APMC junction is 3.15** km long and connects major commercial areas, high end residential areas like Shyamal and Anandnagar road, and Ashram road at Sarkhej APMC junction.

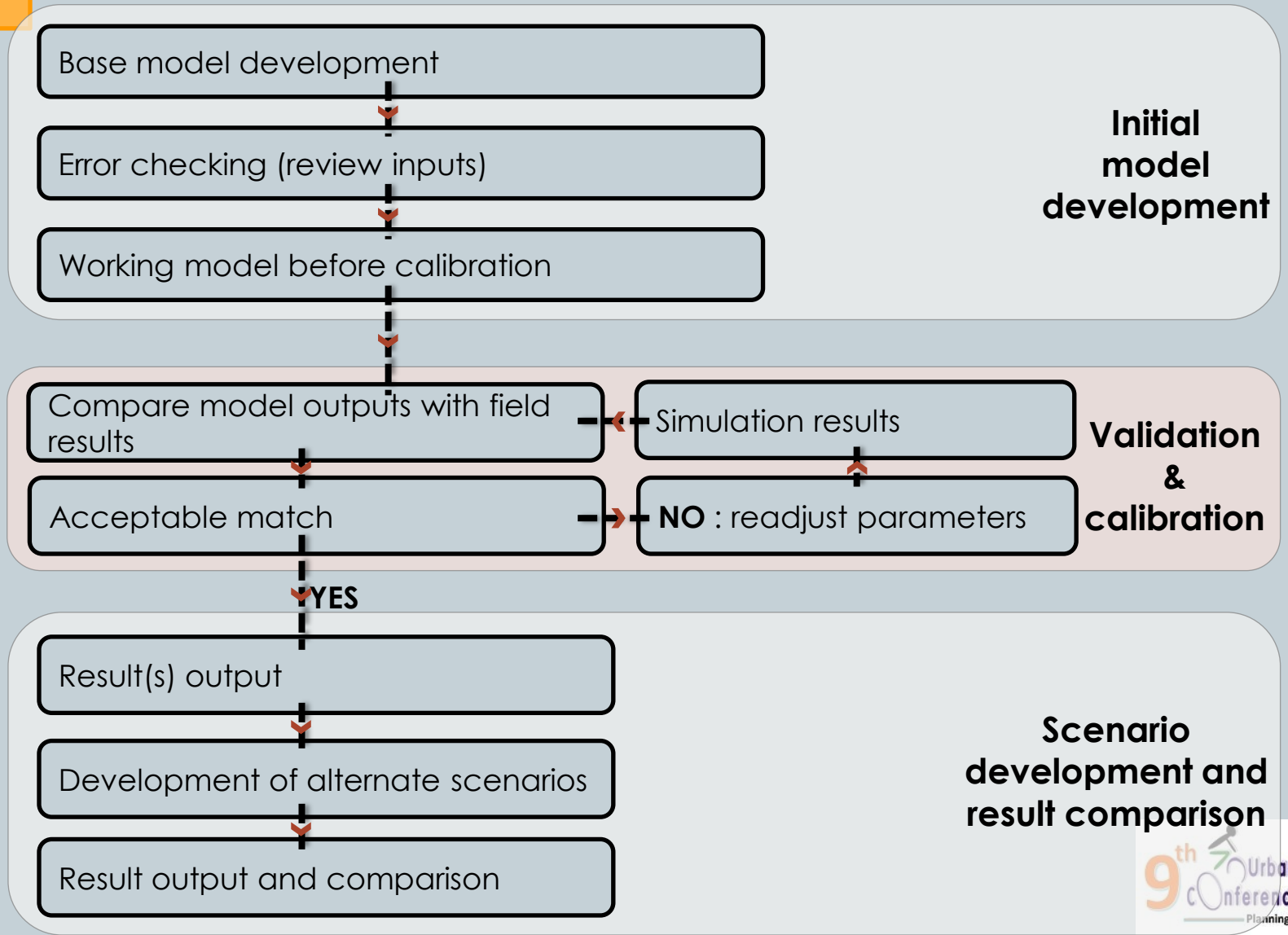
- Catchment area (500 m buffer) is 374 Ha with population of 62907. The employment in catchment area is 15276. The total population in catchment zone is around 78179.



DATA COLLECTION

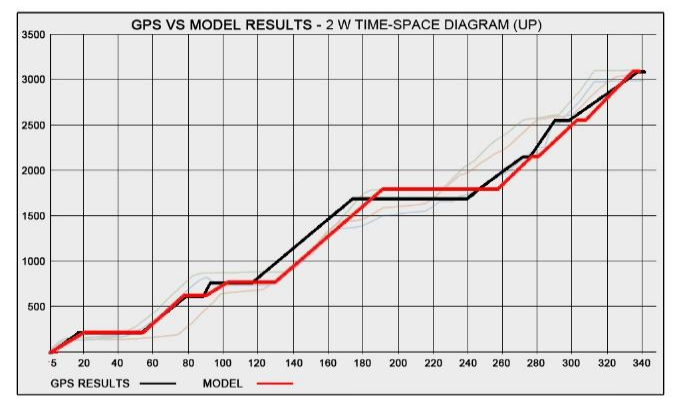


VISSIM MODEL DEVELOPMENT



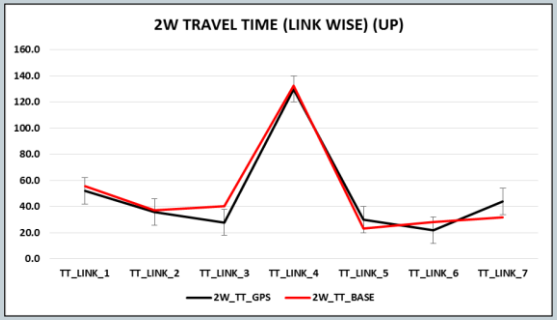
CALIBRATION AND VALIDATION

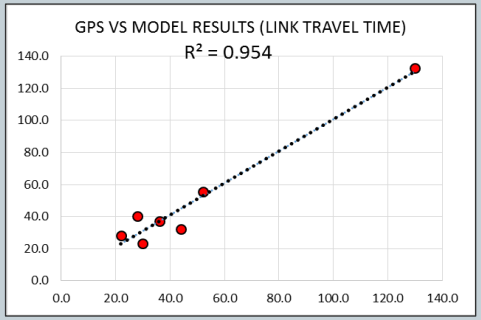
Speed and delay



GPS vs. model results

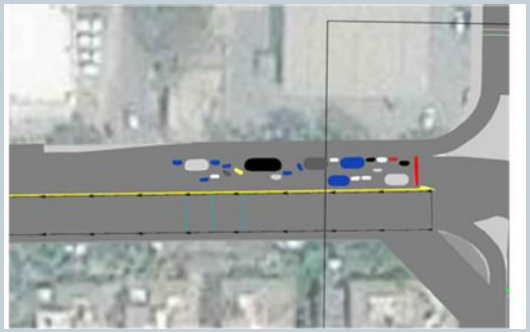
(fig. 2W calibration)

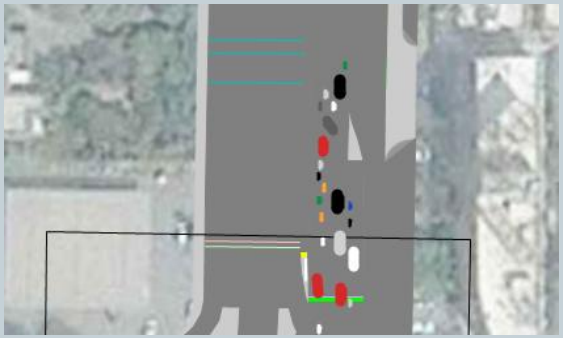




- GPS survey average (5 days) : TT and Delay (per link)
- Model calibration to achieve +95 % coincidence for travel time and delay.

Driving behavior





- Standstill distance 0.2 m
- Headway distance 0.5m,
- No cooperative lane change, waiting time before diffusion is 0 seconds

SCENARIOS DEVELOPMENT

	Network properties	Signal priority
BASE SCENARIO (Business as usual)	• Base network representing site • Curb side bus stations	N/A
Segregated lane	• Segregated bus lanes • Central bus stations	No signal priority
Segregated lane with passive signal priority		Passive signal priority
Segregated lane with active signal priority		Active signal priority (VAP)

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- **RESULTS EVALUATION AND CONCLUSIONS**

- *Results comparison for various indicators*
- *Conclusions*

BUS PERFORMANCE

Bus travel time

Bus Delay

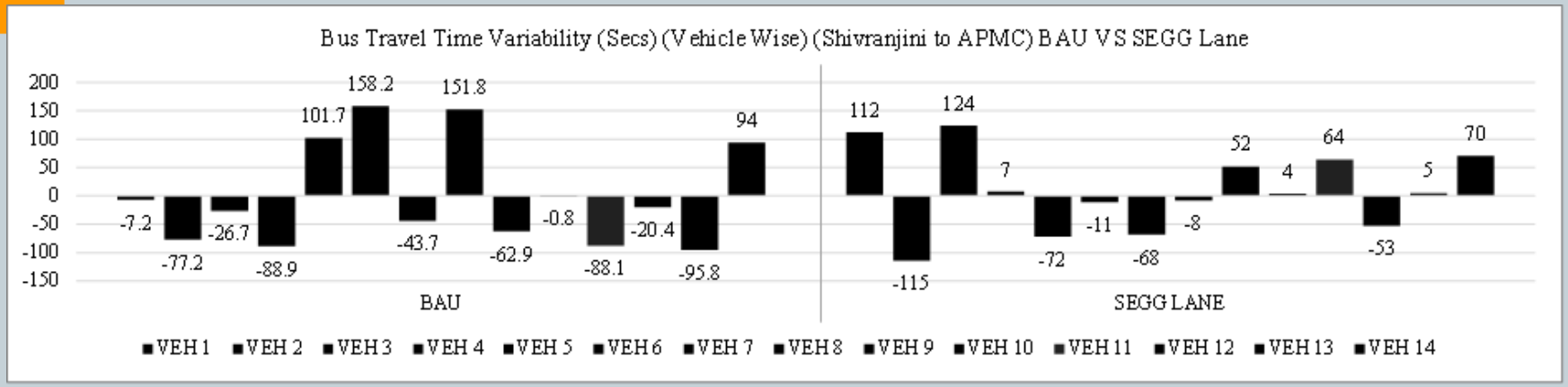
No significant reduction

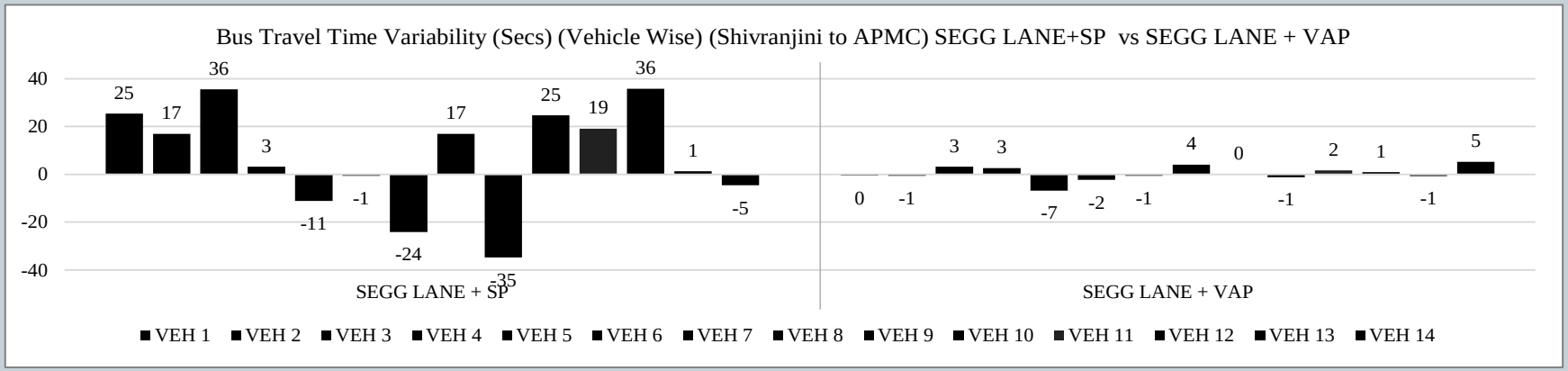
Reduction by **10 %**

Reduction by **30 %**

- VAP resulted in max. delay reduction
- Vehicle maneuvering from one lane to other resulted in delay (less amount)

BUS TRAVEL TIME VARIABILITY





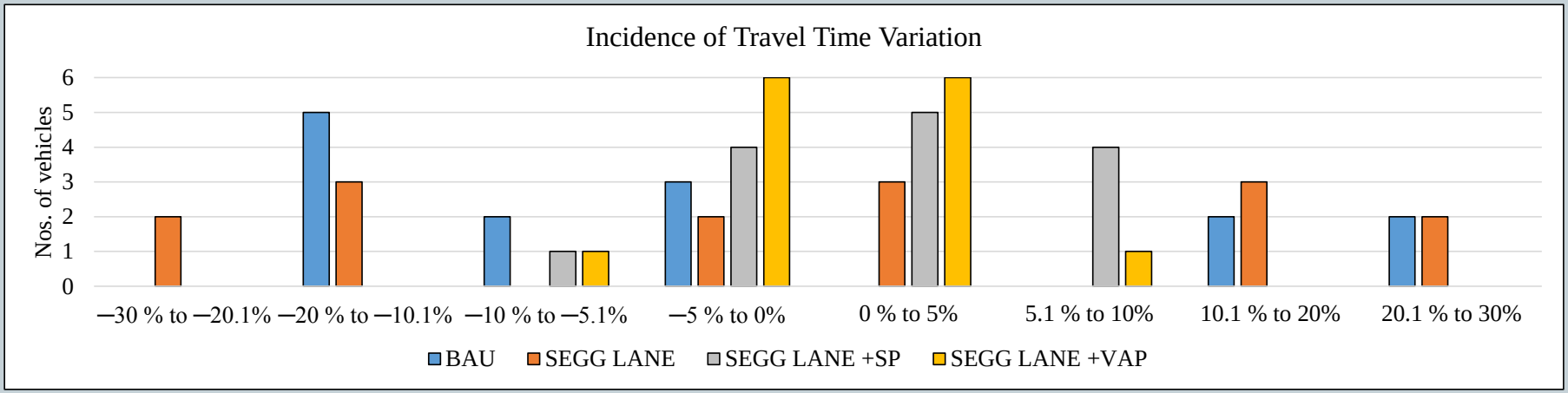
Business as usual

± 30 % variation

SEGG LANE + VAP

-10 % to +10 %variation

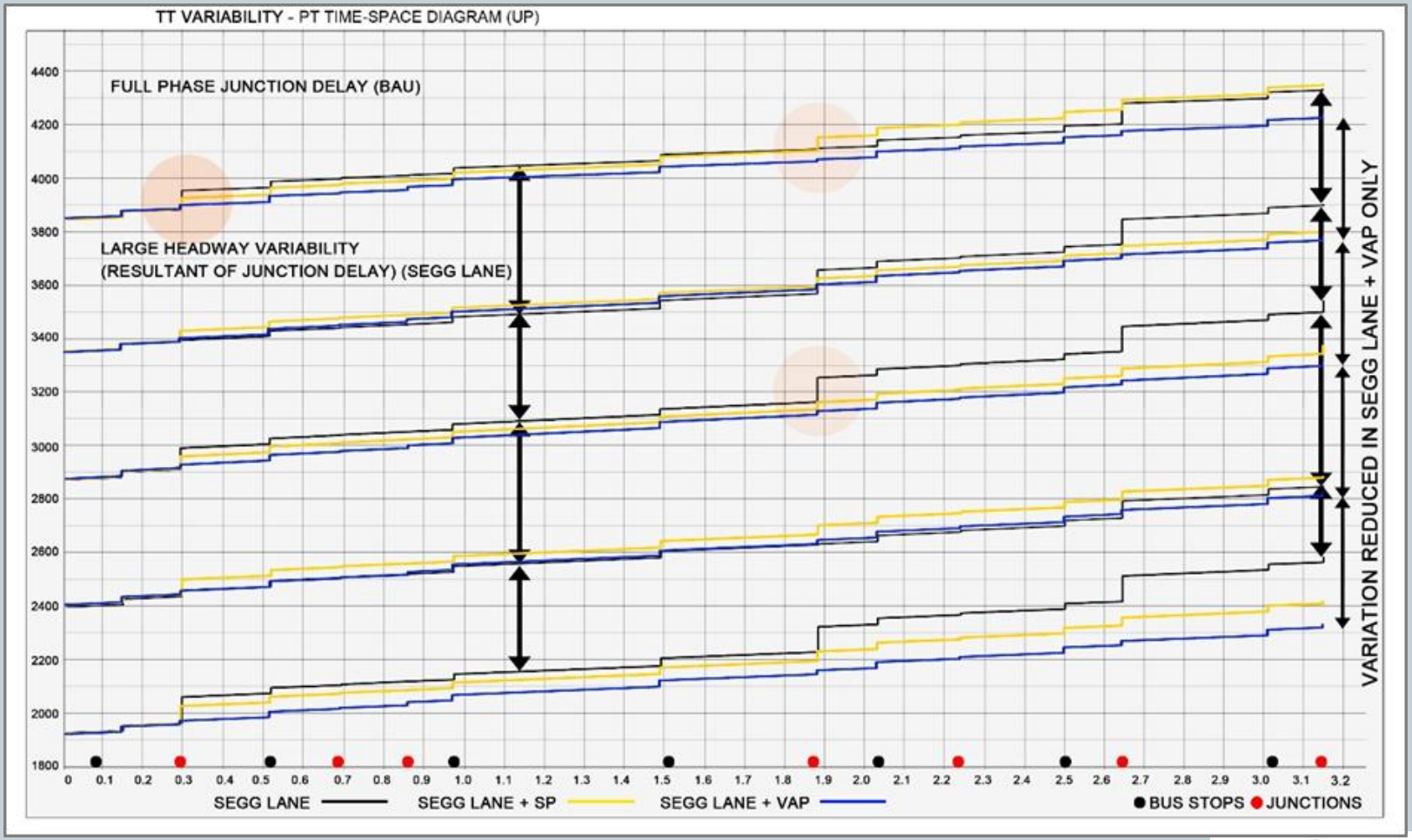
BUS TRAVEL TIME VARIABILITY INCIDENCE



SEGG L → **SEGG L + SP** → **SEGG L +VAP**

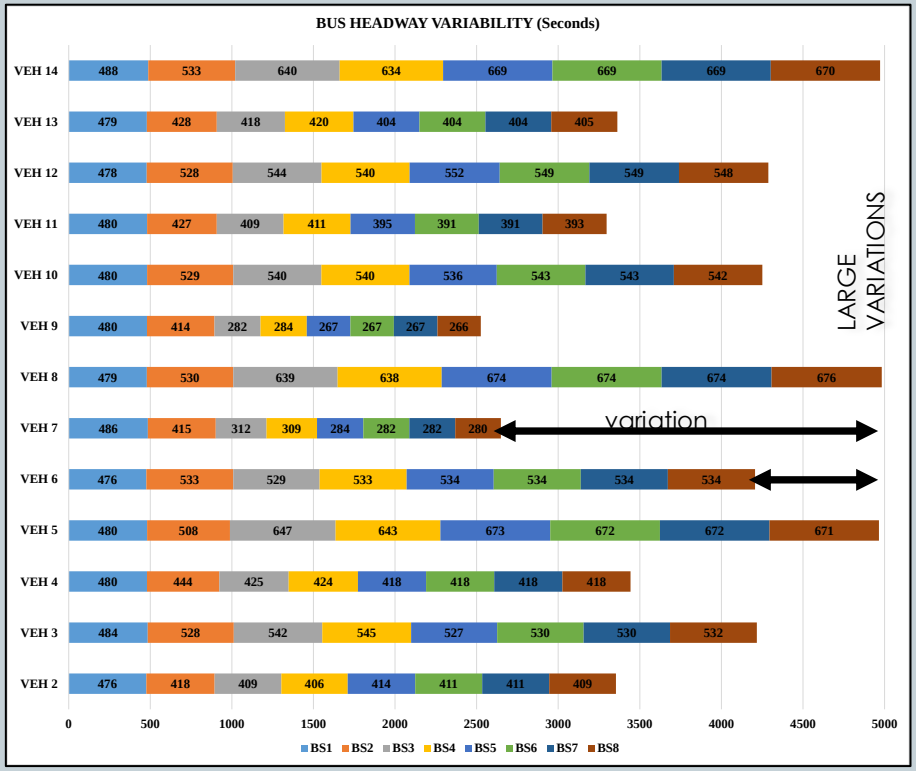
SEGG L	SEGG L + SP	SEGG L +VAP
-115 SECS to 124 SECS	-35 SECS TO 36 SECS	-7 SECS TO 5 SECS
16 %	4.9 %	2.9 %

ARRIVAL TIME VARIABILITY

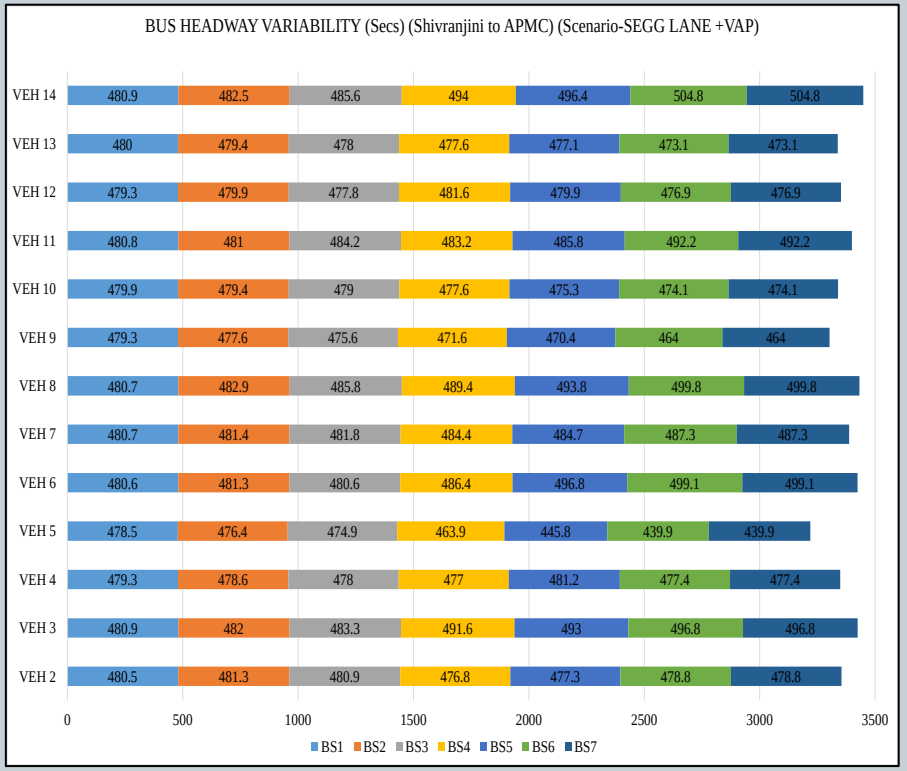


HEADWAY VARIABILITY

Business as usual



SEGG LANE + VAP



CONCLUSIONS

	Short term	Long term
No priority	• No significant improvement compared with BAU	• Travel time increase compared with BAU resultant of delay increase (junction signaling).
Passive signal priority	• improvement (bus) comparison to business as usual. • No improvement for private vehicles	• Bus TT and delay increases gradually • No negative impact on private vehicles (gradual increase)
Active signal priority	• Maximum improvement with comparison to other priority systems. • Private vehicle (3W and 4W affected)	• Bus TT, delay remain unaffected • Private vehicle performance deterioration • Poor network performance

Thank you