



# Assessing the Impact of Shift of AMTS buses on the BRTS Corridor

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# Background

Ahmedabad city has two bus based transport systems:

- The Ahmedabad Municipal Transport Service (AMTS), (runs in mixed traffic)
- The Bus Rapid Transport System (BRTS): Janmarg, started in 2009

## 2015

- AMC shifted 46 AMTS buses to move in BRTS corridors. (2 corridors : Iskon to Shivranjini & Tilak Bagh to Sarangpur)

## 2018

- Again, decision to shift AMTS buses to BRTS corridor was taken.
- A total of 320 buses and 41 routes were shifted to BRT corridor.
- Routes running parallel to BRTS were shifted in the corridor
- Currently GSRTC buses are also allowed to run inside the corridor

## Problem Statement

- **Competition among both the services** for passengers moving to the same destinations
- **Lack of operational integration** of BRTS and AMTS
- This may adversely impact overall public transport instead of benefitting

## Research Question

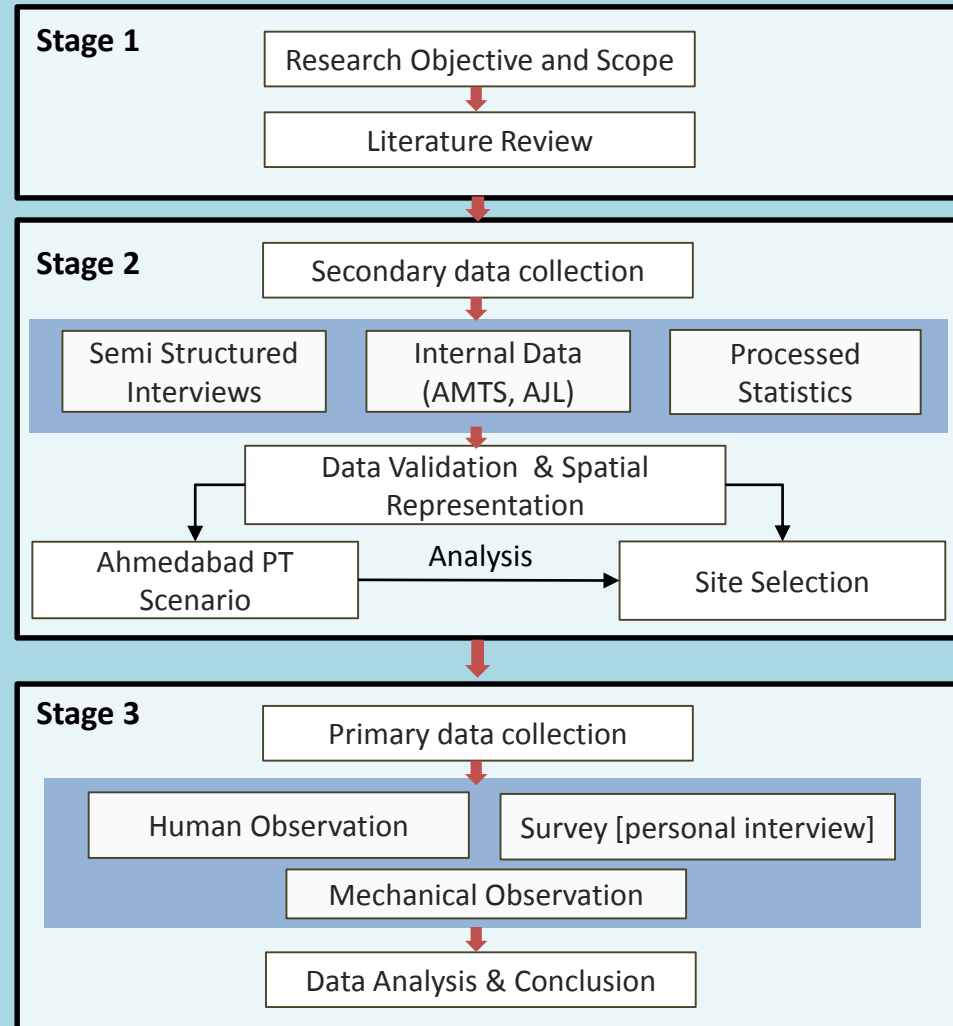
- Did the AMTS buses running in the BRTS corridor **impact the operations** of the of the public transport system?
- What **changes did the users face** due to shift of AMTS to the BRTS Corridor

# Aim & Objective

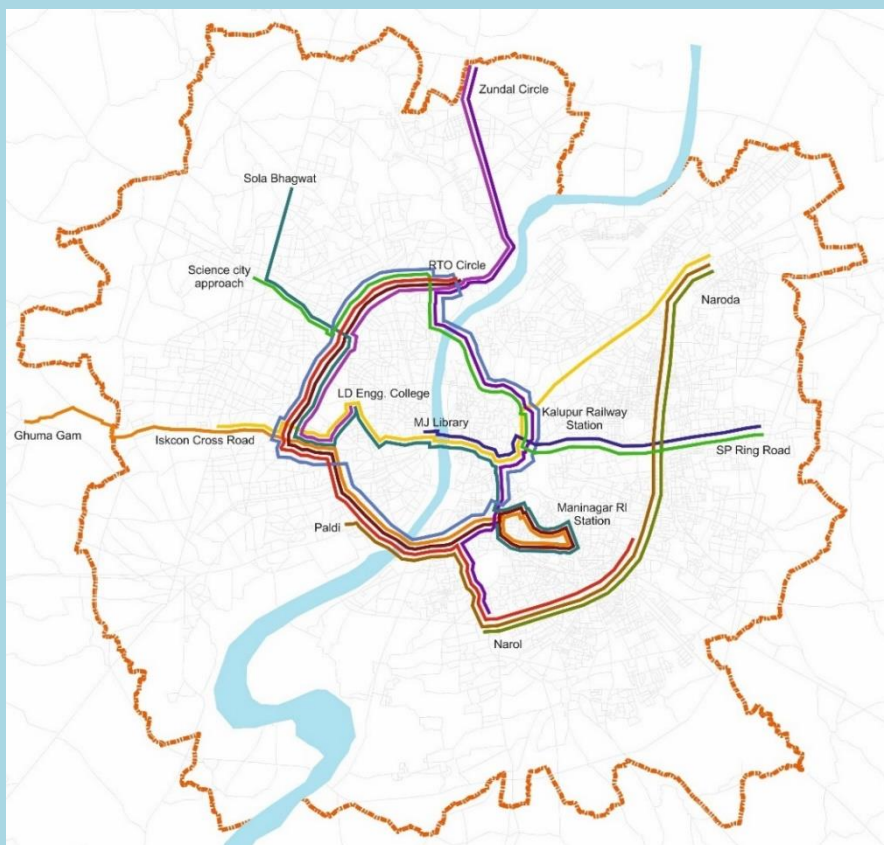
The aim of the research was to study the **impacts of shifting of AMTS bus routes to the BRTS corridor on different stakeholders**

- ❑ Identification and analysis of current public transport scenario in Ahmedabad
- ❑ To understand the impact AMTS buses using the BRTS Corridor on
  - Janmarg bus operation
  - AMTS operations
  - On Mixed Vehicle lanes
- ❑ To understand the impact of shift of AMTS buses to the BRT corridor on the users

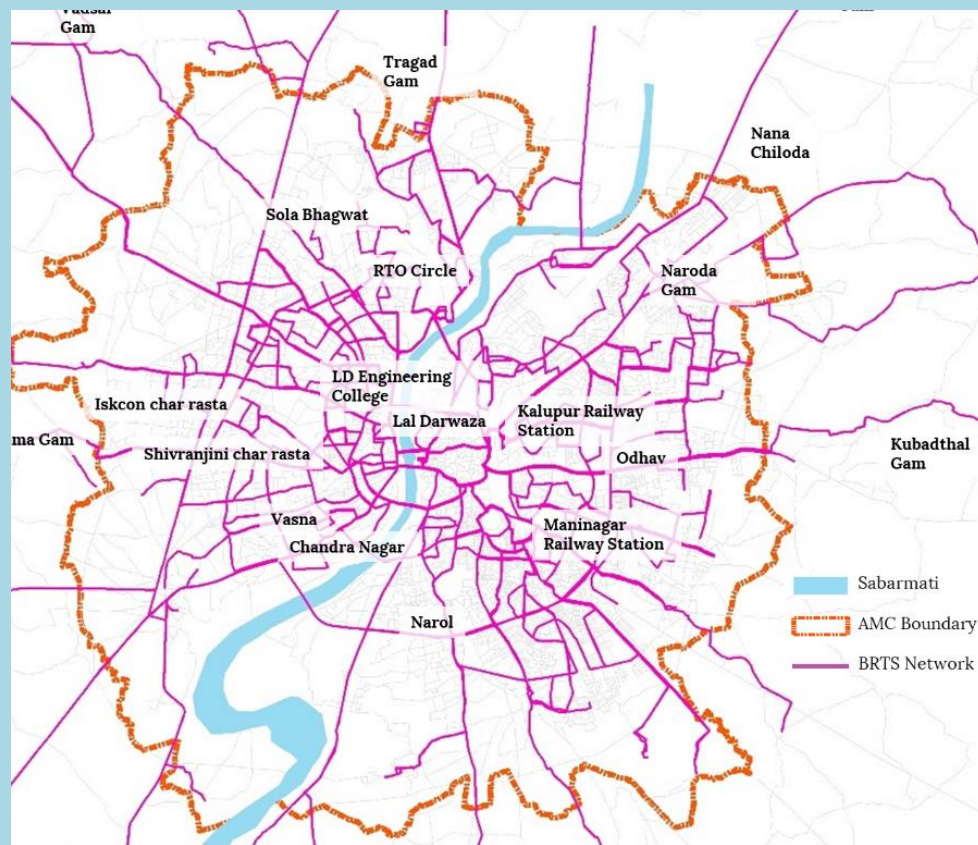
# Methodology



## BRTS



## AMTS



### BRTS

|                      | BRTS          |
|----------------------|---------------|
| Routes               | 15            |
| Fleet Size           | 236           |
| Network Length       | 101 km        |
| Headway              | 3min   15min  |
| CPKM   EPKM          | 68 Rs   38 Rs |
| Avg. daily ridership | 1.40 lakh     |

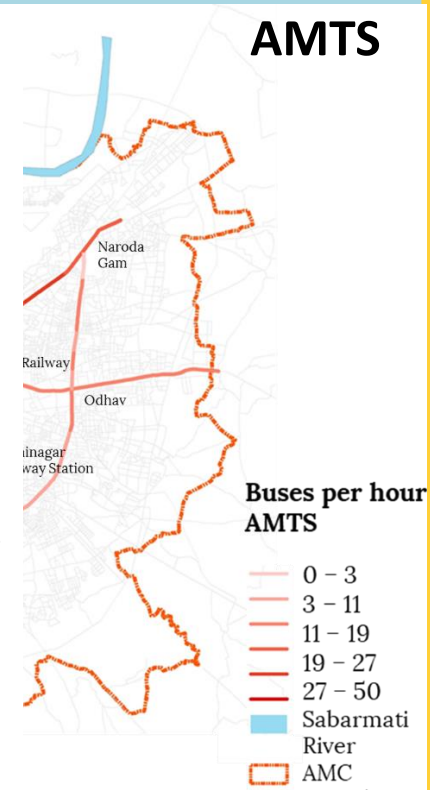
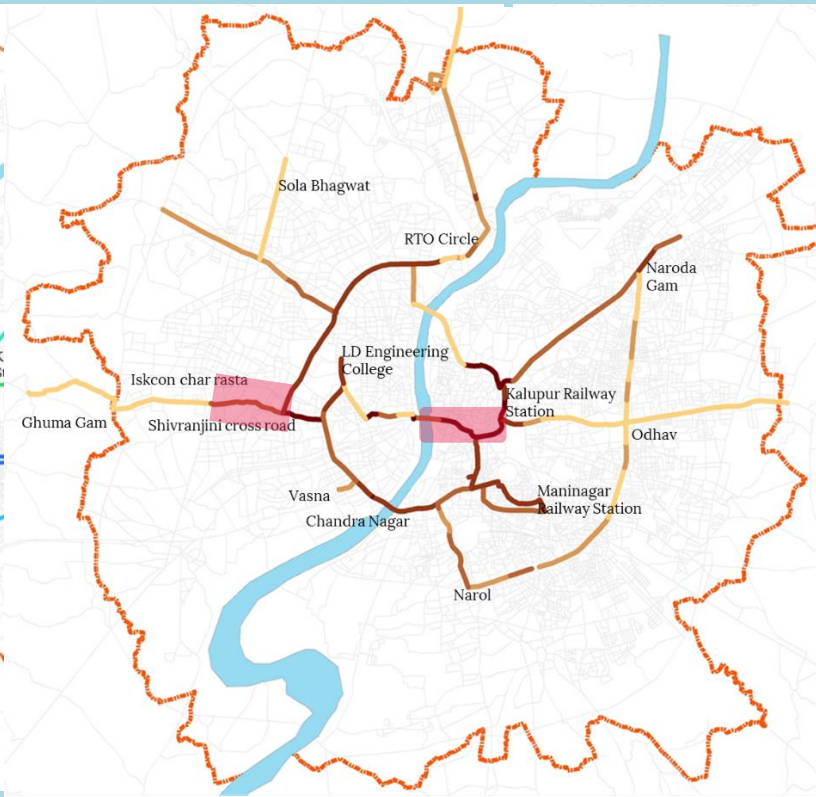
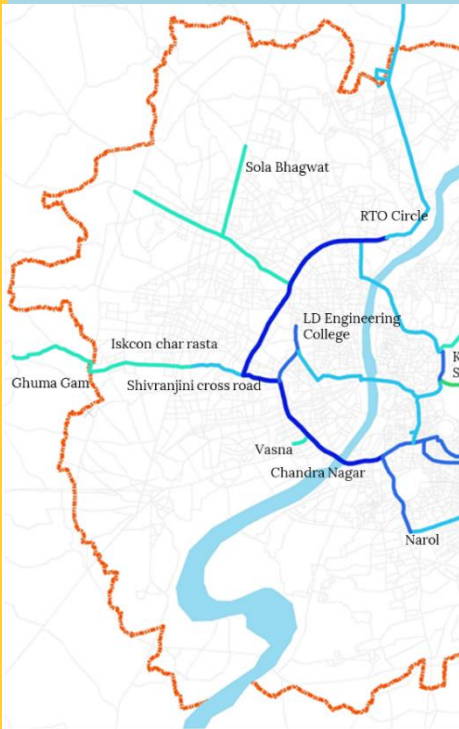
### AMTS

|                      | AMTS           |
|----------------------|----------------|
| Routes               | 173            |
| Fleet Size           | 706            |
| Network Length       | 634 km         |
| Headway              | 10min   180min |
| CPKM   EPKM          | 88 Rs   27 Rs  |
| Avg. daily ridership | 5.70 lakh      |

# Site Selection:

With focus on BRTS Corridor, frequency of buses per hour for AMTS and BRTS was seen

**AMTS**



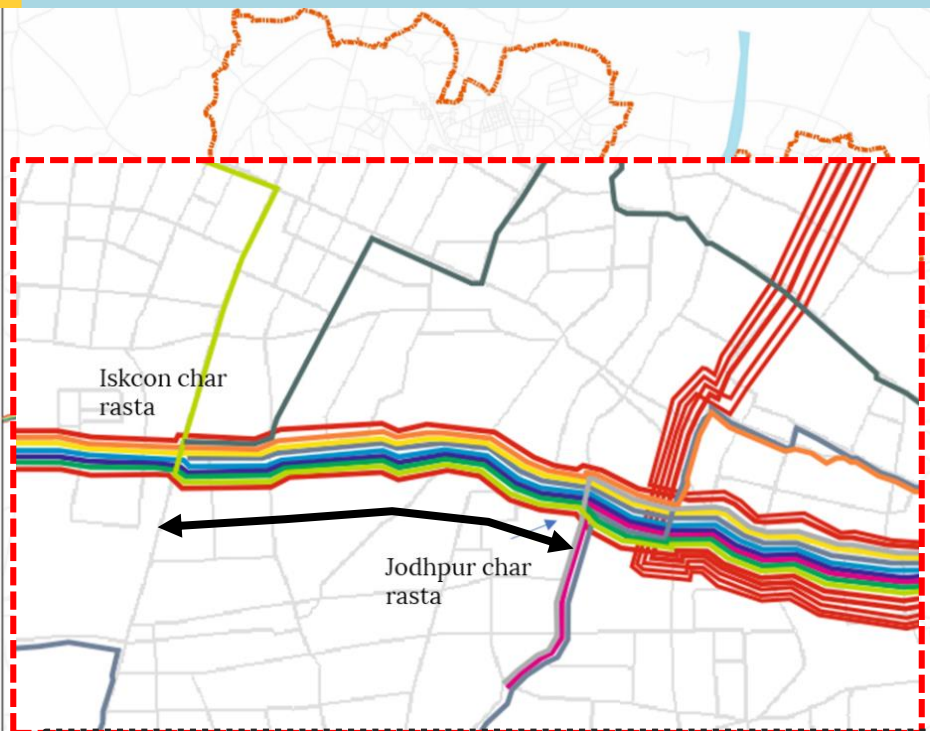
2 stretches on either side of the river were selected.

- One with highest frequency of AMTS buses
- Another with less frequency

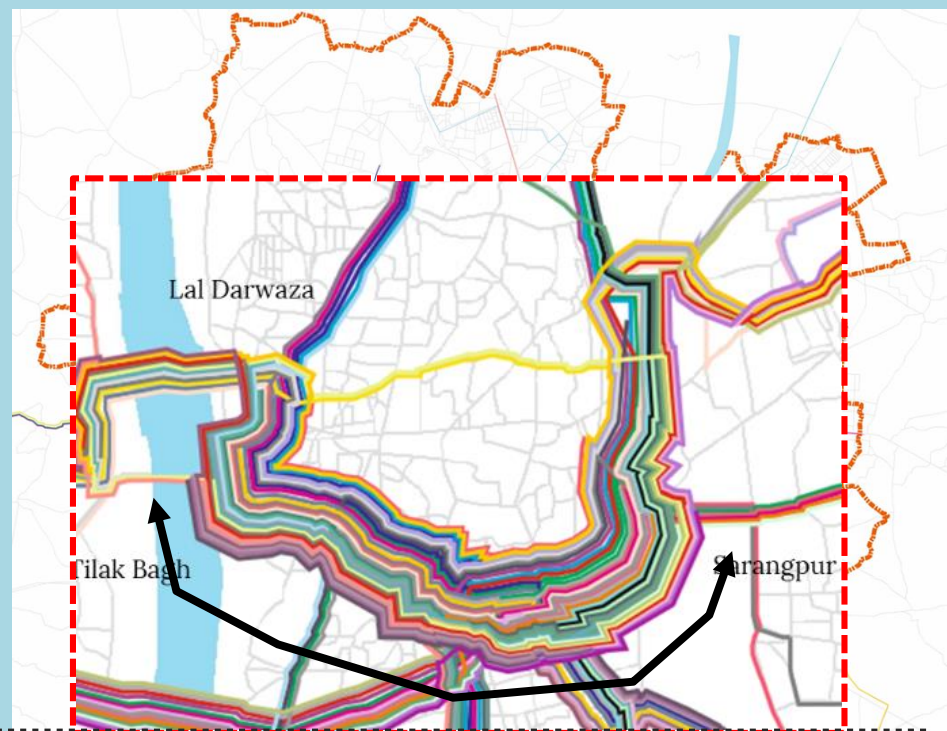
**Site 1 Iskcon Cross road to Jodhpur Cross Road**

**Site 2 Lokmanya Tilak Bagh to Sarangpur Darwaza**

## Stretch 1 (Iskcon Cross road to Jodhpur Cross Road)



## Stretch 2 (Lokmanya Tilak Bagh to Sarangpur Darwaza)



Primary data collection on both sites were done to obtain the following information

- Speeds and Delay (Through Speed GPS Android App)
- Delay & Dwell Time (Calculated using stopwatch)
- Frequency of buses (Measured at Bus stations)
- Traffic volumes (Measured using videography)
- User Survey (Primary survey through structured questionnaire)

# Objective 2-1

## Impact on BRTS: Speed: Stretch 1

Impact on  
BRTS

Stretch 1

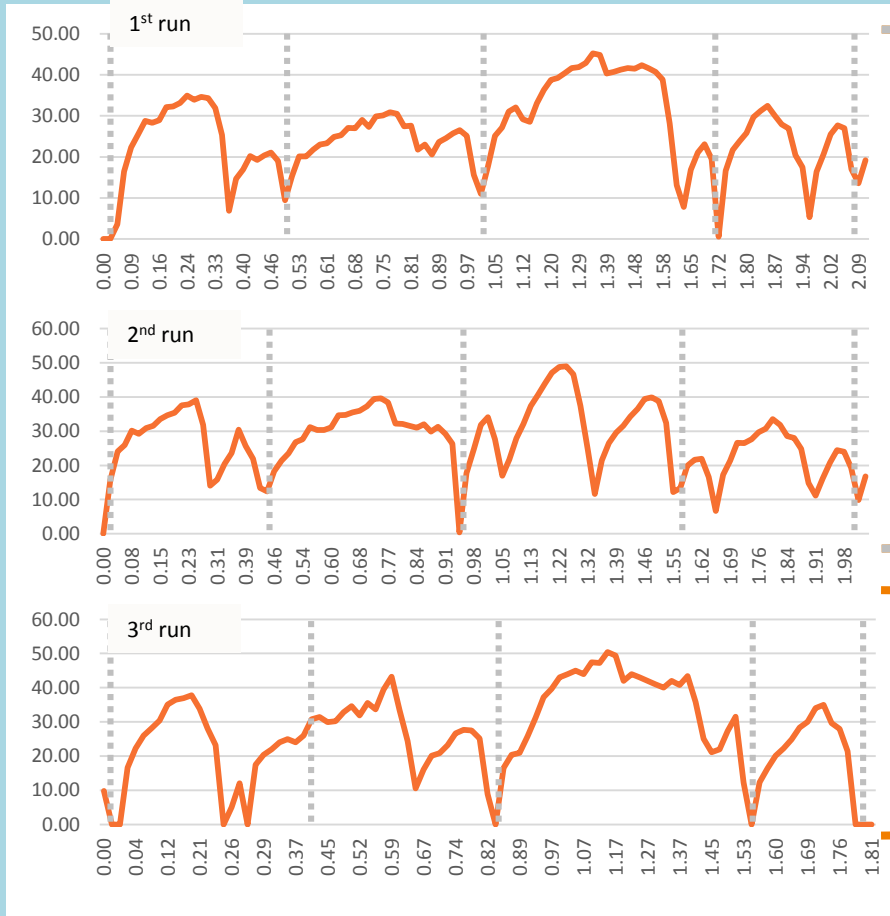
Speed

Stretch 2

Frequency

Dwell Time

### Stretch 1 Iskcon cross road to Jodhpur cross road [Speeds in peak hour]



Average speed = **17.06 kmph**

Avg Speed = 17.62

- It is less than **20kmph** [commercial speed of BRTS in Ahmedabad]

- It is less than **24.49 kmph**, i.e. average speed in 2014 following AMTS & GSRTC Buses BRTS Ahmedabad, CoE – UT CEPT)

Avg Speed = 16.50

Average Speed : 17.06 kmph

- **Average speed decreased by 30%**

Average speed = **23.15 kmph**

Avg Speed = 23.15

- More than **20kmph**
- Approximately equal to speed in 2014 i.e. Speed in corridor with only BRTS Bus **24.49 kmph**, (Source: Speed delay analysis of BRTS Ahmedabad, CoE – UT-CEPT)

\*All speeds in kmph

— Speeds BRTS

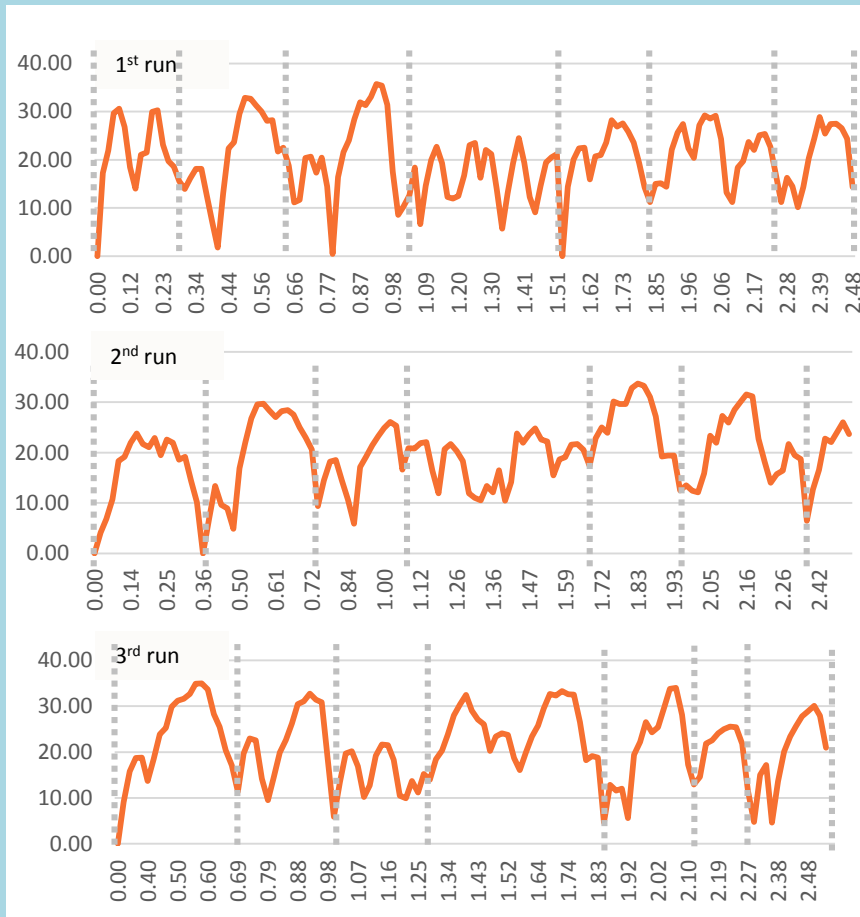
..... BRTS bus station

# Objective 2-1

## Impact on BRTS: Speed: Stretch 2

| Impact on BRTS | Stretch 1 | Speed      |
|----------------|-----------|------------|
|                | Stretch 2 | Frequency  |
|                |           | Dwell Time |

### Stretch 2 Sarangpur Darwaza to Lokmanya Tilak Bagh [Speeds in peak hour]



#### Bus speeds variation

Average bus speed : **14.30 kmph**  
 Avg Speed = 14.93  
 The bus average speeds vary as the signalised junction phasing

- It is less than **20 kmph** [signalised junction speed] in Ahmedabad. Junctions are managed manually by traffic police with

- It is less than **24.77 kmph** [average speed in 2015 from Iskcon to Naroda Corridor (Source: Performance Evaluation of BRT in Ahmedabad, Karan Gandhi, dissertation report)]

Avg Speed = 12.10  
 Speeds in segregated corridor and unsegregated corridor almost same

- Average speeds are lesser than average speeds of unsegregated corridor in 2015, i.e. 19 kmph

|                | unsegregated corridor | segregated corridor |
|----------------|-----------------------|---------------------|
| 1st run        | 15.25                 | 16.34               |
| 2nd run        | 16.4                  | 12.47               |
| 3rd run        | 16.84                 | 16.26               |
| Average speeds |                       |                     |

- It is less than **28 kmph** i.e. speeds in BRTS corridor where no AMTS buses run inside

- Average speed seem to have decreased by **42%**

\*All speeds in kmph

# Objective 2-1

## Impact on BRTS: Frequency: Stretch 1

|                |           |            |
|----------------|-----------|------------|
| Impact on BRTS | Stretch 1 | Speed      |
|                | Stretch 2 | Frequency  |
|                |           | Dwell Time |

### Stretch 1 Iskcon cross road to Jodhpur cross road

| 5 min interval at ISRO |                           |      |                            |      |
|------------------------|---------------------------|------|----------------------------|------|
|                        | Towards Iskcon Char Rasta |      | Towards Jodhpur Char Rasta |      |
| Time                   | BRTS                      | AMTS | BRTS                       | AMTS |
| 09:30                  | 2                         | 2    | 1                          | 2    |
| 09:35                  | 2                         | 1    | 3                          | 0    |
| 09:40                  | 2                         | 1    | 2                          | 0    |
| 09:45                  | 2                         | 2    | 1                          | 1    |
| 09:50                  | 0                         | 1    | 2                          | 3    |
| 09:55                  | 2                         | 1    | 1                          | 1    |
| 10:00                  | 1                         | 1    | 0                          | 1    |
| 10:05                  | 1                         | 0    | 2                          | 3    |
| 10:10                  | 3                         | 1    | 2                          | 2    |
| 10:15                  | 1                         | 2    | 2                          | 0    |
| 10:20                  | 2                         | 0    | 2                          | 1    |
| 10:25                  | 1                         | 3    | 1                          | 1    |
| Total                  | 34                        |      | 34                         |      |

### Observations

Bus per hour in peak hour **< 45** per direction

The BRTS bus stations were designed to accommodate around 45 buses per hour per direction.

(Source: Bus station design, Professor HMS Swami, Dr. Abhijit Lokre)

Buses per hour :BRTS **20**  
:AMTS **17**

Bus **arrival time not uniform** over the course of one hour

::Count of real time bus arrival at ISRO at interval of 5 min

# Objective 2-1

## Impact on BRTS: Frequency: Stretch 2

|                |           |            |
|----------------|-----------|------------|
| Impact on BRTS | Stretch 1 | Speed      |
|                | Stretch 2 | Frequency  |
|                |           | Dwell Time |

| 5 min interval at tilak bagh |      |                   |      |      |
|------------------------------|------|-------------------|------|------|
| Towards Law College          |      | Towards Sarangpur |      |      |
| Time                         | BRTS | AMTS              | BRTS | AMTS |
| 05:25                        | 1    | 6                 | 3    | 4    |
| 05:30                        | 1    | 3                 | 0    | 4    |
| 05:35                        | 1    | 2                 | 1    | 4    |
| 05:40                        | 0    | 2                 | 0    | 4    |
| 05:45                        | 1    | 5                 | 2    | 3    |
| 05:50                        | 2    | 2                 | 1    | 4    |
| 05:55                        | 2    | 2                 | 0    | 1    |
| 06:00                        | 1    | 5                 | 2    | 5    |
| 06:05                        | 1    | 1                 | 2    | 4    |
| 06:10                        | 2    | 4                 | 1    | 3    |
| 06:15                        | 0    | 2                 | 0    | 4    |
| 06:20                        | 1    | 6                 | 1    | 3    |
| 06:25                        | 1    | 0                 | 0    | 1    |
| 06:30                        | 2    | 5                 | 1    | 2    |
| 06:35                        | 2    | 5                 | 0    | 5    |
| 06:40                        | 1    | 3                 | 1    | 9    |
| 06:45                        | 1    | 2                 | 2    | 0    |
| 06:50                        | 0    | 3                 | 2    | 2    |
| 06:55                        | 3    | 5                 | 3    | 3    |
| 07:00                        | 0    | 7                 | 2    | 4    |
| 07:05                        | 0    | 4                 | 1    | 4    |

| Time duration                      | Buses per hour      |                   |
|------------------------------------|---------------------|-------------------|
|                                    | Towards Law college | Towards Sarangpur |
| 5:25 to 6:25                       | 53                  | 56                |
| 5:30 to 6:30                       | 47                  | 50                |
| 5:35 to 6:35                       | 50                  | 49                |
| 5:40 to 6:40                       | 54                  | 49                |
| 5:45 to 6:45                       | 56                  | 55                |
| 5:50 to 6:50                       | 53                  | 52                |
| 5:55 to 6:55                       | 52                  | 51                |
| 6:00 to 7:00                       | 56                  | 56                |
| 6:05 to 7:05                       | 57                  | 55                |
| 6:10 to 7:10                       | 59                  | 54                |
| 10 min interval (6 to 7 peak hour) |                     |                   |
|                                    | Towards Law college | Towards Sarangpur |
| 0-10 min                           | 8                   | 13                |
| 10-20 min                          | 8                   | 8                 |
| 20-30 min                          | 8                   | 5                 |
| 30-40 min                          | 14                  | 8                 |
| 40-50 min                          | 7                   | 12                |
| 50-60 min                          | 11                  | 10                |
| Total Buses                        | 56                  | 56                |

### Stretch 2 Sarangpur Darwaza to Lokmanya Tilak Bagh

#### Observations

Bus per hour in peak hour **> 45** per direction

The BRTS bus stations were designed to accommodate around 45 buses per hour per direction.

(Source: Bus station design, Professor HMS Swami, Dr. Abhijit Lokre)

Buses per hour :BRTS **14**  
:AMTS **46**

Bus **arrival time not uniform** over the course of one hour

# Objective 2-1

## Impact on BRTS: Dwell & Queueing Time

|                |           |            |
|----------------|-----------|------------|
| Impact on BRTS | Stretch 1 | Speed      |
|                | Stretch 2 | Frequency  |
|                |           | Dwell Time |

### Stretch 1 Iskcon cross road to Jodhpur cross road

| Bus station        | Queueing time range (seconds) | Dwell time range (seconds) |
|--------------------|-------------------------------|----------------------------|
| Iskcon Char Rasta  | 0 to 120                      | 10 to 20 (exc. 60)         |
| Ramdev Nagar       | 0-25                          | 8 to 12                    |
| ISRO               | 0-20                          | 5 to 12                    |
| Star Bazar         | 0-20                          | 5 to 15                    |
| Jodhpur Char Rasta | 0-35                          | 8 to 18                    |

### Stretch 2 Sarangpur Darwaza to Lokmanya Tilak Bagh

| Bus station            | Queueing time range (seconds) | Dwell time range (seconds) |
|------------------------|-------------------------------|----------------------------|
| Tilak Bagh             | 0 to 80                       | 8 to 25                    |
| Raikhad Char rasta     | 0-30                          | 8 to 18                    |
| AMC Corporation        | 0-20                          | 5 to 12                    |
| Astodia Chakala        | 0-20                          | 8 to 10                    |
| Astodia Darwaza        | 0-45                          | 5 to 15                    |
| Raipur Darwaza         | 0-50                          | 5 to 12                    |
| Karnamukteshwar Mandir | 0-20                          | 10 to 20                   |
| Sarangpur Darwaza      | 0-45                          | 8 to 35                    |



Bus bunching observed at bus stop

In Ahmedabad BRTS, usual dwell time = 10-20 sec;  
Usual Queueing time= 0-15 sec

Observed queueing time 45 - 80 seconds and dwell time exceeding up to 35 seconds.

This was observed due to the reason of bus bunching at bus stations and lack of integrated schedules.

# Objective 2-2

## Impact on AMTS: Speed: Stretch 1

Impact on  
AMTS

Stretch 1

Stretch 2

### Scenario1: AMTS following, other buses

Speeds inside the BRTS corridor, and in the MV Lane are similar

- Avg speed in BRTS Corridor : 18.35kmph
- Avg speed in MV Lane: 17.7kmph

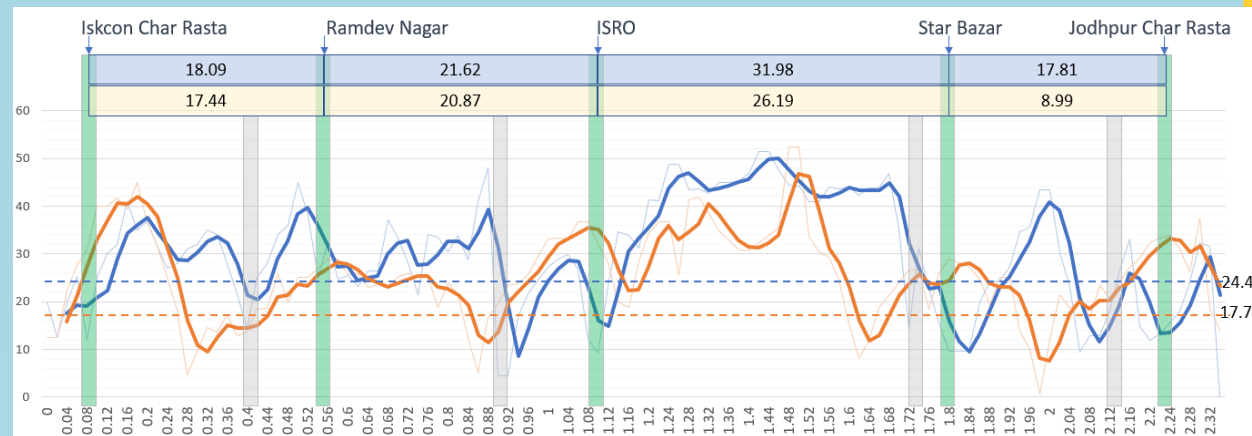
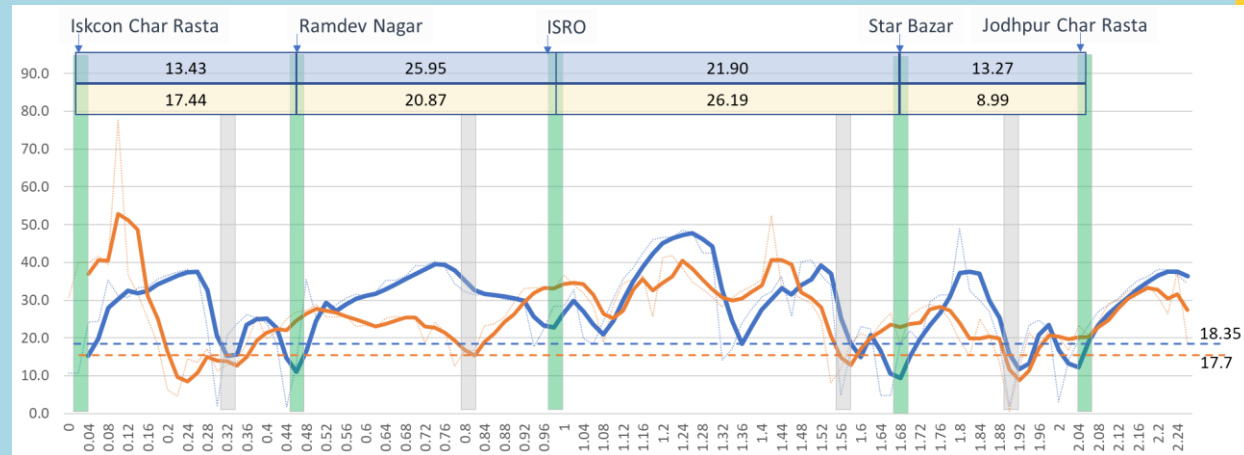
### Scenario2 :Speeds when buses do not run in proximity to each other

Average speeds inside the BRTS corridor, and in the MV lane differ by 26%

- Avg speed in BRTS Corridor : 24.4kmph
- Avg speed in MV Lane: 17.7kmph

### Observations

- The two scenario, indicates that the AMTS buses when not following BRTS buses, get an advantage of higher speeds.
- It also indicates **towards need of integrated operational plans** of both services



- Spot Speeds MV Lane
- Moving average speed MV Lane
- Moving average speed BRT Lane

- BRTS Station
- Junction
- Unsegregated lane

Average speed BRT Lane

Average speed MV Lane

# Objective 2-2

## Impact on AMTS: Speed: Stretch 2

Impact on  
AMTS

Stretch 1

Stretch 2

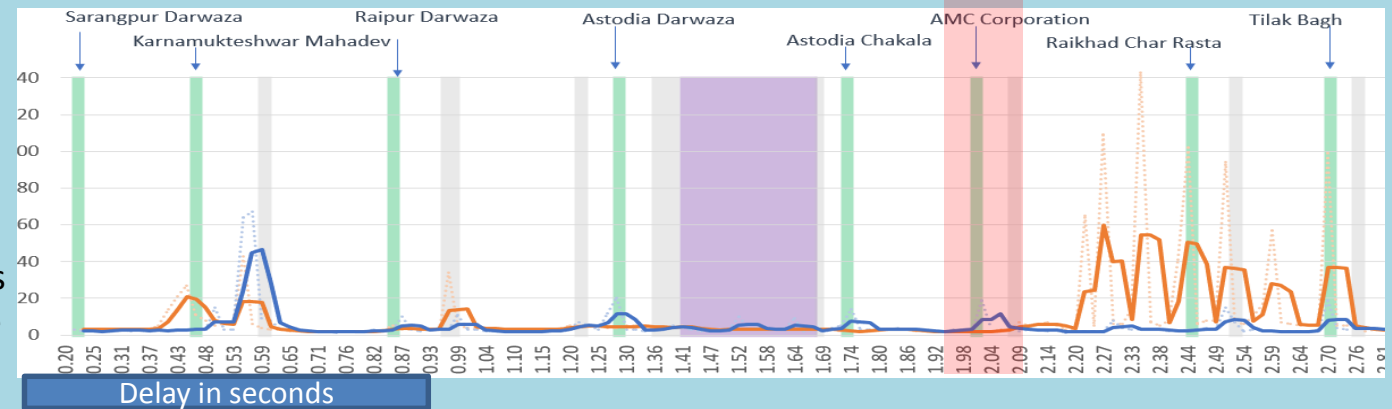
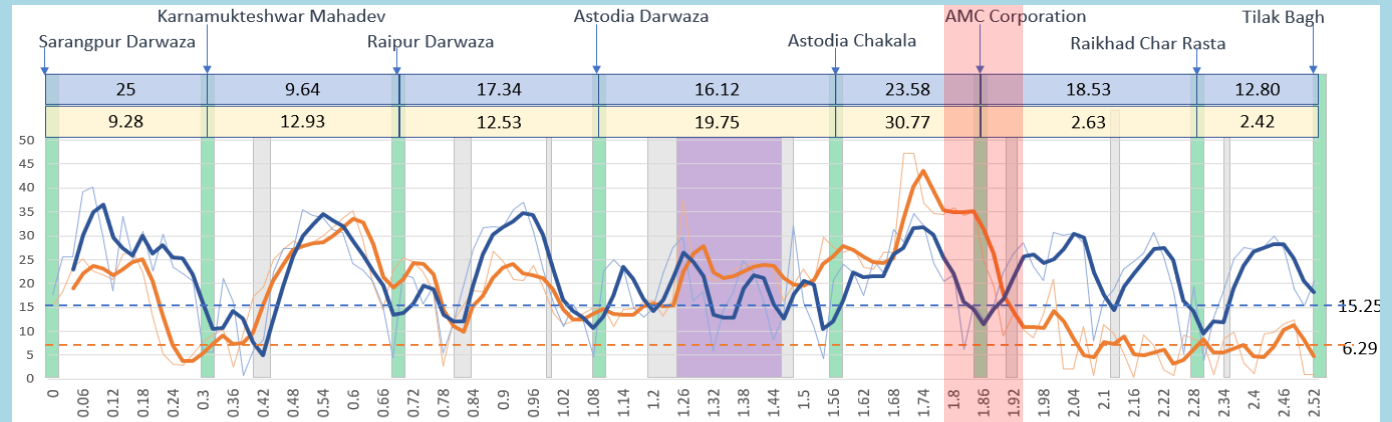
### Observations

- Average speeds in BRT lane : **15.25 kmph**
- Average speeds in MV lane is **6.29 kmph**

After Municipal corporation station

- MV lane avg. speed: dips by 91%
- Due to four back to back junctions and high congestion and delays

Even without signal priority, the BRTS bus average speeds are higher than the MV Lane speeds



This signifies that the AMTS buses have an advantage upon shifting inside the BRTS corridor

Spot Speeds MV Lane  
Moving average speed MV Lane  
Moving average speed BRT Lane

BRTS Station  
Junction  
Unsegregated lane

Average speed BRT Lane

Average speed MV Lane

## Objective 2-3

### Impact on MV lanes

#### Stretch 1 Iskcon cross road to Jodhpur cross road

| Year  | Average Speeds |
|-------|----------------|
| 2014* | 10-15 kmph     |
| 2019  | 8-17 kmph      |

#### Stretch 2 Sarangpur Darwaza to Lokmanya Tilak Bagh

| Year  | Average Speeds |
|-------|----------------|
| 2014* | 10-15 kmph     |
| 2019  | 6-10 kmph      |

\*Source: Assessing adequacy of investments in public transportation, a case of AMTS, Krishna Desai(CEPT), dissertation report, 2014

#### Stretch 2: (MV Lane)

- Speeds decreased over the years
- High delays ranging from 10 to 150 seconds

Hence, **volume counts** of this stretch were taken during peak hours (evening peak)

|                              | Volume | Capacity | V/C  | LOS* |
|------------------------------|--------|----------|------|------|
| from Tilak Bagh to Sarangpur | 3491   | 3600     | 0.97 | E    |
| from Sarangpur to Tilak Bagh | 3191.4 | 3600     | 0.89 | E    |

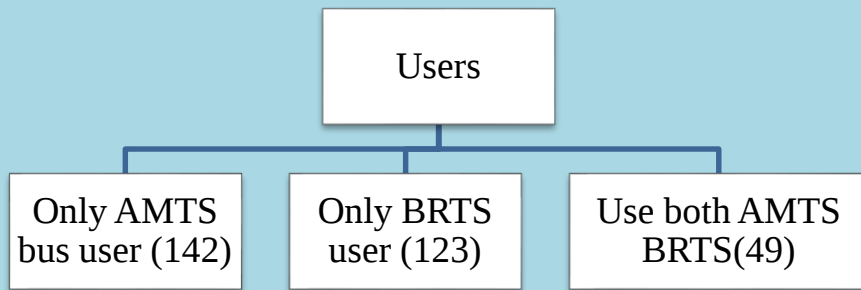
\* as defined by Chetan R Patel and Dr. G.J. Joshi in Capacity and LOS for urban arterial road in Indian mixed traffic condition

#### Observation

**The desired impact of the decision to shift AMTS buses to BRTS Corridor (i.e. reducing congestion in MV lane) was not achieved**

## Objective 3

### Impact on Users



**Surveys conducted : 265**

(approximately 1% of average daily boarding for BRTS)

#### Changes in travel experience for BRTS Users

- **Travel time increased** for more than 24% users
- **Seating availability** remained same for 80% users whereas decreased for 20% users
- **Travel experience** for 80% users remained the as before, and for 19% it decreased in quality

#### Do you use AMTS? Or switched to it

**Yes**

28%

**No**

72%

#### Reason for the same:

Fare lesser (85%)

Already used to use both services (15%)

#### Changes in travel experience for AMTS Users

- **Travel time decreased** for more than 50% users (of which 87% were from stretch2)
- **Access Egress time increased** for 17% users
- **Headway decreased** for 1/4<sup>th</sup> of the users
- For **96%** of the users, the seating quality at bus stops improved
- And for 45% users the service quality improved as well

#### Do you use BRTS? Or switched to it

**Yes**

9%

**No**

91%

#### Other observation

##### Benefits

- Better bus stops,
- WiFi availability
- Buses became regular

##### Issues

- Staff conduct not changed
- Bus information unavailable
- Buses still do not stop at bus stops

## Economic impacts of shifting AMTS to BRTS corridor

The impact of the shifting of AMTS to BRTS corridor in terms of economic benefit was calculated in 3 ways:

- 1) Time Savings by buses
- 2) Time savings by passenger
- 3) Potential passengers which can be shifted to PT
- 4) Potential tail pipe emissions reduced due to shift to PT

### Time Savings by buses

The time saved / lost (due to change in speed) by the AMTS and the BRTS buses is as follows

|                               | time hr |
|-------------------------------|---------|
| Total time saved (hr) / day   | 146     |
| Total time saved (hr) / month | 4,386   |
| Total time saved (hr) / year  | 52,635  |

### Time Savings by passengers

The time saved / lost (due to change in speed) by passengers in the two stretch during peak hour was converted to economic benefits of PT users as the man hours saved.

|                      | time hr   | cost         |
|----------------------|-----------|--------------|
| Time saved per day   | 4,361     | 4,00,878     |
| time saved per month | 91,580    | 84,18,431    |
| time saved per year  | 10,98,963 | 10,10,21,171 |

### Potential passengers which can be shifted to PT

Based on time saved by buses, if more trips could be undertaken, then more passengers could be moved on to the PT

|                                                 |      |
|-------------------------------------------------|------|
| Passegers could be added to AMTS per day        | 2986 |
| Passegers could be reduced from BRTS            | 546  |
| Effective Passengers added to PT system per day | 2440 |

### Potential tail pipe emissions reduced due to shift to PT

Based on passengers shifted to PT, lesser tail pipe emissions take place. Hence requirement of lesser the emission treatment cost.

| Annual Treatment Cost |                 |
|-----------------------|-----------------|
| CO                    | 3,41,726        |
| HC                    | 1,51,859        |
| NOX                   | 67,025          |
| PM                    | 11,171          |
| CO2                   | 54,258          |
| Total                 | <b>6,26,040</b> |

# All Observations

Indicates that the approach taken for decision of shift may not be correct, as for short term the speeds increased, but may have induced more demand

## Impact on BRTS Operation

- BRTS bus speeds decreased in both corridors
- Bus **frequency increased** in corridor 2 beyond design capacity
- Delay at bus stops observed due to high frequency, bus bunching and no operational integration

## Impact on AMTS Operation

- In comparison to the speeds in MV lane, AMTS bus seem to have benefitted due to higher speeds inside BRTS corridor
- The AMTS speeds also varied with buses running in proximity to each other causing delays

## Impact on MV Lane

- For stretch 1, the speeds in the MV Lane seem to have remained the same from before and after the decision
- For stretch 2, the speeds were observed to have decreased even after shift of AMTS buses to BRTS Corridor

## Impact on Users

- For maximum AMTS users, travel time and bus headway decreased, with better seating facility and overall service quality
- For maximum BRTS users, service quality remained the same, with decreased seating space and increased travel time for around 20% of the users
- Transfers observed are very low

# Conclusion

- It is observed that overall public transport benefited
- The analysis indicates towards a requirement of operational integration of both AMTS and BRTS system. This may include
  - Integration of schedule of buses
  - Fare integration, to make both systems interoperable,
  - Network integration to prevent competition among both systems

The decision to shift AMTS to BRTS presents an opportunity for public transport improvement in  
AHMEDABAD