



International Association of Public Transport (UITP)  
Rue Sainte-Marie, 6 | B-1080 Brussels | Belgium

Tel: +32 2 673 61 00  
[info@uitp.org](mailto:info@uitp.org)  
[www.uitp.org](http://www.uitp.org)

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## SUMMARY

UITP India organised the 6th edition of UITP India Bus Seminar 2022, hosted by Delhi Integrated Multi-Modal Transit System (DIMTS) Ltd. The flagship annual event held on 15 July 2022 in New Delhi, was supported by Ministry of Road Transport and Highways (MoRTH) and Association of State Road Transport Undertakings (AS-RTU). In line with Government of India's commitment to decarbonise public sector transport by 2030, the seminar focused on critical theme of 'Demystifying Electric Buses for India'.

The seminar witnessed a gathering of more than 200 participants at the convention and 50+ domestic and international participants online. The participants included representations from State Transport Undertakings (STUs), Ministries, Original Equipment Manufacturers (OEMs), technology service providers, think tanks, and multilateral organisations. The seminar encompassed 22 key national and international speakers from eminent organisations sharing their knowledge and experiences on various topics of **electric buses** in India such as contracting, planning and operations, and digitalisation. The event saw substantial number of female speakers joining from reputed organisations in India and abroad.



The event was sponsored by Optibus, Enel-X, Force Motors Tata Motors, Switch Mobility, Microgrid Labs, Chalo, PMI Foton, JBM, Allison Transmission

The event was set about with an inaugural session addressed by esteemed guests focusing on importance of electric buses as the future of public transportation in India. **Mr Kailash Gahlot, Minister of Transport, Government of National Capital Territory of Delhi** made the keynote address and highlighted significant steps taken by the Government of Delhi for the past few years in domain of electric bus introduction. **Mr Ashish Kundra,**

**IAS- Principal Secretary and Commissioner of Transport, Government of National Capital Territory of Delhi** emphasised the need to bring private transport users within the ambit of public transportation in the city and reduce carbon footprint.

The inaugural session was followed by a plenary discussion on energy mix and roadmap for electrification of Indian bus systems. The session was chaired by **Mr Sudhendu J Sinha, Advisor, NITI Aayog**. The panellists included **Mr Shekhar Channe, IAS, Managing Director, Maharashtra State Road Transport Corporation**, **Mr Lokesh Chandra,**





IAS, General Manager, BEST Undertakings, Mr Ashish Kundra, IAS- Principal Secretary and Commissioner of Transport, GNCTD Ms Swati Khanna, Senior Sector Specialist, Urban Development and Mobility, KfW Development Bank discussed significant developments and challenges from their respective cities such as Delhi and Mumbai on introduction of electric buses in the city and state. The discussion focused on issues such as financing for electric buses, payment security concerns for OEMs, and contract management.

The first technical session focused on contracting for electric buses. Paresh Goel, Director, Ministry of Road Transport & Highways, highlighted 5-pronged approach to evaluate current bus contracts undertaken by State

Transport Undertakings (STUs) and recommended various ways to improve them. C K Goyal, Senior Vice President, DIMTS presented Government of Delhi's target of building a fleet of 7000+ electric buses by FY 2024 and discussed the implementation challenges involved in the process. Hema Russell, Operations Manager, Water Loo Garage, Go Ahead London shared several lessons from her experience of running London's first electric buses with regards to contract structures, tendering process, and implementation challenges. Ravi Gadepalli, Research Manager, UITP India demonstrated how India has made significant progress in reducing e-bus contract prices through standardised procurement of buses.





The second technical session was held on planning and operations of electric buses. **Jalpa Jain, Vice President, Aadinath Bulk Pvt Ltd**, highlighted the challenges faced by operators that are not only limited to high up front costs associated with e-buses, but also contract designs for bidding of e-bus fleets. **Flavio Grazian, Project Manager, Knowledge and Innovation Bus Unit, UITP**, presented key learnings and outcomes of the ZeEUS (Zero Emission Urban Bus System) and Assured projects, both of which represent ground-breaking work done by UITP to implement e-buses in Europe. **Shaun Brestien, General Manager, Optibus Ltd**, claimed that scale will be the biggest challenge in India's journey to electrify its bus fleet and made a strong case for adopting technology and software that can help build an efficient public transport system.

**Neeraj Bhagwatula, Strategy and Development Lead – eBus APAC, Enel-X**, shared several international case studies on charging infrastructure planning for electric buses across Columbia, Chile, the UK, and Spain.

The third technical session was conducted on digitalisation in electric bus operations. **Iván López De La Casa, Head of Electrical Infrastructure Department, EMT Madrid**, spoke about monitoring and control for electric buses through the example of Madrid. **Sylvain Haon, Senior Director Strategy, UITP**, shared his perspective on leveraging electronic payments and ticketing systems for improving passenger experience and improving fare collection and

revenue streams. **Priya Singh, Co-Founder, Chalo**, presented a case study on NCMC compliant integrated digital ticketing solutions for public transport that are currently implemented in Mumbai. **Mustafa Sonasath, Manager at Surat Sitilink Limited**, shared an action plan to promote bus-based e-mobility in Surat and highlighted the impact of the Intelligent Transportation System on electric bus operations in Surat.



## INTRODUCTION

Climate change has become a harsh reality and is affecting human health, wildlife, food production, clean water access and the economy at large scale across the globe. As per United Nations Environment Programme (UNEP), the transport sector is responsible for nearly a quarter of energy-related greenhouse gas emissions globally. One significant way to reduce GHG emissions from transportation sector and tackle climate change is by reducing the dependence on private vehicles and build more efficient public transportation systems.

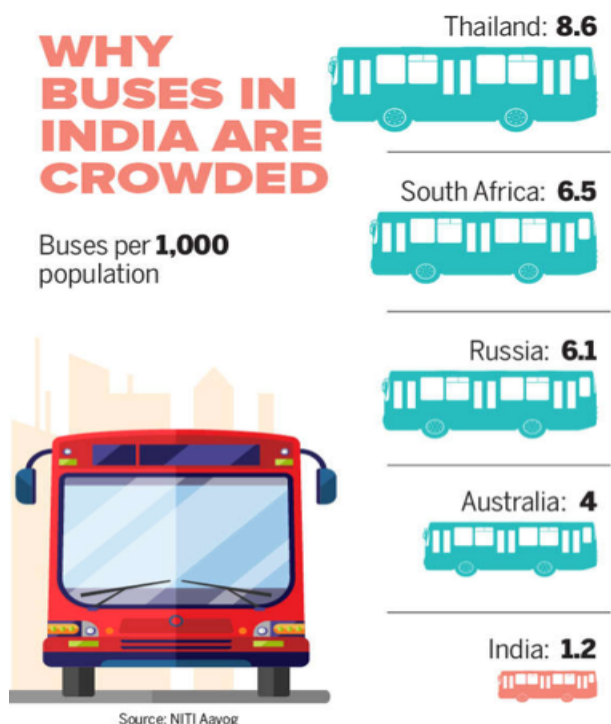
Buses across the globe and in India significantly, are a crucial and affordable constituent of public transportation system as they allow majority of citizens to access day to day activities such as education, work, recreational activities, social needs, and medical care. However, according to a NITI Aayog report, India has only 1.2 buses per 1,000 people - a number much below developing nation benchmarks.

As a result, the introduction of electric vehicles to upgrade and expand India's bus fleets is being seen as a significant step to reduce dependence on fossil fuels and to tackle climate change. Several policy initiatives have been taken in this regard

at the central as well as state level such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicles, constitution of National Council for Electric Mobility, tax incentives for electric vehicle owners and developing EV charging infrastructure. However, a lot needs to be discussed to successfully shift from ICE based vehicles to Electric Vehicles.

With this background, the UITP India organised the 6th edition of UITP India Bus Seminar 2022, hosted by Delhi Integrated Multi-Modal Transit System (DIMTS) Ltd. The flagship annual event held on 15 July 2022 in New Delhi, was supported by Ministry of Road Transport and Highways (MoRTH) and Association of State Road Transport Undertakings (ASRTU). In line with Government of India's commitment to decarbonise public sector transport by 2030, the seminar focused on critical theme of 'Demystifying Electric Buses for India'.

The seminar witnessed a gathering of more than 200 participants plus many more domestic and international participants joining online. The participants included representations from State Transport Undertakings (STUs), Ministries, Original Equipment Manufacturers (OEMs), technology service providers, think tanks, and multilateral organisations. The seminar encompassed 22 key national and international speakers from eminent organisations sharing their knowledge and experiences on various topics of electric buses in India such as contracting, planning and operations, and digitalisation. The event saw substantial number of female speakers joining from reputed organisations in India and abroad such as Swati Khanna from KfW Development Bank, Hema Russell from Go-Ahead London, Jalpa Jain from Aadinath Bult Pvt Ltd, Priya Singh, from Chalo and Anupama Saha from DIMTS. The event was sponsored by Optibus, Enel-X, Force Motors, Tata Motors, Switch Mobility, Microgrid Labs, Chalo, PMI Foton, JBM, Allison Transmission, and media partners MotorIndia, Sustainable Bus, Urban Transport News and ETN.



Population of India - 1,38 billion (Census 2020)



## INAUGURAL SESSION

The event kickstarted with the lighting of the lamp by esteemed guests, followed by an opening address by **Mr T Surya Kiran, Executive Director, Association of State Road Transport Undertakings (ASRTU)**. He expressed his confidence in electric buses being the future of public transport in India which will be run by State Transport Undertakings (STUs). Every activity from operations to maintenance will be transformed by electrification and inputs and knowledge from this event will help respective stakeholders look at the future of public transport in a new way.



Mr Kiran's address was followed by opening remarks by **Mr Sylvian Haon, Senior Director – Strategy, UITP** who highlighted the work done by UITP across 100+ countries with respect to advocacy, research, networking, publications, events, research innovation projects and training sessions. One of these training sessions was a 3-month-long program on electric buses called E-bus UpSchool Training, that concluded recently.

We next had an opening address by **Mr Rajesh Aggarwal, Managing Director & Chief Executive Officer, DIMTS Ltd** who spoke about the prominent role the Delhi government has played in bringing e-mobility to the city and that Delhi wants to be at the forefront of the e-mobility initiative in India. Helping the planet to breathe, the Delhi cluster buses scheme has evolved into a public-private partnership model in the city transit system with 3300 electric buses under the scheme.



Followed by Mr Aggarwal, Mr Ashish Kundra, IAS- Principal Secretary and Commissioner of Transport, Government of NCT of Delhi, gave the inaugural address. He shared the various benefits of plying electric buses instead of diesel buses in terms of cost savings and reduction in vehicular pollution.

While in the past STUs owned and operated all buses, with e-buses, bus contracts have undergone a shift towards a GCC (Gross Cost Contract) or Opex model. Mr Kundra highlighted the challenges associated with electrification of the country's fleet such as need for more robust contract management, thorough planning to manage the additional load on the power grid for charging infrastructure and the need for OEMs to ramp up their production capacities. He also emphasised on the need to capture the fence sitters—people who use personal cars or two-wheelers and bring them onto public transport.

## KEYNOTE ADDRESS

In his keynote address, Mr Kailash Gahlot, Minister of Transport, Government of NCT of Delhi reiterated that the future of India's public transport system lies in electrification of buses as it's a more economical as well as an eco-friendly option in comparison to CNG & diesel buses. With the launch of the Delhi Electric Vehicle Policy two years ago, he said that the Delhi Government has released over Rs 86 crore (~10 million USD) in subsidy dedicated towards pushing this change. He acknowledged that given the enthusiastic push from the government, this is a wonderful time and opportunity for manufacturers to ramp up production.

1€ ~ 80 INR or Rs

Good to know: A crore denotes 10million and is equal to 100 lakh (1lakh = 1,00,000) in the India numbering system.



Mr. Gahlot acknowledged that this growth also comes with its challenges such as electrification of depots which is difficult for cities. The supply and delivery time of buses from different manufacturers also varies between 9 to 12 months or more. The feedback of passengers travelling in electric buses has been positive with metro-like experience, no noise, no pollution and high quality, state-of-the-art buses. Mr Gahlot also touched upon his own experience of driving an electric bus and how these buses are comfortable for the drivers as there is no engine.

The inaugural session concluded with the vote of thanks by Ms Rupa Nandy, Head of UITP India, who welcomed all the participants and thanked all the sponsors of the event for helping organise the first post-pandemic event of this scale in India.







## PLENARY SESSION

After the inaugural session, **Mr Sudhendu J Sinha**, Advisor NITI Aayog chaired the Panel Discussion on energy mix and roadmap for electrification of Indian bus systems. The panellists included **Mr Ashish Kundra**, IAS-Principal Secretary and Commissioner of Transport,

Government of NCT of Delhi, **Mr Shekhar Channe**, IAS – Vice Chairman and Managing Director, Maharashtra State Road Transport Corporation, **Mr Lokesh Chandra**, IAS – General Manager, BEST, Mumbai and **Ms Swati Khanna**, Senior Sector Specialist, Urban Development & Mobility, KfW Development Bank. Some of the key takeaways from the session were:





- Mr Ashish Kundra pointed out that the bid for 4000-5000 electric buses by a single city is arguably the largest bid made for a bus fleet in the world. Mr Kundra emphasized that while 9 mega cities are taking the lead in the adoption of e-buses, there is also a growing trend of smaller cities like Pune and Chandigarh adopting them in a big way. The arrival of these buses, however, must be in sync with the electrification of depots for this to be a successful model.
- Mr Shekhar Channe shared that the Maharashtra State Road Transport Corporation has about 17,000 diesel buses, 50 CNG and 2 electric buses and focuses on 90% of villages in Maharashtra. The state doesn't have an assured electric supply in all places and there is need for OEMs to manufacture buses that can cover 200-300 kms in one charge. Currently, MSRTC is in the process of completing tender of 2000 buses, with target of 5,300 electric buses by 2025-26, while only 1-2 OEM fulfil the range requirement.



- Mr Lokesh Chandra put into perspective the massive impact of an efficient public transport system which has helped save 40 million tonnes of fuel, 65 million tonnes of emissions and public money savings of up to \$4.5 trillion. Comparing the costs of operating diesel, CNG and e-buses, he highlighted that the cost of operations per km for a diesel bus is Rs 43-44, a CNG bus is Rs 28 while for an e-bus, the cost is Rs 10. The upfront cost of acquiring e-buses is high but if the OPEX model is taken into consideration, it is more cost effective.
- Ms Swati Khanna, in a question posed by Mr Sinha, responded with details about how Development Financial Institutions (DFIs) like the World Bank, KfW and other financiers are willing to provide finance to help Indian cities and states electrify their bus fleets but mentioned that they are looking for impact. In addition to DFIs, she stressed on the need for proactive involvement of states and public sector banks to finance electrification projects.
- The panel also mulled over the issues that OEMs face, especially when it comes to payment security. It is important that contracts are honoured by STUs, and liquidity continues for OEMs. STUs don't have experience dealing with e-bus contracts that involve payments based on performance benchmark, so this is a new era ushering in for them too. STUs are in bad shape themselves financially and depend on the government or some other parent organisation for financial support. Escrow account financing, the GCC contract models, better payment termination conditions in the contract and more refining of these contracts are some ways to help comfort OEMs and bus operators. In addition, the gross cost contract model helps further reduce the risk and provides more security to the parties involved.



## TECHNICAL SESSION I: CONTRACTING FOR ELECTRIC BUSES

The first technical session discussed insightful presentations and case studies on contracting for electric buses and the session was moderated by **Ms Swati Khanna**, Senior Sector Specialist, Urban Development & Mobility, KfW Development Bank.

### Grant support for improving bus services in cities

**Paresh Goel**, Director, Ministry of Road Transport and Highways, put into perspective the current state of public sector infrastructure in Delhi. He highlighted that there are 4,400 bus stops in Delhi for a population of over 2 crore (20 million) while London has 19,000 bus stops for a population of 80 lakh (8 million).

- Sharing analysis of the contracts currently undertaken by STUs, the team at MoRTH evaluated these contracts on components such as customer focus, service planning and came up with various recommendations to improve them. He advocated for the need to have incentives & disincentives for good and bad performances of buses and related services. An automatic extension of contracts for 2-3 years if performance is found satisfactory, was discussed. The talk emphasised on the importance of a fully mature ITS system linked to payments to fully automate billing.



- At last, one of the most important changes required for India's public transport system was discussed, which is understanding customer's needs and demands, and building a robust mechanism to receive customer feedback through SMSes, social media, and surveys. These surveys should have questions regarding the overall journey, bus stops, ease of buying tickets, value of money, driver friendliness, and staff behaviour.

- A customer charter should be introduced, and the services should be measured and monitored against this charter. Mr. Goel made a remark for revising fares from time to time and the need for a five-year vision and routes to be decided as per demand and not as per earnings per kilometre.

## EXPERIENCE OF DELHI – CAPITAL CITY OF INDIA

- **C K Goyal**, Senior Vice President Delhi Integrated Multi-Modal Transit System Limited began the presentation with the reform journey of public transportation in Delhi from the conversion of the entire fleet of buses into CNG in 2001 to revamping private bus operations into a PPP model (50% of the fleet) by FY 2007-08 to the current plan of introducing electric buses in Delhi.



- The plan to procure EVs for Delhi was shared which involved steps starting with the requirement assessment of e-buses for the next 3 years along with their type, earmarking depot(s) space with capacity, feasibility assessment of power load with cost and timelines with DISCOMS for charging stations, routes selection, route mapping with depots for least dead mileage, deciding operating model, and provision of capital funds for construction of depot with power load infrastructure and capital subsidy.
- The presentation advocated the need for a GCC model for e-buses as the focus is on functional specifications of vehicles which provides flexibility to manufacturers, leaves them with technical responsibility and transfers the complete operating risk to end operators.
- The presentation explained that the government's contractual obligations should include provision of depots with supporting infrastructure, provision of power load, formation of economic unit of depots/routes for open bidding, provision for inflation indexation towards manpower and consumables and public operator to run in accordance with unified timetable.



### > Key Terms & Conditions of Bid Document ( RFP) in Delhi...(1/2)

- ✓ Bundling/ Aggregation of demand both for augmentation and in lieu of retiring fleet in next three years to get economy of scale
- ✓ Assured kilometerage @ 70,000 per bus per annum
- ✓ E-Bus Specification: Requirement of driving range @ 200kms per bus on a single charge with daily utilization of 225 kms/ bus/ day with one opportunity charging
- ✓ Facilities provided by Authorities- Depot infra with up stream power infra with sanctioned power load provided by Authority in depot

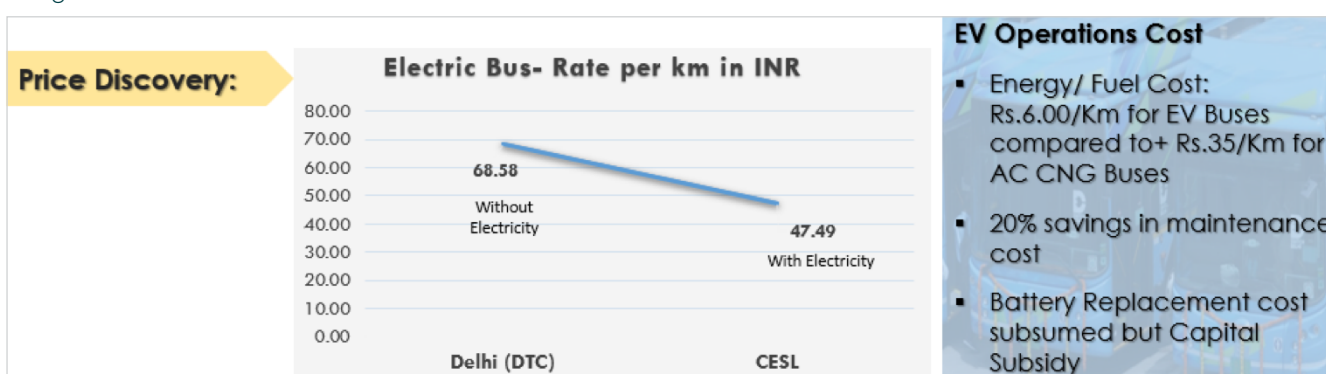


### > Key Terms & Conditions of Bid Document ( RFP) in Delhi... 2/2

- ✓ Concession Period-12 years
- ✓ Commitment of amount of upfront capital subsidy (Demand Incentive)
- ✓ Performance security.
- ✓ Payment Security Mechanism with provision of Escrow Account
- ✓ Annual Revision of Fees based on index value for manpower cost and other consumables



- Mr Goyal showcased how aggregation of demand for electric buses under the **Grand Challenge Scheme with the CESL (Convergence Energy Services Ltd)** helped reduce the price of procurement and ensured uniform bid management.



## LONDON CASE STUDY

Hema Russell, Operations Manager at Waterloo Garage, Go Ahead London shared her experience from London's first fully electric fleet bus garage. London bus fleet has 8,800 vehicles of which 9% (785 buses) are electric, less than 1% are fuel cell and about 44% are hybrid. The plan is to have all new buses to be zero emissions by 2034.

Few highlights of London bus contracts were shown such as the 7-year contracts which are delivered on a 'Quality Incentive Contract' basis since 2001, with bonus or penalties based on operational performance. For high frequency services, performance is measured based on excess wait time and for lower frequency routes, it is measured as per on-time services.

- Explaining the tendering process, she mentioned that the contracts are tendered on a route-by-route basis and are evaluated on price and the ability to deliver high quality services including depot, vehicles, staffing and safety record. The bidding process is transparent and are published. The implementation required six years of planning, research, and development including ramping up the infrastructure for e-bus fleets, training drivers, and hiring specialist engineers needed for electric buses along with three years of trials.

- She also shared the approach followed by Go Ahead London including envisioning the future of public transport in London. For instance, they considered the 'future state' of each depot for all-electric fleet, while developing the infrastructure. As new routes were electrified, the fleet was renewed, and infrastructure incrementally added to support them.





## WAY FORWARD FOR ELECTRIC BUS CONTRACTING IN INDIA

Ravi Gadepalli, Research Manager, UITP India, shared the timeline of electric bus deployment in India from 2019 through 2022 under the FAME I and FAME II subsidy schemes and highlighted how recent bids for electric buses in April-May 2022 have demonstrated the value of aggregated procurement.

### » Electric bus deployment timeline in India

- **2017-19: FAME I and City level procurement**
  - Included outright purchase and Gross Cost Contracts (GCC)
  - 425 e-buses across 10 locations through FAME I
  - Different vehicle specifications and contractual templates across cities
- **2019-21: FAME II Phase I**
  - Gross Cost Contract (GCC) & standard Model Concession Agreement (MCA) mandated
  - 3,600 buses sanctioned subsidy across 32 cities
  - Significant variation in procurement volumes, technical and functional specifications across cities
  - About 40% variation in costs between cities for similar specifications
- **2021-22: FAME II Phase II and City level procurements**
  - Aggregated procurement of 5,450 buses under FAME II
  - City level procurements predominantly concentrated in Mumbai (2,100 buses) and Delhi (330 buses)
  - Harmonised procurement specifications and Concentrated development in Metropolitan cities
- **2022-23 (Upcoming): National Electric Bus Program (NEBP)**
  - Targeted deployment of 50,000 buses across urban, mofussil and intercity services

June 2022 - Approx. 2000 buses

End of 2023 - 7000 e-buses



- The presentation discussed several challenges faced by state or city's operators and contracted operators with regards to e-bus implementation. State and city operators face operational challenges like range, charging needs, availability of power infrastructure, lack of functional Intelligent Transport Systems (ITS)

for effective payments and Service Level Agreements (SLA) management. Operators face challenges such as lack of timely payments by cities, impacting cash-flows, significant variation in payment profile of cities, issues with contract management, and lack of clarity in management of SLAs

- The presentation acknowledged the contributions of the Indian government to support electrification of buses till date through national-level capital subsidy and procurement which helped improved bidder confidence in the program and improved negotiating power with OEMs on bus specifications
- He mentioned there is a need for continued support from the Government of India for the upcoming National Electric Bus Program (NEBP) and invited MoRTH (Ministry of Road Transport and Highways) to submit its expression of interest and play an active role in project delivery beyond price discovery. The national-level payment guarantee mechanisms will be key to deliver the targeted 50,000 e-buses and there is a need for mobilising capital investments in depot and power infrastructure through financial intermediaries, providing technical support to states and cities on planning, procurement, ITS, contract management and exploring newer business models like financial leasing of buses.

## TECHNICAL SESSION II: PLANNING AND OPERATIONS OF ELECTRIC BUSES

The second technical session witnessed discussion on planning and operations of electric buses and was moderated by Flavio Grazian, Project Manager, Bus Unit, UITP.



### FINANCIAL VIABILITY OF ELECTRIC BUSES FOR OPERATORS

Jalpa Jain, Vice President, Aadinath Bulk Pvt Ltd, spoke about the financial viability of procuring, operating, and maintaining e-buses from a bus operator's perspective. With respect to procurement, she explained that the up-front costs of acquiring e-buses are 2 to 2.5 times that of diesel buses and the general financing criteria of banks is to provide finance for five years and cover only 80% of the cost of the vehicle which limits operators.

- With respect to operational and maintenance challenges, she discussed that battery costs constitutes up to 50% of vehicle costs which are said to reduce in the future, but not yet known by how much. She mentioned about India's unique climatic and topographical conditions and the uncertainty associated with the performance of e-buses in it, given that most e-bus implementations have taken place in America, China, European or Latin American countries which experience different climatic conditions.
- In addition to the above, the current charging infrastructure and range of e-buses is limited which reduces their performance on roads. As the technologies associated with e-buses are not stable or mature and are constantly evolving, leading to increased costs, reduced fleet availability and fleet uptime.

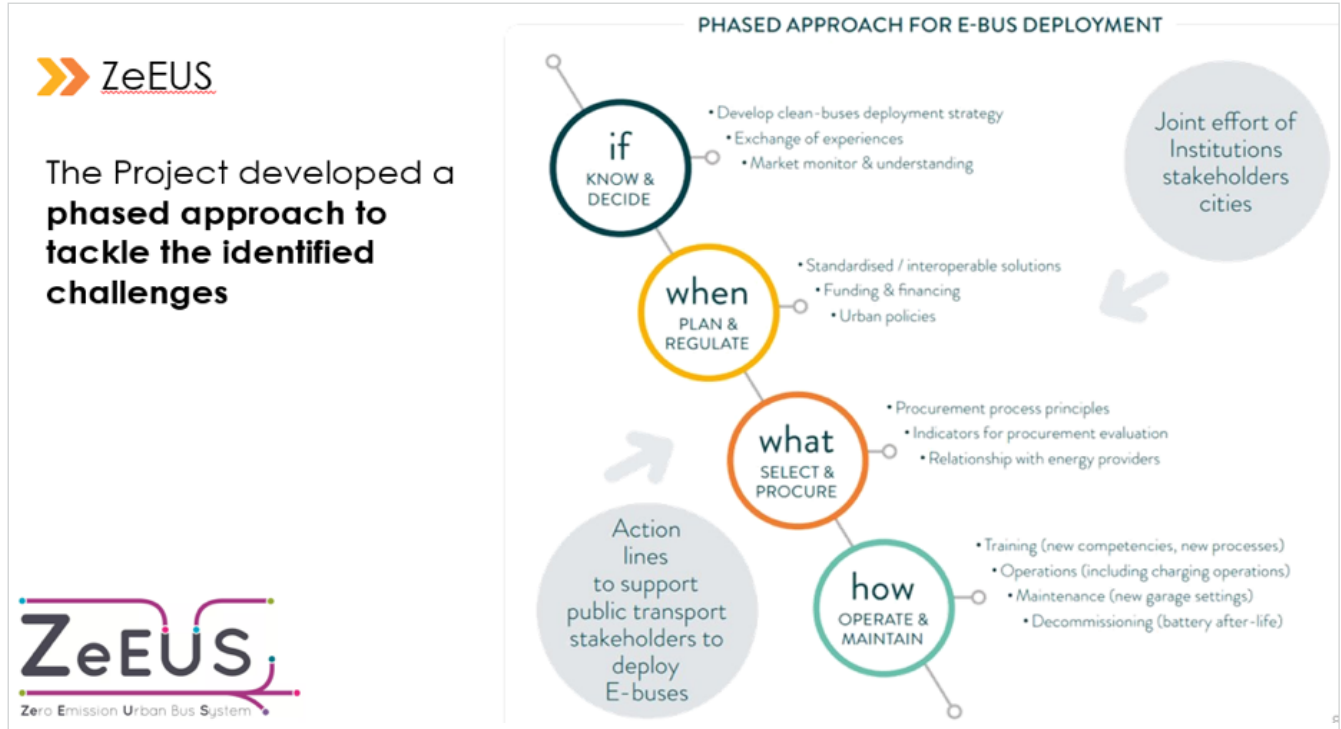
- She recommended that to acquire e-buses for private operators they must have better financing models such as battery leasing, financial leasing or incremental costs to be covered by the government instead of operators. She also advised changing the eligibility criteria for bidding for e-buses to less than 250 buses, to make it financially viable for operators to bid. Reduced and certain payment cycles and training of staff and maintenance support by OEMs will also help mitigate risks faced by operators.





## ZEEUS PROJECT AND ITS LEARNINGS

Flavio Grazian, Project Manager, Knowledge and Innovation Bus Unit at UITP, shared key learnings and outcomes from the ZeEUS and ASSURED research projects implemented in Europe showcasing the groundbreaking work of UITP on e-Buses. The main objective of the ZeEUS (Zero Emission Urban Bus System) project was to bring electrification to the heart of the urban bus network in Europe with 10 demonstrator cities.



- Five main challenges were identified by ZeEUS for e-bus deployment namely high upfront costs, new ways to procure vehicles and equipment, standardisation or interoperability and reinforcing cooperation with energy players. The project developed a phased approach to tackle each of these challenges as shown in the figure above.
- The aim of Assured was to boost the deployment of urban commercial fleets (buses, trucks and vans) across Europe and ensure their integration with high power fast charging infrastructure. It brought together the most relevant players along the entire value chain of electric mobility to collectively address the



standardisation and interoperability challenges and develop solutions that enable the full electrification of urban commercial fleets.

- The depot and opportunity charging challenge led to innovations such as interoperable high power charging systems, charger-vehicle interoperability, standardisation and innovative energy storage systems and charging management strategies.
  - » Along with it, the ASSURED project agreed on standards that encourage innovation, boosts confidence, and creates suitable market conditions for further technological development, reducing deployment barriers and facilitating competition.





- The ASSURED project demonstrated that the deployment of larger fleets and their integration with high-power, interoperable fast charging infrastructure is possible, and the innovative solutions introduced under it contributed to reduced TCO and OPEX.

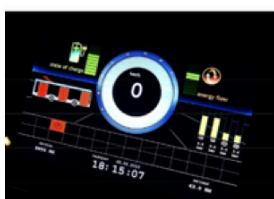
#### KEY INNOVATIONS



INTEROPERABLE HIGH POWER CHARGING SYSTEMS



CHARGER-VEHICLE INTEROPERABILITY AND STANDARDISATION



SMART TOOLS FOR FLEET LEVEL OPTIMIZATION



INNOVATIVE ENERGY STORAGE SYSTEMS AND CHARGING MANAGEMENT STRATEGIES



## OPERATIONAL PLANNING OF ELECTRIC BUSES

Shaun Bretstein, General Manager APAC, South Africa & Israel, Optibus, a software company that provides planning and scheduling solution to the public transportation bus industry, gave a brief introduction on Optibus software journey in public transportation.



- He explained how Optibus software leverages advanced optimisation algorithms and AI to continuously plan, schedule, and optimise every aspect of mass transportation networks for route planning, analysis, timetable creation and optimisation, vehicle and crew scheduling and rostering.
- He also shared two global case studies of E-bus excellency achieved through optimisation using Optibus software. In Chile, Metbus has a mixed fleet of buses (436 e-buses out of 1,542) which constitutes 25% of public transport in Santiago. They faced constraints of trip hours being only for e-bus or diesel and some routes being both EV + diesel or only diesel. Optibus captured the EV parameters and increased visibility into charging events. It also created multiple scenarios to save vehicles and drivers by optimising routes and schedules of the e-buses by letting the algorithm find the right balance.

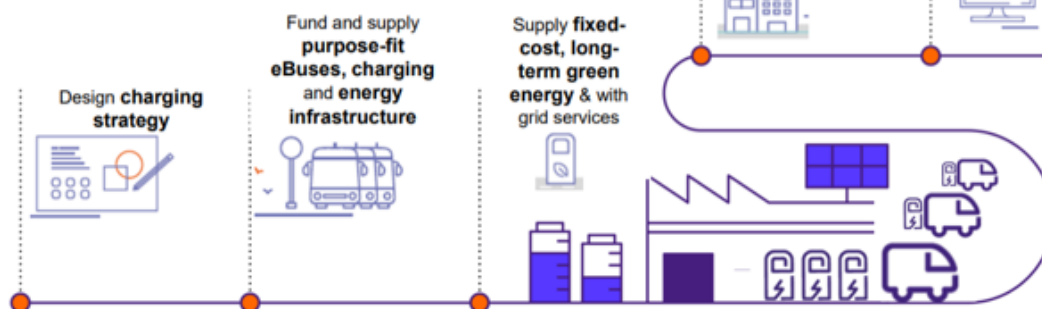


- In California, USA, the Public Transit Agency has a mixed fleet of 90 vehicles with challenges like inefficiencies due to manual scheduling, change in bus range at different times of the year, range anxiety and driver's range anxiety. The Optibus software helped create schedules that reflected the reality of charging stops and brought down the Peak Vehicle Requirement from 38 to 32 (-15%) by optimising charging events. The software also helped the agency to fully transition to 100% electric buses.



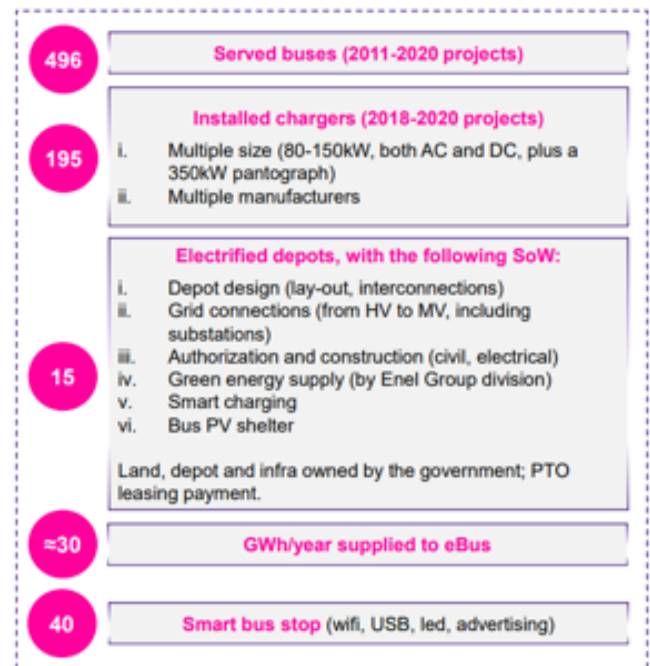
## CHARGING INFRASTRUCTURE PLANNING FOR ELECTRIC BUSES

Neeraj Bhagwatula, Strategy and Development Lead – eBus APAC, Enel X, started with a brief overview experience of Enel X in e-bus deployment with more than 3,400 e-buses served, more than 1000 charging stations deployed, over 30 electro terminals created, 106 smart bus shelters built and 11 pantographs developed across the world with a target of serving 20,000 e-buses by 2030.

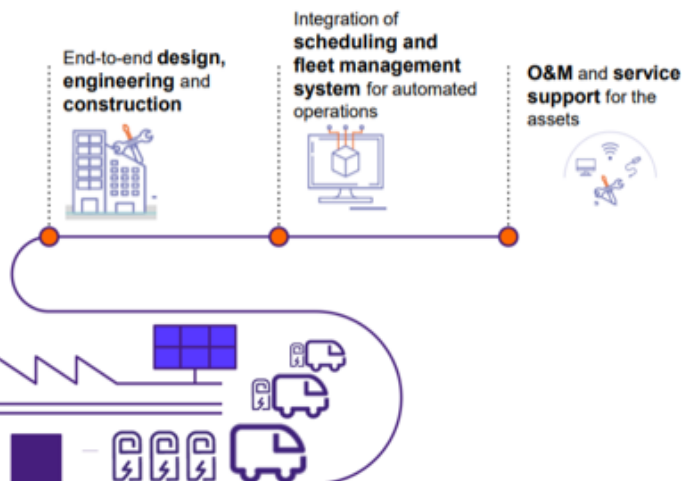


- He shared three different charging models used in various scenarios. The first is as-a-service model, which is low-cost, operation-ready fleet electrification service with complete renewable power. Here, the bus operator takes care of the service operations and insurance and pays Enel X an annual service fee (Rs/km) to take care of financing and performance of the e-bus fleet, and service and charging infrastructure maintenance. This model was deployed in Columbia and Chile using depot plug in charging for e-buses.

## Charging Infrastructures in Chile



- The second is charging-as-a-service model, where Enel X offers flexible approach including charging-as-a service, battery-as-a-service including battery diagnostics, e-bus-as-a-service and energy-as-a-service.



- Third is pantograph charging services, 2 case studies from Spain were shared where Enel X was the main electrification partner responsible for the design, supply, installation, and maintenance of 11 opportunity chargers (pantograph up to 500kW power) and 30 overnight chargers (pantograph). They provided as the charging points, electrical substation, construction of supporting structures of inverted pantographs and smart charging Enel X platform.



- The key learnings shared by Enel X included:
  - » Charging infrastructure is both an input and a result and therefore requires co-optimisation
  - » Mode of charging (depot or opportunity) depends on timetable and demand aggregation ability
  - » Considering depot-level energy management (with PV, batteries, PPAs), CAPEX can be reduced for grid connection

## TECHNICAL SESSION III: DIGITALISATION IN ELECTRIC BUS OPERATIONS

In the last technical session, speakers discussed on the digitalisation in electric bus operations and the session was moderated by Anupama Saha, Assistant General Manager, DIMTS.



## MONITORING AND CONTROL FOR ELECTRIC BUSES

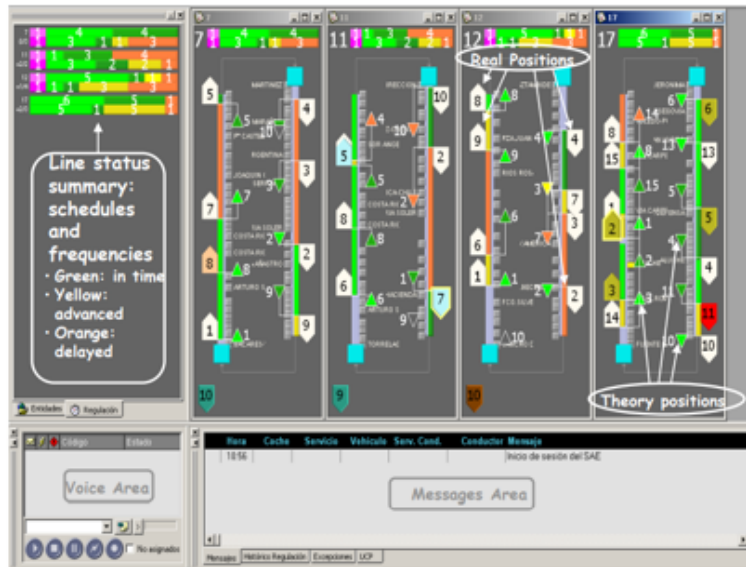
Iván López de la Casa, Head of Electrical Infrastructure Department, Municipal Transport Company of Madrid (EMT MADRID) gave a brief overview of EMT Madrid that has currently 179 e-buses in service with a target of deploying 254 buses by the end of 2022.

- He explained the Help Operation System that uses GPS satellites to track and gather bus position data and displays real-time bus arrival information on variable messaging panels. The AVL location system uses the GPS data and bus door movement along with the odometer to track speed and location of the bus. The communications system has 12 data channels and 24 voice channels across 4 base stations, 2 additional stations and the control center. These three systems combined help monitor the arrival and delay of buses in real time.



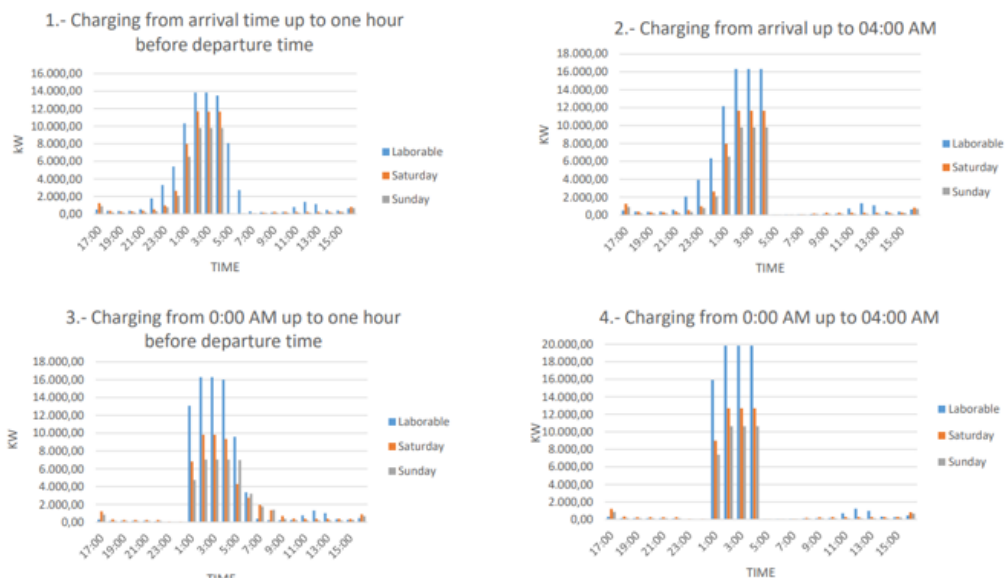


## » BUSES VISUALISATION IN REAL TIME



- He then detailed out the evolution of charging infrastructure from induction opportunity charging and wired charging to inverted pantographs and smart charging depots for Madrid's e-buses. Mr. Casa further made a case that operation costs are always lower with smart charging as seen in the diagram below.

## » NEXT STEPS. SMART CHARGING



- In the end, he shared several recommendations such as gaining access to the storage CAN of buses which currently is the copyright and intellectual property of manufacturers. It will help gather information in real time from the odometer, level of charge and autonomy of the bus.

## LEVERAGING ELECTRONIC TICKETING & PAYMENT FOR BUS SERVICES

Sylvain Haon, Senior Director Strategy, UITP made a strong case for the importance of electronic ticketing and payment towards achieving several key objectives of the public transportation sector such as renewing the passenger experience, improving fare collection and operator revenue streams.



- The talk discussed about one of the latest ticketing systems i.e., the Open Loop payment systems which remove the ticket from the equation entirely, as the payment card or mobile device becomes the ticket. Passengers can access public transport simply by tapping a valid open loop contactless payment media on the payment terminal. He spoke about the [Urban Mobility Open Payment Forum](#), an initiative of UITP with payment schemes, technology providers and operators that was started in July 2021 with the main objective to provide a platform for exchange and dialogue around open loop payment.

### » Cities adopting open loop ticketing in public transport



- The talk concluded by saying that the introduction of new services and fleets is an opportunity to launch a new ticketing system as it supports a renewed customer experience, allows integration of the new service within existing services, and supports the integration of the new service with complementary public transport and last mile mobility services.

### » the evolution of ticketing solutions



## NCMC COMPLIANT INTEGRATED DIGITAL TICKETING SOLUTIONS FOR PUBLIC TRANSPORT IN INDIAN CITIES, CASE STUDY: MUMBAI

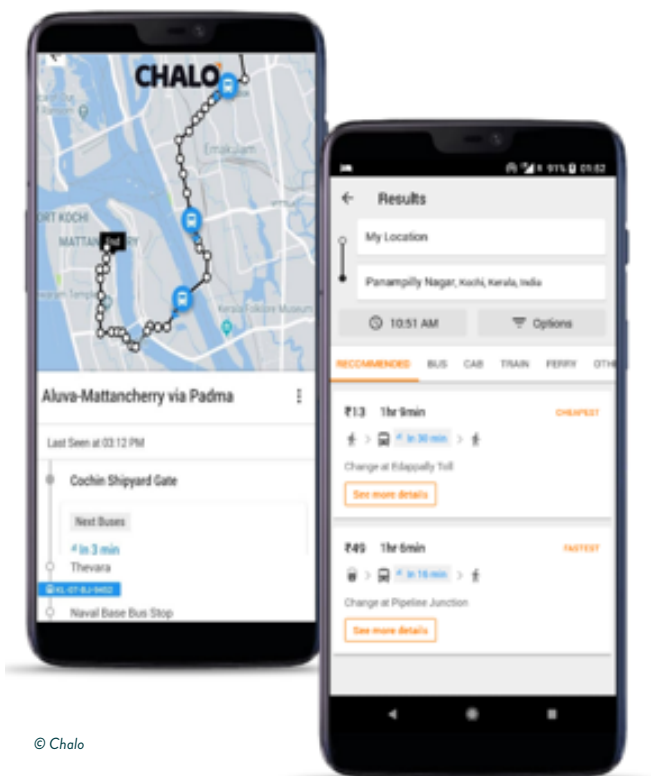
Priya Singh, Co-Founder, Chalo, is a public transport technology provider company in India that serves in 37 cities and live tracks over 15000 buses with more than 1 billion rides annually. Chalo has digitised bus services in Mumbai in two significant ways i.e., through real-time bus tracking and bus ticketing services.

- Live tracking of buses and reporting their accurate time of arrival helps solve for traffic conditions and making buses more reliable. As a result of this, more people are ready to ride buses leading to an increase in revenues for STUs and bus operators.





- Ms Singh attributed the success of NCMC initiative to customer focus, integration of online and offline capabilities, and making the bus crew champions of distribution. Chalo leveraged bus conductors as digital champions responsible for distribution and sales of cards amongst bus passengers and recharges for payments.



© Chalo



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- She also spoke about the pilot of the self-serve digital tickets recently implemented by Chalo in a few BEST buses. This ticketing system allows commuters to tap in upon boarding and tap out while alighting and the fare is automatically calculated and deducted from the card. This system supports NCMC/Cards, mobile tickets, and passes. The successful deployment of this system has the potential to save \$100 million annually across 10,000 buses, \$36 million savings with conductor less buses and \$66 million savings in pilferage, cash loss, cash handling cost.



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## EXPERIENCE OF SITILINK: IMPACT OF ITS ON ELECTRIC BUS OPERATIONS

Mustafa Sonasath, Manager at Surat Sitilink Limited looks after the operations and administration of Surat Public Transport including BRTs and City buses. Surat currently has 49 e-buses in operation, 3 dedicated depots for e-buses out of which 2 are under construction with plans to electrify existing 9 depots as well as identify more pockets of land for e-bus depots.



- Sitilink uses the Intelligent Transport System (ITS) that combines the Intelligent Transit Management system (ITMS) and Automatic Fare Collection System (AFCS) for real time monitoring of bus operations and revenue collection. The ITMS includes several sub-systems such as the Automatic Vehicle Location System (AVLS), Passenger Information system (PIS), Depot Management System (DMS), Incident Management System (IMS) and the Enterprise Management System (EMS). The DMS automates vehicle and driver allocation through virtual codes, the AVLS tracks real-time bus operations and alerts and reports operational violations. The IMS helps log operational incidents in the system such as traffic congestion, accidents, riots, fires, or vehicle breakdowns.
- The ITS allows for data-driven decision making across all aspects of bus operations facilitating bus services and frequency planning including last mile connectivity. However, perhaps the most important impact of SITILINK's Intelligent Transport System has been the reduction in private vehicles, and a slow but apparent shift from private to public transportation.

## KEY TAKEAWAYS

The UITP India Bus Seminar 2022 successfully provided a platform for policymakers and key stakeholders to discuss necessary steps toward the meaningful deployment of electric buses in India. More than 200 participants and key national and international speakers came together to share their knowledge and insights on key topics of electric buses such as contracting, planning and operations, and digitalisation.

Mr. Ashish Kundra, Principal Secretary and Commissioner of Transport, Government of NCT of Delhi in his inaugural address not only highlighted various benefits of plying electric buses in terms of cost savings and reduced vehicular pollution but also emphasised the need to bring private car users onto the public transport system in Delhi. The keynote address and strong political commitment by Mr. Kailash Gahlot, Minister of Transport, Government of NCT of Delhi on the future of India's public transport system especially in the capital city of Delhi, with a core focus on electrification of buses installed high confidence among the participants.

During the panel discussion on energy mix and roadmap for electrification of Indian bus systems, it was made clear that there is a need for active involvement of states in contract formulation with support from public sector banks to finance electrification projects and provide more security and reduce risk to all the parties involved in the electrification of bus systems.

Discussing the procurement of electric buses through the GCC model in the case of Delhi, the grand challenge launch by CESL and Go-Ahead London bus contracts, the Contracting session on Electric buses highlighted the value of aggregated bus procurement

in India, and how a transparent bidding process and continuous support from the Government of India can further strengthen the smooth transition of public transport system from ICE based to Electric buses.

The Planning and Operation session of Electric Buses highlighted that the inadequate deployment and non-availability of charging infrastructure is one of the main challenges associated with the successful roll-out of electric buses. There is a need for better and innovative long-term financing models to fuel investment and build confidence among the key policy players in the E-bus domain. A successful planning and scheduling software through the use of AI algorithms can further help to optimise mass transport systems in terms of route planning, timetable creation, and scheduling.

Digitalisation in Electric Bus Operations such as re-vamping ticketing systems, tracking real-time data on charging and scheduling of electric buses, and deployment of Intelligent Transport Systems (ITS) can help to better analyse and take data-backed decisions for the smooth operation of bus services. A customer-centric approach can further help to streamline and attract more users to the public transport system in a city.

As an advocate of public transport, UITP India through organisation of the 6th edition of Bus Seminar continues to play an important role in the clean and green transition journey of the public transport system in India.



## PROGRAM OF THE SEMINAR

**15 JULY, 2022**

### INAUGURAL SESSION

**09:45 – 10:45 IST**

- Opening Address – **Mr T Surya Kiran**, Executive Director, Association of State Road Transport Undertakings
- Opening Remarks – **Mr Sylvain Haon**, Senior Director - Strategy, UITP
- Opening Remarks – **Mr Rajesh Aggarwal**, Managing Director, DIMTS Ltd
- Inaugural Address – **Mr Ashish Kundra**, IAS- Principal Secretary and Commissioner of Transport, Government of National Capital Territory of Delhi
- Keynote Address – **Mr Kailash Gahlot**, Hon'ble Minister of Transport, Government of National Capital Territory of Delhi
- Vote of Thanks – **Ms Rupa Nandy**, Head of UITP India

### PLENARY SESSION : PANEL DISCUSSION ON ENERGY MIX AND ROADMAP FOR ELECTRIFICATION OF INDIAN BUS SYSTEMS

**11:00 – 12:00 IST**

**Moderator : Sudhendu J Sinha, Advisor NITI Aayog**

- **Mr Ashish Kundra**, IAS – Principal Secretary and Commissioner of Transport, Government of National Capital Territory of Delhi
- **Mr Shekhar Channe**, IAS – Vice Chairman and Managing Director, Maharashtra State Road Transport Corporation
- **Mr Lokesh Chandra**, IAS – General Manager, BEST Undertakings, Mumbai
- **Ms Swati Khanna**, Senior Sector Specialist, Urban Development & Mobility, KfW Development Bank

### TECHNICAL SESSION-I : CONTRACTING FOR ELECTRIC BUSES

**12:00 – 13:30 IST**

**Moderator : Swati Khanna, Senior Sector Specialist, Urban Development & Mobility, KfW Development Bank**

- Grant support for improving bus services in cities – **Paresh Goel**, Director, Ministry of Road Transport & Highways, Government of India
- Experience of Delhi – **C K Goyal**, Senior Vice President, DIMTS
- International Case Study – **Hema Russell**, Operations Manager, Waterloo Garage, Go Ahead London
- Way forward for electric bus contracting in India – **Ravi Gadepalli**, Research Manager, UITP India

## TECHNICAL SESSION-II : PLANNING AND OPERATIONS OF ELECTRIC BUSES

14:15 – 15:45 IST

### Moderator : Flavio Grazian, Project Manager, UITP

- Financial Viability of electric buses for operators – **Jalpa Jain**, Vice President, Aadinath Bulk Pvt Ltd
- ZeEUS project and its learnings – **Flavio Grazian**, Project Manager, Knowledge and Innovation Bus Unit at UITP
- Operational planning of electric buses – **Shaun Bretstien**, General Manager, Optibus Ltd
- Charging Infrastructure Planning for electric buses - International Case Study – **Neeraj Bhagwatula**, Strategy and Development Lead – eBus APAC, Enel-X

## TECHNICAL SESSION-III : DIGITALISATION IN ELECTRIC BUS OPERATIONS

16:00 – 17:30 IST

### Moderator : Anupama Saha, Assistant General Manager, DIMTS

- Monitoring and control for electric buses – **Iván López De La Casa**, Head of Electrical Infrastructure Department, EMT Madrid
- Electronic payments in bus transport – **Sylvain Haon**, Senior Director Strategy, UITP
- NCMC compliant integrated digital ticketing solutions for public transport in Indian cities, Case Study - Mumbai – **Priya Singh**, Co-Founder, Chalo
- ITS for electric buses – Experience of Surat Sitilink: Impact of ITS on electric bus operations - **Mustafa Sonasath**, Manager at Surat Sitilink Limited

## KEY TAKEAWAYS AND WRAP UP

17:30 – 18:00 IST

- **Sylvain Haon** – Senior Director Strategy, UITP





## SPEAKERS

### INAUGURAL SESSION



**MR KAILASH GAHLOT**  
Hon'ble Minister of Transport  
Govt. of NCT of Delhi



**MR ASHISH KUNDRA, IAS**  
Principal Secretary and  
Commissioner of Transport  
Govt. of NCT of Delhi



**MR SYLVAIN HAON**  
Senior Director – Strategy  
UITP



**MR RAJESH AGARWAL**  
Managing Director and CEO  
DIMTS Limited



**MR T SURYA KIRAN**  
Executive Director  
ASRTU



**MS RUPA NANDY**  
Head of  
UITP India

### PLENARY SESSION



**MR ASHISH KUNDRA, IAS**  
Principal Secretary and  
Commissioner of Transport  
Govt. of NCT of Delhi



**MR SHEKHAR CHANNE, IAS**  
Managing Director  
Maharashtra State Road  
Transport Corporation



**MR LOKESH CHANDRA, IAS**  
General Manager  
BEST Undertakings



**MS SWATI KHANNA**  
Senior Sector Specialist  
KfW Development Bank



**MR SUDHENDU J SINHA**  
Advisor  
NITI Aayog

### TECH SESSION - I



**PARESH GOEL**  
Director  
Ministry of Road Transport  
and Highways



**C K GOYAL**  
Senior Vice President  
DIMTS Limited



**HEMA RUSSELL**  
Operations Manager  
Go Ahead London



**RAVI GADEPALLI**  
Research Manager  
UITP India



**MS SWATI KHANNA**  
Senior Sector Specialist  
KfW Development Bank

### TECH SESSION - II



**JALPA JAIN**  
Vice President  
Aadinath Bulk Pvt Ltd



**FLAVIO GRAZIAN**  
Project Manager, Knowledge & Innovation  
UITP



**SHAUN BRETSTEIN**  
General Manager  
Optibus Ltd



**NEERAJ BHAGWATULA**  
Ebus Business Development Manager  
Enel-X

### TECH SESSION - III



**IVÁN LÓPEZ DE LA CASA**  
Head of Electrical Infrastructure Department  
EMT Madrid



**MR SYLVAIN HAON**  
Senior Director – Strategy  
UITP



**PRIYA SINGH**  
Co-founder  
Chalo



**MR. MUSTAFA SONASATH**  
Manager  
Surat Sitilink Limited



**ANUPAMA SAHA**  
Assistant General Manager  
DIMTS Limited

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## ABOUT UITP

UITP - International Association of Public Transport, is a passionate champion of sustainable urban mobility and is the only worldwide network to bring together all public transport stakeholders and all sustainable transport modes and players such as policy decision makers, authorities, operators, supplier and service industry. It has 1900 members from 100 different countries and 13 regional offices. 47% of UITP's membership is under Bus sector if it is divided members by modes.

UITP works in the public transport sector through 3 main channels – Advocacy, Research and Networking. Concretely UITP releases publications and statistics, organises events, leads research and innovation projects and delivers training sessions.

In March 2007, UITP opened its first Indian office in Bangalore and in December 2019 in New Delhi. The prime objective of the Indian office is to better address the specific needs of regional members as well as the Indian public transport sector and its stakeholders.

UITP in India aims to offer assistance and services to public transport organisations in the country through access to knowledge on national and international technical and policy developments in urban mobility, peer reviews, projects and studies on specific issues of concern. There are over 50 UITP members in India.

## FOR FURTHER INFORMATION

### Rupa Nandy

Head of UITP India

Mob- +91 9811864099

Email- [rupa.nandy@uitp.org](mailto:rupa.nandy@uitp.org)

### Delhi Office

UITP India

Office of Chief Project Manager-5

Delhi Metro Rail Corporation Ltd

Ground Floor, Airport Express

Metro Station, Dhaula Kuan

New Delhi-110010

### Bangalore Office

UITP India Regional Office

2nd Floor BMTC

Shanti Nagar Bus Station

Complex, Shanti Nagar

K H Road, Bangalore - 560027

## PUBLICATIONS

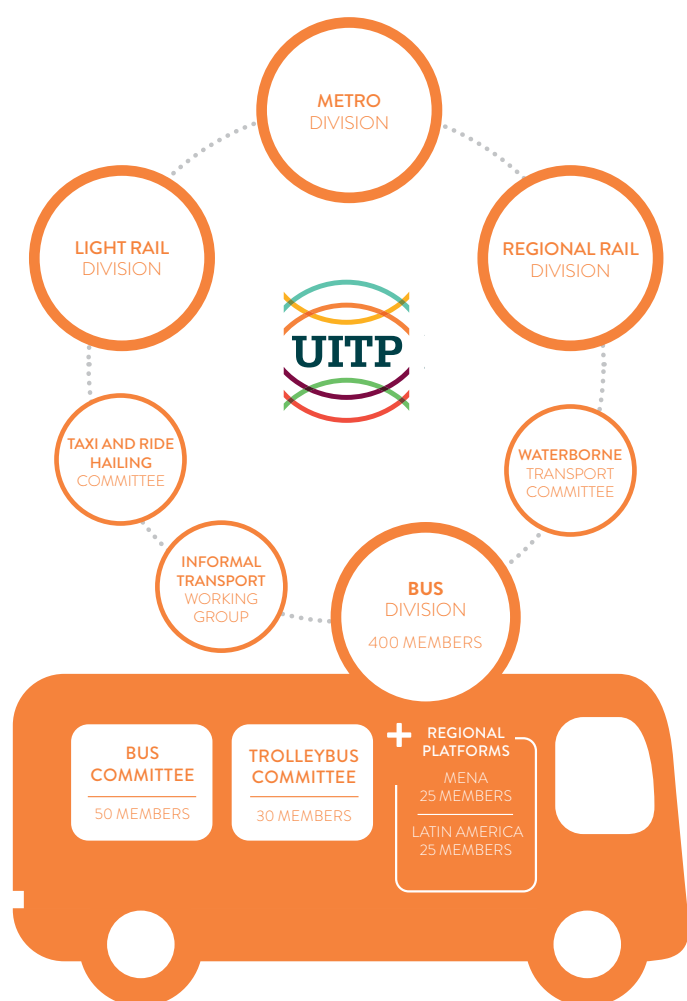
Some key publications from UITP focusing on busses are:

- Report: ASSURED 1.0 Interoperability Reference:  
[https://mylibrary.uitp.org/GED\\_V14/186830290401/d44-assured-11-interoperability-reference-pdf.pdf](https://mylibrary.uitp.org/GED_V14/186830290401/d44-assured-11-interoperability-reference-pdf.pdf)
- Report: ASSURED Clean Bus Report:  
[https://mylibrary.uitp.org/GED\\_V14/186027990420/ASSURED\\_Clean\\_Bus\\_report\\_final2.pdf](https://mylibrary.uitp.org/GED_V14/186027990420/ASSURED_Clean_Bus_report_final2.pdf)
- Report: Large Scale bus electrification: New Challengers for IT Systems  
<https://cms.uitp.org/wp/wp-content/uploads/2022/08/Report-August17.pdf>
- Report: Transforming cities with BRT systems:  
[https://mylibrary.uitp.org/GED\\_V14/176586899476/BRT\\_ENG\\_Web.pdf](https://mylibrary.uitp.org/GED_V14/176586899476/BRT_ENG_Web.pdf)
- Report: Electric Bus Procurement Under FAME-II: Lessons Learnt and Recommendations for PHASE II,  
[https://cms.uitp.org/wp/wp-content/uploads/2020/12/UITP-India\\_FAMEII\\_E-Bus-Procurement.pdf](https://cms.uitp.org/wp/wp-content/uploads/2020/12/UITP-India_FAMEII_E-Bus-Procurement.pdf)
- Report: Performance Evaluation Framework for Electric Buses in India  
[https://cms.uitp.org/wp/wp-content/uploads/2020/12/UITP-India-Performance-Evaluation\\_Electric-Bus.pdf](https://cms.uitp.org/wp/wp-content/uploads/2020/12/UITP-India-Performance-Evaluation_Electric-Bus.pdf)

## ABOUT UITP BUS DIVISION

Bringing together 400+ organisations and operators from around the world, the **Bus Division** is the largest modal community in UITP.

Collectively, the Division provides a global platform for the exchange of knowledge and business opportunities. This work is led by the **Committees**, which are responsible for a range of initiatives and supported by the **Regional Platforms** for a localised exchange of information.



### What we work on:

- ✓ Autonomous vehicles
  - ✓ Customer service
  - ✓ Decarbonisation
  - ✓ Design
  - ✓ Digitalisation
  - ✓ E-buses
  - ✓ Electrification
  - ✓ Network planning
- ...and many more!

From Knowledge & Innovation projects to the development of business intelligence, guidelines and benchmarking tools, the Bus Division engages with all facets of the industry.

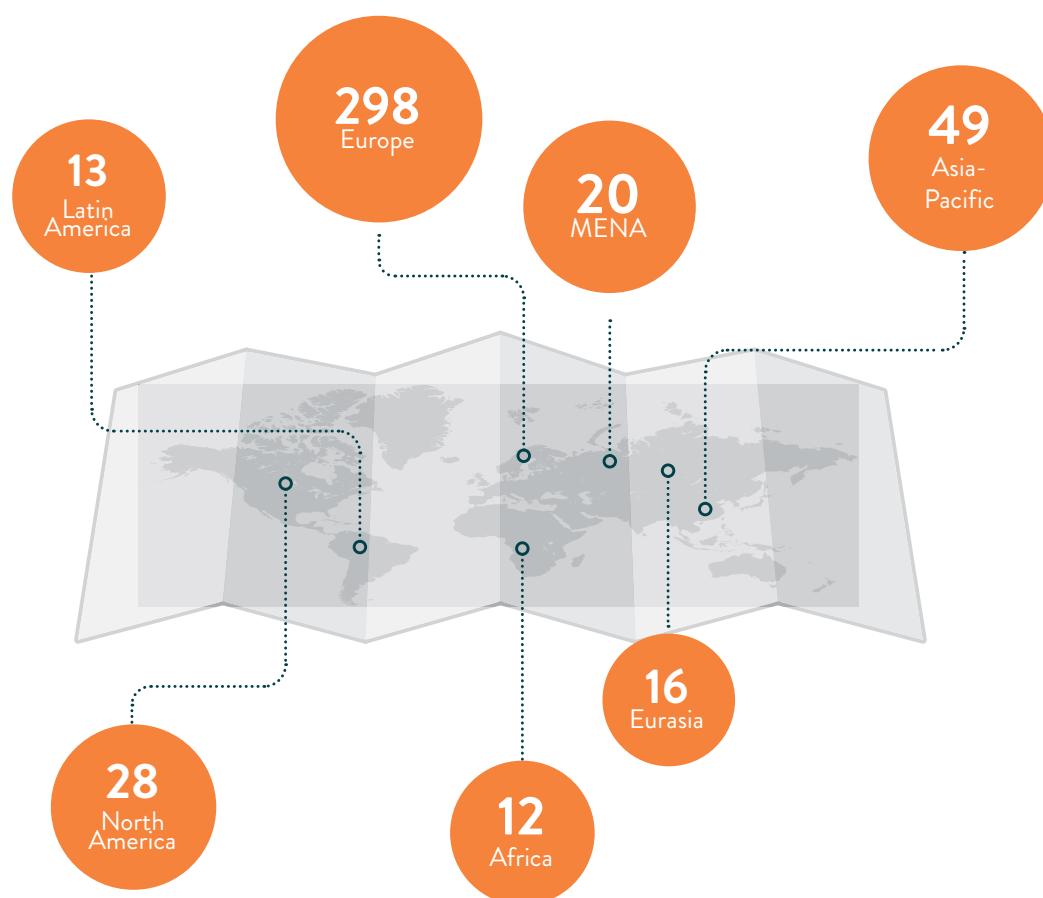
#### Recent projects include:

- ▶ SORT and E-SORT referential – setting the standard for the sector
- ▶ Bus and e-bus tender – procurement structure document
- ▶ Standards for e-bus charging interface
- ▶ Bus benchmarking project – based on standard cost activity model
- ▶ BRT Guide and Workshop
- ▶ Trolleybus asset peer review
- ▶ EU Advocacy achievements
- ▶ Bus fleet renewal Checklist
- ▶ Training programme on electric buses, safety, planning and operations or bus network design and route structuring



## UITP BUS DIVISION MEMBERS

We bring a truly global perspective to the table:



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For more information on UITP Bus Division activities, please contact Arno Kerkhof, Head of UITP Bus Transport Unit, [arno.kerkhof@uitp.org](mailto:arno.kerkhof@uitp.org) or Yussup Khassiev, UITP Trolley Bus Committee Manager [yussup.khassiev@uitp.org](mailto:yussup.khassiev@uitp.org)

## ABOUT DIMTS

Proud member of UITP since 2008

Delhi Integrated Multi-Modal Transit System Ltd. (DIMTS) is a joint venture company with equal (50:50 ) equity participation of the Government of National Capital Territory of Delhi (GNCTD) and IDFC Foundation (a not-for-profit CSR initiative of IDFC Ltd.) DIMTS is a knowledge-based organisation with expertise in the urban transport sector and transport projects development. DIMTS has a multi-disciplinary team of professionals and specialists drawn from diverse fields of road transport/ bus operations, information technology, transport planning, financial and transaction advisory, engineering, project and programme management amongst others.

DIMTS helped Government of NCT of Delhi (GNCTD) in conceptualizing and launching city bus operations using Gross Cost model during 2010-11. This has emerged as one of the most successful PPP based bus operations in India. DIMTS has been managing the Gross Cost Contracts of bus operators for GNCTD since 2011 using in-house developed IT tools/ applications. In addition, DIMTS is also managing the Gross Cost Contracts of bus operators for Nagpur and Gurugram cities.

DIMTS has undertaken projects in most of the States in India and also in other countries in Asia and Africa such as Afghanistan, Sri Lanka, Ethiopia and Republic of the Congo.

For further information on DIMTS, please contact C K Goyal on [ck.goyal@dimts.in](mailto:ck.goyal@dimts.in)





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This is an official Report of UITP, the International Association of Public Transport. UITP has more than 1,800 member companies in 100 countries throughout the world and represents the interests of key players in this sector. Its membership includes transport authorities, operators, both private and public, in all modes of collective passenger transport, and the industry. UITP addresses the economic, technical, organisation and management aspects of passenger transport, as well as the development of policy for mobility and public transport worldwide.

This Report was prepared by UITP India.



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**SEPTEMBER | 2022**



Rue Sainte-Marie 6, B-1080 Brussels, Belgium | Tel +32 (0)2 673 61 00 | Fax +32 (0)2 660 10 72 | [info@uitp.org](mailto:info@uitp.org) | [www.uitp.org](http://www.uitp.org)