Building Capacity for the Integration and Application of digital technologies in urban public transport systems in Asia-Pacific Cities
(Project ID: 2021-TD-001)

A Guidebook on Integrated Public Transport System

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Introduction to the Guideline

Chapter 1

Presents an introduction, an overview of the guidebook and its structure.

Why Integrated Public Transport is Important?

High motorization rates in Asia-Pacific cities due to urbanization and economic growth

356 per thousand inhabitants
Motorisation Rate (2018-19)

75-80% of Vehicle Registered
Share of 2W & 3W in Low- & Middle-Income Country

57-69% of Vehicle Registered
Share of 4W in High Income Country

In the past two decades, for nearly 80% of the economies, **registration rates of public transport vehicles have grown slower** than private vehicle ownership.

Share of Bus in total Vehicles

1.9% in low- & lower-middle income with annual increase of 6.8%

1.3% in upper-middle income with annual increase of 3.1%

0.4% in high income with annual increase of 0.9%

Source: ADB (2019). What are the patterns in development of Motorisation in the Asia Pacific Region? Asia Transport Outlook.

Objective

This document attempts to present **methodological guidelines for developing integrated public transport systems.**

The guidebook is **aimed at decision-makers and key stakeholders** in Asian cities involved in urban and transport development and operations.

An attempt is made to illustrate innovative practices from Asian cities. Due to inadequate information wherever necessary, few case studies from other parts of the world have been included.

Structure of the Guidebook

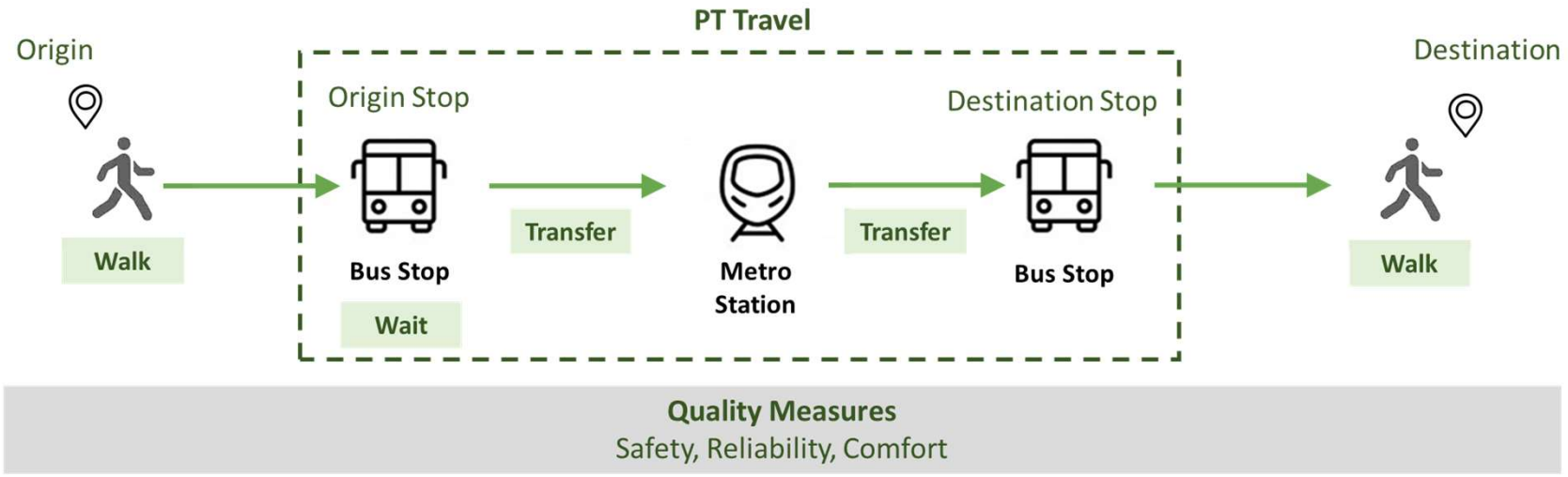
Integrated Public Transport Systems

Chapter 2

Defines concepts and describes integrated public transport systems' advantages, disadvantages, and challenges

Definition of an Integrated Transport Systems

Integrated public transport combines various transport modes and operators, through organisational and planning processes, facilitated through the adoption of infrastructure and technologies to maximise ease and efficiency for passengers.



- Different legs of journey may be valued differently
- Qualtiy of service offered may have an effect on the value
- Passengers perceive public transport as a bundle of service and place different valuations on various components

Elements of an Integrated Public Transport Systems

Network Integration

- Deals with linking up of routes & services across different modes to create a network
- Services are coordinated to ensure easy transfers
- Increases the PT service/catchment areas
- Improves PT accessibility

Physical Integration

- Brings stops/stations of various modes within close proximity of each other
- Improves last mile connectivity
- Facilitate easy transfers and improve attractiveness of multi-modal transport systems

Fare integration

- Integrated fares removes transfer penalties -enables payment as a single journey
- Single tickets - Eliminates purchase of separate tickets for different modes
- Makes travel attractive, affordable and convenient

Institutional integration

- Coordinated working of agencies to plan and deliver integrated transport systems
- Draws out strategic plans and plans to ensure continuous cooperation and coordination between institutions at different stages
- Key for achieving integration across other core areas

Information integration

- Information to help passengers make informed decisions regarding their travel
- Information at various stages, i.e. prior to the start of the journey and enroute
- Information about stops/stations, on-board travel, services (real-time) and way-finding

Benefits of Integrated Public Transport Systems

- Improved travel experiences on public transport, which is comparable to journeys using private vehicles.
- Increased reliability and safety
- Reduced travel times and costs
- Greater coverage and accessibility.
- Greater flexibility while planning journeys/trips.
- Improved customer satisfaction
- Increased physical and mental well-being

- Reduction in VKT, consumption of fossil fuels, and emission
- Greater road safety
- Optimal use of scarce urban street space
- Improved quality of living

- Reduce unhealthy competition and brings complementarity to the system.
- Increased public transport ridership and revenues.
- Optimal utilisation of vehicles, increased efficiency, and enhanced capacity of each mode and for the system as a whole

Source: MoHUA (2013). Toolkit on Land Use Transport Integration and Density of Urban Growth. Ministry of Housing and Urban Affairs.
ADB (2023). Bengaluru Metro Rail Project: Manual for Planning, Design, and Implementation of MMI and TOD for Bangalore Metro Rail Corporation Limited and Directorate of Urban Land Transport. Asian Development Bank

Benefits of Integrated Public Transport Systems

- When public transport is accessible to the citizens, it **increases the routine physical activity levels as a user walks 8 to 30 minutes more daily** compared to non-transit users. Source: Rissel, C., Curac, N., Greenaway, M., & Bauman, A. (2012).
- Public transportation has the potential to **diminish harmful CO2 emissions by 37 million metric tons each year** through measures such as curbing the increase in vehicle miles travelled, alleviating congestion and supporting more efficient land use patterns. Source: APTA (n.d.).
- Public transport **reduces fuel use and greenhouse gas emissions** compared to private vehicles as a passenger car carrying one person emits 89 pounds of CO2 per 100 passenger miles, while a conventional bus emits only 14 pounds. Source: Rubin, A. T., (2010).
- Public transport systems are **safe and secure** as the potential of causing fatality on-street per passenger km travelled by bus is 1/25th of a car. (Source: Swamy, HMS and Sinha)
- On average, a **bus can accommodate the equivalent passenger load of approximately 5.83 cars**, highlighting the efficient utilisation of road space by public transport systems. Source: Rubin, A. T., (2010).

Challenges in Integrating Public Transport Services

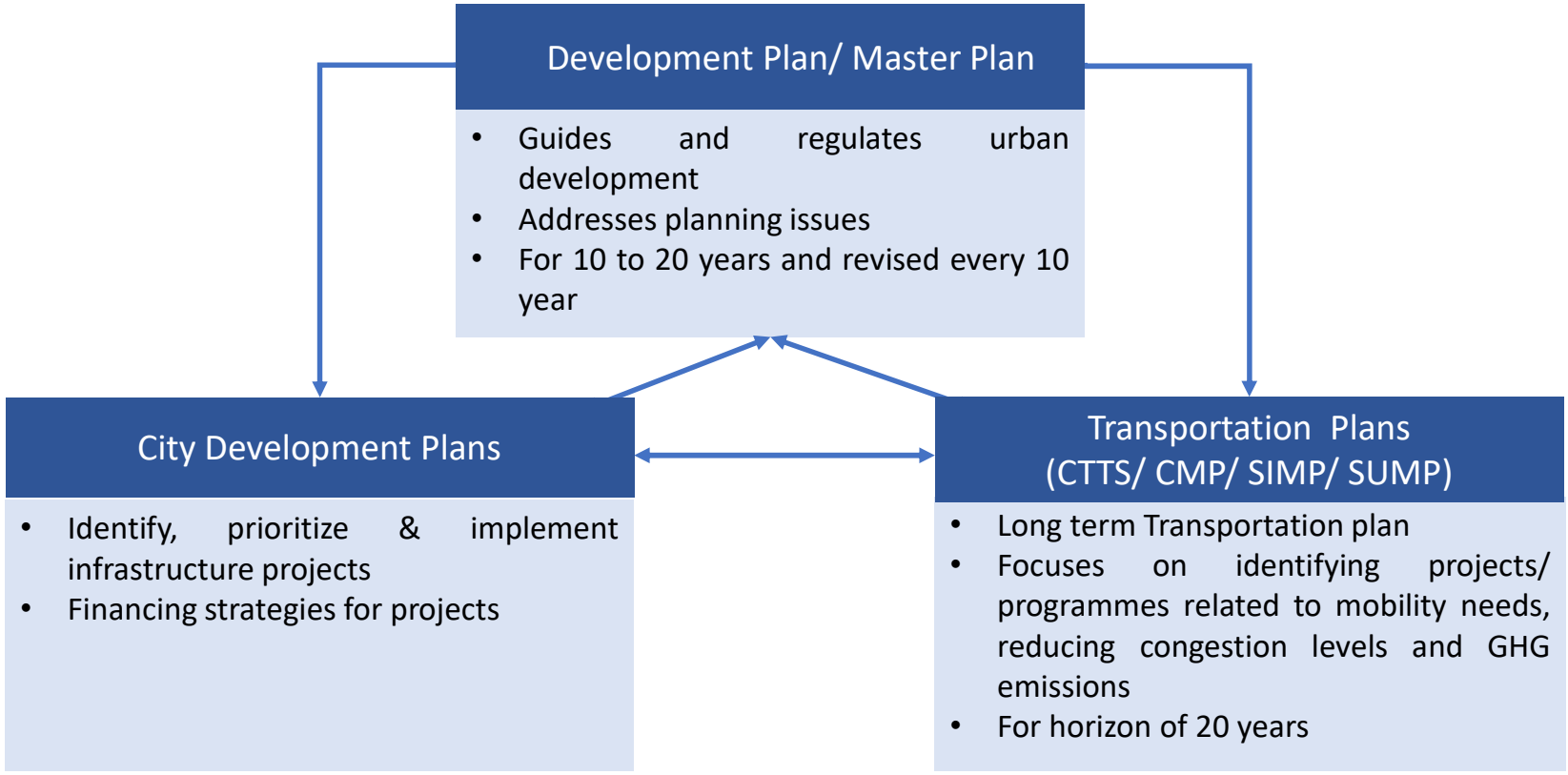
The Multiplicity of Operators	As public transport systems are introduced at different time horizons, this results in formation of various organization to manage and operate public transport system in the city.
Institutional Inadequacies	No agency with the legal backing to mandate integration exists and operators tend to continue with how they have been operating.
Financial Barriers	Integrating different systems would involve investments in infrastructure, especially digital and physical. Mobilising these resources and cost-sharing between agencies/operators is an issue
Technological and Practical Barriers	Integration in public transport faces obstacles due to varying contractual agreements and non-compatible technologies among operators.
Political Barriers	Lack of political will is a major issue in reforming public transport and lack of appreciation of the benefits of integration is a major issue.
Public Awareness	During the gradual implementation, public resistance may arise as people adjust to new travel methods and face temporary inconveniences due to hurdles.

Public Transport supportive of Urban and Transport Planning

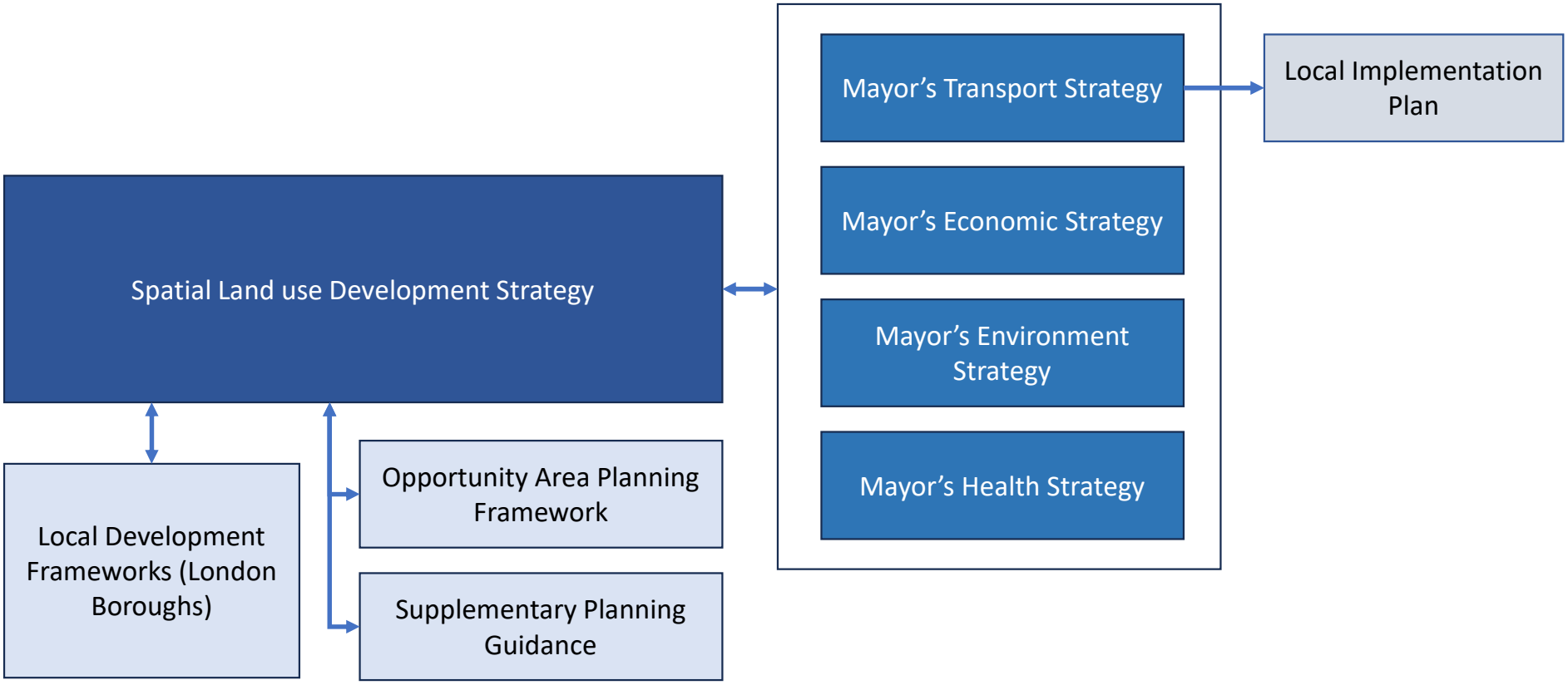
Chapter 3

Presents the approaches and methodologies for preparing public transport-supportive urban and transport plans.

Urban and Transport Planning Framework in India



Planning Framework in London



Source: Verma, S. (2023). Presentation on Integrated Transport of Transport for London: Institutions and Services. FP50 Commemorative Lecture. CEPT University

Integrated Land Use and Transport Planning Principles

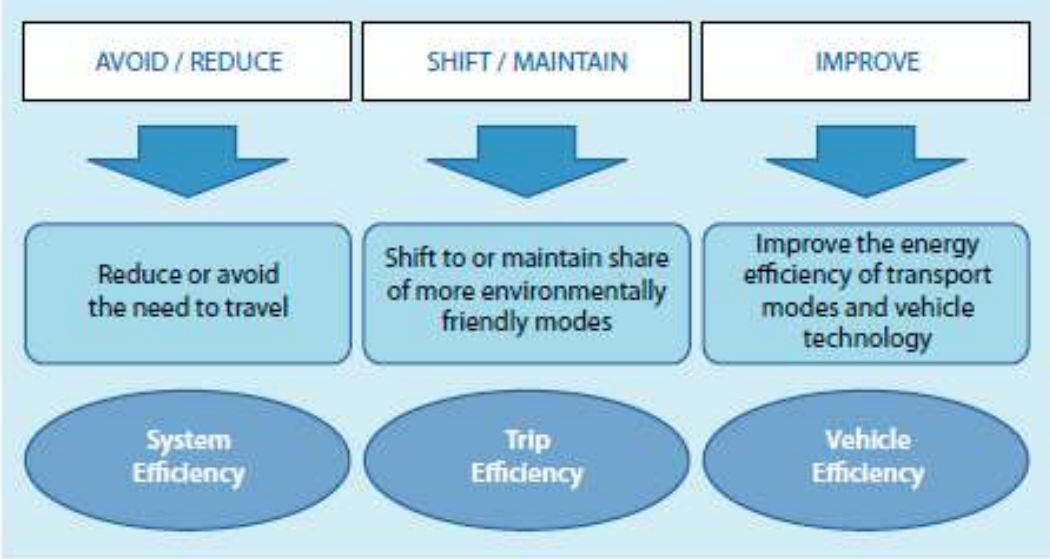
Avoid-Shift-Improve Approach

Urban Structure

Complete Network and Complete Street

Strategic Alignment and Public Transportation

Transit Oriented Development and Value Capture



- Technology improvements make mobility efficient
- Alternate energy introduction reduces emissions
- Introduction of Information technology improves the operational efficiency

Source: GIZ (2011). Sustainable Urban Transport: Avoid Shift Improve (ASI). SUTP. Division 44, Water, Energy, Transport.

Integrated Land Use and Transport Planning Principles

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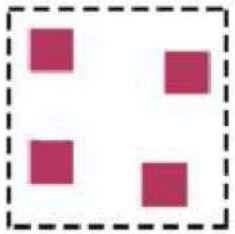
Transit Oriented Development and Value Capture

Sprawl Development

In the sprawl scenario, the city expands beyond its official limits, causing horizontal growth and urbanizing large surrounding areas with low-density development and a dependence on personal vehicles.

Compact Development

This scenario is marked by a central area of dense development and closely spaced patterns, with concentrated development hubs or nodes along transportation corridors.



Poly-centric Development

The city experiences concentrated growth in a limited number of central hubs or nodes, while the remainder of the city witnesses low-density development

Source: CoE-UT CRDF (2022). City Electric Mobility Strategy (CEMS). CEPT Research and Development Foundation. GIZ GmbH.

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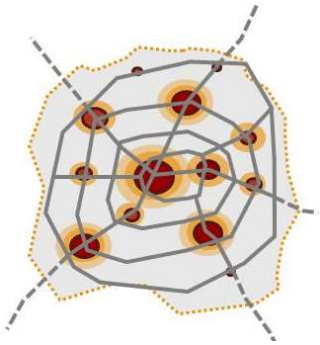
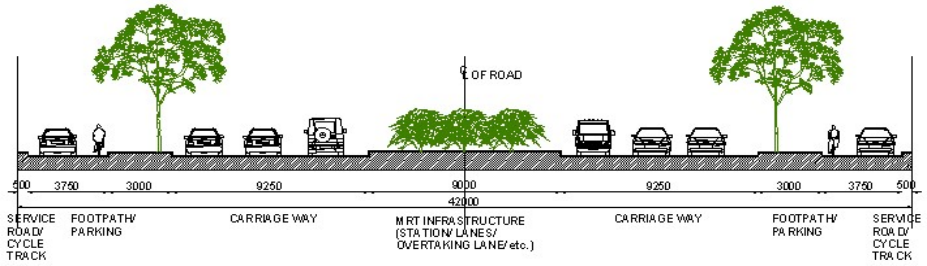


Complete Network

- Extension/Provision of Road infrastructure
- Establishing Missing links
- Using Road structure with hierarchy to shape urban structure



Complete Streets

- Higher priority to public transport and NMT
- Planning/ designing streets to ensure safety, accessibility, equilty and sensitivity to local context

Source: MoHUA (2013). Toolkit on Land Use Transport Integration and Density of Urban Growth. Ministry of Housing and Urban Affairs.

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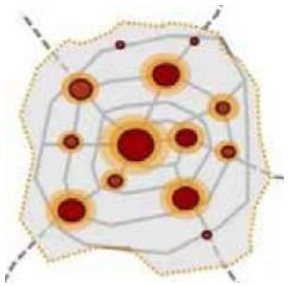
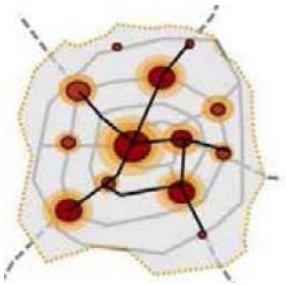
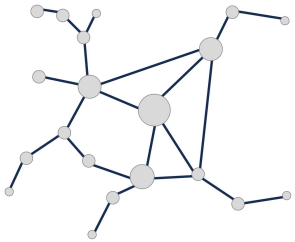


An urban form with sub-centres and road network

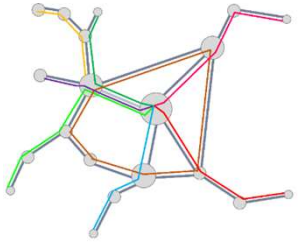


Strategic alignment of Public Transportation

The placement of a public transit system within a city is a critical element of urban planning and transportation strategy, as it greatly **influences the efficient movement of people throughout the city**.



Integrated Network



Integrated route structure on network

A network in transportation consists of interconnected routes where public transport services operate, and it's **designed based on travel demand and land use with routes planned to connect different areas** within that network after a thorough feasibility study.

Source: MoHUA (2013). Toolkit on Land Use Transport Integration and Density of Urban Growth. Ministry of Housing and Urban Affairs.

Integrated Land Use and Transport Planning Principles

Avoid-Shift-Improve Approach

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Strategic Alignment and Public Transportation

Transit Oriented Development and Value Capture

Focus on creating urban development patterns which facilitate the use of public transit, walking and cycling as primary modes of transport which **support vibrant and diverse and livable communities.**

Land value capture captures **increased land value from changes** in land use, public investment, or decisions, particularly benefiting areas near Transit-Oriented Development (TOD) and contributing to future development or infrastructure enhancements.

Source: The World Bank (2021). Transit-Oriented Development Implementation Resources & Tools. 2nd Edition.

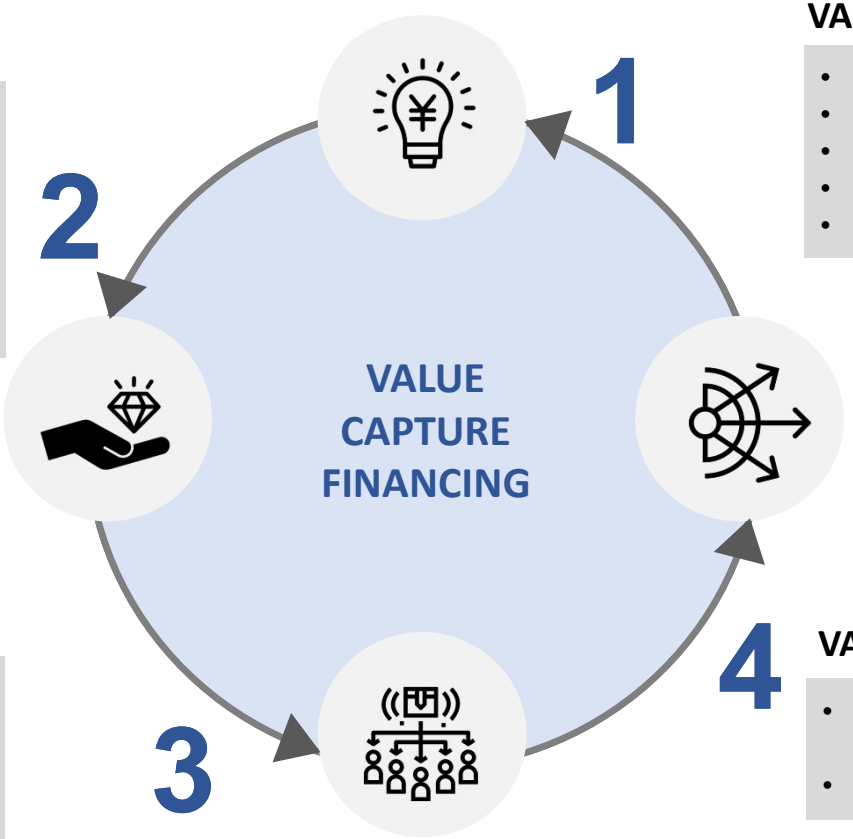
Integrated Land Use and Transport Planning Principles

VALUE CAPTURE

- Reduces travel time /cost *(Fare income)*
- Land price increase *(Taxes)*
- New Developments *(FSI, Betterments)*
- Emission Reduction *(Carbon Credits, Carbon Taxes)*

VALUE CREATION

- Agglomeration benefits
- Scale economics
- Real estate markets
- New developments
- Health



VALUE DISTRIBUTION

- Ring-fenced Funds
- Institutional mechanisms for fund management and distribution
- Clear distribution formula

VALUE RECYCLING

- Investment in infrastructure and transport projects
- Multiplier effects

Source: Patel, G. (2023). Presentation on Land Value Capture and Finance. Training Programme on TOD and MMI for Transport Agencies in Bengaluru. Asian Development Bank

Hong Kong, China

Yee Wo Street in Hong Kong

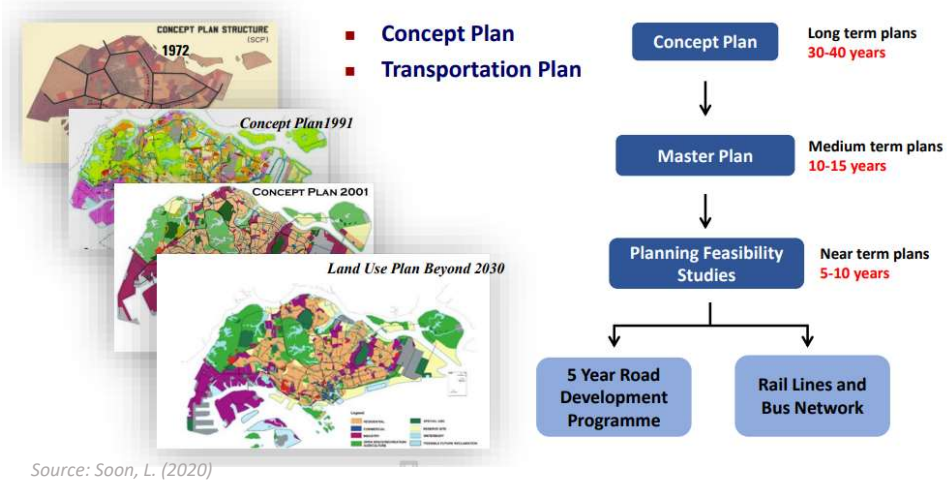
Kowloon Station in Hong Kong

- Hong Kong's long-term planning until 2030 emphasizes spatial strategies **integrating land use and transportation.**
- Hong Kong heavily relies on various modes of public transportation, including railways, trams, buses, mini-buses, taxis, and ferries, with **a daily ridership of 9.7 million passengers**.
- **Accessibility improvements** have been implemented to cater to the needs of elderly individuals, those traveling with infants or toddlers, and individuals with special needs.
- Land near transit stations remains under public control, preventing speculative markets and ensuring that the **benefits generated are channeled towards the public interest**.

Source: Transport Department. (2012). Average Daily Public Transport Passenger Journeys by Public Transport Operator

Singapore

A consistent strategy applied since independence in 1965



Source: Soon, L. (2020)

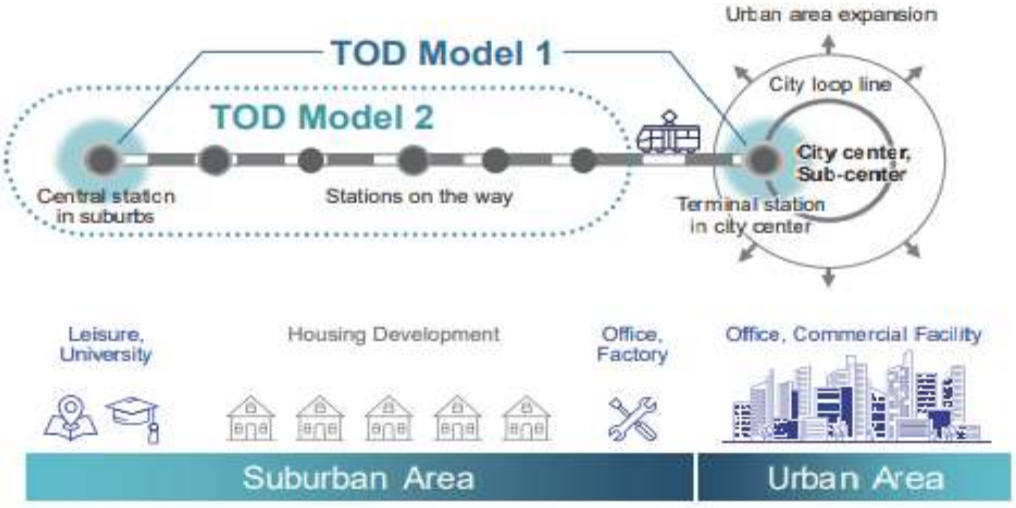
Source: Chye, B. (2019).

Source: Reddit (2020).

- Through integrated land use and transport development, **public transport is the central component of the city's transportation system**.
- Singapore's Land Transport Authority (LTA) aims to **increase the use of public transport** through strategies like expanding the Mass Rapid Transit (MRT) network, enhancing bus services, and implementing policies and Electronic Road Pricing (ERP) to manage private vehicle demand.
- Public transport planning in Singapore **prioritizes commuters,** emphasizing shorter journey times and improved transfers.
- The rapid transit system serves heavy-demand corridors for long trips, while buses complement high-demand routes, **ensuring accessibility for a large population** and avoiding duplication of routes.

Source: MoHUA. (2013). Toolkit on Land Use Transport Integration and Density of Urban Growth. Ministry of Housing and Urban Affairs.
World Bank. (2021). Transit – Oriented Development Implementation Resources & Tools. International Bank for Reconstruction and Development. The World Bank.

Japan



(1) The two models of TOD

Urban Model

Urban TOD enhances station value by intensively developing commercial and office spaces around transit hubs.

Suburban Model

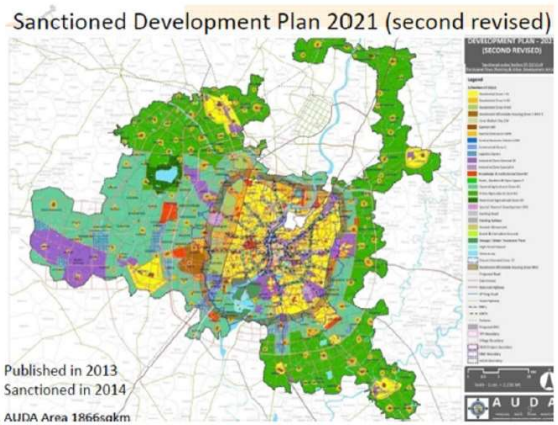
Suburban TOD addresses housing shortages and long commutes by developing both the railway network and the areas around suburban stations.

Tsukuba Express, Kashiwa-no-ha Campus Station Area

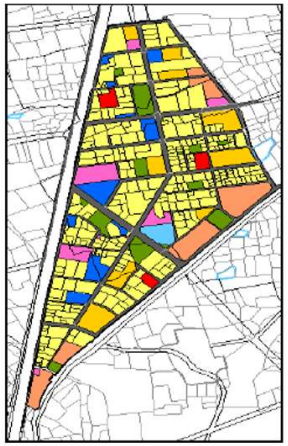
Tsukuba Express is a 58.3 km suburban railway showcasing smart city management serving 36,000 daily passengers (2019) via a public-private joint venture with local authority shares.

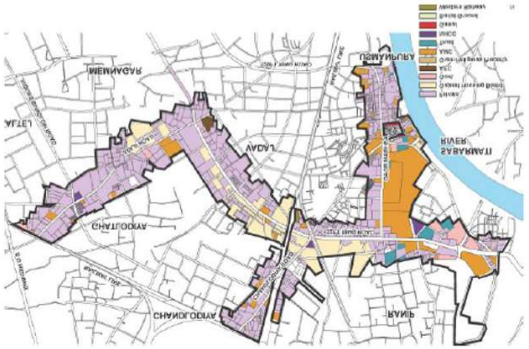
Source: Ministry of Land, Infrastructure, Transport and Tourism. (2021). Japan's TOD guidebook.

Ahmedabad



Development Plan


Town Planning Schemes


Local Area Plan

- Development Plan and Town Planning Scheme enables effective town planning with a mix of land uses, compact city structure, and comprehensive road network.
- Comprehensive Mobility Plan aligns the transportation network with urban development, showcasing integration of land-use and transportation planning.
- Transit-Oriented Zones in the city were strategically planned along Bus Rapid Transit System (BRTS) and Mass Rapid Transit System (MRTS) corridors.

Recommendations

- Implement reforms that synchronize land use and transport planning efforts, ensuring they work in harmony and complement each other. This can involve treating them as a unified plan or allowing them to progress simultaneously, with mutual support.

- Foster Transit-Oriented Development (TOD) by incorporating it into local area plans or redevelopment strategies.

- Establish mechanisms for capturing the increased value generated by improvements in land use and transportation infrastructure. Additionally, create systems for sharing these benefits among the various stakeholder agencies involved.

Urban Public Transport Modes

Chapter 4

Presents various urban public transport modes, their application and choice.

Mass Rapid Transit Modes

Mass Rapid Transit System (MRTS)

- Dedicated infrastructure like dedicated running ways, universal accessible transit stops, level boarding;
- Heavy capacity vehicles;
- Passenger Information System;
- ITS & fare payment;

Higher performance public transport:

Speed **Capacity** **Riding Comfort**

Safety **Accessibility** **Affordability**

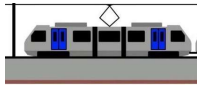
Types of MRTS

Rail-based MRT

Metro-rail

Light Rapid Transit

Monorail



Metrolite

Bus-based MRT

BRTS

City Bus with priority

City Bus

Metro Neo

Types of Bus Based Transit

A bus-based transit system is a public mass transit service, provided through the use of buses, primarily used as a local/urban public transport on the road network within a designated city or town, usually within defined areas in suburban and urban areas, for relatively short distances with multiple stops

Source:- Ahmedabad_amts_bus

City bus

- No Segregated bus way, operation in mixed traffic
- On-board fare collection
- Passenger information system

Source:-Deccanherald

Bus priority lane

- Segregated bus-way
- On-board fare collection
- Passenger information system

Source:- smartcityindore.org

BRT

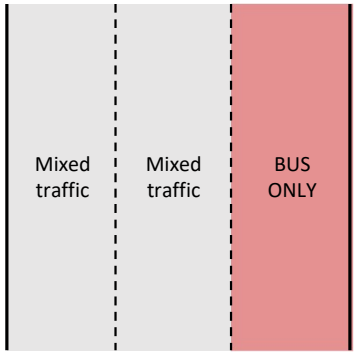
- Segregated busways with a form of bus priority
- Off-board fare collection
- Improved travel times
- Passenger information system (Digital)
- Automated fare collection (AFCS)

Source:- Surat/BRTS/Sitilink

Dedicated BRT

- Segregated bus corridor
- Off-board fare collection
- Improved travel times
- Priority at junction
- Passenger information system (Digital)
- Automated fare collection (AFC) System

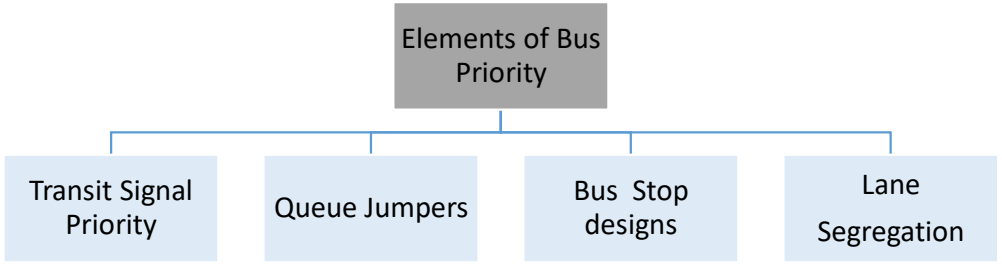
Bus Priority



Street with bus priority lane

Bus Priority

*A **bus lane** or **bus priority lane** is a lane restricted to buses, often on certain days and times, and generally used to speed up public transport that would be otherwise held up by traffic congestion.*

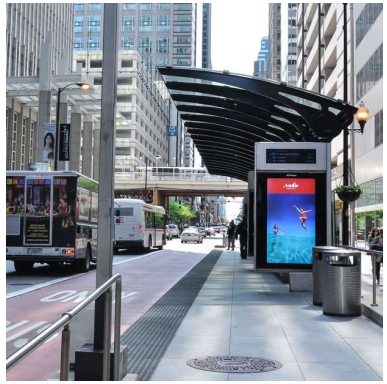


Elements in bus priority

Lane marking

Bollards

Signages



Bus stop improvements

Bus Rapid Transit System (BRTS)

- BRTS, is an enhanced form of a busway with demarcated bus lanes
- BRTS with segregated bus lanes are typically median-aligned.
- Off-board fare collection, having level boarding
- Bus priority at intersections,
- All the quality-of-services provide fast and frequent operations of public transport.

BRT Standard, 2015

Source: ITDP, Growth-of-bus-rapid-transit-in-India.

Components of BRTS

- Dedicated Right-of-Way
- Depot & Terminal
- Passenger information system
- Off-board Fare Collection
- Signal Priority
- Automated fare collection System

Types of Bus Based Transit

Guided Bus Systems is a rapid transit system exclusively for bus fitted with appropriate guidance equipment to use the system

- Dedicated guideways
- **Flexible** to run without guideways on smaller roads
- Caters maximum 15000 PHPDT
- Generally uses fleets of 18m and 24m buses

Adelaide O-Bahn

Trolley Bus Systems is an electric that draws power from dual overhead wires using spring loaded trolley poles

- Uses **OHE** as a means of energy; **environment friendly**
- Higher PHPDT compared to a bus system
- Uses fleets of 12m, 18m and 24m buses
- Mostly, utilized as a **feeder system**

Moscow Trolleybus

Energy Options

Conventional Fuel Buses

Electric Bus

Hydrogen Bus?

Types of Buses

Parameters	Mini	Midi	Standard	Articulated	Bi-Articulated
Length (meters)	7	9	12	18	25
Floor Height (mm)	400/650/900	400/650/900	400/650/900	400/650/900	400/650/900
Carrying Capacity (Seating + Standing)	22	34	80	140	225
Width (meters)	2.2	2.5	Up to 2.6		
Vehicle Cost (In crores)	0.20	Diesel-0.5 Electrical-1	Diesel-0.7 Electrical-1.3	3.7	5.5

Mini bus

Midi bus

Standard bus

Articulated bus

Bi-Articulated bus

Directional Line Capacity of Buses

Bus Type	Directional capacity by headway in min. (no of buses/hour)										
	No of buses per hour →		4	5	6	7.5	12	20	45	45(90)	45(135)
	Headway in min →		15	12	10	8	5	3	1.3	1.3	1.3
	Length (mt)	Capacity (no of pass.)	.....single unit.....							Convoy of 2	Convoy of 3
Mini	7-7.5	20	80	100	120	150	240	400	900	1800	2700
Midi	9-9.5	40	160	200	240	300	480	800	1800	3600	5400
Double Deck-Midi	9.5	70	280	350	420	525	840	1400	3150	--	--
Standard	12	70	280	350	420	525	840	1400	3150	6300	9450
Double Deck-Standard	12	110	440	550	660	825	1320	2200	4950	--	--
Articulated	18	110	440	550	660	825	1320	2200	4950	9900	14850
Bi-Articulated	24	180	720	900	1080	1350	2160	3600	8100	16200	24300

Suitable for mixed traffic operations

Suitable for exclusive lane (BRT) operations

Types of Rail Based Systems

Rail Based Systems

- **Urban Rail Systems**
  - **Metro Rail**
    
    Delhi Metro
  - **Mono Rail**
    
    Mumbai Monorail
  - **Tram/ Light Rail Transit**
    
    Melbourne LRT
- **Regional Rail Systems**
  - **Passenger Trains**
    
    Tejas Rajdhani Express
  - **Semi-High Speed Trains**
    
    Vande Bharat Express
  - **Bullet Trains**
    
    Shinkansen Bullet Train

Metro Rail Transit System Specifications

Metro Rail Transit System

	Light Capacity Metro	Medium Capacity Metro	Heavy Capacity Metro
	10,000-20,000 PHPDT	20,000-45,000 PHPDT	45,000-80,000 PHPDT
Alignment	Fully grade Separated	Fully grade Separated	Fully grade Separated
Axle Load	9T-12T	14T-16T	>16T
Cars per Train	2-3	4-6	6-8
Pax per train	500-750	1000-1500	1500-2000
Min Curve Radius	60m	100m	120m
Coach width	2.6m	2.9m	3.2m

Source: CEPT University (2022). Presentation on Feasibility Study For Mass Rapid Transit In Rajkot.

LRT/Tram and Monorail

Tunis, Africa

***Light-Rail Transit** is a rail-based rapid transit system that uses predominantly exclusive, but not grade-separated, right-of-way.*

LRT can be called an
Upgraded Tram and Downgraded Metro

Tram | **LRT**

Tramways or light rail transit (LRT) is a medium-capacity mode of mass rapid transport that straddles between the heavy-capacity Metro rail and the low-capacity bus services.

PHPDT:
2,000 (Min.) - 15,000 (Max.)

Alignment:
At grade

Mumbai Monorail

***Monorail** is a guided transit mode with vehicles riding on or suspended from a single rail, beam, or tub using an overhead structure.*

Source: Metro Rail Policy, 2017

Straddled | **Suspended**

PHPDT:
6,000 (Min.) -12,000 (Max.)

Alignment:
Elevated

Source: CEPT University (2022). Presentation on Feasibility Study For Mass Rapid Transit In Rajkot.

Light Metro (Automatic Light Vehicle System with Rubber Tyres)

Lille Metro, France

- 2 Car Train, Driver Less
- Elevated & Underground
- Headway – 66 secs
- Standard Gauge, 750 V DC Third Rail
- 2 Lines – 45 km, Platform – 4 car

Max PHPDT:
10,000

Taipei Metro, Taiwan – Wenhu Line

- 2 Car – 4 Car Train
- Driverless
- Elevated & Underground
- Broad Gauge, 750 V DC Third Rail
- 1 Lines – 24.1 km

Max PHPDT:
7,000

Techno-Economic Considerations

Indicators	Metro Rail	LRT	BRT	Monorail
Type of Segregation	Elevated or underground	At-grade with horizontal segregation	At-grade with horizontal segregation (soft or hard)	Elevated
Capacity (PHPDT)	15,000-90,000	5,000-12,000	3,000-40,000	5,000-20,000
Travel Speeds (kmph)	30-40	18-24	20-28	30
Cost per KM	300–600 (Cr INR) 36-73 (mn USD)	100-130 (Cr INR) 12-16 (mn USD)	20-30 (Cr INR) 2.5-3.6 (mn USD)	150-200 (Cr INR) 18.2-24.4 (mn USD)
Average Station Spacing	1000-1200 meters	600-800 meters	500-600 meters	1000-1200 meters
Period of implementation	3-6 years	5-10 years	2-4 years	6-10 years
Land acquisition	Not required except for depots	Re-allocating Road space amongst the uses does not require major land acquisition	Re-allocating Road space amongst the uses does not require major land acquisition	Not required except for depots

Recommendations

- Concentrate on identifying and constructing transportation modes and networks that align with the current demand.
- While choosing a transportation mode, consider its long-term suitability, as these systems are expected to endure for the city's entire lifespan and transitioning from one rapid transit mode to another can be both disruptive and time-consuming.
- Recognize that transportation demand evolves gradually over time, and it's essential to tailor the system to the right scale.
- The introduction of a national framework for both bus-based and rail-based rapid transit systems can greatly aid in selecting the most appropriately sized transportation mode for a given area.

Integrated Public Transport Operations Strategy

Chapter 5

Focuses on principles, concepts, and techniques for preparing the operating strategy of integrated public transport networks and services

Network Integration

Network integration

Involves aligning and structuring the bus routes with the rapid transit corridors. ensures that metro/BRT and bus systems are in close physical proximity to each other at intersecting nodes.

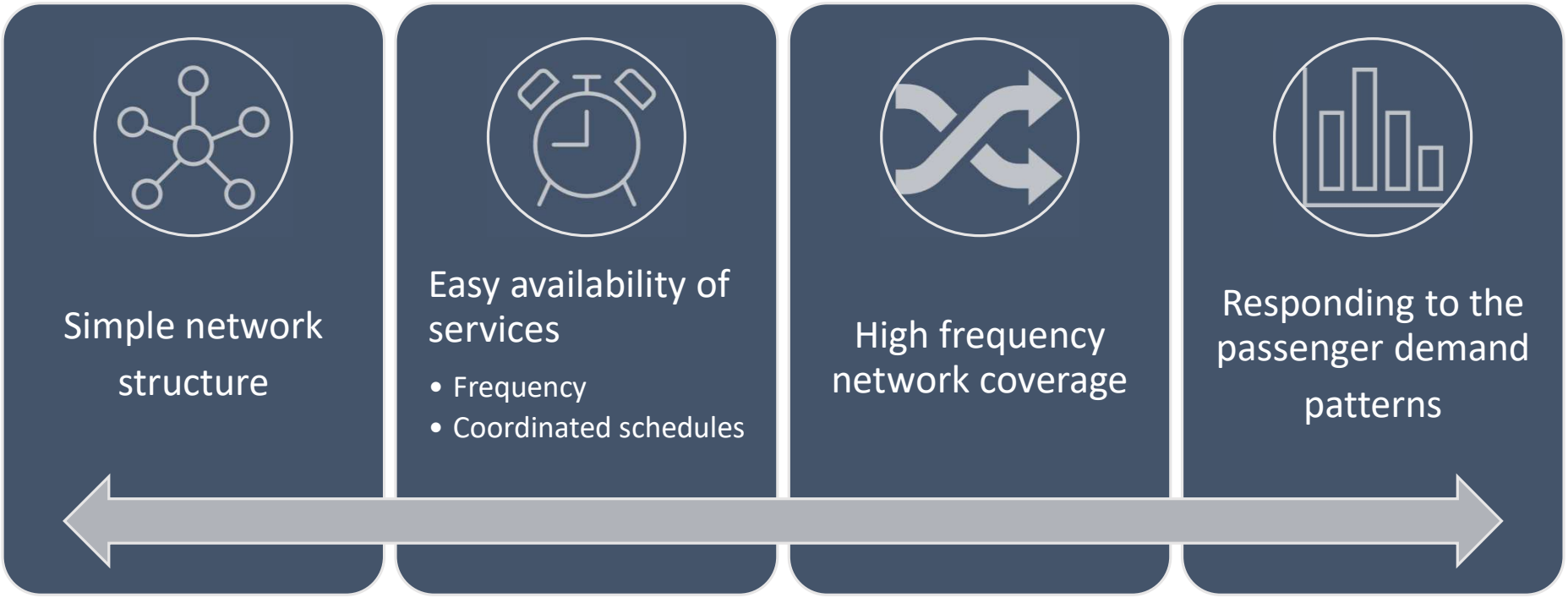
The twin objectives of the integrated public transport operations strategy are:

to optimize the allocation of resources and coordinate services to achieve efficient/cost-effective operations.

to guarantee a seamless ride and an easy transfer to the user between different lines/routes and modes within the system.

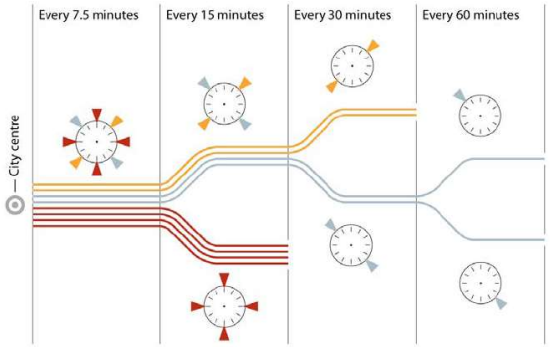
Source: Iman Ikbar Muhtadi, Dita Trisnawan; Multimodality of Jakarta's public transportation interchange case study: Lebak Bulus MRT station. AIP Conf. Proc. 3 September 2020; 2255 (1): 070019.

Key Principles of Network Integration

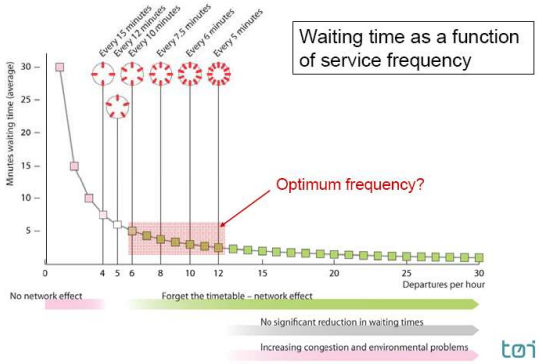


Integrated Public Transport Operating Strategy

Design Aspects	Parameters
Span of service	Full Day, Peak, Shuttle, Night service, on-demand
Service coverage	The extent of the city area covered
Frequency of service	High frequency, moderate frequency, low frequency
Access to service	Maximum walking distance to the nearest stop/station
Bus stop spacing	Minimum distance between stops
Scheduling	Clockface vs timetable based
Reliability	On-time arrivals
Capacity	Capacity matching demand



High frequency by timetable coordination

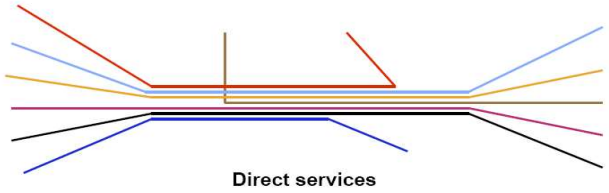


Design a network with optimal frequency

Types of Route Structure and Services

Direct services

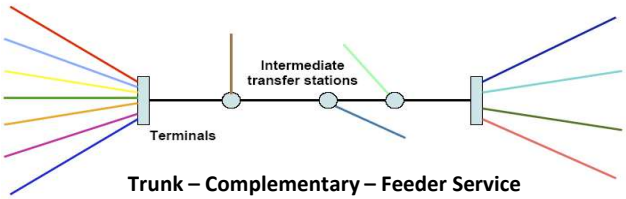
Take passengers directly from origin to destination; no need of transfer



Direct services

Trunk-Complementary-Feeder services

Rapid transit modes in high demand corridor, buses or smaller vehicles in low density corridors feed them. Transfer required.



Trunk – Complementary – Feeder Service

Trunk Routes are high demand routes mainly running on urban arterials, connecting various parts of the city.

Complementary Routes are designed to be straight running on second order arterial/sub-arterial routes catering to medium-to-long trips

Feeder Routes feed passengers from the local area which are uncovered by the trunk routes and run on collector distributor and local streets.

Types of Services

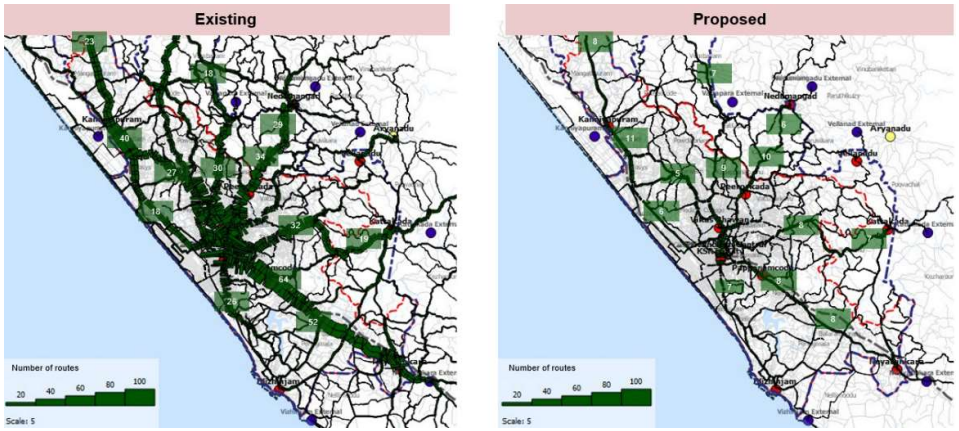
Rapid Service

BRT, LRT and Metro services are termed as rapid services as they provide services faster than regular services.

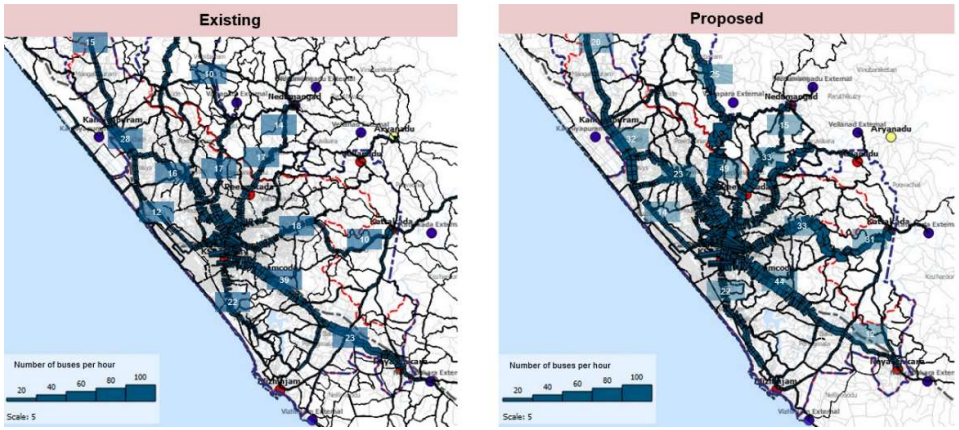
Express Service

Express services are also faster, but the speed is achieved through skipping stops

Reorganizing Urban and Sub-urban Bus Services – A Case of Trivandrum



Number of routes



Number of buses/hour

Population of Trivandrum (2011)	**7,50,000**
Total Routes	**1650**
Total Bus Fleet	**1006**

Only about **140 (21%) routes of 650** are urban routes, however, about **55% passengers are within urban area**

Urban passengers travelled in sub-urban services increasing crowding levels

Operational issues:

- Centralised Route Structure
- Inadequate service coverage with high frequency
- Bus operations Inefficiency
- Overall data management

City bus improvement strategy recommendations:

- Reducing of routes and increasing frequency
- Distinguishing city & sub-urban services & route rationalization
- Proposal of circular route with interchanges to enable transfers between trunk & radial routes
- High frequency sub-urban services stop in major interchanges only

The study recommended route rationalization of urban and sub-urban routes and terminate most of the sub-urban services outside of the city limit and bring few services to city center with high frequency

Introduction of New Mode: BRT – A Case of Ahmedabad

Ahmedabad's public transport comprises **AMTS, BRTS, and Metro systems.**

- **AMTS:** 700 buses, 4.15 lakhs daily commuters
- **BRTS:** 385 buses, 150 km network, 2 lakhs daily ridership
- **Metro:** 38 km network, 0.5 lakhs average daily ridership

	2011	2021
PT Share	22%	8%

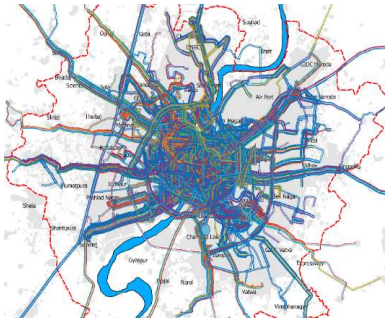
Total PT Ridership adds to 6.6 – 7 lakhs, however, PT share has been reducing

Reasons for declining ridership:

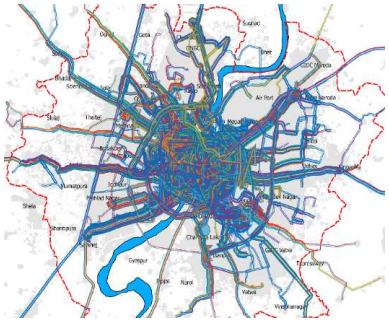
Insufficient fleet size

Centralized route structure

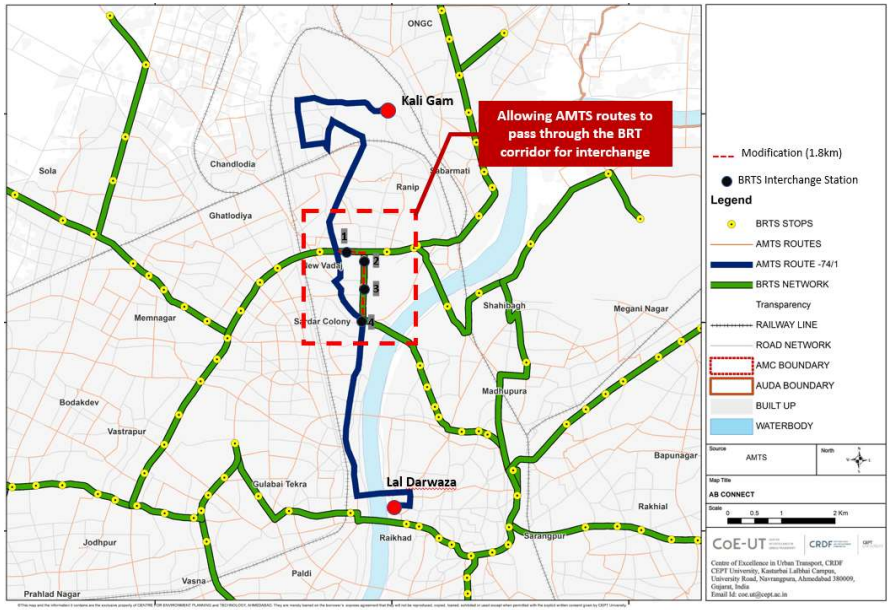
Demand-Supply Mismatch



Overlapping of routes on almost all the major radials



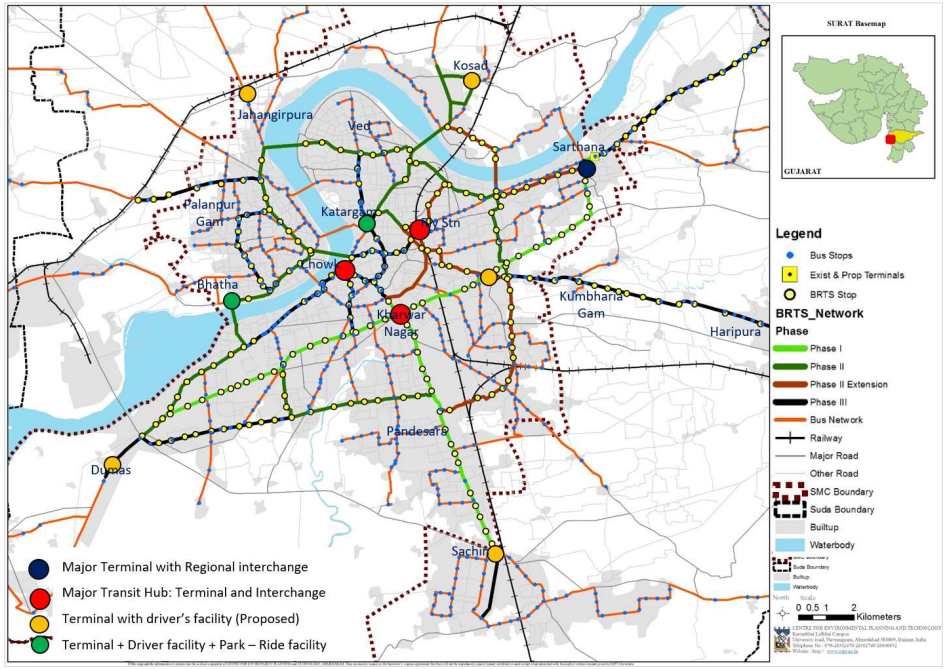
Centralized route structure - >60% routes start from Lal Darwaja



Action Plan for Integrated PT:

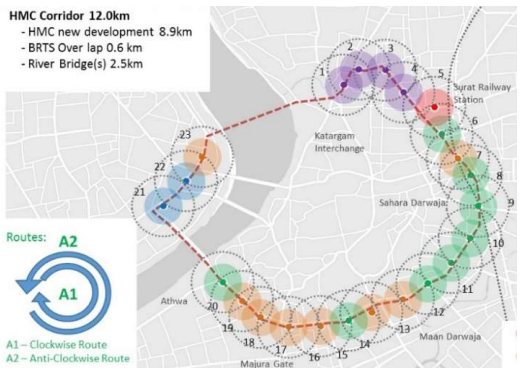
- Existing city bus terminals also allowed to plan decentralized integrated city bus service planning
- Ahmedabad is now taking steps towards physical and fare integration
- City is planning to implement AMTS – BRTS Connect (A B Connect)

Planning & Implementation Integrated PT Services– A Case of Surat



Integrated Public Transport Network (Integration bus services)

Surat, India's eighth most populous city, experienced rapid growth and urban development. From 2014 to 2018, city initiated major transport projects, including BRTS expansion, Metro DPR, and Bus Operations plans, leading to an integrated public transport system.



High Mobility Corridor

Physical integration of BRT & City buses

Surat Public Transport Network Characteristics

- Segregated BRTS Network: **102 km**
- Integrated City Bus Services: **550 km**
- Buses in Operation: **875**
- Daily Passengers (2022): **2.5 Lakhs**

- Integration: BRTS as Trunk Corridors, City Buses as Feeders
- High Mobility Corridor (HMC) for Inner Ring Road
- Fare Integration (AFCS) for Seamless Travel

Success Due to Institutional Integration and Holistic Planning

LRT as Feeder Services to Metro – A Case of Singapore

Operating Metro Rail system and LRT lines of Singapore

Bukit Panjang LRT line (1999)	**7.8km**
Senkang & Punggol (2003, 2005)	**10.3km & 10.7km**

- Singapore Metro system - established in 1987, currently has **six main Metro lines & two LRT lines covering a total of 200 km.**
- **LRT lines serve as feeder services**, enhancing accessibility for residential areas.

Bukit Panjang LRT Schematic map & Bukit Panjang station Interchange

- Objective was to ensure that **station access** to residential estates **was lesser than 400m walking distance**
- LRT system - average daily ridership is **1,83,000 (6500 passengers per km)**

Specifications & Performance (Bukit Panjang Line):

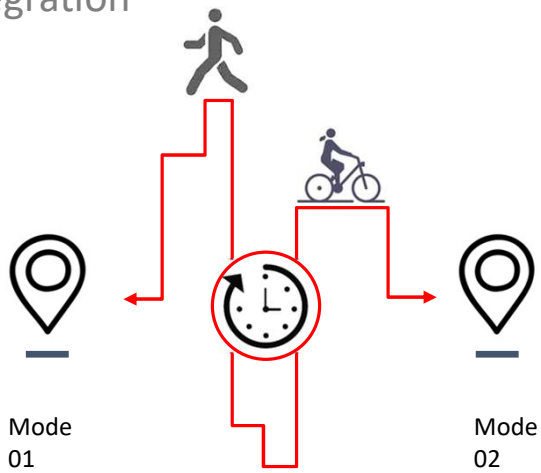
- Operates **fully automated single or double car** rubber tyred trains
- Average headway of 5 minutes per day
- Ridership increased from **15,000 to 54,000 passengers** from year **1999 to 2022 (72% increase)**

Physical Integration

Detailing the 'Act of Transfer'

Lack of Integration

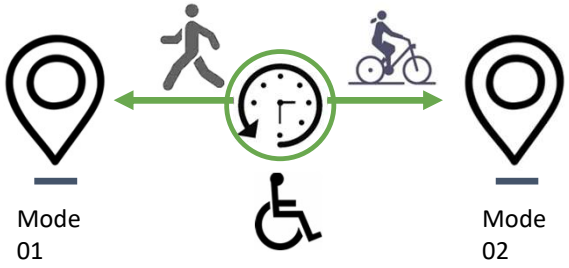
Inadvisable



Passenger transfers are **unsafe**, **indirect** and **uncomfortable**
Longer **distance** travelled
Longer **time** taken
Multiple level differences, turnings, vehicular **conflicts**
Lack of safety, **barrier** free access elements

Physical Integration

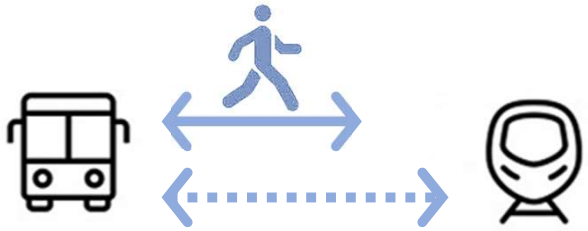
Recommended



Passenger transfers are **safe**, direct and **comfortable**
Shorter distance travelled
Shorter time taken
Minimum level differences, turnings, vehicular **conflicts**
Safe Passenger **access**, barrier free access elements

Source: Lokre, A., Paul, S. (2022). Presentation on Physical Integration. Training Programme on TOD and MMI for Transport Agencies in Bengaluru. Asian Development Bank

Walkability – Key Principles



Reduce transfer distance between modes

Prioritize passenger safety

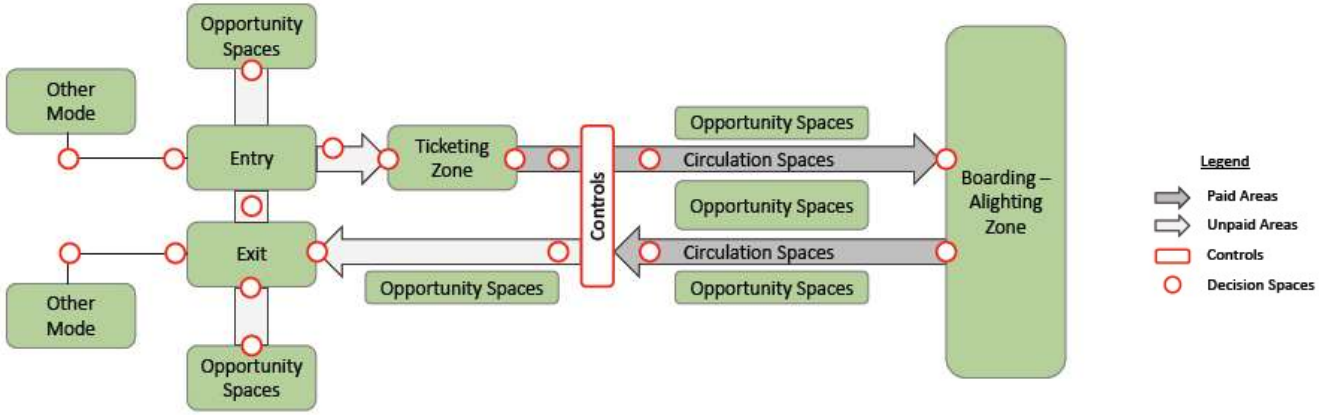
Clarity in spaces, navigation and information, wayfinding

Avoid vehicular conflicts for passengers

Provide Barrier free access

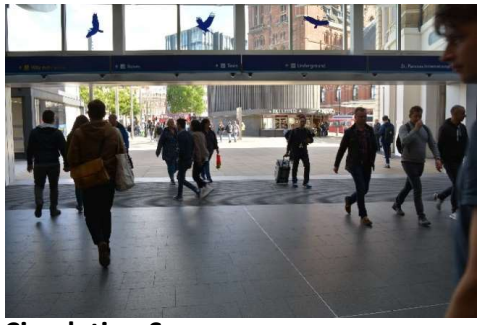
Source: Lokre, A., Paul, S. (2022). Presentation on Physical Integration. Training Programme on TOD and MMI for Transport Agencies in Bengaluru. Asian Development Bank

Station Design Considerations



Decision Space
KL Central interchange, Kuala Lumpur

Opportunity Space
King's Cross Station, London



Circulation Space
King's Cross Station, London

Source: The Urban Lab, ADB (2023). Bengaluru Metro Rail Project: Manual for Planning, Design, and Implementation of MMI and TOD for Bangalore Metro Rail Corporation Limited and Directorate of Urban Land Transport. Asian Development Bank

Station Area Considerations

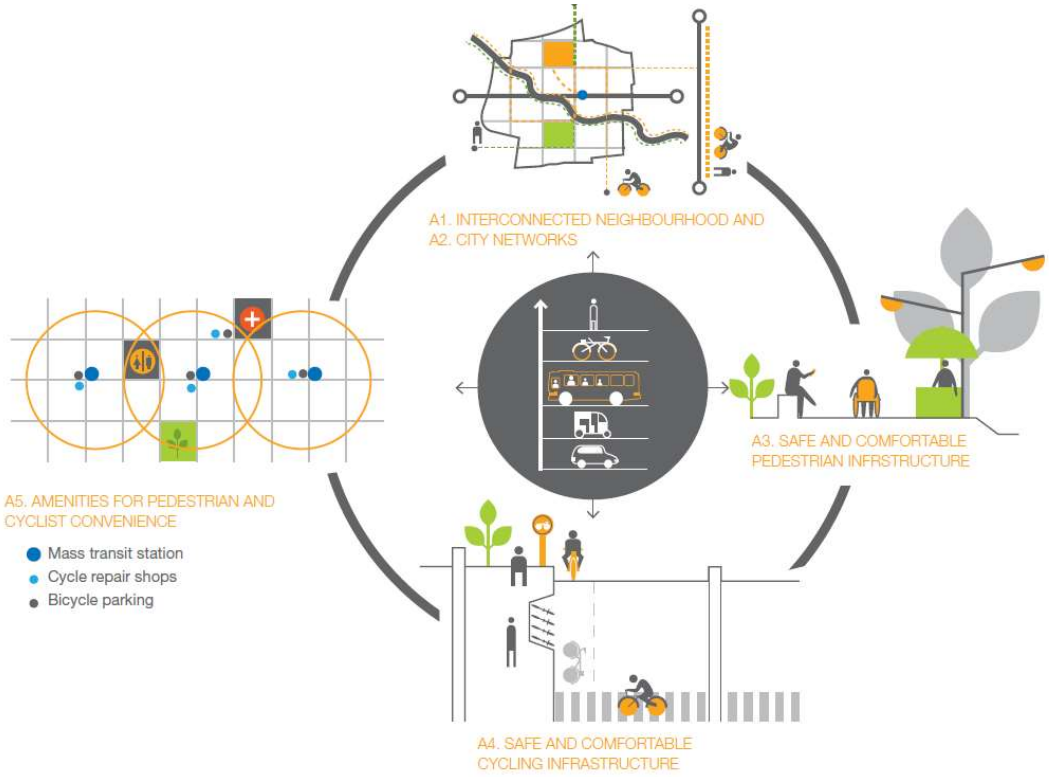
Accessibility
Enhancing the quality of pedestrian transfers in the interchange area requires safe streets, barrier-free design, and pathways designed for all users, following a complete street approach.

Safety and Comfort
The streets leading to the interchange area and the pathways within it must be designed to accommodate larger numbers of pedestrians with shades to protect them from weather.

Activity Zones
A well-planned interchange area with diverse activities can enhance the transfer experience, attract foot traffic, and promote a transit-oriented environment that encourages public transportation use and engagement in various activities.

Last-mile Connectivity
Interchange station shall provide connectivity to various other modes of transportation, in this case, passengers use the station for last mile connectivity over the modes such as feeder services, taxi, cycle, or personal vehicles.

Wayfinding
Signages help commuters about direction and connecting them to different modes with its proper placement and legibility to ensure guidance and smooth navigation.



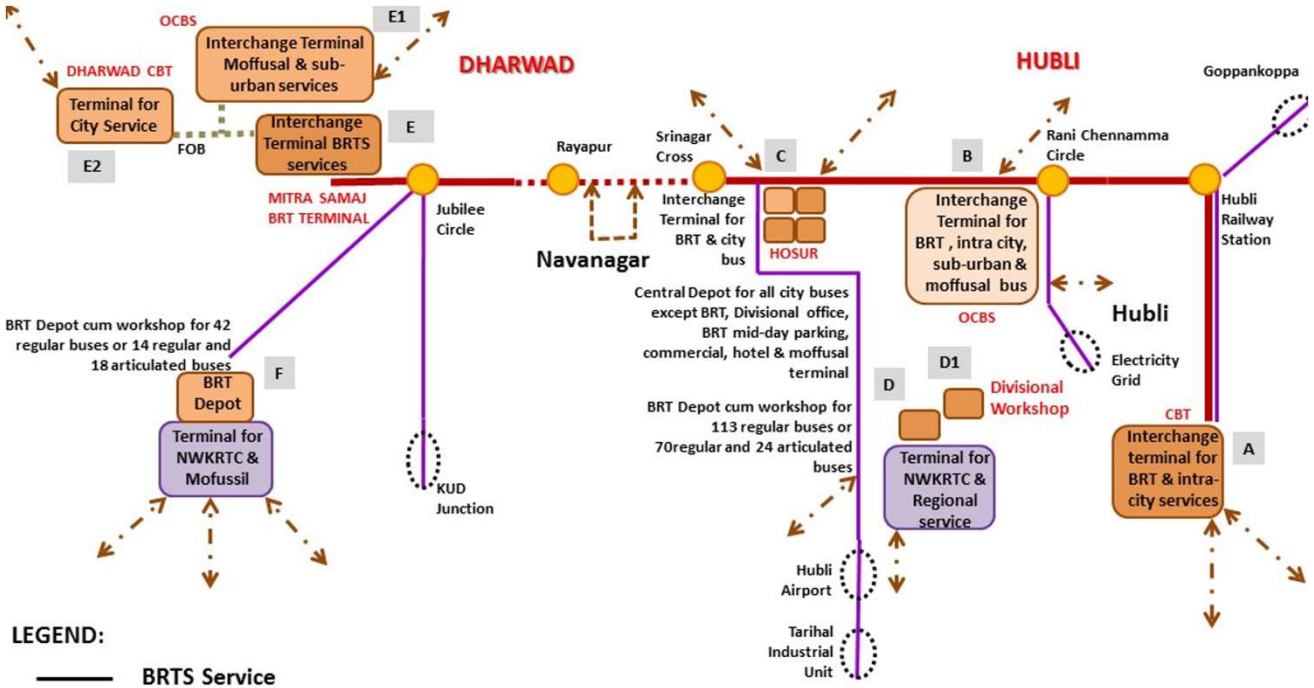
Strategies for Pedestrian and Cyclist Priority

Source: WRI (2014). SAFE ACCESS MANUAL Volume I: Safe Access to Mass Transit Stations in Indian Cities

Hierarchy of Interchanges

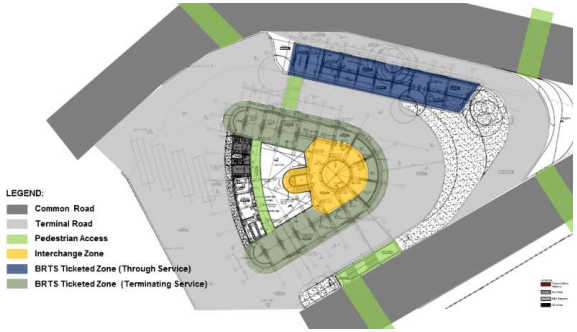
- **Level 1 interchanges** are between Regional services and Urban services
  - Barrier free and direct transfers from regional service to urban services
  - Located in CBD
  - Well connected through other services
  - Access to the station are seamless
- **Level 2 interchanges** are between two or more services of same mode or different mode
  - Barrier free transfers between two services
  - Located in sub centers like employment hubs
- **Level 3 interchanges** are mainly between rapid transit services and buses
- **Level 4 interchanges** are mainly for transfer from feeder
  - Located mainly in residential areas

Infrastructure Planning – A case of Hubli Dharwad



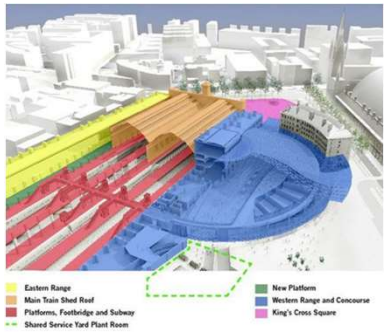
A	Hubli CBT	E	Mitra Samaj Terminal
B	Hubli OCBS	E1	Dharwad OCBS
C	Hosur Interchange	E2	Dharwad CBT
D	BRT Depot Hubli	F	BRT Depot Dharwad
D1	Divisional Workshop		

Hubli CBT



Dharwad – Mitra Samaj

King’s Cross St. Pancras Station, London



- King's Cross St. Pancras Interchange in London is a vital transportation hub, serving as a pivotal **connection point for both the London Underground and National Rail services**.
- This station area is a **level 1 interchange** type which includes integration of multiple modes both regional and urban services.
- This interchange facilitates seamless travel between six different London Underground lines.
- The interchange is **connected to 14 bus routes** and consists of 10 public squares of a **total area of 10.5 hectare** with **over 400 bike share parking** around it.

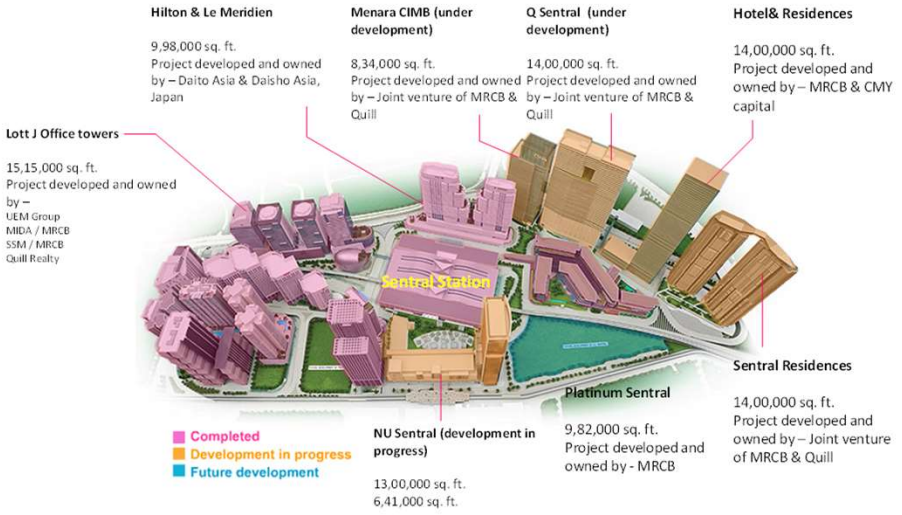
Source: Gelbart, B. H. (2015). Oxford Circus Tube station “closes every three days” for overcrowding. BBC News.

Sengkang Transport Hub, Singapore

- Interchange facilitates seamless transfer of commuters between multiple transport modes including **6 bus routes and two rail lines**.
- For pedestrian access, the interchange concourse boasts two entry/exit points along Sengkang Square. Inside the interchange building, multiple entry/exit points lead to Sengkang MRT/LRT station and the buildings adjacent to it
- The hub has been developed as a **commercial and residential hub** with shopping malls, food courts, and various public amenities to cater to the needs of commuters and residents in the area.

Source: Land Transport Guru. (n.d). Sengkang Bus Interchange. (1 B.C.E.).

Kuala Lumpur Sentral, Malaysia



- The Kuala Lumpur Sentral **inter – modal transit hub** that spread over 30 hectares provides easy access and transfer between several modes **including express rail link, intercity trains, Rapid LRT, monorail and bus services.**
- The hub is **developed as a Transit Oriented Development (ToD**) with an intention to develop it as an integrated and self-contained live, work and play environment making it a self-contained urban development

Source: Kaula Lumpur Sentral Development (n.d.). Retrieved from http://www.klsentral.com.my/MasterPlan.aspx

Bury Interchange, Manchester

- Located in the northern part of Greater Manchester which **integrates on Metrolink Light rail line and the urban bus services**
- Interchange manages 10,000 bus and 1,000 light rail departures per week with 57,000 and 1,35,000 passengers per week.
- **About 20,000 transfer passengers** passes through this interchange being the highest among the integrated facilities in Greater Manchester.

Interchange integrating Metrolink LRT and Bus services

Source: Terzis, G., & Last, A. (2000). GUIDE - Urban Interchanges - Interchanges - A Good A Good Practice Guide

Recommendations

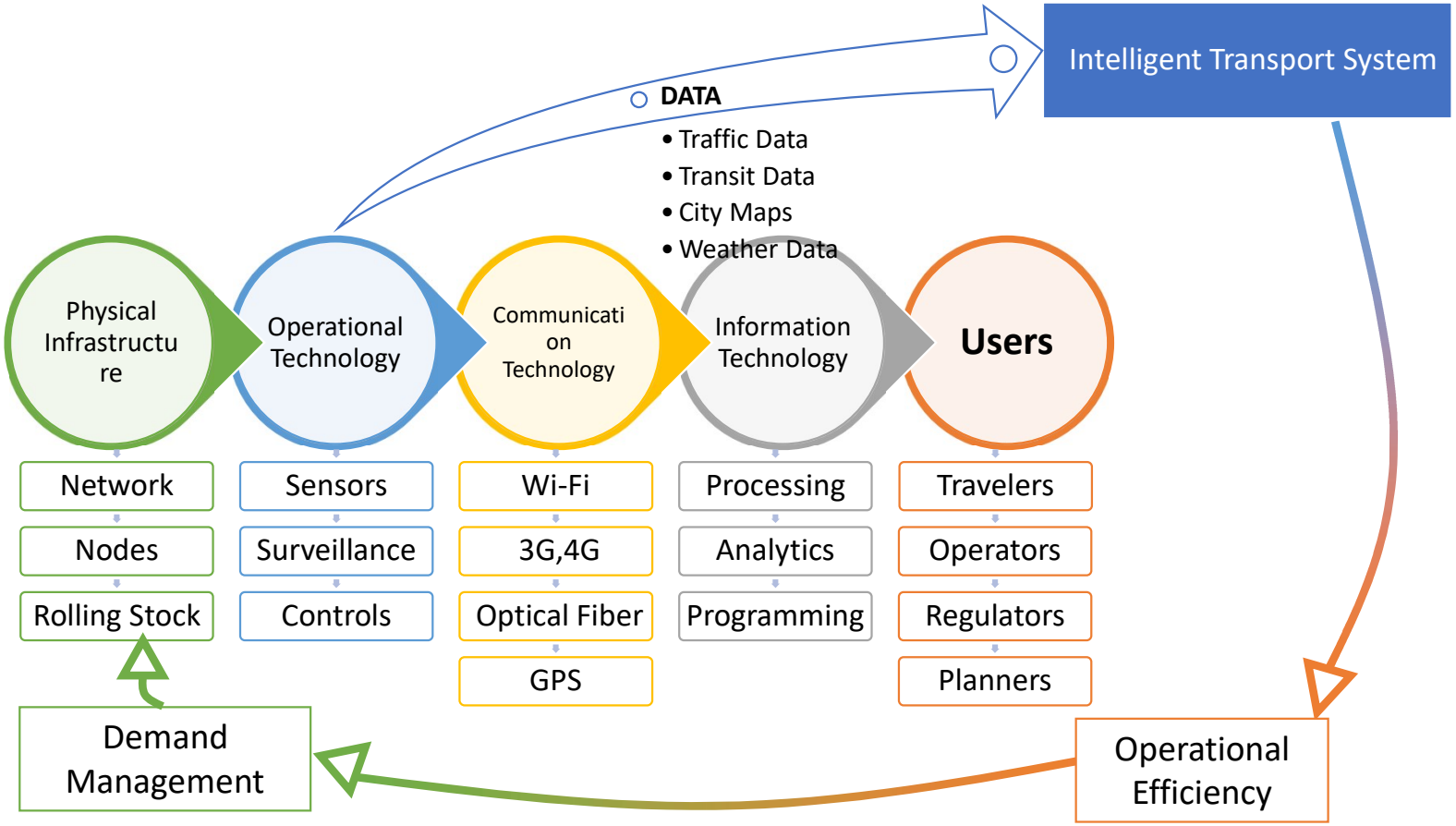
- Operation strategy planning is to allocate modes matching with the demand which vary over the space and time
- Recognize the crucial role of interchanges in the success of integrated multimodal transportation systems.
- Facilitate the development of areas surrounding interchanges to promote public transport ridership and harness opportunities for creating and capturing added value.

Operations Planning, Monitoring and Customer Information through ITMS

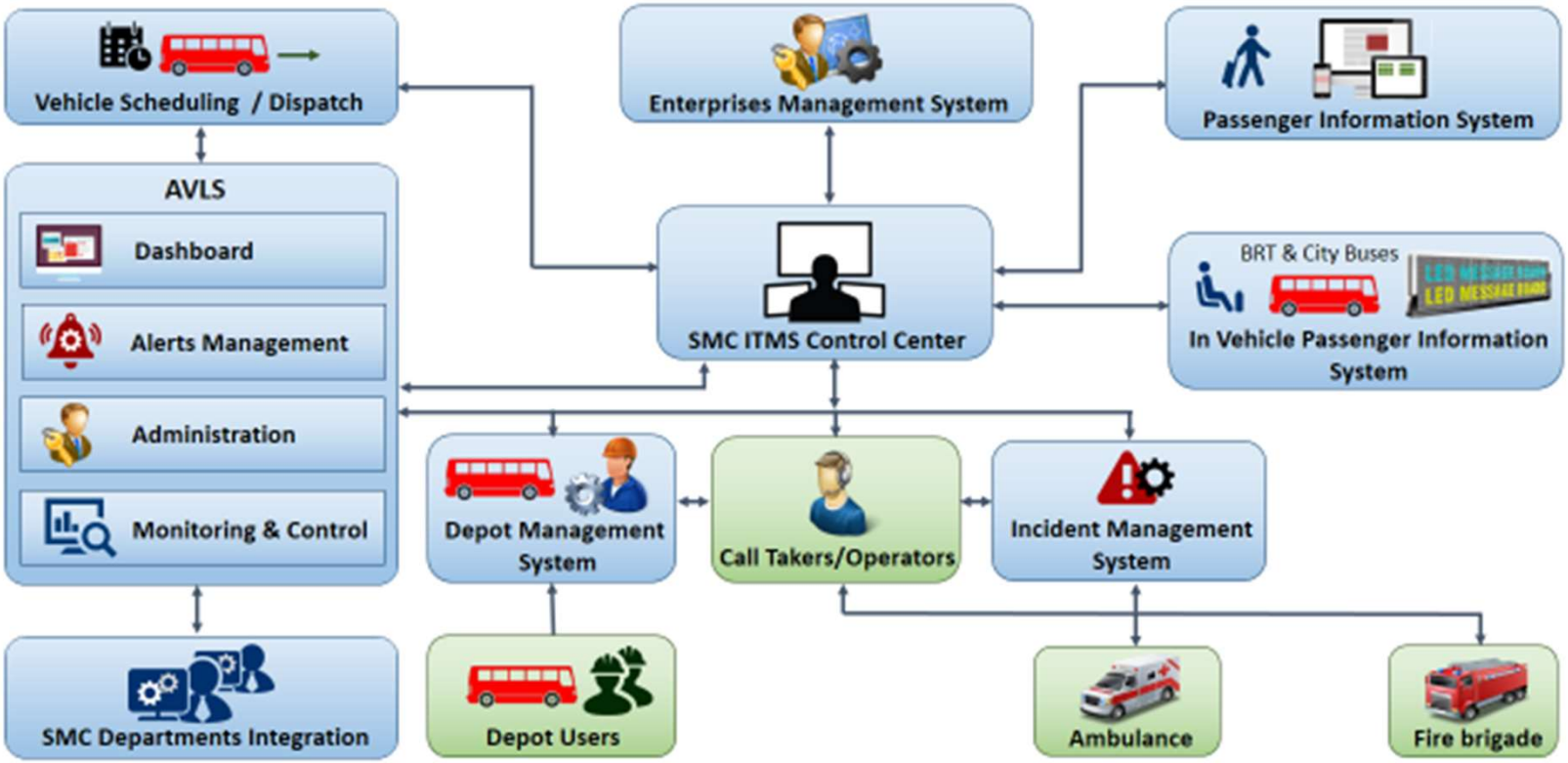
Chapter 6

Covers public transport operations management through digital technology applications.

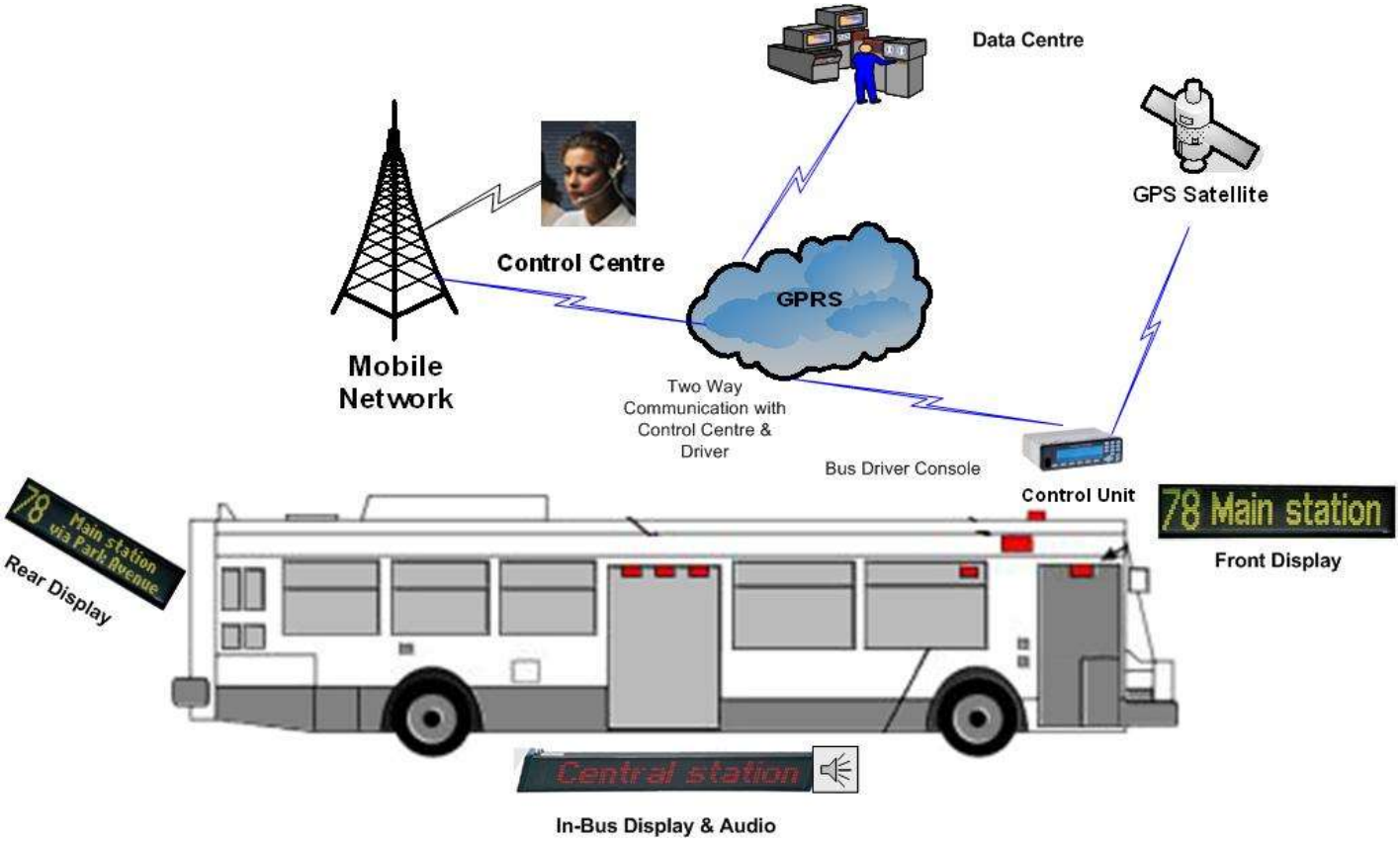
How ITMS Works?



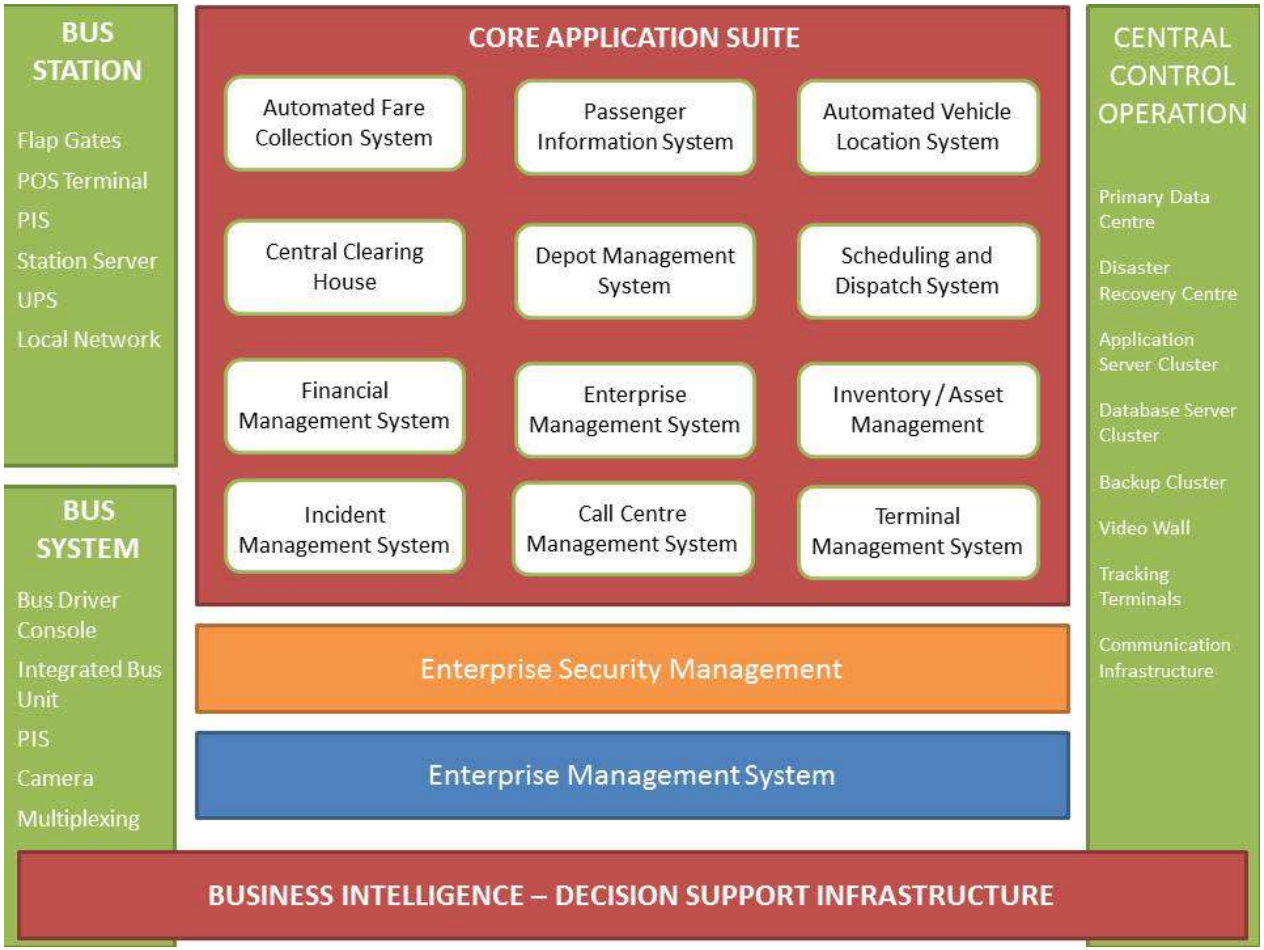
ITMS – An Overview



Bus Equipment Overview



ITMS APPLICATION LANDSCAPE



SMAC Smart City Centre

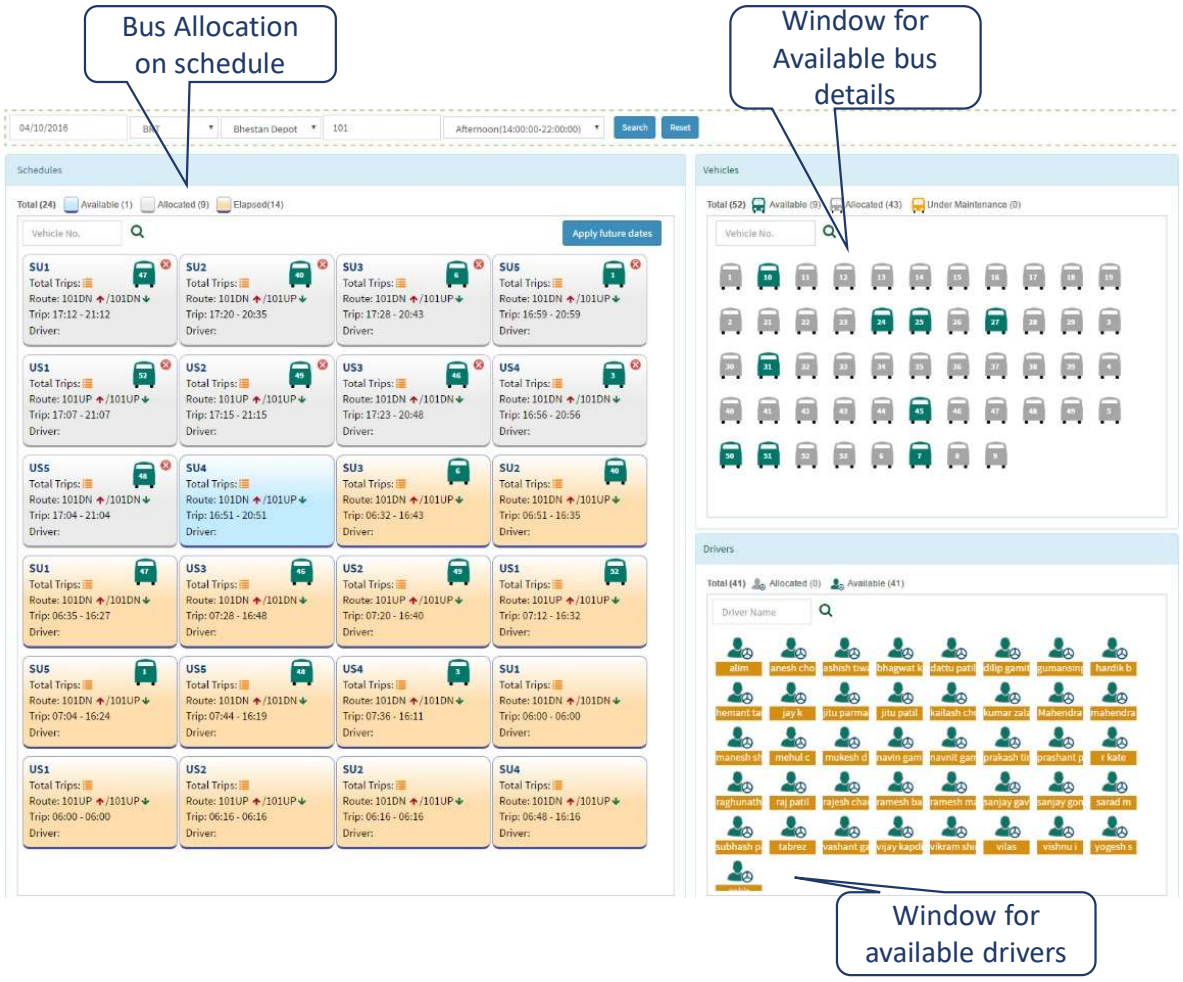
Characteristics:

- ***House of various departments/agencies*** like BRTS, City Bus, Fire, Traffic Police, RTO, etc

Key Benefits:

- **Efficient monitoring** of all service from one place
- ***Better coordination between departments*** to manage incidents

Depot Management System



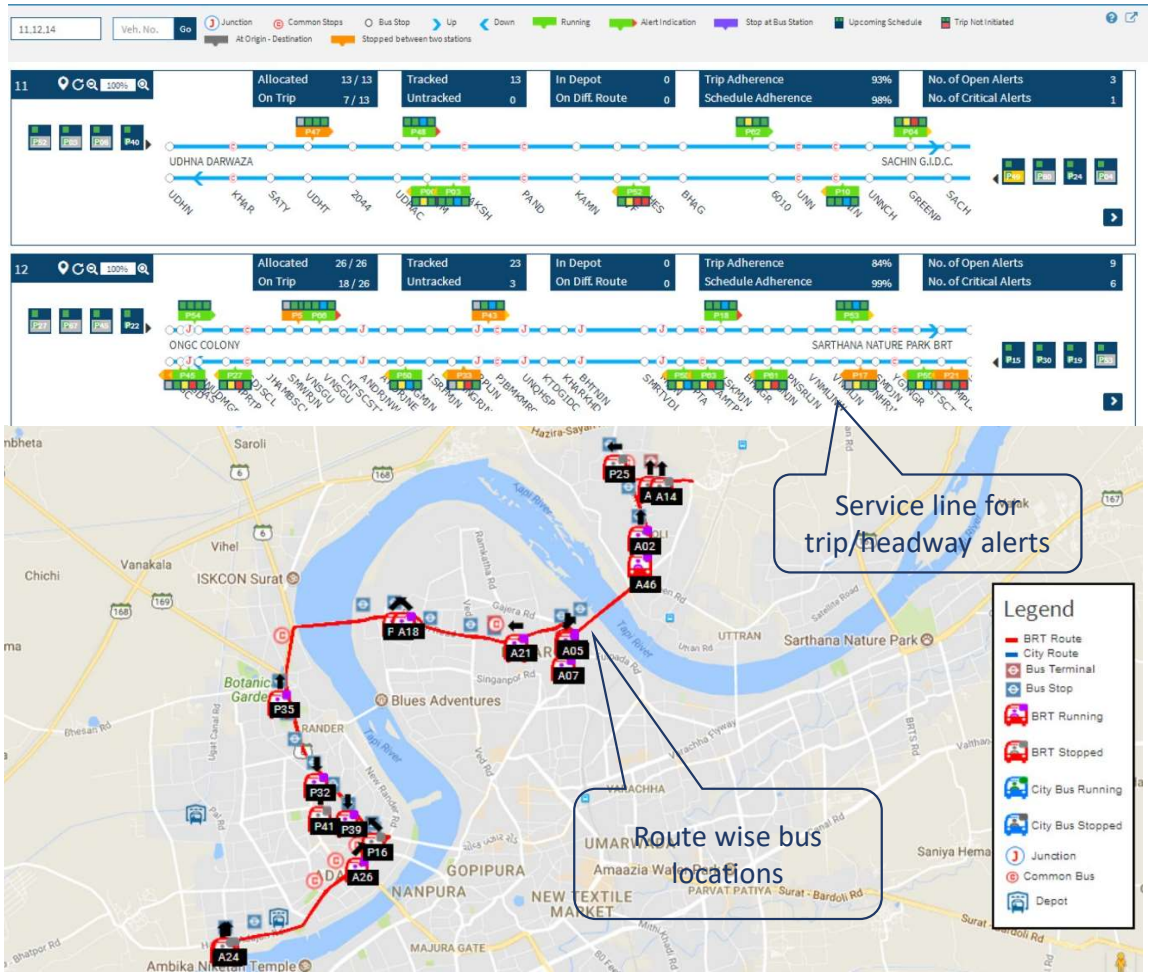
Characteristics:

- Human Resource Management
- Store Inventory
- Workshop Module
- Vehicle & Crew Allocation

Key Benefits:

- Reduced human involvement in allocation process – ***Digitization of depots***
- ***Single format*** across all the operators for all Depot related activity
- ***Database for allocation*** – Bus, Driver, ETM & Conductor
- With inputs from AVLS data, Sitilink can ***terminate or black list driver***
- ***Driver Performance Assessment*** program can be started with available data from DMS

Automatic Vehicle Location System



Characteristics:

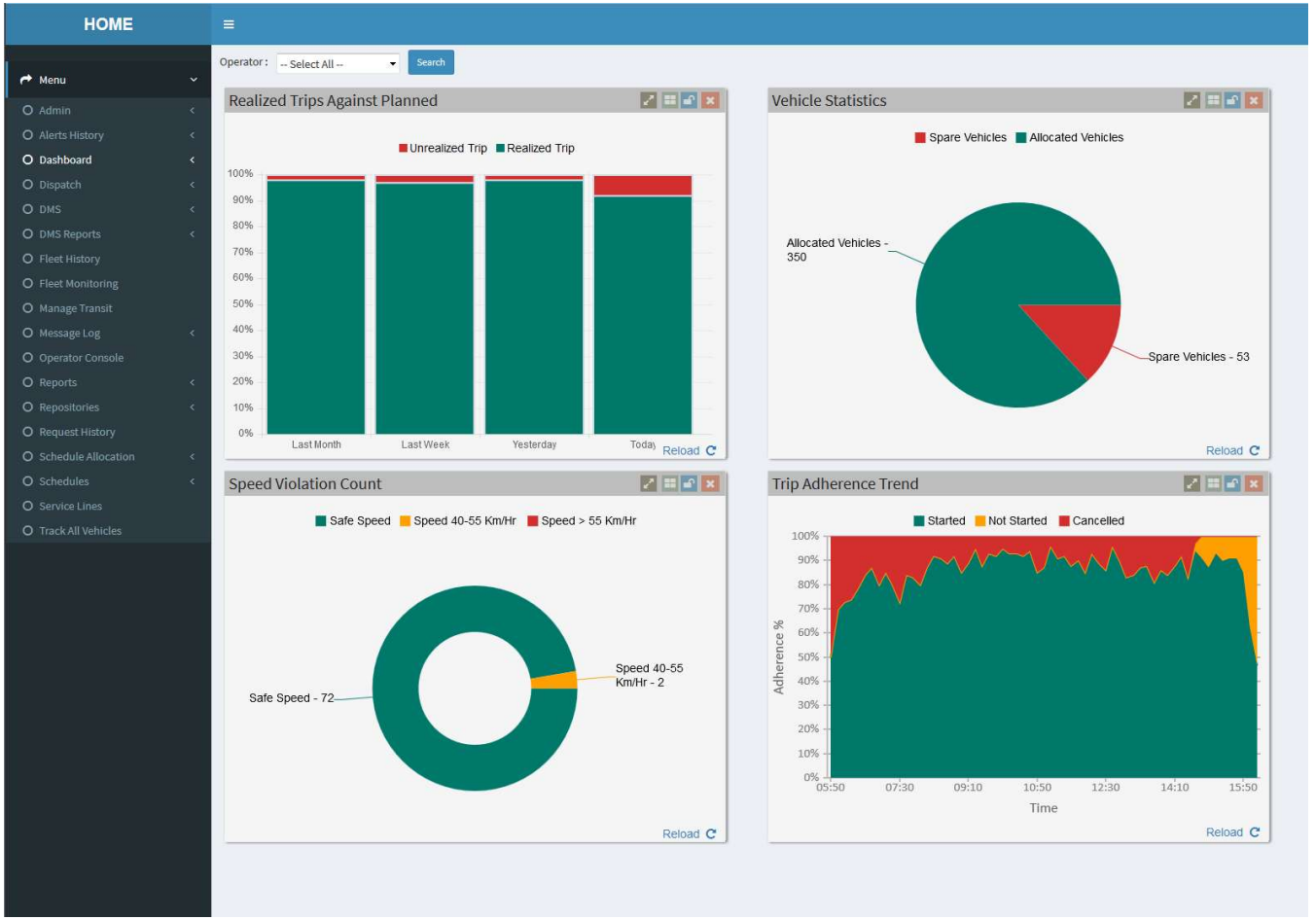
- Vehicle tracking at every 3 sec in BRTS & 6 sec in CBS.
- Passenger Information System (PIS) & Passenger Announcement System (PAS)
- Two way communication with driver
- Alert management w.r.t. operational & real time issues

Key Benefits:

- ***Real time monitoring*** of public transport
- With inputs from AVLS, Sitilink started ***system generated operator billing*** after reconciliation
- ***Availability of database*** which can directly use for several Transit Performance Indicators
- ***Panic message*** to control center through BDC
- ***Real time information*** to users through PIS & PAS
- In case of any event, Sitilink can send ***centralized messages*** to all the vehicles through BDC

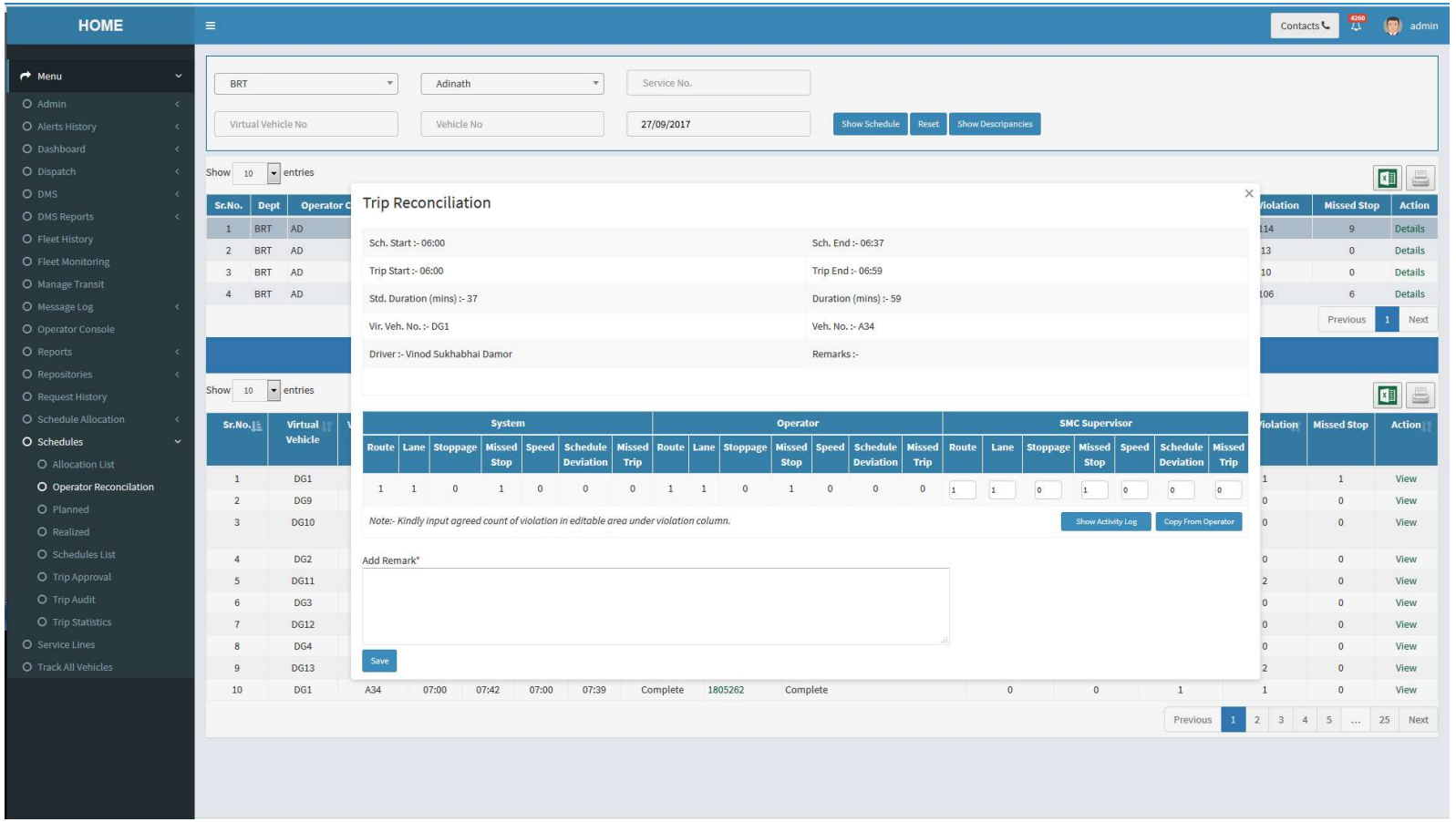
Automatic Vehicle Location System

AVLS Dashboard



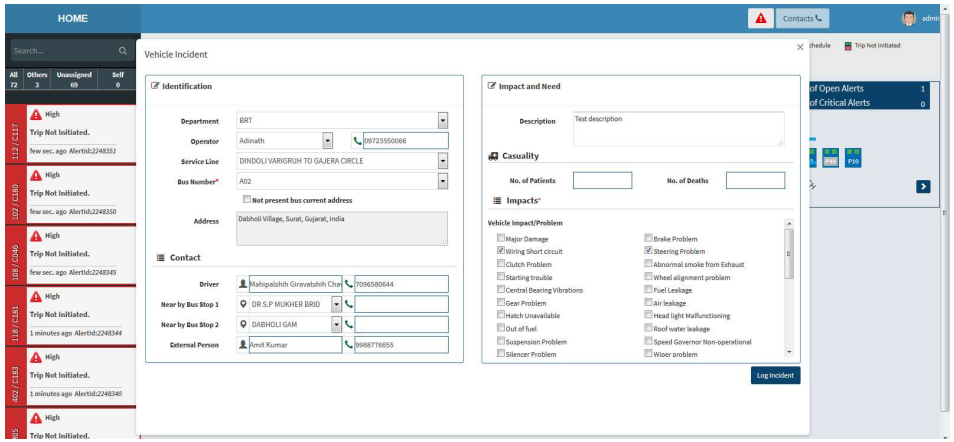
Automatic Vehicle Location System

Reconciliation window for operator & Sitilink

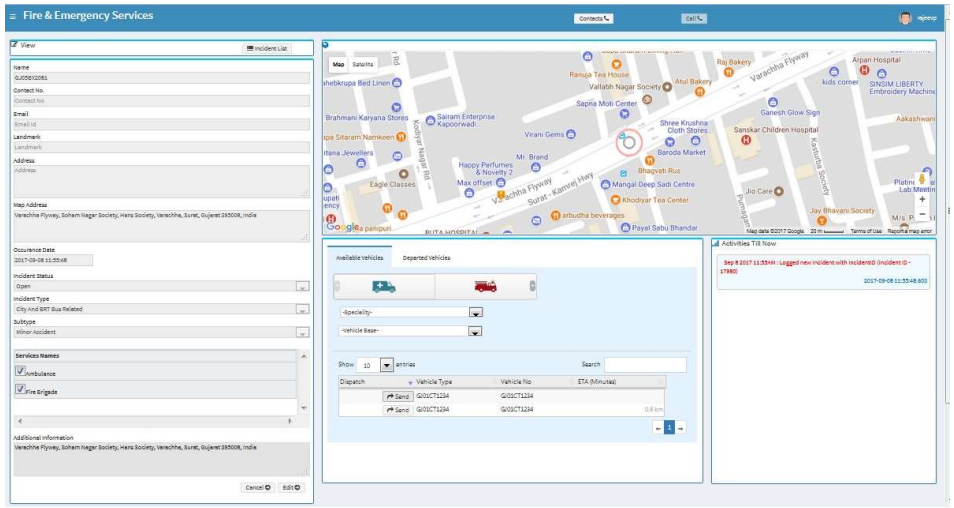


Incident Management System

Vehicle Incident Management System



Dispatch of Emergency Vehicle



Characteristics:

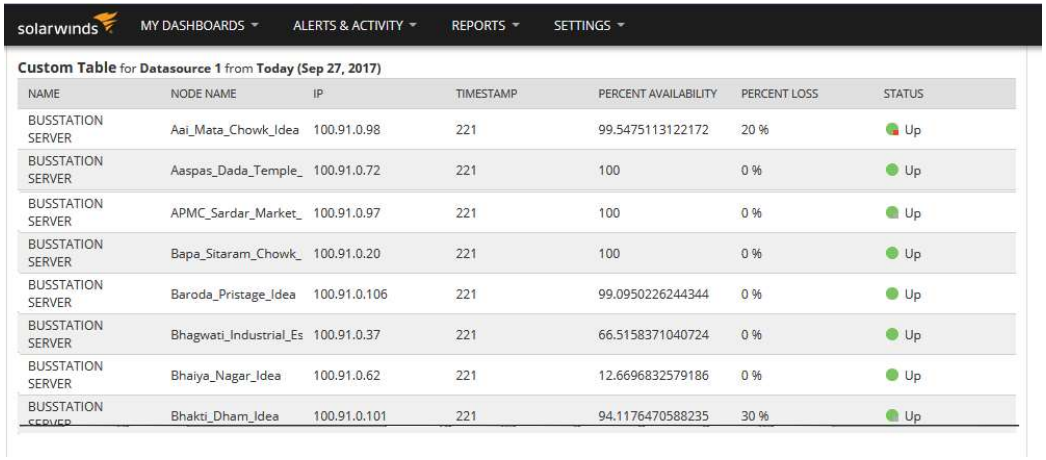
- capability to manage any incident from control center
- provide quickest route to reach location of incident location and provides location of nearby emergency service.

Key Benefits:

- Different ***department work close*** to resolve incident
- Provides ***quick response & service*** during critical duration of incident

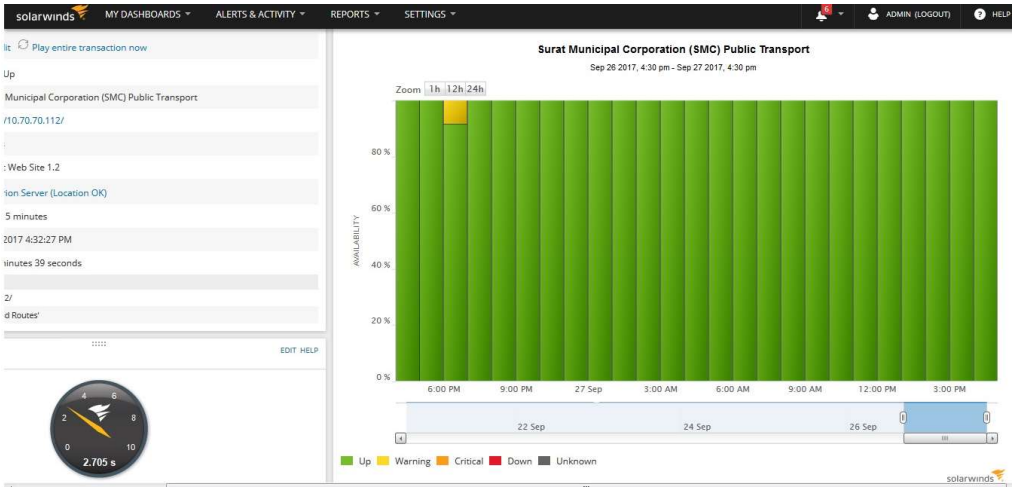
Enterprise Management System

Station PIS Server Up time



NAME	NODE NAME	IP	TIMESTAMP	PERCENT AVAILABILITY	PERCENT LOSS	STATUS
BUSSTATION SERVER	Aai_Mata_Chowk_Idea	100.91.0.98	221	99.5475113122172	20 %	Up
BUSSTATION SERVER	Aaspas_Dada_Temple_	100.91.0.72	221	100	0 %	Up
BUSSTATION SERVER	APMC_Sardar_Market_	100.91.0.97	221	100	0 %	Up
BUSSTATION SERVER	Bapa_Sitaram_Chowk_	100.91.0.20	221	100	0 %	Up
BUSSTATION SERVER	Baroda_Pristage_Idea	100.91.0.106	221	99.0950226244344	0 %	Up
BUSSTATION SERVER	Bhagwati_Industrial_Es	100.91.0.37	221	66.5158371040724	0 %	Up
BUSSTATION SERVER	Bhaiya_Nagar_Idea	100.91.0.62	221	12.6696832579186	0 %	Up
BUSSTATION SERVER	Bhakti_Dham_Idea	100.91.0.101	221	94.1176470588235	30 %	Up

Website up time



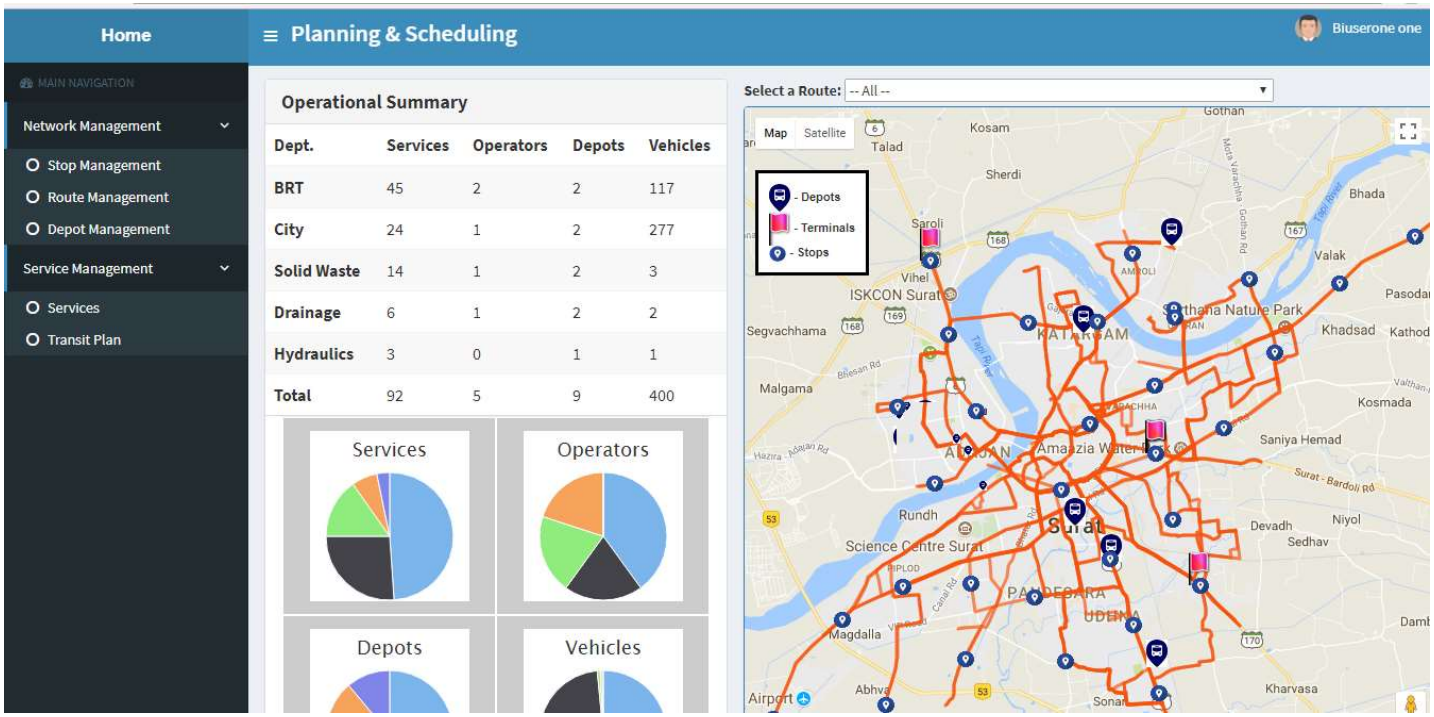
Characteristics:

- Monitors assets owned by Sitilink
- Provide working status of all equipment such as GPS, BDC, station server, etc

Key Benefits:

- Sitilink is ***able to monitor all the equipment*** from control center

Planning & Dispatching System



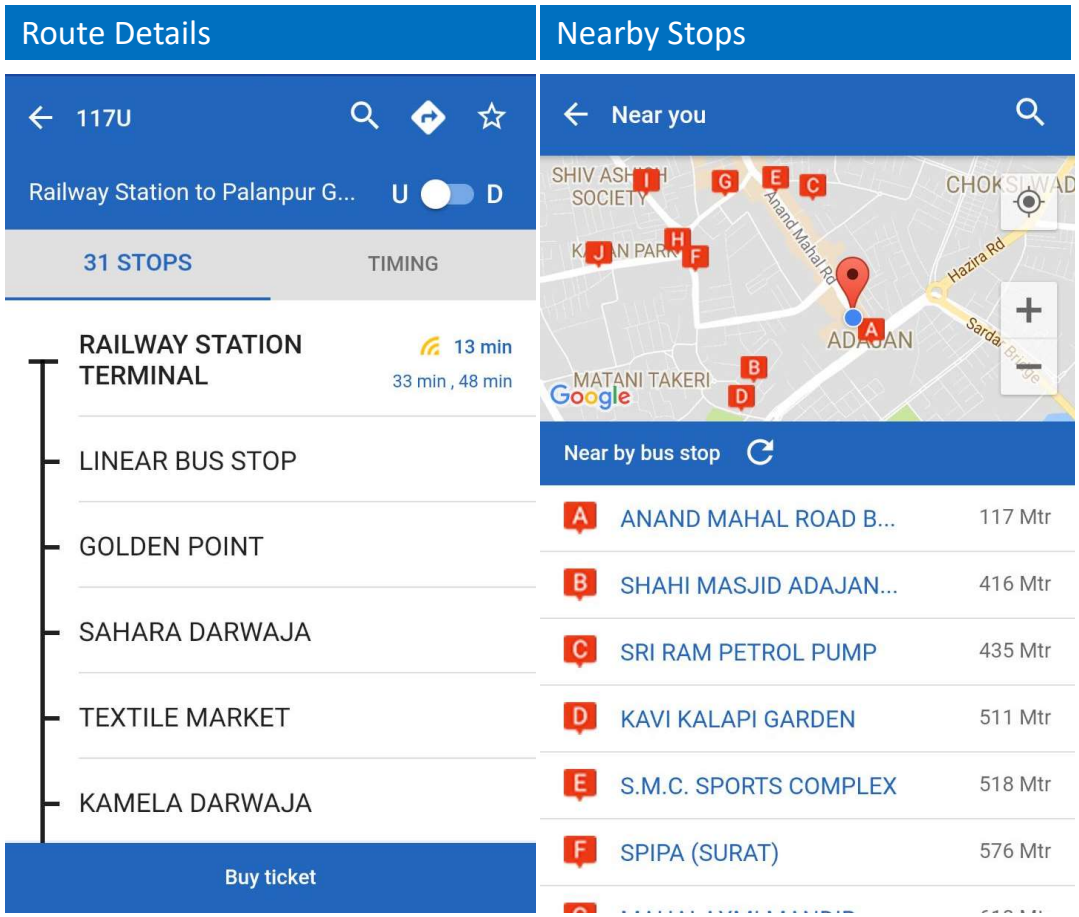
Characteristics:

- Creates schedule for system, bus & drivers
- Can use data available in AVLS

Key Benefits:

- ***Reduced dead km***
- Effective schedule in short time period

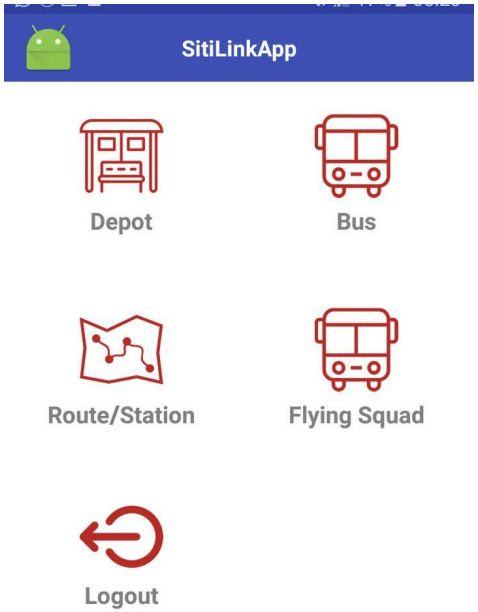
User Mobile Application

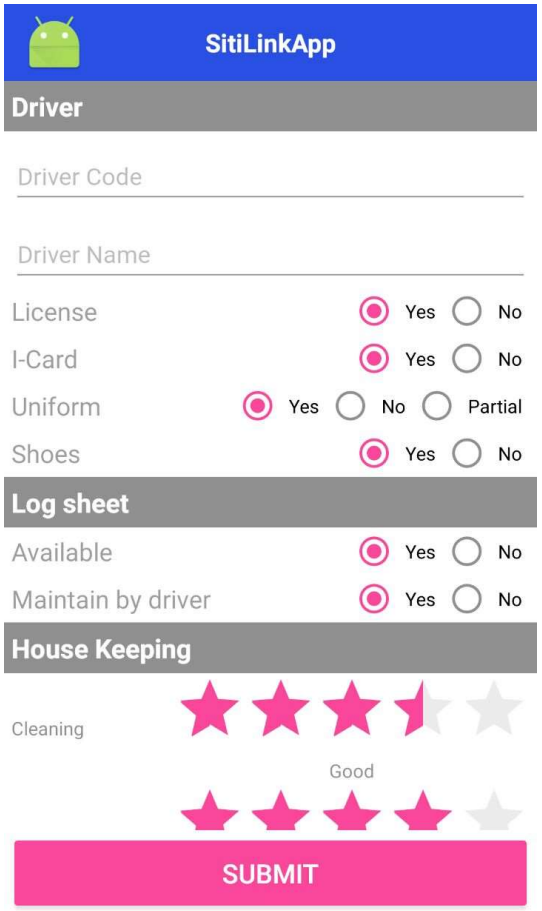


Characteristics:

- Route planner
- Near by stations
- Estimated time of arrival (ETA),
- Timetables,
- Route information

Supervisor Mobile Application





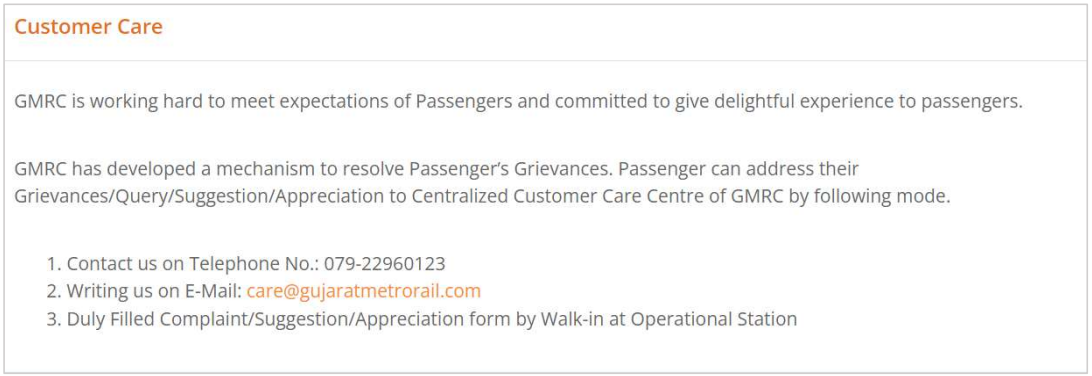
Characteristics:

- ***Location tracking*** of all the supervisors
- ***Flying Squad module*** records details of penalty
- Driver & conductor module
- Station inspection to check cleanliness & station infrastructure

Key Benefits:

- ***Efficient monitoring*** of penalty collection
- ***Efficient management of human resource*** by tracking of each supervisor
- ***Reduced human intervention*** to create database

Customer Redressal

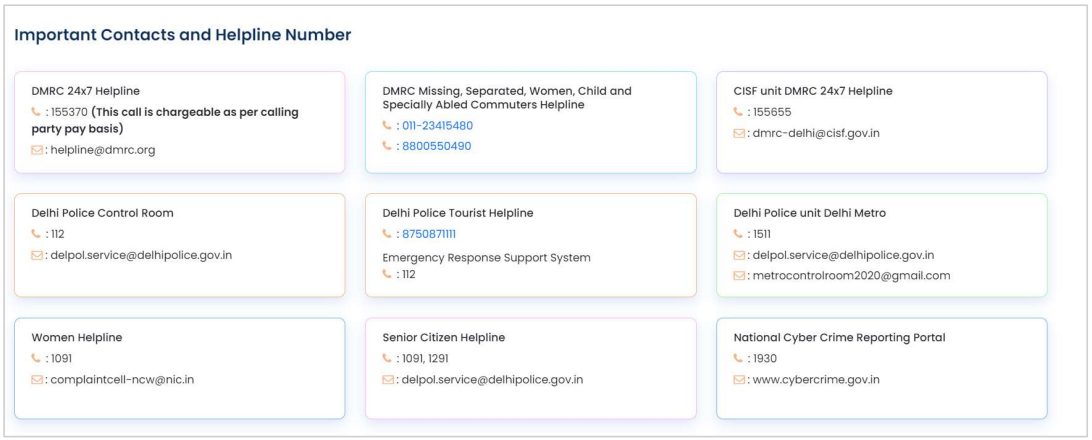


Customer Care

GMRC is working hard to meet expectations of Passengers and committed to give delightful experience to passengers.

GMRC has developed a mechanism to resolve Passenger's Grievances. Passenger can address their Grievances/Query/Suggestion/Appreciation to Centralized Customer Care Centre of GMRC by following mode.

1. Contact us on Telephone No.: 079-22960123
2. Writing us on E-Mail: care@gujaratmetrorail.com
3. Duly Filled Complaint/Suggestion/Appreciation form by Walk-in at Operational Station



Important Contacts and Helpline Number

DMRC 24x7 Helpline : 155370 **(This call is chargeable as per calling party pay basis)** : helpline@dmrc.org	DMRC Missing, Separated, Women, Child and Specially Abled Commuters Helpline : 011-23415480 : 8800550490	CISF unit DMRC 24x7 Helpline : 155655 : dmrc-delhi@cisf.gov.in
Delhi Police Control Room : 112 : delpol.service@delhipolice.gov.in	Delhi Police Tourist Helpline : 8750871111 Emergency Response Support System : 112	Delhi Police unit Delhi Metro : 1511 : delpol.service@delhipolice.gov.in : metrocontrolroom2020@gmail.com
Women Helpline : 1091 : complaintcell-ncw@nic.in	Senior Citizen Helpline : 1091, 1291 : delpol.service@delhipolice.gov.in	National Cyber Crime Reporting Portal : 1930 : www.cybercrime.gov.in

Characteristics:

- Customers can ***lodge complaints*** through different communication channels, including phone, email, social media, or in-person.
- ***Grievances are documented*** to make a record of the issue and its resolution
- Agency aim to respond to customer grievances promptly to ***address concerns in a timely manner***.

Key Benefits:

- Effective grievance handling ***enhances passenger satisfaction***
- Customer feedback helps ***identify areas that require improvement***
- Addressing grievances promptly can ***prevent escalation of smaller issues***

Benefits achieved in Surat with Application of ITMS

- **Single established system** across operators
- System generated **operator billing report** after reconciliation process
- **Real time information** to the public transit users
- Increased **reliability**
- Average user satisfaction **8.6**
- **Driver assessment program** to incentivize or penalize driver
- **Close monitoring** on any incident at control center
- **Transit violations monitoring** such as speed violation, missed stop violations and route deviation.
- Availability of **transit database** with each minor detail
- Central **message publication** to all transit vehicle in case of any event
- Real-time information at any time through **mobile application**.

Surat has moved from no public transport to quality Public Transport

Before 2007 | **2007 onwards** | **BRTS in 2014** | **City bus in 2015** | **Satisfaction of people**

Framework for Assessment of Public Transport

Sustainable Urban Transport Index (SUTI) Indicators

- Extent to which Transport Plans Cover Public Transport, Intermodal Facilities and Infrastructure for Active Modes
- Modal Share of Active and Public Transport in Commuting
- Convenient Access to Public Transport Service
- Public Transport Quality and Reliability
- Traffic Fatalities per 100,000 Inhabitants
- Affordability – Travel Costs as a Share of Income
- Operational Costs of the Public Transport System
- Investment in Public Transportation Systems
- Air Quality (PM_{10})
- Greenhouse Gas Emissions from Transport

Measuring is Monitoring,

Monitoring is Management of Public Transport

Fare Systems

Chapter 7

Explains alternative approaches to formulating integrated fare policies, strategies, level and structure, and collection and distribution, with the application of digital technology.

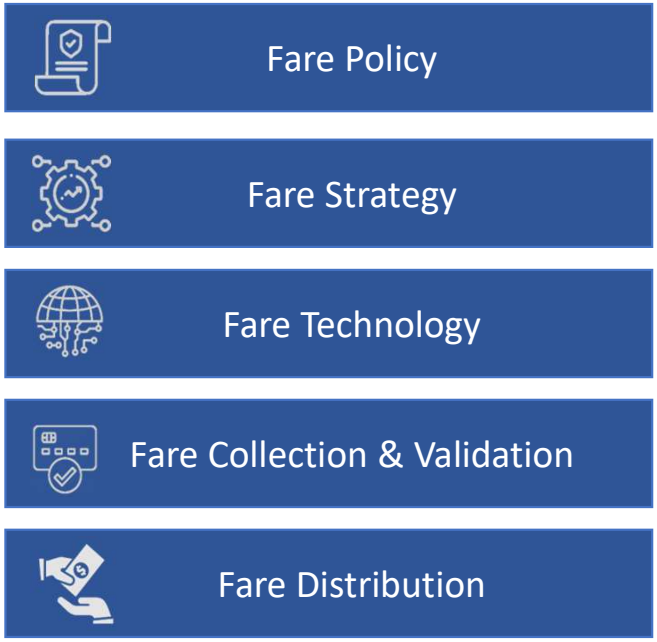
Why Fare Integration?

Fare is a crucial factor which impacts **Ridership** and **Revenue**.

Fare integration increases **Convenience** and **Reduces Cost of Travel**.

Fare integration simplifies public transportation use, by making it more **accessible, equitable,** and **environmentally friendly** while boosting **economic benefits.**

Components of **Fare Integration**



Fare Policy

Goals

Constraints

Customer

- Increase ease of use and convenience
- Reduce complexity for the customers

Management

- Improve Data Collection
- Improve Mode Integration
- Improve fleet
- Maximise ease of implementation
- Increase pricing flexibility
- Demand management
- Improve operations
- Improve reliability of fare equipment

Political

- Maximise political acceptance

Financial

- Improve revenue control
- Reduce Fare Collection costs
- Increase prepayment
- Minimise ridership loss
- Minimise Fare abuse and evasion
- Reduce use of cash

Relation

- Integration with larger development plans
- Adopting effective marketing services
- Increasing public support

Community

- Ensuring passenger safety
- Improving environmental equity
- Conserving energy

Source: Fleishman, D., Shaw, N., Joshi, A., Freeze, R., & Oram, R. (1996). TCRP Report 10:Fare Policies, Structures,and Technologies. Washington, D.C.: Transportation Research Board.

Fare Policy

Goals

Constraints

Constraints which binds with every agency and they play an important role in fare system related decisions

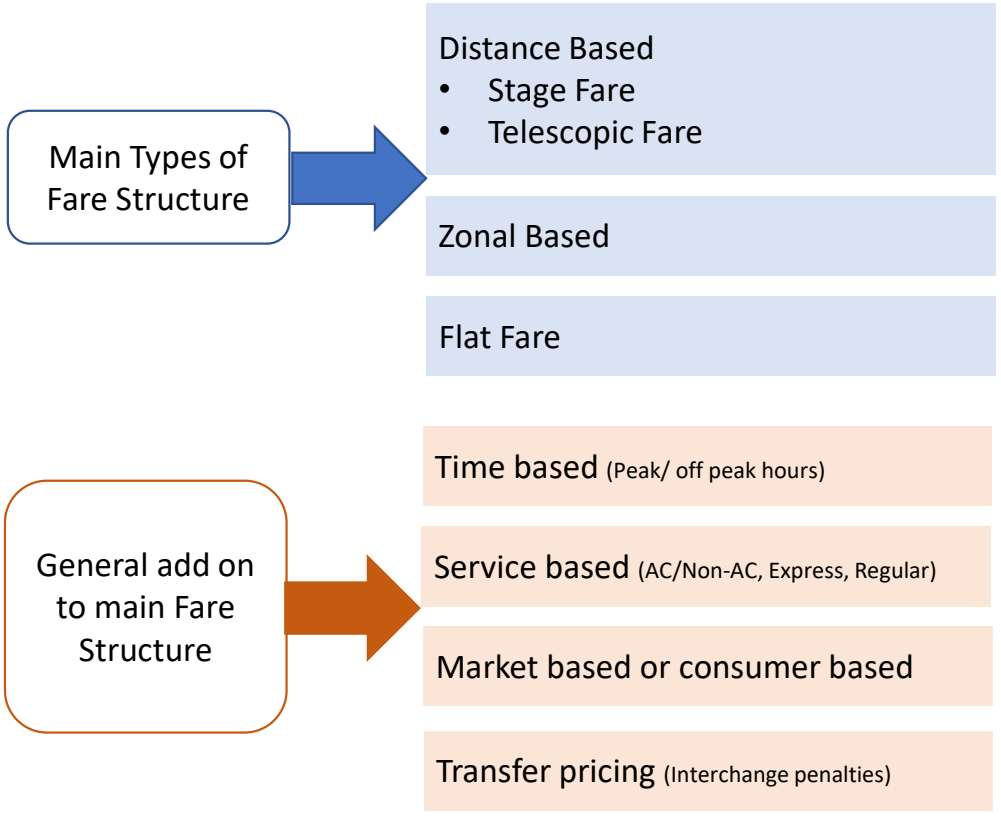
- Constraints within the agency – constraints may exist in the management practices, labour agreements and organizational structure.
- Constraints in the transport system in the city – interaction with other transport systems of the city will also affect an agency's fare decision (competition with other modes).
- Socio-economic constraints – Political, social and economic conditions of the city can also effects fare policy decisions.

Source: Barr, J. E. (1997), Intermodal Fare Integration: Application to the Sun Juan Metropolitan Area, Massachusetts: Massachusetts Institute of Technology.

Fare Strategy – Levels and Structure

Based on the **overall policy of the organization** about the level of system cost recovery expected.

Full Cost Recovery
Both capital and operating expenditure
Partial Cost Recovery
Partial of full or operating costs
Full Operating Cost Recovery
Capital is funded by the government
No cost Recovery
Free Fare Policy



Integrated Fare Determination and Distribution

Equitable revenue sharing is worked considering the share of journey on different services. The revenue is proposed to be shared in ratio of base fare (of the service) to combined base fare.

Revenue sharing is considered after deducting 5% administrative exchange. The equation governing the sharing of revenue is described below:

$$\text{Apportionment Ratio} = \frac{\text{Fare on particular service}}{\text{Total Fare of both services}} \times \text{Integrated Fare (95\%)}$$

Example for Revenue Collection and Distribution		How much Passenger travels		What Passenger Pays		Revenue share (without administrative exchange)	Revenue share (after 5% administrative exchange)
Up Direction							
Operator	Link	km	cumulative distance	base fare	incremental fare	Revenue from service	operator's share
Service A	A-B	5	5	8	8	(8 / 20) x 15 = 6	5.70
Service B	B-C	10	15	12	7	(12 / 20) x 15 = 9	8.55
		15		20	15	15	14.25

*Commuter benefits of Transfer penalty of Rs 5 in above case with integrated fare.

Fare Technology

Payment Options

- **Single-ride**
- **Multi-ride**
- **Period pass**
- **Stored value**

Payment Media

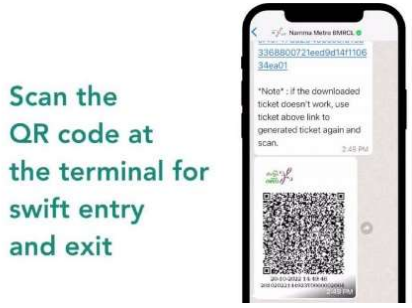
Cash

Token

Paper Ticket

Magnetic Ticket

Smart Card, Debit/Credit Card



Mobile Tickets

Fare Collection

Ticket Vending Machines

Ticket Validators

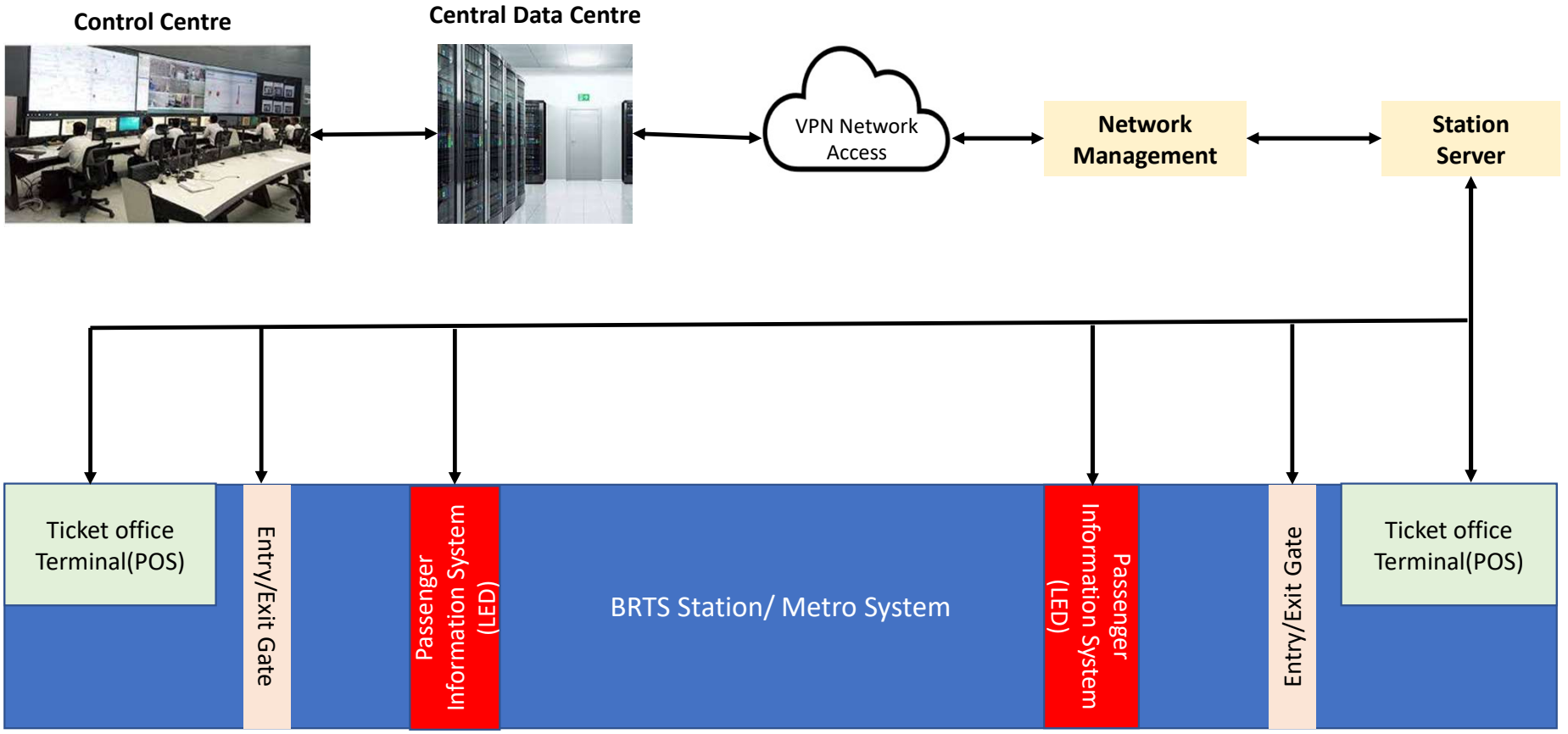
Ticket Office Machines

Ticket Processing Unit/ Fare box

Fare gates

Hand-held devices

Automated Fare Collection System



Source: Swamy, H., & Ogra, V. (2016). Development of Toolkit for implementing ITS – Public Transport & BRT Services.

London

Commuters have to pay separate fares across different modes.

Buses and Trams

Flat Fares – tap in only and Cashless

£1.75 per PAYG Journey
£5.25 daily PAYG cap
£24.70 per Weekly Bus Pass/Cap

Underground, DLR and Overground

Zonal Fares

e.g. Zones 1-2
£2.50 daily peak hour Journey
£8.10 daily peak and off-peak PAYG Cap
£15.20 Daily cap, £40.70 Weekly Travelcard/Cap

Zones	Bus and Tram Fares	Caps for Tube, DLR, London Overground, Elizabeth line and National Rail services
Zone 1 only	£1.75 £5.25 Cap	£8.10
Zone 1 - 2		£8.10
Zone 1- 3		£9.60
Zone 1- 4		£11.70
Zone 1- 5		£13.90
Zone 1- 6		£14.90
Zone 1- 7		£16.20
Zone 1- 8		£19.10
Zone 1- 9		£21.20

Source: TfL. (2023). Fares from 5 March 2023. Transport for London. Retrieved from https://tfl.gov.uk/campaign/new-fares#on-this-page-0

Singapore

A commuter pays a single fare for the entire journey and does not pay an additional fare or boarding charge while transferring to another mode.

Train Fares – MRT & LRT

Bus Fares – Basic Services

Distance Based Fare

Fare Ranges from S$0.99 to S$2.26 for adults by card
(regardless of mode of travel)

Source: PTC. (2022). Public Transport Council. Retrieved from https://www.ptc.gov.sg/docs/default-source/default-document-library/ptc-fre-implementation-flyer-2022.pdf

Fare Integration Benefits in Singapore

Distance based fare= Base fare structure + Surcharges applicable for the use of higher-level service

Surcharge = difference between fare of standard transport system/ minimum value fare system and premium service

Trip Legs	Mode	Origin	Destination	Dist. Km	Cumulative Distance in km	Individual Fare in cents	Distance based fare in cents	Revenue to operator in cents
Trip 1	MRT	Tai Seng	Marymount	6.9	6.9	126	126	64.1
Trip 2	Bus 14e	Blk 403	East Coast Ville	5.8	12.7	163	88	82.9
Trip 3	Bus 30e	Opp Blk 32	Pasir Panjang Ct	19.3	32	226	48	115.0
					Total Fare	**515**	**262**	
R.Trip 1	Bus 30e	Opp Blk 32	Pasir Panjang Ct	19.3	19.3	226	226	115.0
R.Trip 2	Bus 14e	Blk 403	East Coast Ville	5.8	25.1	163	13	82.9
R.Trip 3	MRT	Tai Seng	Marymount	6.9	32	126	23	64.1
					Total Fare	**515**	**262**	

Base fare (111) + Surcharge for 6.9 km (15)

[Incremental fare = Base fare of 12.7 km (139) - Base fare of 6.9 km (111)]+ Surcharge for 5.8 km (60)

[Incremental fare = [Base fare for 25.1 km (187) - Base fare of 6.9 km (111)] + Surchage for 25.1 km (60) - Previous Trip Leg price (88)

Surat

Commuter purchases a single ticket for an entire journey using bus systems

City Bus Service

Surat BRTS

Integrated Distance Based Fare across bus systems in the city

- Open-loop Smart Card and barcoded paper tickets with payment of cash
- Maximum transfer time between buses is fixed and while exceeding it, the trip will be counted as a new trip.

Distance (km)	City Bus and BRTS (in INR)
0-2	4
2-3	6
3-4	6
4-5	8
5-6	8
6-8	10
8-10	12
10-14	17
14-18	20
18-22	22
22-26	22
26-32	22
32-38	22
>38	22

1 INR = 0.012 US Dollars

How to Plan for Fare Integration

Step 1	Formulate and establish an organisation that works dedicatedly to integrate modes and services which has legal backing for the decisions taken.
Step 2	Set up fare policy with consideration of legal requirements, affordability index, sustainability and inflation. Fix fares in case of single mode and different modes along with fare revision provision
Step 3	Develop clear framework on settlement mechanism and business rules to avoid conflicts and disagreements which includes fare apportionment and subsidies.
Step 4	Decision on payment mechanism, fare medium and technological tools

Market Approach on Fare Integration

Rapid Evolution of Technology

Continuous reevaluation of tech choices is essential for adopting evolving mobile ticketing over cash.

Embracing Non-Fare Gate Systems

Emerging technologies like mobile app self-validation are simplifying fare collection in metro stations.

Exploration for Seamless Integration

Continuous Creating a National Common Mobility Card (NCMC) is necessary to streamline and standardize fare systems across various public transport systems.

Role of Information Interoperability

Interoperable information, driven by platforms like ONDC, is critical for successful fare integration, provided it effectively serves the public.

Mobile-Centric Future

The future envisions complete reliance on mobile devices for transactions, necessitating meticulous planning for end-of-day settlements due to the accumulation of multiple transactions.

Integrating Fare Management with Lifestyle

Fare integration should extend beyond transportation, integrating seamlessly into daily life and various services, redefining the use of public transport smart cards.

Summary

- Fare is a matter of public policy and not necessarily a tool for cost economy
- Affordability is crucial
- Public transport benefits the users as well as non-users – Cost recovery from non-users need to be explored in terms of - Who pays for the public transport?

Polluter Pay
Incentivize the use of public transport over private vehicles, which are more polluting and contribute to congestion, greenhouse gas emissions, air pollution, etc.
eg: Congestion charge, Cess on Petrol, Add. Tax on RTO Tax

Beneficiary Pay
Concept that suggests that those who benefit from a public service or policy should pay for it proportionally to their benefits
eg: TOD-Values Capture, Employment Tax

User Pay
Concept that suggests that those who benefit from a public service or policy should pay for it proportionally to their benefits
eg: Fare

Institutions

Chapter 8

Defines urban transport functions and their hierarchy and presents approaches to integrating urban transport institutions towards more efficient delivery of urban public transport services.

What is Institutional Integration?

Institutional integration means creating an organisational framework including different agencies and stakeholders involved in planning, operations and managing (urban and) transport services.

The institutional framework consists of:

- an agencies set up through an act of the legislature or an order of the government,
- allocation of a defined set of functions and responsibilities to deliver, and
- a set of powers, resources and procedures (rules, regulations) allocated to provide the assigned roles

Agencies Responsible for Transport in Delhi

Transport Department
Planning and Design
Operations and Management
Licensing
Regulation
Provincial

Delhi Transport Corporation
Implementation
Operations and Management
Provincial

Delhi Metro Rail Corporation
Planning and Design
Implementation
Operations and Management
Provincial and National

Delhi Integrated Multimodal Transport Services
Planning and Design
Implementation
Operations and Management
Provincial

Delhi Cantonment Authority
Management of Cantonment Land
National

Indian Railways
Planning and Design
Implementation
Operations and Management
National

Delhi Development Authority
Planning and Design
National

Municipal Corporation
Planning
Implementation
Management
Local

Delhi Police
Regulation
National

Environment Department
Emission Standards
Provincial

Public Works Department
Implementation
Provincial

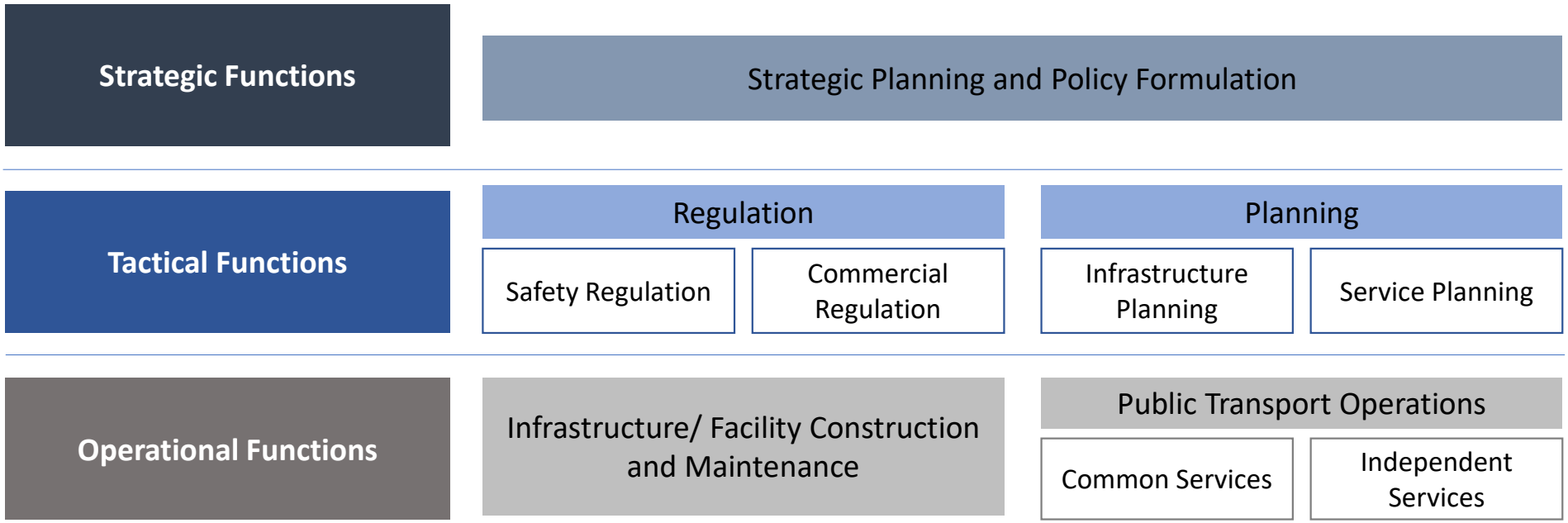
NCR Region Delhi, Faridabad, Ghaziabad, Gurugram, and Noida. Also introduction of Regional Rail

While functions carried out by multiple agencies results in

- Overlapping of responsibilities
- Poor coordination with each other.
- Inefficient use of resources.

This raises a challenge at the institutional level, where actions must be integrated and well-coordinated to balance supply and demand effectively.

Functions to be Performed in the Provision of Urban Transport



Source: The World Bank (2013). Institutional Labyrinth. Designing a Way Out for Improving Urban Transport Services. Australian AID. Washington, DC.

Institutional Models on Integrated Public Transport

Single Authority for integrated land use and transport development

Single Authority as Regulator and Organiser of Urban Transport with existing institutions

Institutional Models

There is no standard model that fits different city contexts

Urban Local Body for higher-order functions

Single Agency for Coordination

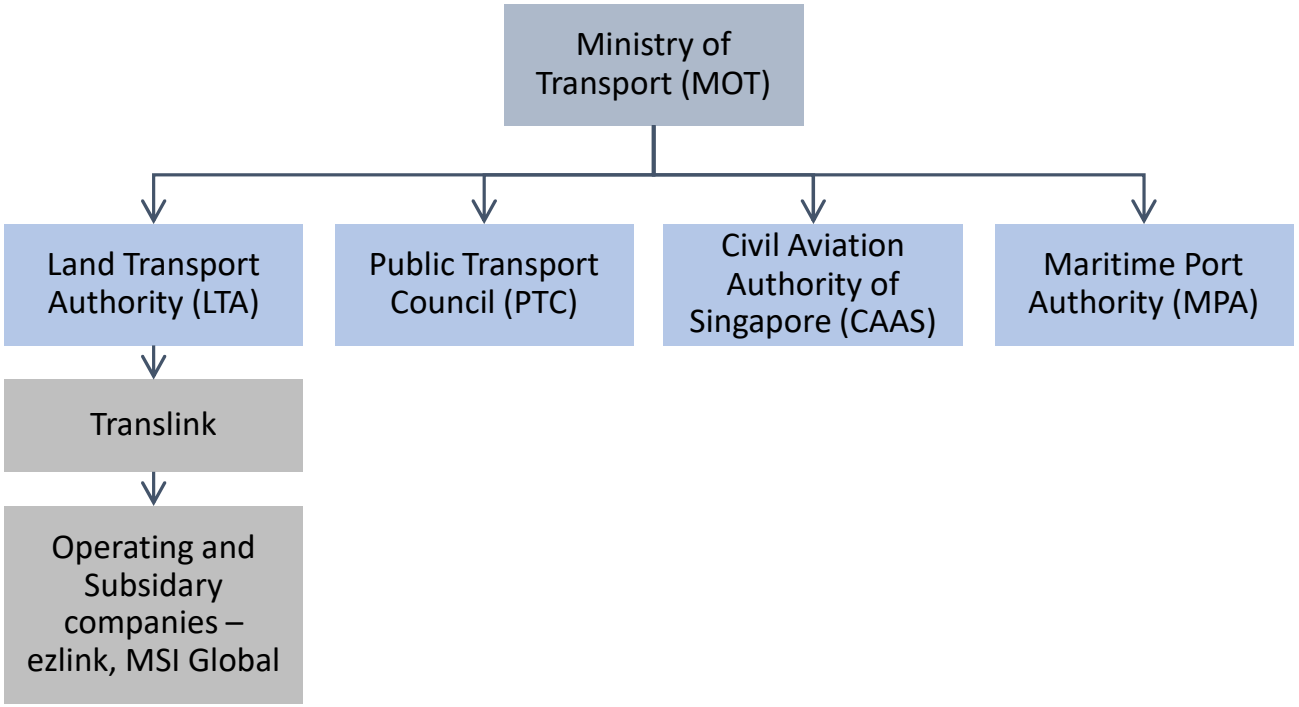
An appropriate institutional model varies with determining factors for developing an efficient institutional model

Historical Context	Size of the city Modes & Operators	Existing governance structure	Political values	Administrative cultures

A Single Authority responsible for Land use and Transport Development

The Land Transport Authority, Singapore

Transport and urban planning managed by a single agency – Land Transport Authority, a state-owned institution.



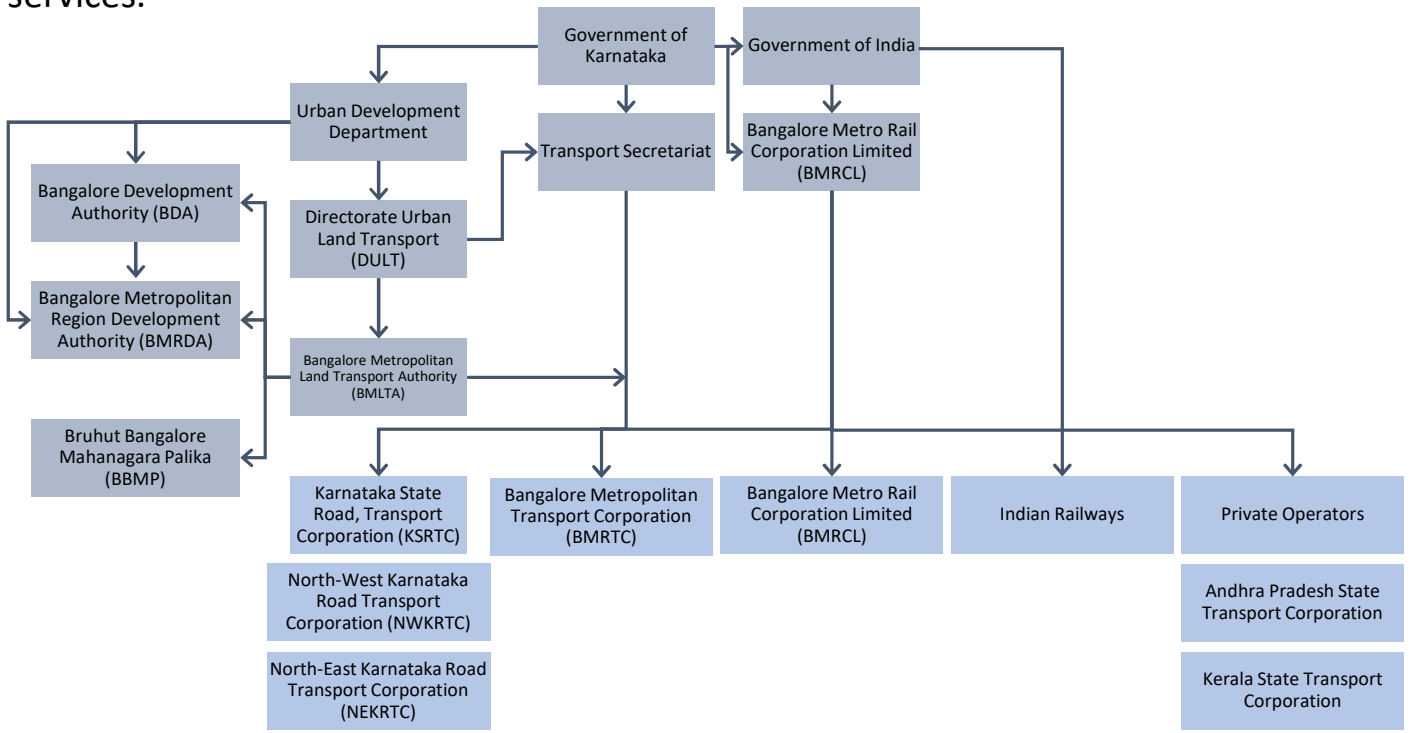
- **Strong governmental control over all aspects of transport and urban planning.**
- LTA is a statutory organisation was created by bringing together the entities to oversee and manage all the public transport modes at strategic and tactical levels.
- **LTA acquired TransitLink to provide an integrated fare collection system.**
- Public-private partnerships to provide transport services.
- TransitLink offers an integrated fare collection system across PT systems.
- Ez-link is a stored value card used widely in transit systems and MSI Global is a solutions provider for land transport infrastructure

Source: LTA (n.d.). Getting Around. Land Transport Authority, Singapore.
The World Bank (2013). Institutional Labyrinth. Designing a Way Out for Improving Urban Transport Services. Australian AID. Washington, DC

A Single Agency as Regulator & Coordinator of Transport with existing institutions

Bengaluru Metropolitan Land Transport Authority (BMLTA), Bengaluru

A single authority as a regulator, organiser and coordinator of urban transport planning **allows all the existing agencies to continue to operate with modified functions/jurisdictions and operations** to deliver integrated services.

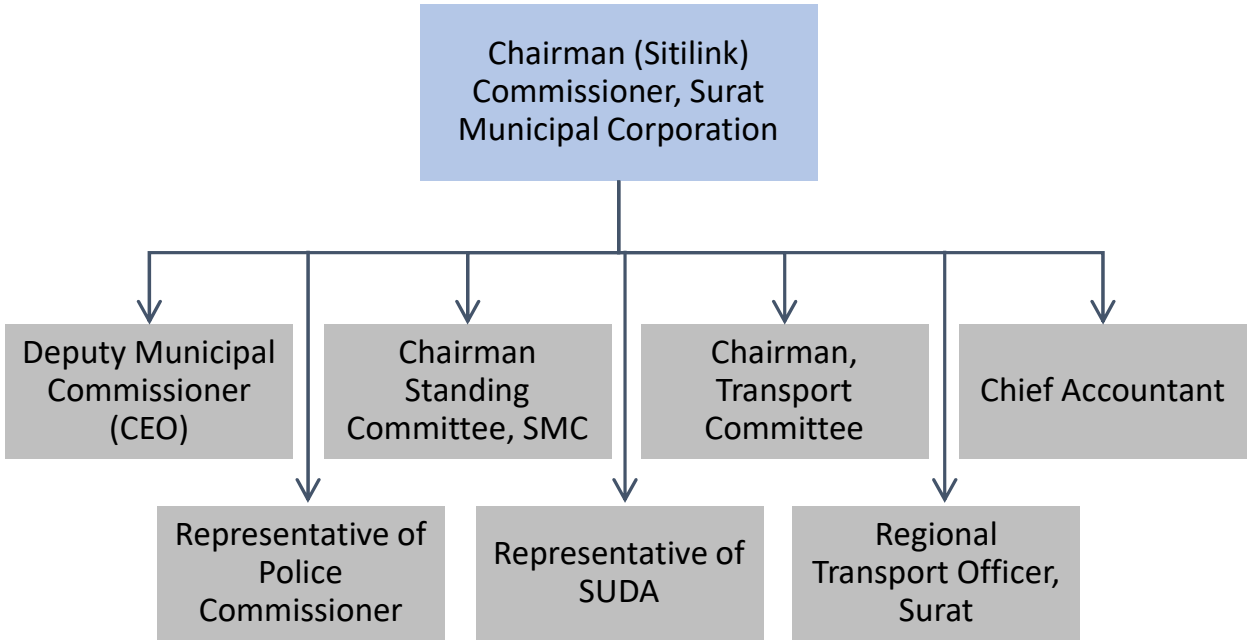


- Bengaluru's urban planning and transportation involve multiple agencies,
- BMLTA Act 2022 established BMLTA with statutory powers to harmonize and integrate urban transportation planning
- This central approach improves coordination for efficient urban planning in Bengaluru.

Source: MoUD. (2016). Guidance Document for Operationalization of Unified Metropolitian Transport Authority (UMTA). New Delhi
DULT. (2008). Directorate of Urban Land Transport.
Batcha, S. F. (2013). Understanding the Governance of Reforms to Urban Transport in Developing Cities (Doctoral Thesis). Leeds: University of Leeds.

An Urban Local Body Delivering Higher Order Functions
Surat Municipal Corporation (SMC), Surat

A local body at the urban level plans the management and operations of public transportation to deliver higher order functions in the city.



Organisation structure of Surat Sitilink

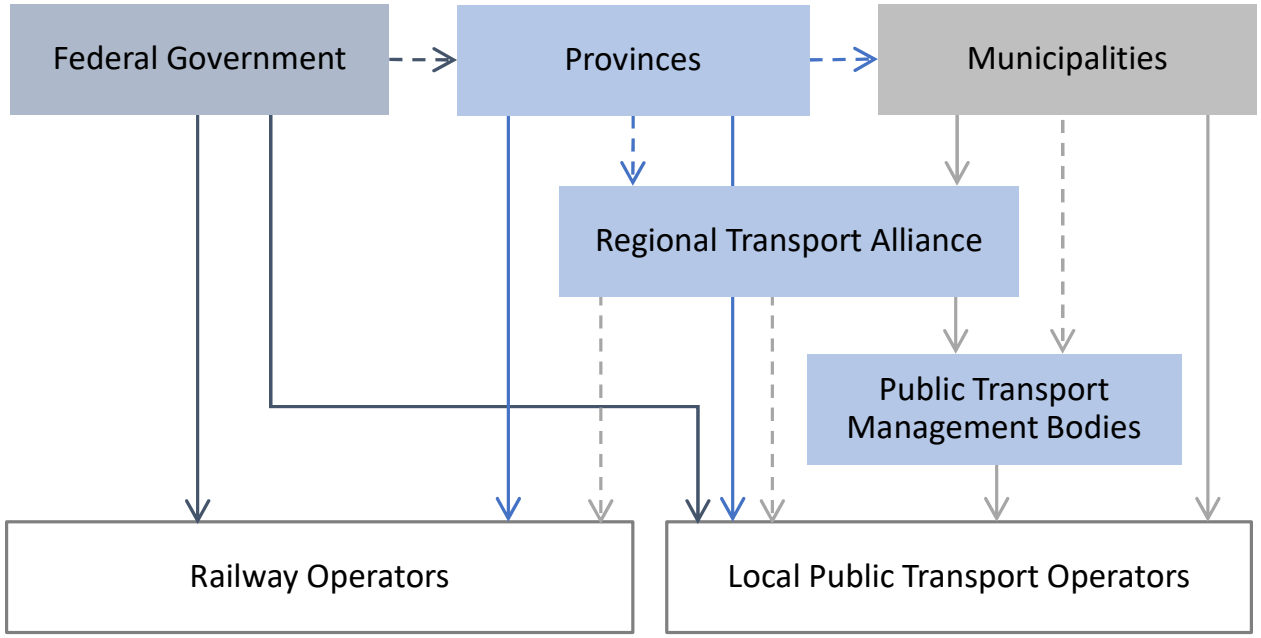
- An urban local body that planned public transport from scratch by adopting an integrated approach with a fair amount of success.
- Local-level agency has role in decision-making and addressing the unique transportation challenges
- Surat has created a public transport system that efficiently caters to the needs of its residents while promoting sustainable and accessible mobility options.
- Sitilink has unbundle the delivery of public transport functions for private participation to reap efficiency of transit system through coordination.

Source: Swamy HMS, Sinha S, et al (2018). "Surat- 2046, Comprehensive Mobility Plan", Surat Municipal Corporation
Swamy HMS, Sinha S, et al (2021). "Towards Sustainable Urban Mobility- Tracking Sustainable Mobility in Asia-Pacific Cities", ESCAP Bangkok, United Nations publication

An Association of Operators and Local Authorities for integrated transport systems

Transit Alliances, Germany

Transit alliances act as an **umbrella organisation, legal entity or administrative unit to oversee and coordinate integrated public transportation.**



- Transit alliance comprised of representatives from city/regional authorities and transport operators to ensure regional and multimodal integration.
- Transit alliance itself is formed based on high levels of coordination between various operators and authorities.
- Authorities or the operators may have higher influence on the decisions made by the alliance based on their influence and funding abilities.
- A legally independent association, who own personnel and equipment to integrate regional and local transport systems.

Source: Daniel Bongardt (2013). Turning the Trend. How Germany Succeeded in Financing Comprehensive Urban Transport Systems. GIZ China. Shenzhen.

Private Participation – Delivering Service

Service Contracts	Facilities are owned by the public agency and some of the services are contracted to private agency.
Management Contracts	Facilities are owned by the public agency but the operations are fully contracted to private agency.
Concessions Contracts	Facilities are owned by the public agency but need costly improvement and capacity addition.
Built-Operate-Transfer	Costly new facilities need to be built and operate.
Joint Ownership	Jointly owned by public and private parties.
Private Supply	Facilities are owned by private agency and also operated by them.

Applicability of Institutional Models

Single Authority for integrated land use and transport development

- Creating a unified authority by merging various agencies for urban transport (UT) functions.
- Necessitates significant political commitment and resources.
- Potentially facing resistance due to administrative restructuring.

Urban Local Body for higher-order functions

- Empowering urban local bodies through legislation is essential for enabling them to undertake urban and public transport planning and management.
- Feasible only if local bodies are adequately empowered through legislation to undertake such a responsibility.

Single Authority as Regulator and Organizer of Urban Transport with existing institutions

- Establishing a single authority as a regulator, organizer, and coordinator for urban transport planning and management is an effective model.
- All the existing agencies to continue to operate with modified functions/jurisdictions and operations.

Single Agency for Coordination

- The model minimally restructures service delivery institutions.
- Balance the interests of responsible authorities and operators, facilitating coordination and integration of stakeholders.
- Takes on expanded administrative responsibilities.

Digital Transformation of Public Transport

Chapter 9

Presents a detailed account of digital technologies and their application towards integrating public transport systems, specifically for traffic management, user information, and public transport operations planning and management.

Summary and Future Direction

Chapter 10

Summarises the guideline and identifies future directions.

Thank you

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