PASSENGER BOOKING MANAGEMENT

Unit-V

Chapter I :Urban Rail Transport in India- Mumbai Suburban, Kolkata, Delhi, Chennai Metro

Fig.5.1

Urban Rail Transport In India

Monorail is generally considered as feeder system for the metro trains in India. In 2004, monorail was first proposed for Kolkata. But, later the idea was put on hold due to lack of funds and infeasibility. The Mumbai Monorail, which started in 2014, is the first operational monorail network in India. (excluding the Skybus Metro) since the Patiala State Monorail Trainways closed in 1927.

Other planned systems are Chennai Monorail, Kolkata Monorail, Allahabad Monorail, Bengaluru Monorail, Delhi Monorail, Indore Monorail, Kanpur Monorail, Navi Mumbai Monorail, Patna Monorail, Pune Monorail, Ahmedabad Monorail, Aizawl Monorail, Bhubaneswar Monorail, Jodhpur Monorail, Kota Monorail, Nagpur Monorail and Nashik Monorail

The Mumbai Suburban Railway

Fig.5.2

The Mumbai Suburban Railway is the first rail system in India, which began services in Mumbai in 1853, transports 6.3 million passengers daily and has the highest passenger density in the world. The Kolkata

Suburban Railway was established in 1854 and the Chennai Suburban Railway in 1931.

The operational suburban rail systems in India are in Mumbai Suburban Railway, Kolkata Suburban Railway, Chennai Suburban Railway, Lucknow-Kanpur Suburban Railway, Delhi Suburban Railway, Pune Suburban Railway, Hyderabad Multi-Modal Transport System, Barabanki-Lucknow Suburban Railway and Karwar railway division.[36] Other planned systems are Bengaluru Commuter Rail, Ahmedabad Suburban Railway and Coimbatore Suburban Railway. The operational systems are Kolkata Metro, Delhi Metro, Namma Metro, Rapid Metro, Mumbai Metro, Jaipur Metro, Chennai Metro, Kochi Metro, Lucknow Metro, Nagpur Metro, Noida Metro, Hyderabad Metro.

The planned systems are Ghaziabad Metro, Navi Mumbai Metro, Metro-Link Express for Gandhinagar and Ahmedabad, Varanasi Metro, Kanpur Metro, Bareilly Metro, Pune Metro, Vijayawada Metro, Patna Metro, Meerut Metro, Guwahati Metro, Chandigarh Metro, Bhopal Metro, Kozhikode Light Metro, Indore Metro, Thiruvananthapuram Light Metro, Agra Metro, Coimbatore Metro, Visakhapatnam Metro, Surat Metro, Srinagar Metro, Greater Gwalior Metro, Jabalpur Metro and Greater Nashik Metro. Currently, rapid transit is under construction or in planning in several major cities of India and will be opened shortly.

Kolkata Metro Rail

Fig.5.3

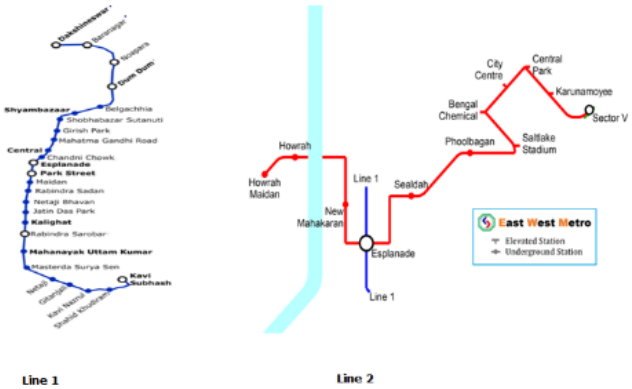


Fig.5.4

Introduction:

The Kolkata Metro is the first planned and operational rapid transit system Metro Railway, and the first underground Metro in India in India.Metro Railway, Kolkata and Kolkata Metro Rail Corporation are the owners and operator of the system. On 29 December 2010, Metro Railway, Kolkata, became the 17th zone of the Indian Railways, completely owned and funded by the Ministry of Railways. It is the only metro in the country to be controlled by Indian Railways. There are around 300 daily train trips carrying more than 700,000 passengers.

It is the fifth-longest operational metro network in India after the Delhi Metro, Hyderabad Metro, Chennai Metro and Namma Metro.It was constructed progressively from 1972 to 2013. Based on traffic studies, the Dum Dum – Tollygunge corridor was first selected for implementation and work started on 29th December, 1972. In Phase-I, a length of 16.450 Kms from Dum Dum to Tollygunge (MahanayakUttam Kumar) completed in 1995 and in Phase-II a length of 5.834 Kms from MahanayakUttam Kumar to Kavi Nazrul Metro station is completed in August, 2009.

In October 2010, Metro services further extended up to Kavi Subhash, a length of 2.851 Kms. It is further extended Dum Dum to Noapara, a length of 2.091 Kms, on 10th July 2013. The last leg was opened on 23rd February 2021 for commercial operation from Noapara to Dakshineswar (4.139 Kms).

The system has a mix of underground, at-grade and elevated stations using both broad-gauge and standard-gauge tracks. Trains operate between 05:45 and 21:55 IST and the fares range from ₹5 to ₹30 (US$0.07 to US$0.40). Due to covid-19 pandemic, tickets cannot be purchased with cash. A metro smart card is essential for buying tickets.

All entry/exit gates and stations are manned by security personnel (RPF, MRP & KP) 661 cameras have been provided on platforms, entry/exit gates, tunnels, escalators, concourses and yards for round the clock surveillance. Cameras commissioned at all stations and connected with Security Control and Station Manager's chamber for close monitoring of happenings in the entire Metro system to enhance security of passengers.

Display of audio-visual clippings through INCODA TVs to create awareness amongst commuters regarding arrangements available to tackle emergent situations introduced. Dedicated women helpline service introduced to assist women in trouble during journey. Lady RPF squad has been provided for security of lady passengers.

Metro Railway Kolkata, the first Metro Railway in India is operational since 1984. At present it has two operational lines. Line1 lies along the busy North-South axis of the city with a length of just over 31 kilometers and 26 stations. The other operational Line2 is planned to have 12 stations out of which 7 are operational. At present an AFC (Automatic Fare Collection) system developed by CRIS with hardware

from multiple suppliers is deployed across all the stations of these lines. The Metro is undergoing expansion along two other lines is likely to add about 40 stations in near future. CRIS is geared up to deal withthe challenges of such expansion.

Background:

Metro Railway Kolkata was naturally the first in India to employ an AFC-PC system. This AFC-PC system developed by the French company "Dassault AT" was based on Magnetic stripe tickets and Turnstile gates and served the Railway well for a period of fifteen-twenty years. Thereafter the aged system gave rise to significant operational and maintenance issues.

The Problem:

The system having outlived its operational life was plagued by various problems. Proper Ticket stationery, spare parts, other consumables and trained technicians were scarce resulting in frequent and prolonged device malfunctions. Large numbers of Automatic Gates (AG) were non-functional leading to revenue loss. Obsolescence of technology and over reliance on specific suppliers led to such unavailability of spares that no agency was willing to undertake Annual Maintenance for the system.

Relevant technical and system security documentation was unavailable. In this scenario upgrading the AFC System's software in order to modify / introduce new business rules was impossible; this was evident during attempts to extend the Smart Card system to six new stations added to the Metro network at that time. Moreover,the system was not designed to support a Centralized Data Network and a Centralized Repository of Data did not exist. Thus, the provision for centralized Accounting & MIS reports and centralized monitoring of devices was non-existent posing severe operational challenges and brewing malpractices.

The Solution:

In order to tide over these issues, it was decided to replace the entire system with a state-of-the-art AFC system based on RFID Smart Cards, Smart Tokens and Retractable Flap Type gates which offered a higher passenger throughput than the Turnstile Gates. The system was to be designed to be compatible with latest fare collection technologies.

Major Challenges:

1. **Monopolies and Cartels:** Experiences of AFC system operators including Kolkata Metro revealed that; the system suppliers/integrators often used proprietary technologies in development of both AFC hardware & software and bundled these two (h/w & s/w) together as a product in order to establish complete control over the maintenance, enhancement and expansion of such systems; thereby ensuring

continued business for themselves. Thus, the challenge was to reduce dependence on system integrators while also reducing the Total Cost of Ownership of the system.

CRIS proposed and implemented a novel model to surmount this challenge wherein CRIS performed the role of the System Integrator by sourcing only the AFC hardware from foreign manufacturers while developing the entire AFC software in house.

2.Overnight Replacement of a heavily used system: This was one of the rarest instances where an operational AFC system was to be completely replaced with not only new AFC devices but also new Fare Media. Furthermore, this replacement was to take place along the entire Metro line, with "Zero Downtime" and with about 5 lakh passengers using the system daily.

3.Tight and Inflexible Timelines: Normally such an implementation across 23 stations and the Central Data Centre would require more than a year to plan and execute but both Metro Railway Kolkata and CRIS were under extreme pressure to expedite implementation as Metro's then operational AFC system was falling apart. CRIS team completed the task in an enviable 8 months through excellent teamwork under effective supervision.

4.The fear of Change: As is the case with any attempt to replace an operational system, CRIS also had to contend with the proverbial "Fear of Change". This fear was particularly noticeable amongst the operational staff deployed at the Metro stations. Many of the staff were aged, had little exposure to technology and had restricted themselves to a limited sphere of activities related to the old system.

5.Coordination with various agencies: Rapid execution of the project demanded synchronized action of the equipment suppliers, works contractors, various Metro Railway departments and its security establishment but such action was often hindered due to operational constraints, archaic rules and procedures, bureaucratic wrangles and conflict of interests. CRIS constituted dedicated teams which effectively coordinated with each stakeholder and resolved conflicts in order to facilitate a smooth time-bound implementation. In this regard CRIS received Metro Railway Kolkata's whole hearted cooperation.

Salient Features of CRIS's AFC system

1. **Low Cost but State of the Art:** The system was developed and implemented by CRIS using latest technologies while employing novel business model to reduce TCO of system.
2. **Rapid response to System problems & Greater control to System Owner:** It has been observed that implementing changes to AFC systems in response to bugschanged requirements/ business rules, expansion of services, introduction of new Fare Media etc. often takes a long time thus causing operator

and user inconveniences while introducing inefficiencies and consequent losses into the

Key management system for generation and transfer of secure keys.

Inventory Management System for managing Token stock & transfer between stations along with tracking of Smart Card stock.

System for Management of Privilege Passes Issued to Employees & their children and Temporary Passes for visitors.

system. This delay is primarily due to the lack of synergy between the local system managers, operators and the offshore system developers. Indigenous software development allows for better appreciation of local problems, accurate requirement gathering, close coordination between development, testing and operating teams which result in faster response times and offers greater control of the system to the system owner.

3. Indianization: CRIS's AFC system is customized to meet the expectations of both the transport operators as well as the passengers in context of the Indian mass rapid transit sector. Any modification in business rules can be implemented without any dependency on the equipment suppliers. The foreign system suppliers generally provide solutions which were designed to meet the expectations of Metro operators in other countries and they rarely meet the Indian expectations; thus, requiring prolonged and expensive modifications.

AFC System Architecture

Fig.5.5

Ther Software developed for The AFC system

System for generating and viewing various adhoc reports

AFC System constituents

Apart from these UPS, network communication and security related equipment were also installed as part of the system.

The AFC system employs three-tier architecture with distributed databases at the Station level devices, Station Servers and the Central servers. Such an arrangement provides for centralized monitoring and troubleshooting of AFC devices, consolidation of commercial data for accounting and MIS reports, centralized tracking of Fare Media inventory and usage while ensuring that key functions of Station level equipment are independent of network connectivity. This design also renders the system highly scalable allowing for smooth integration of any new station or device into the system.

The system design provides for a single point of implementation for system wide changes thus allowing the system to quickly adapt to any change in business and operational rules. System security is ensured through various levels of authentication and encryption during data capture communication and storage. CRIS has developed its' own Key Management System for generation of keys for securing data on Smart cards and Tokens. The system is designed to use SAMs for transfer and storage of keys.

Fig.5.6

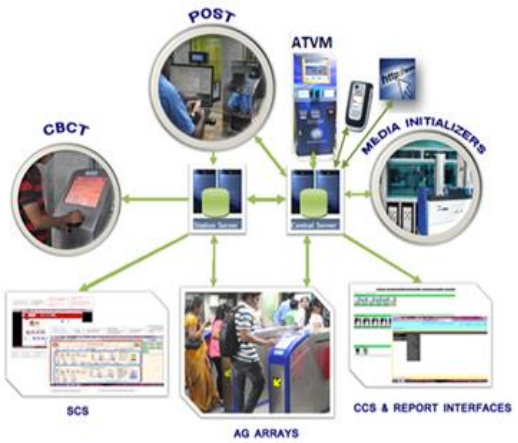


Fig.5.7

System constituents

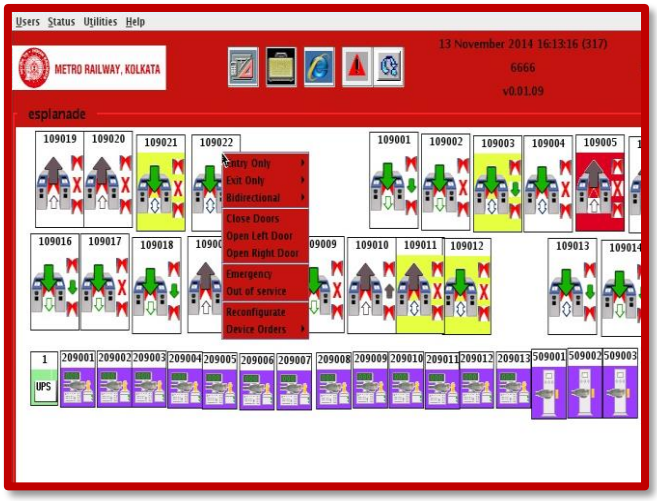


Fig.5.8

Station Level Command and Control Interface

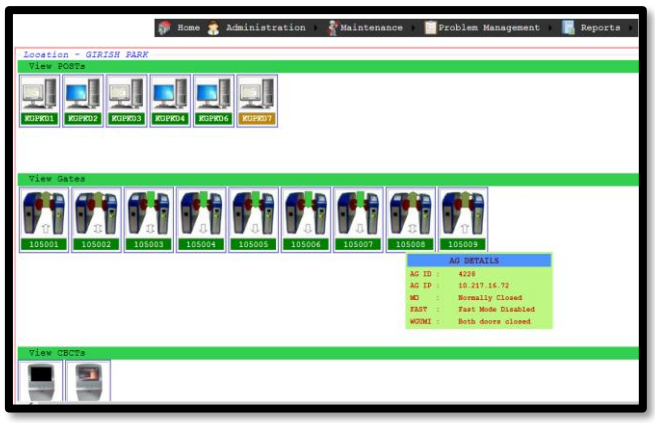


Fig.5.9

Centralized Command and Control Interface

Fig.5.10

Real Time Station Sales Dashboard

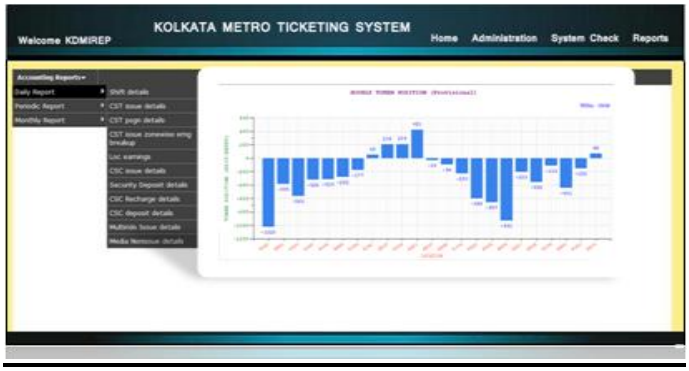


Fig.5.11

Accounting & MIS Reports

1. System Capacity, Efficiency and Scalability (Note: all figures are pre – COVID average values)

Till date the system has catered to over 150 crore passengers accounting for a revenue of over Rupees 1000 crores. About 12 lakh Smart Cards are in circulation and 3 lakh Tokens are issued daily.3.25 lakh Point of Sale transactions are performed daily and the AFC system as a whole hosts more than 15 lakh transactions daily. In this context it is worthwhile to note that very limited space is available at Kolkata Metro stations as compared to Metro's constructed later thus severely limiting the number of AFC devices. The low device to passenger ratio demands that the devices function at their highest efficiently and have minimum downtime. The fact that the system has been functioning satisfactorily under such demanding conditions bears testimony to its capacity &efficiency.

The system's flexibility & efficiency has been repeatedly proved over the years of its service with multiple successful implementations of modifications to Kolkata Metro's Fare and Business Rules without any glitches.Kolkata Metro added 10 new stations to its lines over the last year and a half the AFC system has been seamlessly extended to include the additional stations demonstrating the scalability of the system in the process.

Ticketing System

- **Automatic Card and Token Vending Machines:**

Kolkata Metro's AFC system was the first in the country to deploy Automatic Smart Card Recharge machines (developed by CRIS) which accept currency notes and add value to the e-purse on the Smart Cards thus adding to operator and passenger convenience. Further proliferation of such machines is in the

pipeline. An enhanced version of this machine capable of dispensing both Smart Cards and Tokens and having provision of accepting surrendered smart cards has been tested. These machines will also be capable of returning change in the form of coins and notes.

- **Online Recharge of Smart Cards:**

The system for online recharge of smart cards was developed and implemented in September 2020. This system enables the patron to to-pup his/her card balance through a web-based interface. The system supports payments through multiple payment channels like Internet banking, Credit Cards, Debit Cards, E- Wallets etc. Upon successful payment the patron can visit any of the numerous Card Balance Checking Terminals (CBCT) installed at the stations and simply place the smart card on the device to get the amount transferred to the purse on the card without even a single click.

The system also reconciles all transactions with the payment gateway to ensure zero revenue leakage for the Railway as well as prompt troubleshooting of problems faced by patrons along with refunds for failed transactions. The system is being further enhanced to improve availability, performance and reliability. Moreover, work is in progress on mobile app-based recharge facility and faster initiation of refunds/ automated refunds for some types of failed transactions.

- **QR Coded Mobile Tickets:**

Fig.5.12

CRIS is working on a QR-coded mobile ticket-based system which is at an advanced stage of development and testing. To use this system the patron has to download and install the CRIS developed mobile application. This application will provide an option of purchasing a journey ticket. The patron can use multiple payment channels like Internet banking, Credit Cards, Debit Cards, E-Wallets etc. to pay the fare upon which a QR code is visible in the app. The ticket is available for a time duration in accordance with the Railways business rules. Within this time period the patrons can show the QR code received on their mobiles to the QR code scanners fitted on the Automatic Gate (AG). Upon successful validation of the QR coded ticket the AG allows entry into or exit from the paid area as permitted by the business rules.

- **Mobile App:** CRIS is developing a mobile application which would offer multiple functionalities like:

Recharge of Smart Cards, QR coded ticket generation & management, Train schedule, relevant notifications etc.

- **Support for multiple payment modes:** The system design is compatible with the latest modes of payment including Internet Banking, Debit & Credit Cards, ATMs and Mobile phones.
- **NFC compatibility:** AFC devices in use are compatible with NFC.
- **Use of Mobile devices:** Hand held terminals and applications are being developed by CRIS for Metro staff manning the gates in order to enable them to analyze Token and Smart Card data for troubleshooting POST, Fare Media or AG malfunctions and also for collecting fines.
- **Open loop solutions:** CRIS is also exploring Open loop, NCMC compatible solutions for the AFC system. Thus, CRIS can not only lay claim to being the pioneer in indigenization of Metro AFC systems in India but also claim to be the only Indian solution provider offering a complete AFC solution which is being constantly enriched in keeping with demands of modern transit systems.

Smart Token

- Token is meant for single journey. There is no provision for return journey token. Token is captured at the exit gate on completion of journey.
- Token is valid for the day of purchase for a particular zone of travel depending on origin and destination. Once purchased across a booking counter, passenger must enter the paid area within 45 minutes from the time of purchase. Token becomes invalid if the passenger does not enter within 45 minutes.
- A token holder is allowed to detrain short of his booked zone of travel without any penalty. He is also permitted a proper exit at the destination station without having entry punched on the token. Lost token is not replaced under any circumstances.

Smart Card

Fig.5.13

Smart Cards are sold at all Kolkata Metro stations.

- The first-time users will have to purchase the smart card by paying Rs.100/200/300/500 & 1000 (inclusive of Security Deposit of Rs. 60/-) and later on get the pass value recharged for any amount of Rs.100/200/300/500 & 1000, up to maximum card balance of Rs.5000/-. A 10% bonus on flat rate is given on issuing new smart card (minus SD) and further on recharging of smart card.
- Validity of such card is one year from the date of purchase or date of "add value". In case the smart card is topped up within validity period, the balance amount remaining on the card is carried forward. In case the validity of card has expired at the time of "topping up", recharging can be done on the smart card; however, the previous balance is not carried forward but forfeited.
- A passenger is allowed to enter through the entry gate only with a minimum balance of Rs.25/- (the maximum chargeable fare).
- In case a patron does not flash his smart card at the exit and makes an improper exit, the card is locked. The booking counter deducts the maximum chargeable fare Rs.25/- from the smart card when the same is presented in the next visit and the card is unlocked.
- When a passenger tries to exit with a card without proper recorded entry in it, the passenger is not deemed to be travelling without ticket. Such a mismatch is penalized by deducting Rs.25/- from the smart card.
- Lost card is not replaced under any circumstances.

Student Smart Card

- Student smart card is sold only at the booking counters of selected stations of Kolkata Metro. This card is issued in favour of 2 fixed stations.
- Concession of 60% of the chargeable fare is granted to students attending School / Madrasas / Vocational Institutions up to classes academically equivalent to Class – XII. Any other discount on the basis of add value is not applicable.
- The first-time user has to pay one time security deposit of Rs.60/- for purchasing the student smart card and get the pass value loaded for 40 or 80 Rides.
- Validity of student smart card is 30 days and 90 days according to value loaded for 40 rides and 80 rides respectively. When this card is recharged before the validity period the balance rides, if any, are carried forwarded. After the validity is over, the same card again can be recharged as per requirement but balance rides, if any, are not carried forward.
- The rule of replacement of the student smart card is same as general Smart Card.
- When a student makes an improper exit without flashing his card on the gate, the card gets locked. One ride is deducted when the card is presented to the booking counter in the next visit and simultaneously the

card gets unlocked. When a student tries to exit with a card without proper entry recorded in it, the student is deemed to be travelling without ticket. He is liable to pay penalty of Rs.250/- in addition to maximum fare in cash chargeable at that exit point.

Tourist Smart Card

- Type of tourist smart cards and details thereof are as under:

After the validity of the tourist card is over, the same can be recharged as per the convenience of the tourist.

Smart Card for MLAs against Rail Travel Coupons (RTC)

Rail Travel Coupons (RTC) is a numbered booklet containing coupons of various denominations in serial order issued to the MLAs / Ex. MLAs of West Bengal Government. Such booklets are to be used only by MLAs / Ex. MLAs whose name is specified on the coupon booklet. The booklet is valid for a period of 3 years from the date of its issue. These coupons are not transferable. If the concerned MLA does not undertake the journey himself / herself against the coupons issued to him / her, the CSC(Contactless Smart Card) / CST(Contactless Smart Token) for companion is not issued against coupons. Coupons are presented for the face value of the CSC / CST at the booking counter for purchase. If the coupons available in the booklet are not sufficient for journey, MLA / Ex.MLA is required to pay the balance amount in cash at full tariff rate. However, if coupons from two different booklets are presented in favour of the same MLA / Ex.MLA for issue of ticket, the same is accepted. If members are found travelling with coupons, and not valid tickets.

Break Journey

- No break journey is allowed in Metro Railway, Kolkata.
- Children below the age of 5 years are allowed free travel in Metro services

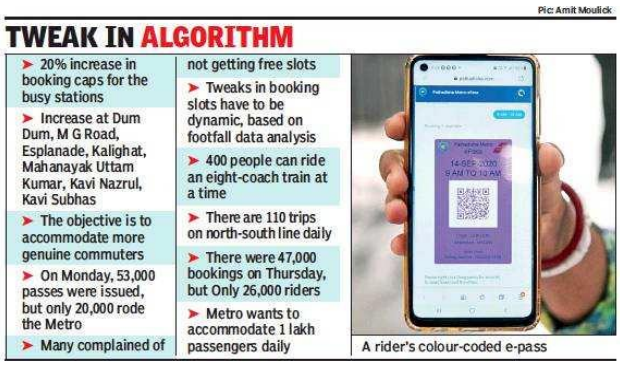
Refund

- No refund is permissible in case engraved ID on the card is NOT clearly readable.
- There is no provision of refund of balance amount in tourist smart cards but SD is claimed on presentation of card after completion of validity. However, Metro Railway administration reserves the right to consider few exceptional cases of refund of tourist smart card.
- Smart card of any type is not permitted any refund in case of unusual incidents.

Penalty Structure

Patron has to pay penalty in cash.

- The maximum permissible time limit between purchase of smart token and entry into paid area at the station is 45 minutes and between entry to exit is 120 minutes for both token and card (smart card and student smart card).
- In case patron is detected travelling without token /any type of card, a penalty of Rs.250/- plus the maximum fare chargeable at the station of detection is charged.
- In case a token holder oversteps his zone of travel, he is required to pay a penalty of Rs.250/- plus the difference of fare between the zone of actual travel and over stepped zone.
- If a passenger loses his authority to travel in the paid area, he is not able to exit through the exit gates. He is considered travelling without ticket and penalty as per applicability.
- A penalty of Rs.250/- is levied on a defaulter who exits without depositing the token at the gate.
- The holder of student smart card is subjected to same penalty when the student oversteps his station of exit. In addition to penalty, one ride is also deducted from the total allowed in the student smart card.
- When the card holder of the student smart card detrains short of his exit point, he is charged a penalty of Rs.250/- in addition to deduction of one ride.
- Penalty for nuisance activities affecting cleanliness of Railway premises is upto Rs. 500/- and penalty for other nuisance activities is upto Rs.250/-. Whenever a passenger holding smart token or smart card or student smart card remains in the paid area for more than two hours, penalty of Rs.10/- per hour, subject to a maximum of Rs.50/- is collected. Whenever the passenger remains in the paid area for more than two hours for reasons beyond his control, no penalty is imposed on him.
- Passenger holding a smart token or smart card or student smart card is allowed to exit from the paid area of the same station at which entry has been punched. In this situation token is collected at the gate and smart card is deducted with Rs.25/- (maximum chargeable fare) and one ride is deducted from the student smart card.


Pic: Amit Moulick

TWEAK IN ALGORITHM

- 20% increase in booking caps for the busy stations
- Increase at Dum Dum, M G Road, Esplanade, Kalighat, Mahanayak Uttam Kumar, Kavi Nazrul, Kavi Subhas
- The objective is to accommodate more genuine commuters
- On Monday, 53,000 passes were issued, but only 20,000 rode the Metro
- Many complained of not getting free slots
- Tweaks in booking slots have to be dynamic, based on footfall data analysis
- 400 people can ride an eight-coach train at a time
- There are 110 trips on north-south line daily
- There were 47,000 bookings on Thursday, but Only 26,000 riders
- Metro wants to accommodate 1 lakh passengers daily

A rider's colour-coded e-pass

Fig.5.14

Multiple false e-pass bookings have been reportedly preventing actual commuters from availing Metro services. To address the issue, Metro Railway has increased the cap on the number of people allowed to book the passes for entry to the busiest of the 24 stations along the north-south corridor.

Delhi Metro

Fig.5.15

Fig.5.16

Fig.5.17

Introduction & Background:

The Delhi Metro has been instrumental in ushering in a new era in the sphere of mass urban transportation in India. The swanky and modern Metro system introduced comfortable, air conditioned and eco-friendly services for the first time in India and completely revolutionized the mass transportation scenario not only in the National Capital Region but the entire country.

Having constructed a massive network of about 389 Km with 285 stations (including NOIDA-Greater NOIDA Corridor and Rapid Metro, Gurugram) in record time in Delhi, NCR, the DMRC today stands out

as a shining example of how a mammoth technically complex infrastructure project can be completed before time and within budgeted cost by a government agency.

The Delhi Metro Rail Corporation Limited (DMRC) was registered on 3rd May 1995 under the Companies Act, 1956 with equal equity participation of the Government of the National Capital Territory of Delhi (GNCTD) and the Central Government to implement the dream of construction and operation of a world- class Mass Rapid Transport System (MRTS).

The DMRC opened its first corridor between Shahdara and Tis Hazari on 25th December, 2002. Subsequently, the first phase of construction worth 65 kilometers of Metro lines was finished two years and nine months ahead of schedule in 2005. Since then, the DMRC has also completed the construction of another 125 kilometers of Metro corridors under the second phase in only four and a half years.Presently, the Delhi Metro network consists of about 389 Km with 285 stations. The network has now crossed the boundaries of Delhi to reach NOIDA and Ghaziabad in Uttar Pradesh, Gurgaon, Faridabad, Bahadurgarh and Ballabhgarh in Haryana. With the opening of the Majlis Park to Shiv Vihar and Janakpuri West - Botanical Garden Sections, new age trains equipped with the Unattended Train Operation (UTO) technology have been introduced. These trains operate with the Communication Based Train Control(CBTC) signaling technology which facilitate movement of trains in very short frequencies. This network also includes the NOIDA - Greater NOIDA Aqua Line. The Aqua Line has been constructed by DMRC on behalf of the NOIDA Metro Rail Corporation and is also being operated by DMRC currently. In addition, the 11.6 kilometer long Rapid Metro also connects with the Delhi Metro network at Sikanderpur station of Yellow Line. The Rapid Metro provides connectivity within the satellite city of Gurugram.

The Airport Express link between the Indira Gandhi International Airport and New Delhi has now propelled Delhi to the league of global cities which have high speed rail connectivity between the city and the airport. The DMRC today has over 300 train sets of four, six and eight coaches. The Delhi Metro has also contributed tremendously on the environment front by becoming the first ever railway project in the world to claim carbon credits for regenerative braking. DMRC has also been certified by the United Nations (UN) as the first Metro Rail and Rail based system in the world to get carbon Credits for reducing Green House gas emissions as it has helped to reduce pollution levels in the city by 6.3 lakh tons every year thus helping in reducing global warming. It has also set up roof top solar power plants at many of its stations. All stations of the presently under construction corridors are being constructed as green buildings. In the present phase of Delhi Metro's construction, the DMRC has completed 160 kilometers of Metro lines which has woven a web of Metro corridors along the city's Ring Road besides connecting

with many other localities in NOIDA, Ghaziabad, Bahadurgarh and Ballabhgarh.Apart from providing Delhites with a comfortable public transport option, the Delhi Metro is also contributing significantly towards controlling pollution as well as reducing vehicular congestion on the roads.

Issues & Challenges:

As Delhi Metro becomes one of the largest city transport systems in the world, we take a look at some challenges that its users and managers face.

1. **Mobile network:** Despite special fibre cables and antennas on Metro pillars, mobile connectivity continues to be a pain. It is worse when you're underground.
2. **Safety:** In 2016, there were 74 suicide bids which led to 12 deaths. Security officials now look out for visibly anxious commuters and talk it out with them.
3. **Men in women-only coaches:** Little seems to have changed when it comes to men expecting to travel in the Pink coach meant for women. Thanks to the women security staff the menace is kept under control.
4. **Dark spots:** Parking lots and roads leading to many stations remain poorly lit. Many of these stretches also do not have 'eyes on street' with lack of security.
5. **Manspreading:** Some do it intentionally, others just don't get it. Taking relaxation in the metro to the next level is not just the act of manspreading, but also lying down on empty seats.
6. **Last mile:** There is acute lack of last-mile connectivity. There are 291 feeder buses while para-transit modes ply as per their free will.
7. **Ticketing system:** New automated ticket system may be a good idea, but what about the multiple machines in most of the stations that say "Out of Service"?

8.Overcrowding: It really irks a commuter when during peak hours even busy corridors like the Blue Line run six coaches. Only eight-coach trains should be run during peak hours to ease overcrowding.

9.No change: Those disbursing tokens sometimes say they do not have change. It creates unnecessary delay in a commuter's journey.

10.Pick-pocketing: Till July alone this year, the CISF had caught 373 pickpockets out of which 329 were women. So, be careful and keep your wallet and phone close to you.

11.social media: Commuters miss an official Twitter handle of the Delhi Metro. The metro system lacks a social media forum.

12.Obstructing doors: Some people are in such hurry that they just won't let go of a train, even if it means having their bag stuck between the metro doors. Take the next train, please.

13.Night-time security: The ladies coach system just vanishes during the last few hours. Men joyfully settle in women's coaches and security staff are rarely found around that time.

14.Snags: The busy Blue Line has seen some of the worst snags this year resulting in complete chaos.

15.Extra baggage: The DMRC recently introduced steel gauges to restrict baggage size. You'll find this baggage loaded travellers at stations like Anand Vihar, New Delhi and Chandni Chowk.

Salient Features:

(i) It is the largest and busiest metro in India. **(ii)** Its total length is 317 kilometres, serving 231 stations. **(iii)** The system has a mix of underground, at grade, and elevated stations using both broad-gauge and standard-gauge. **(iv) It operates 2,700 trips daily and carries 2.76 million passengers.**

The Delhi Metro Rail Corporation (DMRC), which has ordered 131 new trains in view of the increased rush on the Metro system in Delhi, will provide passengers with power connections inside the coaches so that they can use their laptops and charge their mobiles while they are travelling in the Metro. Every new Metro coach of Phase – II will have power supply points for this purpose.

The Metro coaches in Phase - II will also have reduced noise levels inside the trains as the DMRC is making major design changes to reduce the noise levels by use of special sound absorbing cushions in the walls of the Metro coaches and more buffing on the Metro doors which will be better sealed by reducing the door gaps to ensure that less sound from outside enters the trains thus enabling the passengers to travel in a better ambience. The noise level in the underground coaches has been reduced by 8 decibels(db) as in Phase-I the internal noise levels was around 92 db which will now be only 84 db in Phase-II. In addition, a new type of compressor called Scroll Compressor System will be used in the air conditioners of the Phase-II coaches which will be sealed and is more compact and this will reduce noise level in the coaches further.

The Phase-II Metro coaches will also provide a much better level of passenger comfort as for the first time there will be Humidity control as Humidity Sensors will activate the newly planned heating system of the air conditioner which will eliminate humidity inside the coaches. The temperature will be maintained at 25 degree Celsius and relative humidity will be maintained at 60 % during the summer and monsoon months (in Phase - I trains, there was only temperature control).

With the start of Phase-II the Delhi Metro will start travelling very far distances covering around 50 kms in some destinations such as Dwarka-Noida, Gugaon-Jahangirpuri, etc. To avoid confusion for the passengers who will travel on these lines, there will be new destination sign boards in LED on one window of the side wall of each coach so that passengers can view the terminal stations while standing on the platform as some Trains may be terminating at intermediate stations depending upon operational needs. This will be necessary as on the same line different trains may be terminating at different destinations.

Phase - II trains will also have Closed Circuit Television Cameras (CCTVs) inside the coaches apart from cameras outside the coaches so that the driver can see the entry and exit of passengers from the train. The

driver of the Metro trains will now be able to observe passenger behavior in every part of the train at all times.

The trains in Phase - II are also being designed to travel upto a maximum design speed of 95 kmph as against 90 kmph in Phase - I. The braking system is also better as DMRC will use Wheel Mounted Disc Brakes which will be microprocessor controlled. In addition, the train will have energy absorbent couplers which can absorb shock and reduce damage to the car body structure in collisions.

Travel Card

- Most convenient for a frequent commuter. The minimum amount payable at the time of purchase of a new card would be Rs 100/- including refundable security of Rs. 50/-. Subsequent recharge of the card can be done at Customer Care Centers of any station with a minimum value of Rs. 100/- and up to Rs. 1000/-.

Following options are available to commuters to recharge the travel cards:

- At CCC – on payment of cash, facility available at all stations.
- At TVM – on payment of cash, facility available at selected stations.
- At POS – through Credit/Debit Card of any bank, facility available at selected stations.
- At TR cum AVM - through web (online), facility is available at selected stations.
- Validity: Ten Years from the date of purchase or one year from the date of last recharge whichever is later.
- Renewal: Rs. 5/- will be charged for renewal of cards whose validity has been expired.
- Facility to check balance on Card: Ticket Reading Machines available at all Metro Stations.

Tourist Card

Suitable for unlimited travel over short duration. Two types of tourists cards are presently available: -

One Day Card: available at a cost of Rs 150/- (Rs 100 + Rs 50 refundable security).

Three Day Card: at a cost of Rs 300/- (Rs. 250 + Rs 50 refundable security).

How to use your Smart Card/ Tourist Card:

• For entry, exhibit your travel card at the entry gate for the flaps to open.

• For exit, exhibit your travel card at the exit gates for the flap to open. While exiting, commuters may note that fare is deducted from the card. If not, contact the Customer Care Operator to avoid inconvenience at later stage. Instructions for Smart Card Holders/ **Travel Card Holders**

1. In case of any difficulty, contact Customer Care Operator for assistance.

2. Smart cards are transferable and can be used for multiple journeys. But it can be used by only one passenger at a time. Any entry on a travel card must be followed by a valid exit from the system.

3. If a passenger performs entry and exit from same station, Rs. 8/- shall be deducted from his Smart Card under normal conditions.

4. The maximum permissible time for entry/exit from the same station is 20 minutes and for entry/exit from different stations is 170 minutes. For stay beyond the permissible limits, a penalty of Rs 10/- per hour subject to a maximum of Rs 50/- shall be charged from the passenger in cash.

5. If a passenger performs simultaneous entry and exit at the same station, i.e., making pseudo entry or exit at AFC gates, a penalty of Rs 50/- plus maximum fare of Delhi Metro will be charged from the passenger and manual penalty receipt shall be issued.

6. In case of any mismatch in entry/exit, passenger shall be charged as per relevant Metro rules.

7. All penalties/charges shall be payable by cash only.

Refund of Smart Card

Refund of Electronically Readable store value smart cards: - The Electronic balance plus security deposit (not in case of physically damaged cards) of a smart card is refundable. During refund, processing charge of Rs.5/- will be deducted irrespective of the condition of the card.

If Smart Card becomes electronically unreadable, it can be deposited at Customer care Centre of any metro station against which a printed receipt will be issued to passengers.

Unreadable Smart Card deposited in full shall only be considered for refund of balance amount.

Balance amount of the Card and security deposit (if physical condition of the card is OK) amount is refunded to the commuter after four working days from the date of submission of the card.

Passengers must claim refund of their electronically unreadable cards by producing the receipt within 90 days from date of submission of the card. Thereafter the refundable amount shall be forfeited.

In case loss of passenger foil of Unreadable Card, NCR/ FIR is required to support the claim.

Token

- Commuters can purchase single journey tokens from Ticket counters/TVMs of all stations.
- Journey is permitted for one way only.
- Tokens are valid only for the day of its purchase.
- Minimum Fare is Rs. 8/- and maximum is Rs. 42/- (fares are subject to revision from time to time).
- A passenger can refund an unused token within 60 minutes of its issue at the same station.

How to use your Token

- For entry, hold your token close to the machine for the gates to open.
- For exit, drop the token into the machine.

Fig.5.18

The Delhi Metro introduced QR code-based ticketing facility for travel on Airport Express Line from 16th September 2018. With the introduction of this facility, commuter's using Delhi Metro's Airport Express Line are able to use the QR Code generated on their smart phones instead of smart cards or tokens to travel.

This system of QR code-based ticketing through smart phones has enabled passengers to purchase tickets using 'Ridlr App' without physically coming to the Metro station. The process to generate QR Code is as given below:

1) Download the Ridlr application from playstore (available on both android & IOS platforms) and register into the App with your valid credentials including mobile no. and email- id.
2) Proceed to buy a QR ticket by selecting the origin station and destination station.
3) Select no. of passengers (Maximum 6 at a time). App will display the fare for the selected journey.
4) Pay the fare using internet banking/credit/debit card. User will receive a notification.
5) App will display the QR code for the journey. User can tap the QR enabled AFC entry gates of the Metro stations on Airport Line. The AFC gate will open and user can commence journey.

Delhi Metro plans biometric-based ticketing system for fare concession to students, senior citizen commuters. These new biometric AFC gate systems will help in developing multiple benefits for both the passengers as well as for the system, in terms of passenger identification, profiling and concession.

Delhi Metro gives fare concession to students and senior citizens: In a recent development towards regulating its fares for students and senior citizens, the Delhi Metro Rail Corporation (DMRC) has planned a technological solution which would allow it to provide fare concession. A DMRC spokesperson told Financial Express Online that this technological solution has been planned by changing the system of biometric smart cards, so that fare concession on Delhi Metro tickets can be provided to students and senior citizens.

DMRC also plans to install devices which will not just have biometric readers but also have smart card readers. These devices will also act as registration devices where the passenger's information as well as biometric details will further be scanned and registered. The devices will have biometric scanners for capturing the commuter's biometric information.

These new biometric AFC gate systems will help in developing multiple benefits for both the passengers as well as for the system, in terms of passenger identification, profiling and concession. There is no refund on unused coupons. Any refund on token / card purchased through RTC is done as per the rules applicable for other similar tickets but the refund is made only to the State Government and not to the individual members

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Chennai Metro

Fig.5.19

The Chennai MRTS and Chennai Suburban, the first elevated railway in India.

The first modern rapid transit in India is the Kolkata Metro which started its operations in 1984 as the 17th Zone of the Indian Railways.[110] The Delhi Metro in New Delhi is India's second conventional metro and began operations in 2002. The Namma Metro in Bangalore is India's third operational rapid transit and began operations in 2011

The Chennai MRTS, which began services in 1995, remains the country's first and only mass rapid transit rail. Although distinct from the Chennai Suburban Railway, the MRTS remains integrated in a wider urban rail network.[109]

Rail as a locomotive for growth

Rail will be a critical factor that will likely determine who leads in India's online travel race. Companies that take advantage of the country's significant leap in online train ticketing could use that as leverage to gain a commanding lead overall in online travel.MakeMyTrip, Paytm, Ixigo, Yatra, Cleartrip, and other companies will, to varying degrees, try to use rail as a gateway drug of sorts to lure people into buying flights, hotels, or other products."More Indians use trains for long-distance, intercity, non-commuter travel than they do than planes or buses," said Sunil Thomas, CEO of tech vendor CleverTap. "But online booking of rail tickets has only recently hit the mainstream."To be sure, the Indian government, which owns the country's railways, has let third-parties sell its tickets as long ago as 2003.

Earlier, it involved a lot of stress to plan a trip for one's family, where one had to take the pains for checking availability & making bookings by standing in long queues for travel tickets & hotel stay. Plus, with so much availability in the market, it was also difficult to compare prices & quotes and make a wise decision. But with the advent of online bookings made through these travel sites, the whole scenario changed.

Now the whole process is less stressful & more fun. One can easily go online check the availability of tickets according to his needs, compare prices, book tickets & enjoy wonderful holiday time with family & friends. There are a number of online travel agencies which through their online portals in India that help in planning these holidays and booking travel & hotel tickets at suitable & reasonable prices. They manage to aggregate travel information and make it searchable and useful.

These companies offer travelers the ability to select and book from a wide selection of hotel accommodation, flights and tourist attractions across the world. They use some technology that brings speed, usability, and transparency to the travel world. It also means that travel planning is no more stressful and one can spend less time searching for tickets and more time planning your holiday. Looking ahead to the next few years, online rail sales in India will grow at a double-digit pace, predicted Shekhar Anand, an analyst for Euromonitor International.

Fig.5.20

List of Best Online Travel Booking Sites in India

MakeMyTrip – It is a NASDAQ listed online travel company for airline tickets, hotel reservations, car rentals, holidays and travel packages in India. MakeMyTrip is an online travel agency which helps in finding the best deals on air tickets, rail/train tickets, bus tickets, hotels booking and holiday packages in India. The site suggests the cheapest possible fares & more comfortable journey with a flexible itinerary, to suit its customer's needs. MakeMyTrip features a wide range of holiday and travel packages including beach resorts, hill stations, luxury tours, and cruises. It also provides several options for short weekend trips all across India. MakeMyTrip owns 20 travel shops in India, and franchisee outlets opened in selected cities across India.

Most of MakeMyTrip's sales are domestic. Roughly 80 percent of its air tickets are for intra-Indian routes. For the hotel market, three out of four of its hotel bookings are domestic, while approximately 60 percent of its vacation package revenue comes from domestic travel, experts said."In the coming year, the lodging offerings from Airbnb.com, Booking.com, and Oyo, and the flight and rail sales from Paytm will combine with pressure from rising new players like Musafir and they'll together present a major challenge for MakeMyTrip," said Shekhar Anand, an analyst for Euromonitor International

MakeMyTrip Group has ramped up its sales of rail. In the fiscal year 2018, it boosted its net revenue from train ticketing by 42.7 percent, year-over-year, to an undisclosed amount.In 2018 it did a soft launch of a mobile app Go Train that has been in development since late 2016. TheAndroid app lets users speak or write in Hindi or English to check on train status or book buses or hotels. The app, which eats less than 2 megabytes of space, aims to respond to requests such as "I need a train ticket from Bangalore to Chennai for tomorrow." MakeMyTrip.com offers the following products and services:

- International and Domestic – Air Tickets, Holiday Packages and Hotels
- Domestic – Bus and Rail Tickets
- Private Car and Taxi Rentals
- Meetings, Incentives, Conferences & Exhibitions
- B2B and Affiliate Services.

EaseMyTrip.com is the second largest flight booking site of India that has made its place in Indian travel industry due to maintaining transparency in pricing. The company provides the best deals on flights, hotels, bus tickets, cab booking, and holiday packages. It also has a huge B2B network with 65 k travel agents, 2500 franchise outlets, 7000 corporate, 1700 distributors and 640 white label solutions. The travel agency offers flight tickets at no convenience fees. At present, EaseMyTrip has 28 branch offices in India, UAE, Thailand, Maldives, and Singapore. They have also come into destination weddings and cruise

tourism. EaseMyTrip has created a niche for itself in the corporate travel and MICE events by exceptional travel planning and professional expertise.

Travelocity – is a leading provider of consumer-direct travel services. It has been in business for the last 10 years and was successful in spreading its know-how around the globe. Travelocity owns the leading European online travel company, lastminute.com and leading pan-Asia Pacific online travel company, ZUJI. Travelocity has created a unique niche in the online travel sector and offers Indian travellers exceptional travel planning and shopping experience online, which is safe and allows secure booking and buying. It markets and distributes travel-related products and services directly to individuals through its various global websites and customer care centers.

Fig.5.21

Travelocity has invested millions of dollars to help customers achieve the best travel experiences and more control over their trip planning. Travelocity booked USD 10.1 billion worth of travel in 2006.Travelocity was named the "World's Leading Travel Internet Site" for the eighth consecutive year at the 2005 World Travel Awards. Travelocity has a global reach & operates multiple businesses for customers in North America and internationally, offering a large number of websites in around twelve languages. It has more than 44,000 affiliates in 40 countries**. Travelocity is in my view one of the best travel agencies and portals in India right now because of its discounts, professionalism, and technology.**

GOIBIBO – Goibibo is part of Ibibo, India's entertainment and social network. Goibibo is an online travel agency, with a vision to make travel booking simpler and to add more fun to the whole booking experience, by creating travel community and offering best deals to the community members. It offers a complete travel solution, including hotel, holidays, car hire, bus, reviews, feedback etc. It lists the best available deals in the market and feedback of the travel community.

IXIGO – iXiGO is a global travel search engine, that searches more than 100 travel sites to find the best flight & hotel deals. It is said to be an infomediary ie. It helps the users search directly across multiple

airlines, hotels, buses, trains and online travel agencies real-time, making the travel search easier. **It is the same way Google does for information on websites.** Hence there is no bias, one can pick and choose the most suitable option for himself and redirect & book directly on the travel site that suits one's criteria.

This ensures that one can retain a direct relationship with the travel vendor and complete a transaction more efficiently. It thus allows retaining complete control of one's travel choices and preferences. It also provides tools to sort, filter and personalize one's results. iXiGO's utility and ease of use have made it a top travel search engine almost entirely through word of mouth from satisfied users. Given that many parts of India's rail network pass through areas with weak internet data signals, Ixigo, launched a similar offline function in its Android mobile app that lets users see train status details and route information for other trains even if internet access is temporarily unavailable. The Ixigo rail app crowdsources information about millions of cell towers in the country and then triangulates where the mobile device user is in relation to those points based on the last-received signal.

IXIGO is though not an online travel agency is the best way to search for the best travel and plane ticket deals in India right now

Yatra – In India Yatra.com is the most famous online travel portal offers cheap air tickets, budget hotels, holiday packages, honeymoon packages, and train tickets a. It offers international flights, Domestic Flights, Hotels or Travel Packages bookings online. It provides with Registration option, which offers various facilities for the members like great deals and discounts through email notification. The customer care support is available 24×7 days & there is also an online query redressal. Yatra had offered up to Rs1,500 off on domestic flight bookings, gift cards ranging from Rs1,000 to Rs50,000 and up to Rs15,000 off on international flight on booking through Yatra.com in years before pandemic.

Various services offered by Yatra are as follows:

- Travel guide
- Air Tickets
- Holiday Packages
- Hotel Booking
- Honeymoon Packages
- Car Hire
- Train/ bus Tickets.

EZEEGO -It is a one-stop online travel bazaar that offers all travel related services. It also allows customization of holidays. It provides a platform where the consumer gets real-time information and transaction capability online. The portal offers a real-time web-based booking engine which is integrated to the mid and back office. It has also tied up with various payment gateway options. It is the first travel portal to have launched a Hindi travel portal http://hindi.ezeego1.com to book domestic tickets. Ezeego1 launched the concept of HBA (Home based agent) in October 2008, in order to cater to travel agents who wish to work out of home at their own pace and also earn attractive commissions while making bookings for relatives and friends.

Expedia -It is the world leader in online travel. Expedia.co.in is a portal for Indian travellers from Expedia, Inc., the world's leading online travel company. Expedia is the one-stop online travel company featuring more than 75,000 hotels and 3,000 exciting holiday activities and attractions from across the world. It also has thousands of independent reviews from fellow travellers. Expedia, Inc. operates localized websites for travellers in the US, Canada, France, Germany, Italy, Denmark, Austria, Belgium, Ireland, Netherlands, Norway, Spain, Sweden, UK, Australia, New Zealand, Japan, China, and India. It offers great savings on holiday packages. There are offers wherein, one can save when flight and hotel bookings are made together. All the prices are quoted upfront in Indian Rupees and include all taxes and supplier surcharges.

Clear Trip – Cleartrip.com travel site offers Search, book, go, without any banners, pop-ups and blinking glitz. They work closely with suppliers to add more airlines and hotels to the search results, presenting all the options for one's trip. Cleartrip takes responsibility for what they give, without any excuses for airlines or hotels or availability or prices.

Online travel services firms such as MakeMyTrip, Yatra and Cleartrip, woo customers during festive season with enticing freebies like gift cards worth up to Rs50,000, one night free on first-time hotel booking and Rs15,000 off on international flights, among others.The companies generallybet big on festive season to cash in on the trend of people preferring to travel during the festivities. "Travelling during the festive season has become the norm amongst Indian travellers baring pendemic.The trends for 2017 with the festivities around Durga Puja, Navratri, Dussehra and Diwali had contributed to around 11% more Indians travelling during Diwalicompared to 2016," He further said another reason for uptick in advance booking was MakeMyTrip's zero cancellation feature resulting in 15% rise in bookings for peak season.

Cleartripwas providing free cancellation on domestic hotels, flights and activities booked through its website and mobile app until 1000 hrs on 18 October,2017. It was additionally offering a 30% cashback on domestic hotels, flights and activities bookings to its users. International flight bookings originating in India will also be eligible for a cashback of up to Rs25,000. Today's battles over India's $2 billion online travel market may not be as bloody as the ones depicted in Mahābhārata but they are sacrificing profits. MakeMyTrip and GoIbibo continue to lead the market, and they continue to narrow their losses.

Morgan Stanley has estimated that Indians book only 10 to 15 percent of their hotel stays online, compared to 25 to 30 percent in China, and about 41 percent in Europe and 46 percent in the U.S.While India's online pie is small, travel takes up the largest slice. Travel accounts for the majority of its e-commerce sales, estimated Meena at Forrester. That's a remarkable inverse of the ratio in countries like the U.S. where retail dominates e-commerce. What's more, those who book travel online tend to be savvy. In November 2018, technology firm Travelport named India as the country with the most digitally advanced travellers, based on its survey of 16,000 travellers from 25 countries. The survey found that 69 percent of the country's travellers surveyed use voice searches via platforms like Apple Siri, Google Home, and Amazon Alexa. It found that 85 percent of Indians surveyed have used a payment app while traveling and that more than 60 percent of them want digital room keys at hotels

Chapter III: Features And Operations Of Integrated Systems

India, one of the strongest developing economies in the world, is reaching a rate of growth of 7.5% per annum. With an increasing population too, the nation is working tirelessly to change itself over the next few decades. Improving public transportation is on priority on the schedule and even though personal-automobile possession in India is increasing and therefore inflicting the most important congestion issues in towns, there are however many plans to redesign bus structures and invest in metro networks.

The towns of this diverse country and its city population play an essential position in the growth of the country. As in keeping with the 2011 census, 31.2% of India's population (377 million) is residing in city areas. As the UN estimates, those numbers will increase to 40% (590 million) by 2030 and 58% (875 million) by 2050. While only 30% of the whole population stays in city areas, about 63% of India's Gross Domestic Product (GDP) is contributed through those city

India's transport issues

Even with the present-day population of the city, Indian towns are dealing with multiple troubles which includes intense congestion; deteriorating air quality; growing greenhouse gas (GHG) emissions from the automobile sector; increasing street injuries; and an exploding increase in the number of personal automobiles (in large part motorcycles). With the city population projected to greater than double in the subsequent generation, the scenario should effortlessly get out of control and thwart India's financial improvement efforts until remedial measures are quickly taken.

In a circulate to realize and act upon city mobility troubles, in 2006 the federal authorities of India brought the National Urban Transport Policy (NUTP), putting the coverage framework for offering sustainable mobility for the future (see Figure 1). In 2015 the authorities unveiled its new plan to improve one hundred towns into 'clever towns' and to 'renew' 500 towns.

Growth of private-vehicle ownership

Fig.5.22

The boom of automobiles has been a lot quicker than that of the population. The number of registered automobiles improved from fifty-five million in 2001 to 142 million through 2011, with a presently anticipated 195.6 million in 20162. Seventy-five percent of those registered automobiles (147 million) are motorcycles. Furthermore, the physical infrastructure hasn't been capable of maintaining tempo with the increase in demand. The city street length has improved from 252,001km in 2001 to 411,840km through 2011. In the remaining decade, registered automobiles per million populaces have increased through 219% whilst city street infrastructure per million only improved by 124%.

This fast motorization has brought about intense congestion, longer trips, and better per capita trips. Indian roads also are famous for the heterogeneity of automobiles sharing the same street space. There are approx. 32 special vehicle kinds in India which include bicycles, cycle-rickshaws, auto-rickshaws ('tuk-tuk'), motorcycles, cars, buses, and trucks.

Congestion

The fast increase in personal-automobile possession has caused elevated congestion issues in towns. The average running speed of a car on Indian roads is simply 17-19km/h between 9:00 and 21:00, with the slowest times witnessed in the night hours. The average biking speed is 15-16kmph3.

Road accidents

India recorded a total of 501,423 road injuries and 146,133 road accident deaths in 2015; this equates to 1,374 injuries and 400 deaths on India's roads each day. Sadly, 54.1% of humans killed in road injuries are in the 15-34 years age group. It is expected that the economic system lost around 3% of GDP (1999-2000) because of road mishaps.

Air pollution

In the Global Burden of Disease 2010 (GBD) study, 'outdoor air' pollution is among the top 10 dangers globally and the top six dangers in the developing nations of Asia. Air pollution has a higher effect on developing nations like India, as 1.4 million humans misplaced their existence because of air pollution; US$ 505 billion toward welfare losses; and US$ 55.4 billion toward lost labour.

A declining percentage of public transport

With population numbers increasing and the growth in personal-car use, India presently faces very high road congestion daily. The share of public transport is reducing in India. According to the survey in 2016, more than 50% of the workforce (apart from domestic and agriculture) continue to work at home or travel to their office on foot in the absence of efficient transport provisions. Citizens are largely dependent on personal transport. The share of public transport is simply 18.1% of office trips.

Because of the absence of public transportation provisions and citizens are largely dependent on personal modes of transport, like bicycles (26.3 million) and motorcycles (25.4 million) in rural and urban India.

Development of 'smart cities'

The federal authorities of India have released flagship programmes – one hundred Smart Cities and Atal Mission for Rejuvenation, and Urban Transformation (AMRUT) for 500 cities that have a population of 100,000 or higher, with an investment of $8 billion and $8.3 billion, respectively. The smart cities initiatives' attention is on core infrastructure service, whereas AMRUT will undertake a project approach to ensure basic infrastructure services.

A ‘smart city’ is an urban area that is exceptionally advanced in terms of universal infrastructure, sustainable actual estate, communications, and market viability. It is a city in which information technology is the principal infrastructure and the basis for offering essential services to residents. Until now the federal authorities have shortlisted the status quo of ‘109 smart cities’ in India. The key concept of smart cities is the alliance of public services with an integrated public transport system. Information Technology, therefore, will play a vital position in both integrating and automating those services.

Many countries, like Japan, France, Germany, Singapore, etc. have come ahead to help the federal government’s plan to broaden smart cities. Smart cities can't be constructed without smart public transport. Under the smart cities programme, the cities are required to construct green urban mobility and public transportation by developing walkable localities, in addition to promoting different options for transport. However, there's no clear guiding principle for building a sustainable public transportation system. An urban transport system is subject to planning, execution, and development by the states and

Fig.5.23

union territories; hence, under the smart cities program every city can prepare its ‘Smart City Vision’ document, highlighting the city’s vision and investment proposal.-

The emergence of metro systems

Delhi Metro is India’s largest and most successful metro system, carrying approximately 2.8 million passengers a day having a total length of 213km. Some of the new metro systems are still facing issues with building ridership; for example, Jaipur Metro carries only 20,000 passengers per day, incurring a loss of INR 30 million (US$ 500,000) every month. After the success of the Delhi Metro, lots of Indian cities are exploring the option of implementing metro rail networks. The Ministry of Urban Development (MOUD) estimates that there is approximately 316 km of metro lines currently in operation and more than 500 km of metro lines under construction across the country. This includes metro/mono rail systems promoted by state governments and private bodies.

Most of the systems are developed by public authorities with external funding and support from federal government. However, some of the cities have developed the system in partnership with private players e.g., Gurgaon (operated by IL&FS), Mumbai (operated by RATP) and Hyderabad (operated by Keolis – under development). In the Union Budget 2014-2015, the government emphasised that the planning of metro projects must begin now. The federal government has earmarked INR 100 billion (US$ 1.5 billion) for metro projects in the fiscal budget 2016-2017.

Revamping city bus system

Buses are the most popular and convenient mode of transportation in urban cities. More than 1.6 million buses are registered in India, and the public bus sector operates 170,000 buses carrying roughly 70 million people per day. However, bus transportation has not been able to cater to the growing travel demand. There are only 30,000 buses serving the city areas, out of which approximately 3,500 buses are operated under a public-private partnership agreement. All bus operators are incurring huge losses and do not have funds for the capital investment needed to procure new vehicles and technology. The average age of the fleet ranges from two years to 11.8 years for state bus transport undertakings.

The National Sample Survey Office (NSSO) carries out an annual survey of household expenditure on service and durable goods in India. As per the details of expenditure on transport, buses are the most preferred mode of transport in both rural and urban India, followed by auto rickshaws.

The federal government launched National Urban Renewal Mission (NURM) in 2009 and embarked upon a massive programme of revitalising urban areas by allocating national funds to speed up the creation of much-needed infrastructure. The programme was split in two phases and was concluded in 2015. Approximately 222km of Bus Rapid Transit (BRT) systems are operational and the remaining 282km are under construction. MOUD has provided financial assistance to 11 cities for the construction of 504km Bus Rapid Transit System (BRTS).

According to estimates from ICRA Limited (2016), 100 of the largest Indian cities require approximately $15.4 billion to procure 150,000 new buses and upgrade ancillary transport infrastructure. It will be difficult for state governments or local bodies to invest such a large sum without further federal government support.

In order to generate more investment in the sector, the federal government has proposed to open the public bus sector to private companies. This will allow buses to operate on nationalised routes. According to the Road Transport Ministry, the opening of the sector will increase the passenger ridership to 120-150 million per day.

Future bus technology

Fig.5.24

The federal government has unveiled an ambitious project to replace all public bus transport fleets with hybrid technology. The government launched the full indigenous retro-fitted electric bus, converting existing conventional fuel buses into electric buses, developed by KPIT Technologies and Central Institute of Road Transport (CIRT).

A main hindrance to the adoption of new technology is the financial implication and capital cost. The average cost of a hybrid bus in India is around INR 23 million (US$ 375,000), compared to INR 9 million (US$ 150,000) for a premium diesel bus. In order to incentivize the operators to procure electric and hybrid buses, the federal government has launched the 'Faster Adoption & Manufacturing of Electric and Hybrid Vehicle (FAME)' scheme to provide a subsidy of INR 6.1 million (US$ 100,000) for electric and hybrid buses.

Innovative technology

The Mumbai Metro currently has one line and 12 stations. There are plans to extend the network.IT solutions are important for public transport systems and information is becoming critical for any service planning. The key factors such as passenger demand; journey demand; service hour; and service frequency have great impact on the expenditure and revenue of any authority or operator. IT tools can also help to refine processes and improve efficiency. Smart transportation systems should have fleet management, ticketing, security surveillance, traffic management and real-time passenger information.

The recent 'Policy Road Map for City Bus Systems in India'6 study identified that most of the city's bus operators are still lagging behind in the implementation of an IT system. The survey revealed that nine out of 12 cities have implemented a vehicle tracking system and 11 out of 12 have implemented electronic ticketing machines (ETMs). However, no cities have yet implemented 'planning and scheduling' or

'depot management' systems; with the majority using manual systems for such operations.

The availability of real-time information is equally important for commuters to plan their journey. In the absence of good quality data, commuters aren't able to obtain accurate service information. However, there are some third-party mobile app providers that provide offline information to users such as Trafi and Moovit.

Smart ticketing has been slow to gain popularity in India. All metro systems have implemented smart ticketing solutions for its 'closed' environment; Delhi Metro sells approximately 16,000 smartcards a day and 1.8 million commuters use the card daily. However, the smart ticketing systems are not yet integrated with the bus system. The federal government did make plans to introduce a Smart National Common Mobility Card (NCMC) to enable seamless travel using different modes of transport across the country as well as having retail purchasing benefits. However, the initiative did not take off. In July 2015 the government established a committee to recommend an inter-operable smartcard.

In June 2016 Bengaluru Metropolitan Transport Corporation (BMTC) became the first city in India to launch the Axis Bank BMTC Smart Card – an open loop EMV contactless smartcard. However, the system is not integrated with other modes such as metro. Mumbai is another example that has various modes of public transport including suburban railway lines, metro, buses, taxis and auto-rickshaws. The Mumbai Metropolitan Region Development Authority (MMRDA) has appointed London's Transport for London (TfL) to prepare a detailed plan for an integrated ticketing system in the Mumbai Metropolitan Region. An integrated system is planned to be rolled-out by 2018.

New measures to strengthen public transport

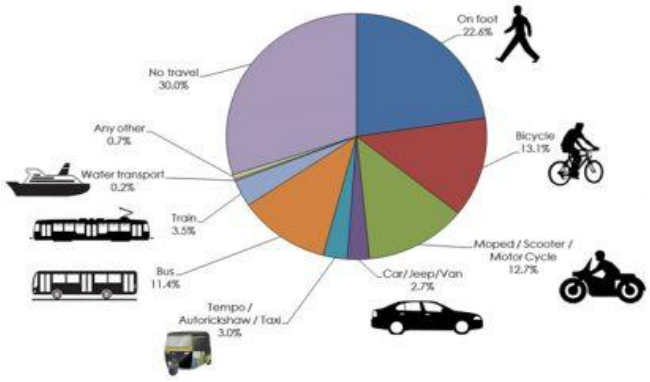

Fig.5.25

Although the key focus is on clean energy generation, the federal government is also looking to reduce emissions from the transportation sector. Some of the key measures include the following:

Strengthening water transport

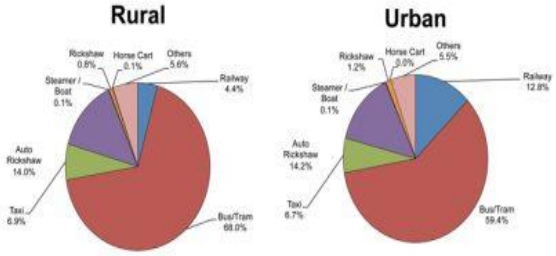

Fig.5.26

The development of waterborne transportation is one of the key priorities of the federal government in India. The 2016 National Waterway Act was enacted in March 2016 to regulate the development of 111 national waterways, out of which 106 are new national waterways. Currently India is conducting only 3.5% of trade through waterborne transport, compared to 47% in China; 40% in Europe; 44% in Japan and Korea; and 35% in Bangladesh. India still has much ground to make up to achieve efficient and sustainable city public transport systems. The public infrastructure will improve the mobility of people and will open the door to new economic opportunities for the country. Investment in public transportation has a multiplier effect for the economy.

Short Answer-Questions-

Q1). How do we use smart card in Metro and how can we get refund of smart card?

Q2). Give a brief note on Expedia.

Q3).What is the concept of Smart City in view of its transport system.

Q4).Write a short note on Future bus technology.

Q5).Explain in brief the working of online travel booking sites in India.

Q6).How will you evaluate the journey of Chennai Metro as compared to Delhi Metro?

Q7).How will you use the Token system while travelling with Delhi Metro? If it is unused any refund is allowed?

Q8).What is the AFC System?

Q 9).What is QR code system in metro system?

Q10).Give a brief account of features of Delhi Metro.

Long Answer-Questions-

Q1). Describe the internet based Private online Portals and their contribution to the Indian economy.

Q2). Elaborate the Features and Operations of Integrated Systems of India.

Q3). Explain the Kolkatta Metro system with its merits and demerits.

Q4). How Delhi Metro has contributed to improve the commuting of a normal Delhite?

Q5). What are the different ticketing system over Metros in India and are they sufficient or needs enhancements? Justify your answer.