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11th Urban Mobility India Conference & Expo 2018

INTEGRATED TRANSIT SYSTEM : CASE OF KOCHI

Research Symposium – Urban Mobility India Conference 2018

3rd November 2018

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INTRODUCTION – NEED OF STUDY

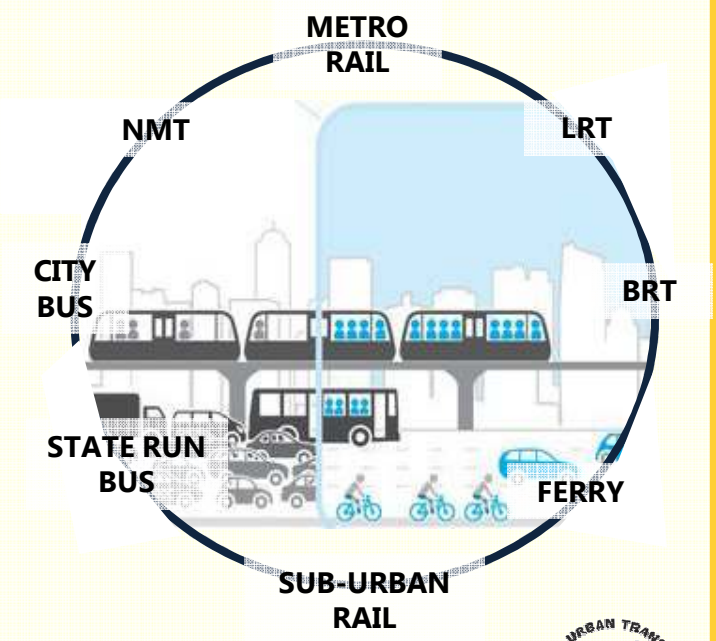
- Integrated Transit System involves **Physical**, **Technical** and **Fare Integration** between different operators of different public transport modes that are operating presently in independent and unintegrated standalone operations.
- Fare Integration is an important part of Integrated Transit System as people are highly elastic to cost than time.

Fare Integration is defined as, ***"Actions taken with respect to fare policy and fare technology that facilitate movement between vehicles. These vehicles can be of the same or different modes, and may be operated by a single operator or by different operators"*** – *Joseph Barr*

BENEFITS

Integrated Transit System is expected to contribute in multiple ways to the society, they are:

- Increase in Ridership
- Decrease in Transit Fares
- Decrease in Time of travel
- Decrease in Cost of Operation thereby increase in Revenue
- Increase in Efficiency with optimal fleet utilization
- Decrease in Fare evasion and frauds
- Decrease in competition between operators



SOURCE: *Fleishman, N. S. (1996). Fare Policies, Structures and Technologies. TCRP Report 10, 53.; Barr, J. E. (1997). Intermodal Fare Integration: Application to San Jaun Metropolitan Area. San Jaun: Massachusetts Institute of Technology*

INTRODUCTION

Concept of Access Fee

*An **Access Fee** in the Fare of a Public Transport is the amount that a user pay for accessing the service of a mode irrespective of the distance or time within the transport system.*

It is also called a **Transfer Penalty** when transfer involves between modes in a non integrated scenario.

Eg: For a bus ride of 5Km the fare is Rs 8, and the fare per Km is 70paisa;
Thus, the distance based fare for 5Km is Rs 3.5 and thereby Access Fee is Rs 4.5
This amount is paid every time a transfer between multiple modes are taken place to reach the destination.

In a cost based fare strategy, Access Fee is the factor of the fixed capital cost and the Fare per Km is the variable cost factor. This is the case of majority of fare strategy of modes whereby both fixed and variable cost is borne by the user.

The above example involves both distance based and cost based as fare strategy to form the fare structure.

INTRODUCTION – Case Study

Singapore : One of the lowest transportation fares in the world (Lowest 10% of income earners spend no more than 8% of their income for Public Transport)

Beijing : Different modes, different operators with integration of fare done considering both quantitative and qualitative methods.

Review of Case Studies:

- Major challenges of integrated transit system are: Institutional hierarchy of different modes, difference in time of operation, revenue and expenditure levels of different modes and thereby the problems of fare apportionment
- Integration of transit modes would need a greater authority who sets the fare and may or may not have an organization to distribute the revenue between the different operators.
- Quantifiable and Non-Quantifiable challenges and benefits should be considered in the process of Transit Integration
- It has been found that use of higher technology provides greater benefits of integration

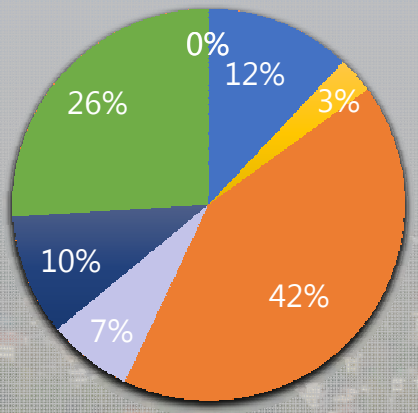
Research Questions

1. **What will be the potential benefits of Integrated Transit System ?**
2. **What will be the possible challenges of Integrated Transit System?**

SOURCE:*Lin, X. C. (2005). Evaluation Analysis on an Integrated Fare Initiative in Beijing. Beijing Jiaotong University and Texas Southern University; Roy, S. (2013). Assessment of Potential Benefits of Fare Integration. Ahmedabad: CEPT University*

STUDY AREA: KOCHI- Commercial Capital of Kerala

Mode Share



2.1 million Population

632 sqkm Area

❑ Travel Demand

2 million passenger trips per day

❑ Trip Length

NMT: 2.78 km

2W: 9.44 km

4W : 10.32 km

Public Transport 10.64km

❑ **Production TAZs** seen outside municipal area and **Attraction** seen more within city center showing dependency of movement to center for various activities

❑ Existing Public Transport Systems :

Metro Rail System, City Bus, Ferries, Sub-Urban Rail System

SOURCE: : *CMP, U. (2017). Comprehensive Mobility Plan for Greater Kochi Region, Volume 1 Kochi: KMRL; Unite to Prosper, Rohan Mohan CUSAT, https://postimg.org/image/j3r2rsyo7/*

STUDY AREA – Present System by Modes

Auto rickshaw | **Ferry System** | **Bus System** | **Metro System**

Private Bus | **KURTC** | **KSRTC**

STUDY AREA – Present System by Modes

MODE	INSTITUTION	FLEET	FARE SETTING	COST (in Rs per day)	REVENUE (in Rs per day)	SURPLUS/ DEFICIT per day
Auto Rickshaw	JDI (Joint Declaration of Intend) signed to form as a single body and 10,000 autos under 6 unions of total 18,360 autos	18,367	• Minimum Fare Rs 20 for 1.25 Km, with Rs 8 per Km after minimum fare.	Rs 350 to 400	Rs 750 to 1000	**Rs 400 to 600**

Base Scenario - Integrated Transit System

1. Integrated Transit System is beneficial to Users, Operators and to Society at large

Current Operations which are organized based on Modes, Operators and Route wise are not integrated and hence is inefficient from operator perspective; and expensive cum inconvenient from user perspective. These effects would translate into negative effects on the society

- **Existing system inefficiency and user inconvenience are been analyzed under following heads:**

1.1 Demand and Supply Analysis	1.2 Customer Inconvenience
•Excess Supply •Optimum Supply •Under Supply	•Direct and Transfer Passenger •Generalized Journey Cost for User

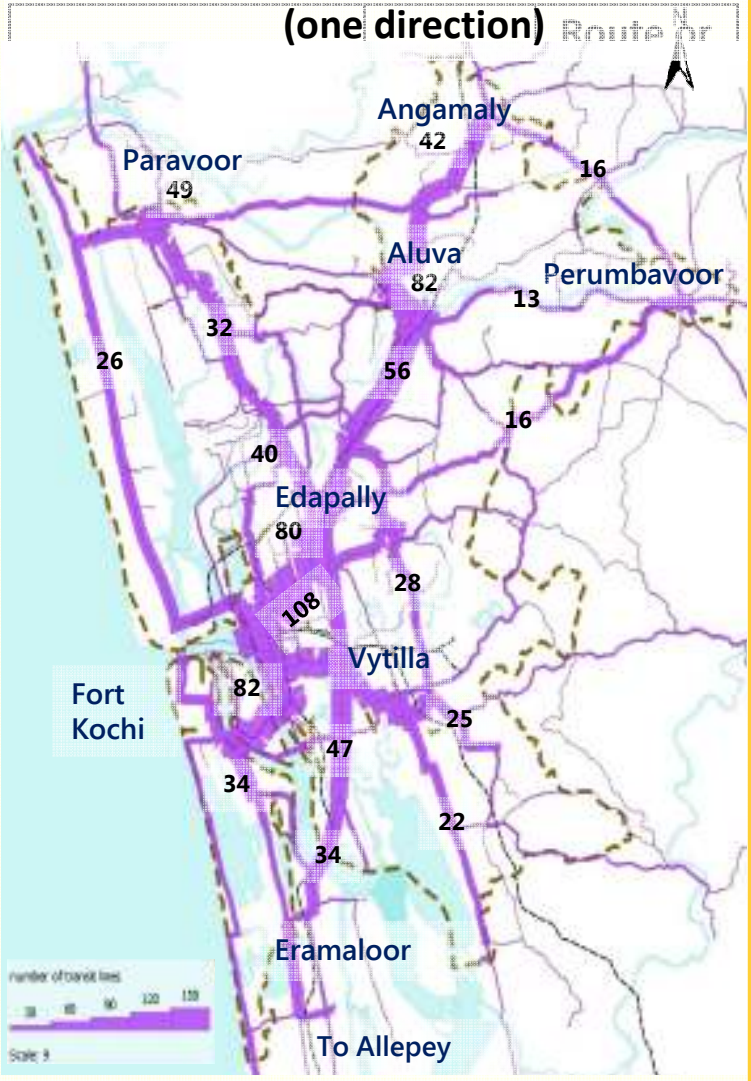
SOURCE: : *CMP, U. (2017). Comprehensive Mobility Plan for Greater Kochi Region, Volume 1. Kochi: KMRL, Integrated Public Transport Solutions for Greater Kochi Region,2016 - UMTC*

1.1 Demand and Supply Analysis

Bus Routes as per Operators

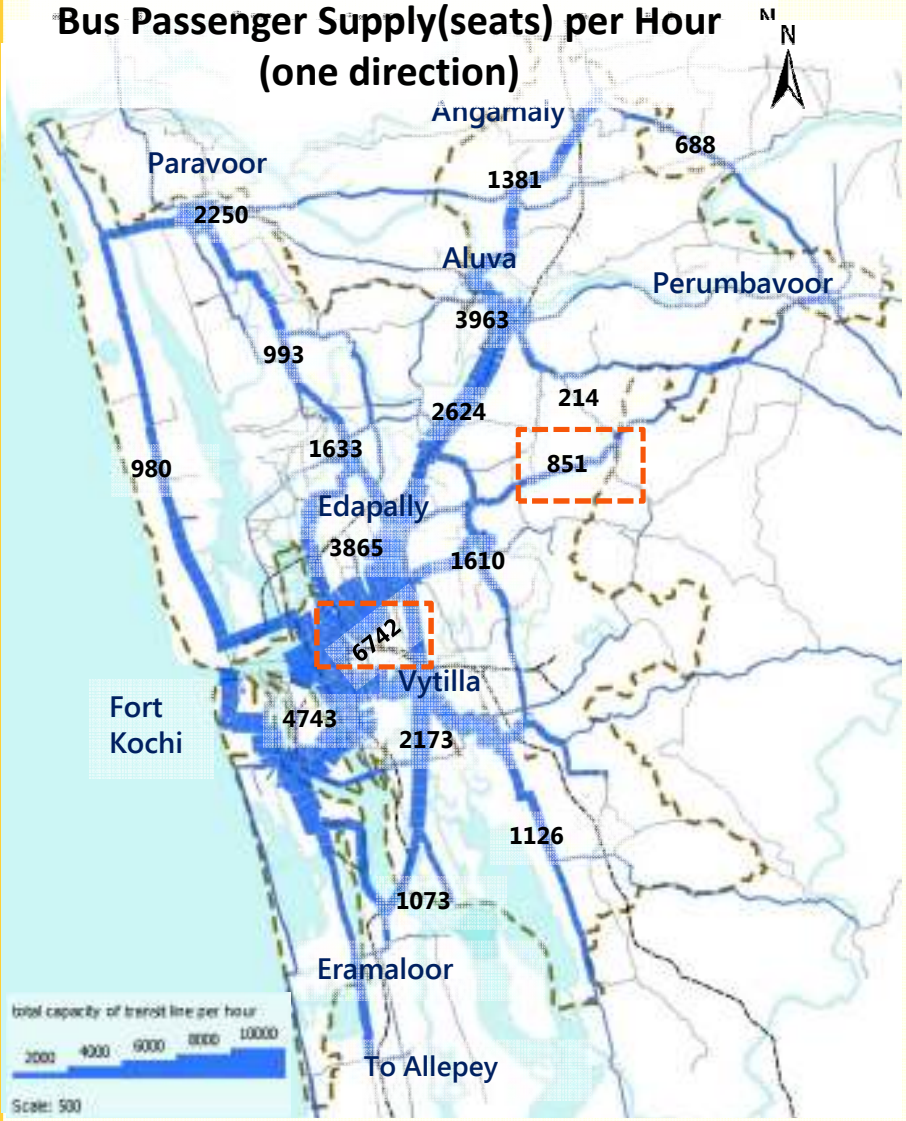
Base scenario involves **775 routes** with city center seen with large number of transit lines been merging

Number of Transit Routes on Corridors (one direction)

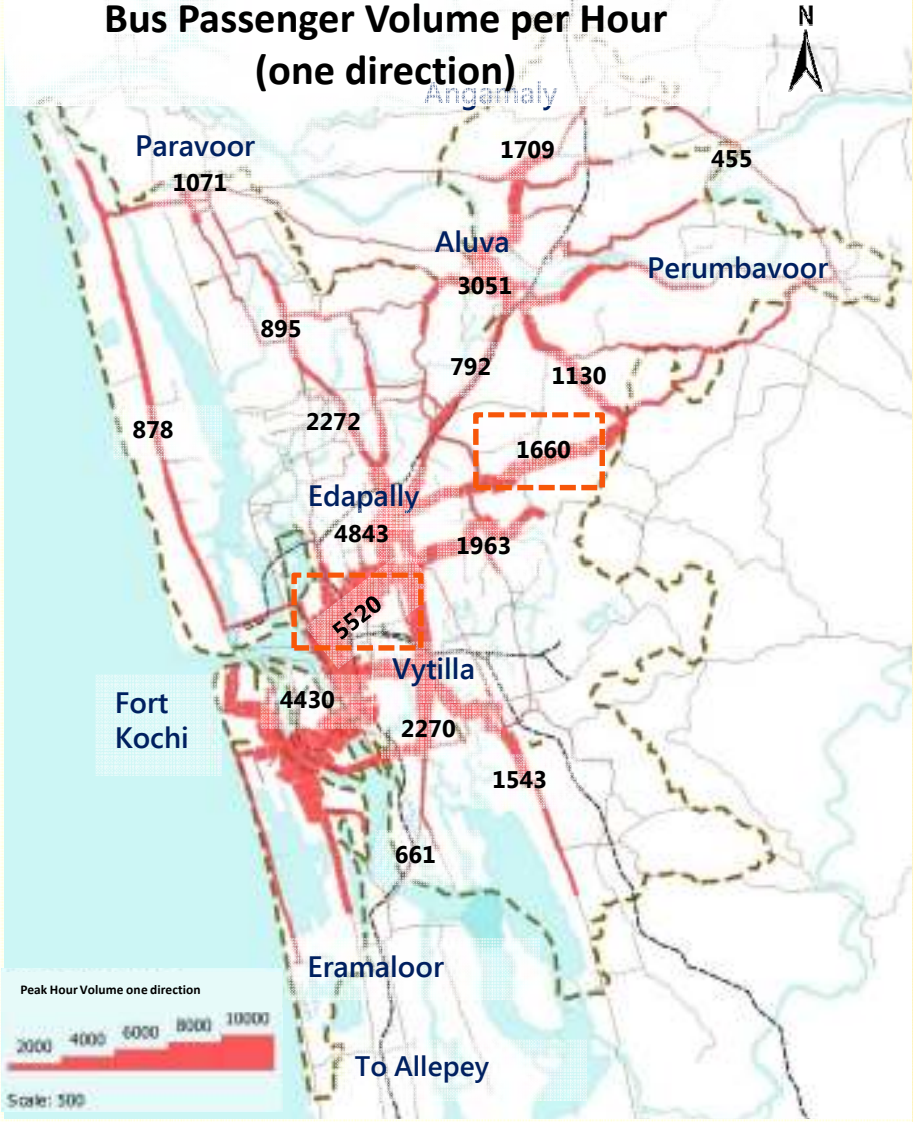


1.1 Demand and Supply Analysis

Bus Passenger Supply(seats) per Hour (one direction)



Bus Passenger Volume per Hour (one direction)



1.1 Demand and Supply Analysis

Excess Supply with Bus Passenger Peak Demand

Excess Supply with All mode Passenger Peak Demand

There is an **18%** increased **VKT** in **existing metro** scenario and is expected to increase to **30%** with **full operational Phase-1**

Bus equivalent of Present Metro: **627**buses

Demanded bus equivalent: **139**buses

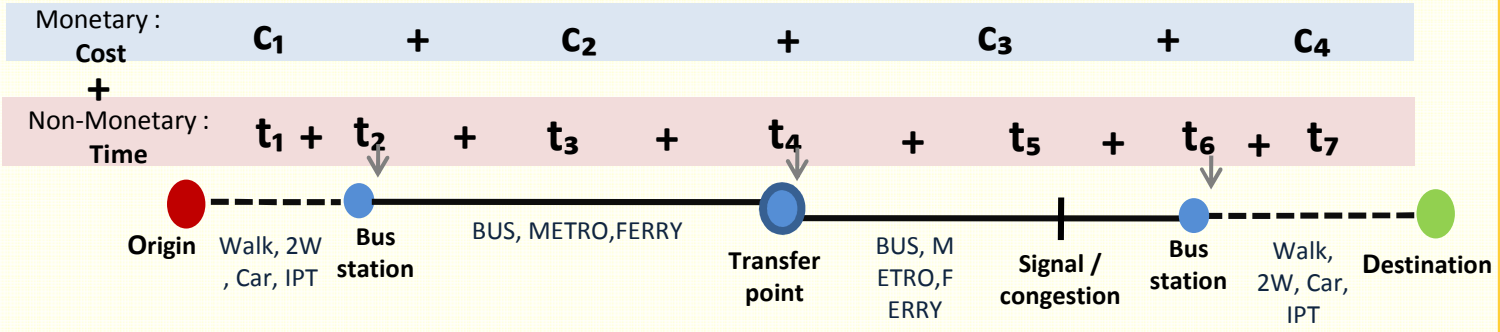
CPKM as Rs37**, Excess Cost of Operation: Rs3.35L** (excess buses 488)

18% increase in VKT_Present Metro

30% increase in VKT_Future Metro

1.2 Customer Inconvenience

Generalized Journey Cost



- Addition of Base Fare Function i.e. the existing distance based fare in the form of a function for all modes wherein the access fee was included is added onto model.
- Waiting, transfer and auxiliary time perception factors were adjusted to calibrate the base scenario with base fare function

Total Boarding as per Mode

- Bus System: **13,16,534** passengers
- Metro System: **34,434** passengers
- Ferry System : **9,852** passengers
- Total: **13,60,820** passengers

Summary Table	Route Length (Km)	Demand (Passengers)	Boarding (Passengers)	Transfer Rate	Vehicle Kilometers Travelled (VKT) (Km)	Passenger Kilometers Travelled (PKT) (Km)	Generalized Journey Cost (Rs)
Base Scenario 1	22,455	8,81,606	13,60,820	1.54	53,658	19,27,482	61

Integrated Transit Scenario

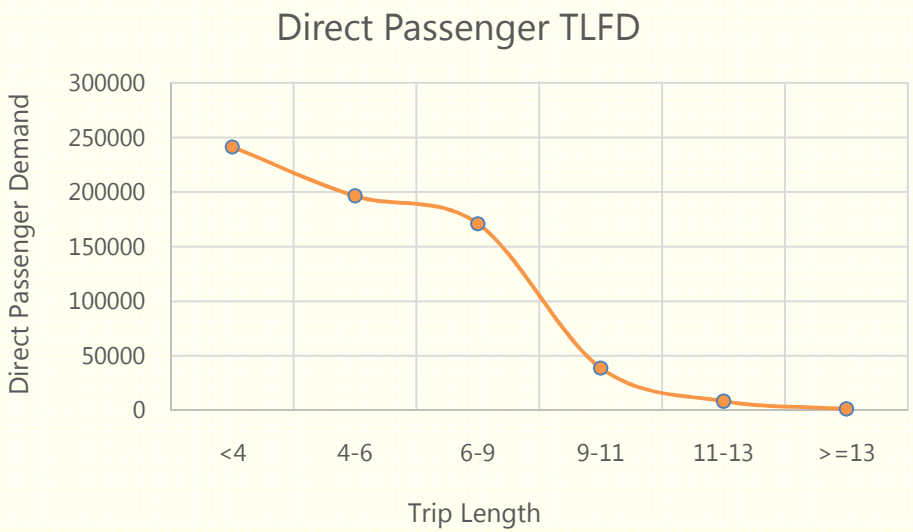
Scenario comparison 1-1A

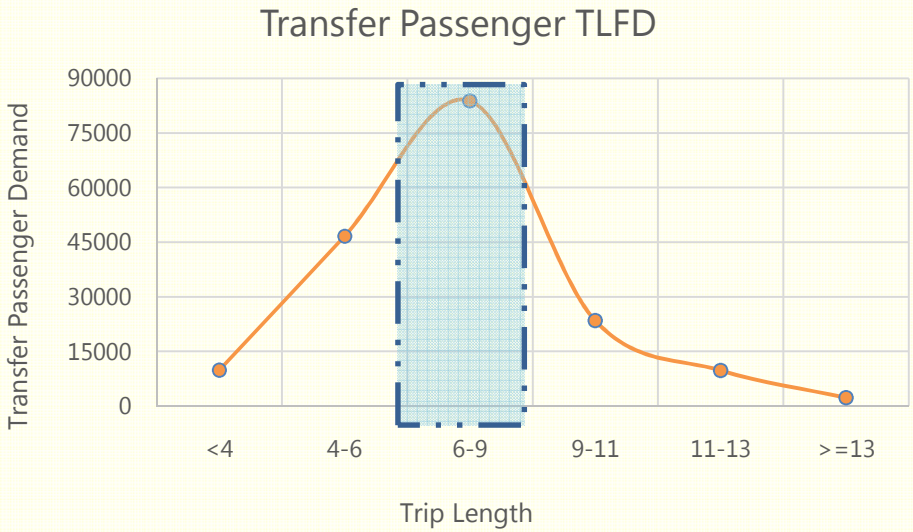
Scenario comparison 1-2B

Scenario comparison 1-1B

Base (Calibrated) 1_2018 (Base Fare on existing 775 Routes)	Do Something 1A_2018 (Integrated Fare 2.0 on existing 775 Routes)	Do Something 1B_2018 (Integrated Fare 2.0 on Restructured 61 Routes)	Do Something 2B_2018 (Integrated Fare 3.0 on Restructured 61 Routes)
DEMAND ASSIGNED: 8.8 Lakh TRIPS **MOTORISED TRIP RATE: 0.86**	**DEMAND ASSIGNED: 8.8 Lakh TRIPS**	**DEMAND ASSIGNED: 8.8 Lakh TRIPS**	**DEMAND ASSIGNED: 8.8 Lakh TRIPS**
• Route Length: 22,587 Km	• Route Length: 22,587 Km • Integrated Fare Setting was done based on Trial and Error process. • Distance based through fare Integrated System is designed	• Restructuring of routes based on Trunk and Feeder Concept • Two Trunk corridors and Feeders of primary, secondary and tertiary were created	• Integrated Fare 3.0 involves all mode to have existing bus fare • Elasticity of fare and thereby private mode shift considered

Scenario 1A – Integrated Fare Setting





Trip Length of Concern:

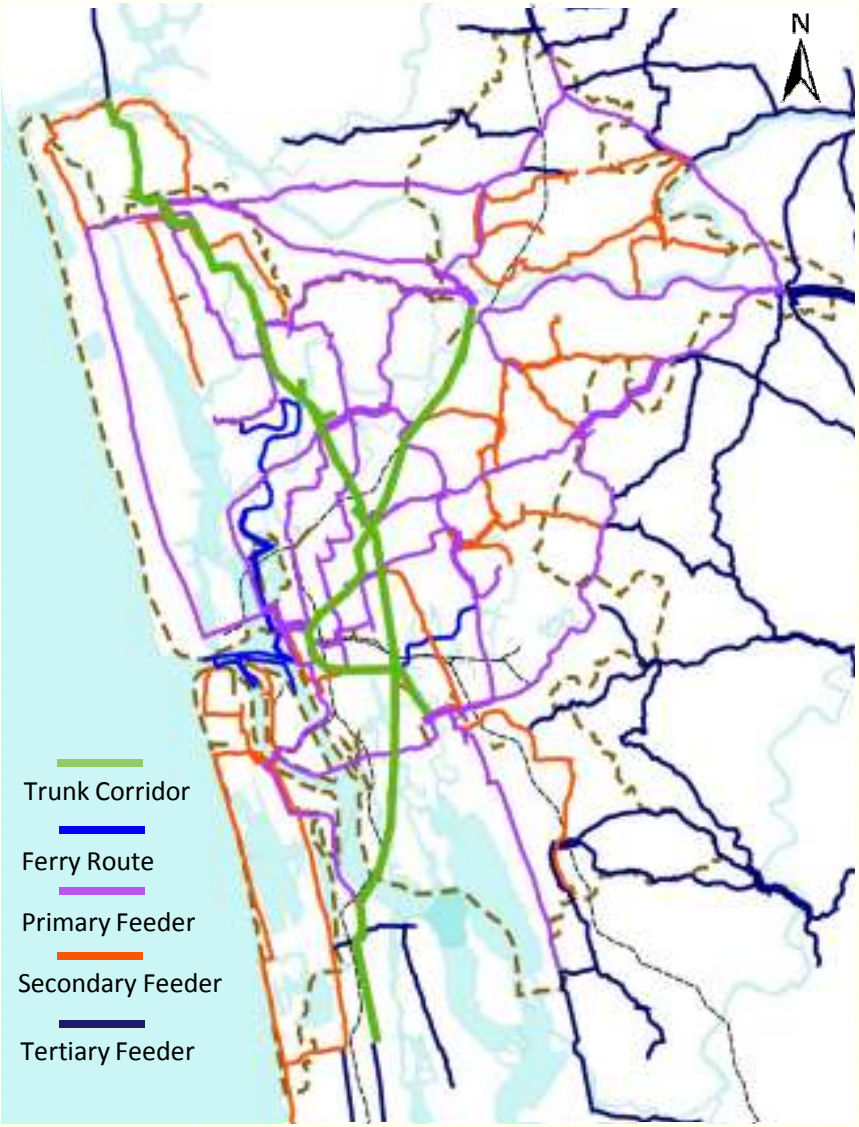
- <4Km involve the major direct passengers and thus they are not likely of the need of transfers.
- 4-6Km is the transition range where possible transfers can happen
- 6-9Km is the transfer range and possibly involves metro transfers
- >=9Km This range involves the more travel in need passengers i.e. long distance commuters

Scenario 1A – Integrated Fare Setting

- Increased Fare of Bus and Ferry to 80paisa per Km is justified by Willingness to Pay for Integrated Transit System i.e. 1.25 times the existing fare
- Downward Revision of Fare per Km of Metro System from Rs2.7 to Rs 1.2 is seen with 46% increase in boarding
- Time savings for 12 major transfer nodes (30% of transfers) was calculated to be 35%
- Generalized Journey Cost was calculated to be Rs47 per passenger per trip

Summary Table	Route Length (Km)	Demand (Passengers)	Boarding (Passengers)	Transfer Rate	Vehicle Kilometers Travelled (VKT) (Km)	Passenger Kilometers Travelled (PKT) (Km)	Generalized Journey Cost (Rs)
Base Scenario 1	22,455	8,81,606	13,60,820	1.54	53,658	19,27,482	61
Integrated Fare 2.0 Scenario 1A	22,455	8,81,606	14,57,654 (7%)	1.65 (6.6%)	53,658	18,41,805 (-)(4.4%)	47 (-)(23%)

Scenario 1B – Route Restructure



Premise:

- The integrated fare setting along with the route restructuring is expected to give the full potential benefits to both user and the operator as with the bus route restructuring the inefficiency of the bus routes will be reduced with less vehicle kilometers catering greater passenger demand
- Trunk and Feeder Concept used to restructure bus routes

Class of Route	No.of Transit Lines	Headway (mins)
Trunk	2	2
Ferry Route	4	Existing
Primary Feeder	20	5
Secondary	14	8
Tertiary	21	Existing
Total	**61 Routes**	

- The primary feeder routes are mostly within city region, secondary feeder routes within study area connecting primary to outside terminals, tertiary feeder are regional service routes terminating at outer terminals of the study area

Scenario Comparison

Scenario Comparison is done between 1-1A , 1-1B and 1-2B

Attributes	Base Scenario 1	Integrated Fare on Existing route Scenario – 1A	Savings Comparing 1 and 1A	Integrated Fare on Restructured Route Scenario – 1B	Savings Comparing 1 and 1B	Integrated Fare 2.0 on Restructured Route Scenario 2B	Savings Comparing 1 and 2B
Route Length (in Km)	22,455	22,455	-	2,036	(-) 91%	2,036	(-) 91%
Demand (in passengers)	8,81,606	8,81,606	-	8,81,606	-	8,81,606	-
Boarding (in passengers)	13,60,820	14,57,654	7%	15,07,676	10%	15,17,278	10.3%
Transfer Rate	1.54	1.64	6.6%	1.71	10%	1.72	10.5%
Vehicle Kilometers Travelled (VKT) (in Kms)	53,658	53,658	-	36,987	(-) 31%	36,987	(-) 31%
Passenger Kilometers Travelled (PKT) (in Kms)	19,27,482	18,41,805	(-) 4.4%	15,16,973	(-) 21%	15,10,330	(-) 22%
Generalized Journey Cost (in Rs)	61	47	(-) 23%	43	(-) 29.5%	33	(-) 46%

Sensitivity Analysis - Scenario 2C

- A stated preference survey was conducted as part of CMP- 2017 based on 1.2 times the then existing fare i.e. fare per km of 80 paisa. Thus, the above raw data is used for scenario2B to identify the benefits with increased mode shift
- Two-wheeler as private mode was only considered for mode shift to give a constructive sample
- A 12% mode shift from the two-wheelers was observed thereby a 54% public transport mode share will be created from the existing 42%

- Thus, Total demand in Public Transport is 11.3 lakh passengers i.e. a passenger increase of 2.5 lakh passengers in Public Transport
- The increased demand with integrated fare3.0 is assigned on the restructured routes to form scenario 2C and this is not compared with other scenarios as the demand varies and so do the attributes

Modes	Boarding
Bus	16,78,678
Metro	4,23,079
Ferry	28,874
Total	**21,30,631**
Demand	11,33,493
Transfer Rate	**1.88**
Trip Length (Km)	**9.73**

Summary Table	Route Length (Km)	Demand (Passengers)	Boarding (Passengers)	Transfer Rate	Vehicle Kilometers Travelled (VKT) (Km)	Passenger Kilometers Travelled(PKT) (Km)	Generalized Journey Cost (Rs)
Integrated Fare 3.0 Scenario with Elasticity – 2C	2,036	11,33,493	21,30,631	1.88	36,987	23,07,046	48

Revenue and Cost Estimates

- The revenue and cost estimates are calculated considering all modes as one single entity of Public Transport

Bus System

Attributes	Value	Unit
Revenue from base fare	46,78,183	Rs
Revenue from Access Fee	30,90,856	Rs
Total Cost Savings	6,16,827	Rs
Non-Fare Revenue	Nil	Rs
Total Revenue per day	83,85,866	Rs
Present Revenue	33,45,647	Rs
Additional Revenue	50,40,219	Rs
Cost_Deficit	47,01,755	Rs
Net Profit per day	**3,38,464**	**Rs**

Metro System

Attributes	Value	Unit
Revenue from base fare	12,37,206	Rs
Revenue from Access Fee	8,17,417	Rs
Total Cost Savings	Nil	Rs
Non-Fare Revenue	4,71,233	Rs
Total Revenue per day	25,25,856	Rs
Present Revenue	16,93,150	Rs
Additional Revenue	8,32,706	Rs
Cost_Deficit	19,66,575	Rs
Net Deficit per day	**(-) 11,33,869**	**Rs**

Ferry System

Attributes	Value	Unit
Revenue from base fare	92,855	Rs
Revenue from Access Fee	61,349	Rs
Total Cost Savings	Nil	Rs
Non-Fare Revenue	3,726	Rs
Total Revenue per day	1,57,930	Rs
Present Revenue	46,630	Rs
Additional Revenue	1,11,300	Rs
Cost_Deficit	1,48,619	Rs
Net Deficit per day	**(-) 37,319**	**Rs**

Net Deficit of whole Public Transport System is Rs 8.32 lakh per day

Total Deficit Reduction : 76%

Challenges, Limitations and Conclusion

Challenges

- Convincing the operators to run in specific routes after the route restructuring in the Integrated Transit System
- Balanced Revenue Risk Sharing especially with the inclusion of para transit mode
- Differing operational characteristics like age of fleet, operational cost, operational timings of different modes
- High Labor per bus rate in government bodies, Hierarchy of institutions and Impact of different Trade unions
- Institutional structure of Integrated system and strong leadership to downwardly reduce fare creating greater affordable system

Limitations

- The methods to overcome the identified challenges were not studied
- Student concession is not being considered in the integrated fare setting and can be a critical factor of concern
- The fare elasticity to set fare can deduce more benefits to users and operators with the increased mode shift from private modes

Conclusion

- A system can be made affordable and viable for the user and the operator if every mode and operators come together catering the mobility needs of the city, through integrated transit system we are attaining the same.
- Greater Integration brings overall system utilization, increased ridership and overall wealth savings to both users and operators.

SOURCE: *Stakeholder Discussions and Understandings*

THANK YOU

SOURCE: https://www.internationaltraveller.com/48-hours-in-fort-kochi-india/

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SOURCE: *Stakeholder Discussions and Understandings*

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SOURCE: *Stakeholder Discussions and Understandings*