CV0425-Metro Systems and Engineering

Unit-2: Electronics & Communication Engineering

SIGNALLING

The signaling system shall provide the means for an efficient train control, ensuring safety in train movements. It assists in optimization of metro infrastructure investment and running of efficient train services on the network.

Signalling and Train Control

Metro carries large number of passengers at a very close headway requiring a very high level of safety enforcement and reliability. At the same time heavy investment in infrastructure and rolling stock necessitates optimization of its capacity to provide the best services to the public. These requirements of the metro are planned to be achieved by adopting 'CATC' (Continuous Automatic Train Control System) based on "CBTC" (Communication based Train Control System) which includes ATP (Automatic Train Protection), ATO (Automatic Train Operation) and ATS (Automatic Train Supervision) sub-systems using radio communication between Track side and Train.

This will:

• Provide high level of safety with trains running at close headway ensuring continuous safe train separation and for bidirectional working.

• Eliminate accidents due to driver passing Signal at Danger by continuous speed monitoring and automatic application of brake in case of disregard of signal / warning by the driver.

• Provides safety and enforces speed limit on section having permanent and temporary speed restrictions.

• Improve capacity with safer and smoother operations. Driver will have continuous display of Target Speed / and other information in his cab enabling him to optimize the speed potential of the track section. It provides signal / speed status in the cab even in bad weather.

• Increased productivity of rolling stock by increasing line capacity and train speeds, and enabling train to arrive at its destination sooner. Hence more trips will be possible with the same number of rolling stock.

• Improve maintenance of Signalling and telecommunication equipments by monitoring system status of trackside and train born equipments and enabling preventive maintenance.

• Signalling & Train Control system on the line shall be designed to meet the required headway during peak hours.

• Radio for CBTC shall work in License free ISM band.

TELECOMMUNICATION & AUTOMATIC FARE COLLECTION

The Telecommunication system acts as the communication backbone for Signalling systems and other systems such as SCADA, AFC etc and provides Telecommunication services to meet operational and administrative requirements of the metro network. The Telecommunication facilities proposed are helpful in meeting the requirements for:

1. Supplementing the Signalling system for efficient train operation.

2. Exchange of managerial information

3. Crisis management during emergencies

4. Passenger information system

The proposed Telecom system will cater to the following requirements:

• Train Traffic Control

• Assistance to Train Traffic Control

• Maintenance Control

• Emergency Control

• Station to station dedicated communication

• Telephone Exchange

• Integrated Passenger Announcement System and Passenger Information and

Display System within the station and from Central Control to each station.

• Centralised Clock System

• Train Destination Indicator

• Instant on line Radio Communication between Central Control and Moving Cars and maintenance personnel.

• Data Channels for Signalling, SCADA, Automatic Fare Collection etc.

• E&M SCADA is not envisaged as part of Telecomm System as such, hence catered to separately in DPR

• Integrated Network Control System

• Access Control System

AUTOMATIC FARE COLLECTION

Metro Rail Systems handle large number of passengers. Ticket issue and fare collectionplay a vital role in the efficient and proper operation of the system. To achieve thisobjective, ticketing system shall be simple, easy to use/operate and maintain, easy on accounting facilities, capable of issuing single/multiple journey tickets, amenable for quick fare changes and require overall lesser manpower. In view of above, computer based automatic fare collection system is proposed. For Multiple Journey, the Store Value Contactless Smart Card shall be utilized and for the Single Journey, the Smart media shall be as utilized as Contactless Smart Token. System should be compatible with the Contactless Smart Chip supplied by at least 2 Chip OEMs as per ISO 14443 standard. AFC system proves to be cheaper than semi-automatic (manual system) in long run due

to reduced manpower cost for ticketing staff, reduced maintenance in comparison to paper ticket machines, overall less cost of recyclable tickets (Smart Card/Token) in comparison to paper tickets and prevention of leakage of revenue. Relative advantages of automatic fare collection system over manual system are as follows:

A) Manual fare collection systems have the following inherent disadvantages:

1. Large number of staff is required for issue and checking of tickets.

2. Change of fare structure is time consuming as has to be done at each station.

3. Manipulation possible by jamming of mechanical parts.

4. Staff and passenger interaction leading to more chances of confrontation.

5. Almost 100% ticket checking at entry / exit impossible.

B) Automatic fare collection systems have the following advantages:

1. Less number of staff required.

2. Less possibility of leakage of revenue due to automatic ticket check by control gates.

3. Recycling of ticket fraudulently by staff avoided.

4. Efficient and easy to operate, faster evacuation both in normal and emergency.

5. System is amenable for quick fare changes.

6. Management information reports generation easy.

7. System has multi-operator capabilities. Same Smart Card can be used for other applications also, including in other lines of the Metro.

8. Contactless Smarts Card based AFC systems are the worldwide accepted systems for LRT/Metro environment.

The proposed ticketing system shall be that to be of Contactless Smart Card type for multiple journey and Contactless Token for Single Journey. The equipment for the same shall be provided at each station Counter/Booking office and at convenient locations and will be connected to a local area network with a computer in the Station Control room.

C) Choice of Control Gates

Flap type Control Gates are proposed which offer high throughput, require less maintenance and are latest in modern metros internationally. Tripod turnstile type gates offer less throughput and require more maintenance and hence are not proposed. All these Gates will have a functionality of Auto Top on Smart cards in case balance goes below the threshold Value (As per User Choice/Business Rules)

D) Ticket Vending Machine (TVM)

At all stations, Passenger Operated Ticket Vending Machines (Automatic Ticket Vending Machines) are proposed. The TVM's will provide convenience to passengers to avoid standing in queues at ticket booths and provide them international standard service. This will be used for

1. Dispensing Smart Tokens for single journey

2. Add Value in Smart card by paying money using Bank Notes or through Credit Card /Debit card /pre Paid card.

3. Return the remaining money through Bank Notes and Coins (Min 2 types)

E) Ticket Reader/Add Value Machines

These machines will be used to know the Card/Token balance and can also be used as

Add value device in case payment for Card top up is made through alternate Internet

based channel like net banking, Credit/Debit card (Payment gateway) etc.

F) Recharge Card terminal Machine (RCTM)

RCTM will be used to recharge the Card using bank Note as well as Credit Card /Debit card /Pre Paid card.