Industrial Internship Training
At
NMRC, Noida

Report

Submitted by

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Register Number

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In partial fulfillment of the requirements for the award of the degree of:

BACHELOR OF ENGINEERING
IN
ELECTRONICS & INSTRUMENTATION ENGINEERING

MANIPAL INSTITUTE OF TECHNOLOGY
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(A constituent institution of MAHE, Manipal)

DEPARTMENT OF INSTRUMENTATION & CONTROL ENGINEERING

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ACKNOWLEDGEMENT

It is a great pleasure to present this report of Summer Training about Noida Metro Rail Corporation Ltd. in partial fulfilment of B.Tech Program under MAHE, MIT , Manipal, 576104. At the outset, I would like to express my immense gratitude to HR & training guide, Mrs. Rajani Bhardwaj,Mr. Indra Raj & Mr. Sunil Kumar for providing me with the opportunities of studying, learning and gaining practical experience in various fields during the period of training. Her invaluable suggestions not only helped me to reach the successful completion of the tasks assigned, but also made me learn a lot. I am falling short of words for expressing my feelings of gratitude towards their for extending their valuable guidance, through critical reviews of project and the report and above. all the moral support she had provided me with all stages of this training.

I am also grateful to my director, Dr Anil Rana, for allowing the students to participate in various internships. I am very thankful to my HOD, Dr Shreesha C, being supportive & impartial throughout our course.

ABSTRACT

In a Metro Rail System, many components such as Telecom & Signaling, Rolling Stock, OCC(Operations Control) etc, need to work together to create the seamless experience of riding a metro from point A to B.

With regards to various components, nothing might be more important then the OCC. It acts as a nerve center for the entire system. In the OCC a team handles everything form station departure to bringing a malfunction rolling stock back to Depot to repair & refurbish. Essentially it acts a connecting tissue between various departments such as work duty, telecom & signaling, revenue system, TO(train operator)etc guiding them wherever necessary.

In conclusion, various departments need to work together to keep the Metro Rail System operational day after day, a system on which so many people have come to place their trust in.

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आज़ादी का अमृत महोत्सव

Certificate No. NMRC/HR/Trg/2022/148

INTERNSHIP CERTIFICATE

This Certificate is awarded to Mr. ...ADITYA TIWARI..... Student of..MIT MAHE...MANIPAL...Roll No. .190932138 Discipline B.TECH C.E.&I.D....who has undergone internship training from ..7/6/22 to ..7/7/22. in NMRC. He was allotted project on TELECOM & SIGNALING His performance during internship training was commendable. His project was awarded as EXCELLENT.. grading. NMRC wishes him success in all his future endeavours.

Dated: .12/7/22.

Rajan

(Authorised Signatory)
RAJANI BHARDWAJ
Asstt. Manager/Human Resource
Noida Metro Rail Corporation Ltd.

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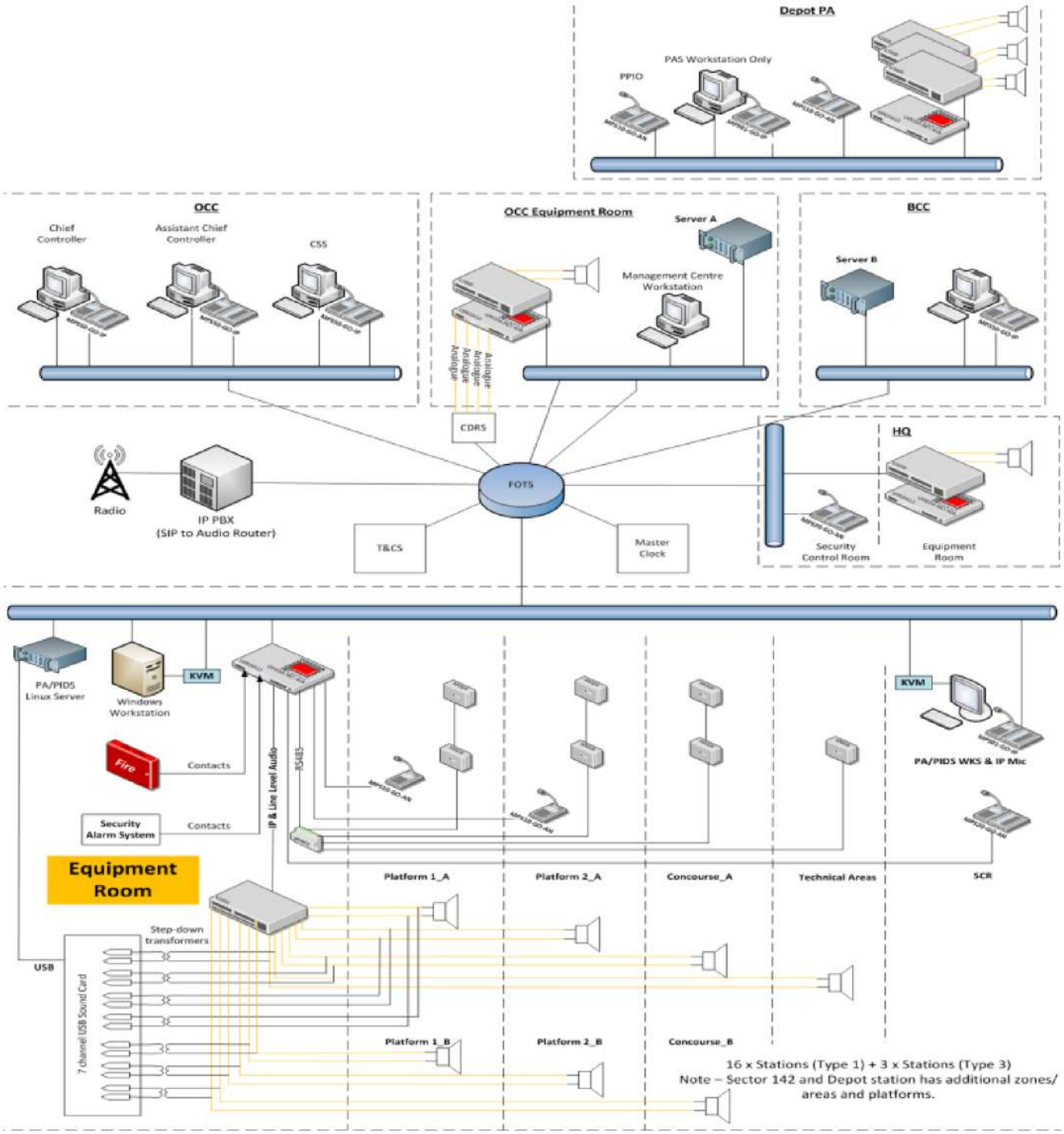
- Telephone and 48V DC Power System
- Closed Circuit Television System (CCTV)
- UPS System

Public Address System (PAS)



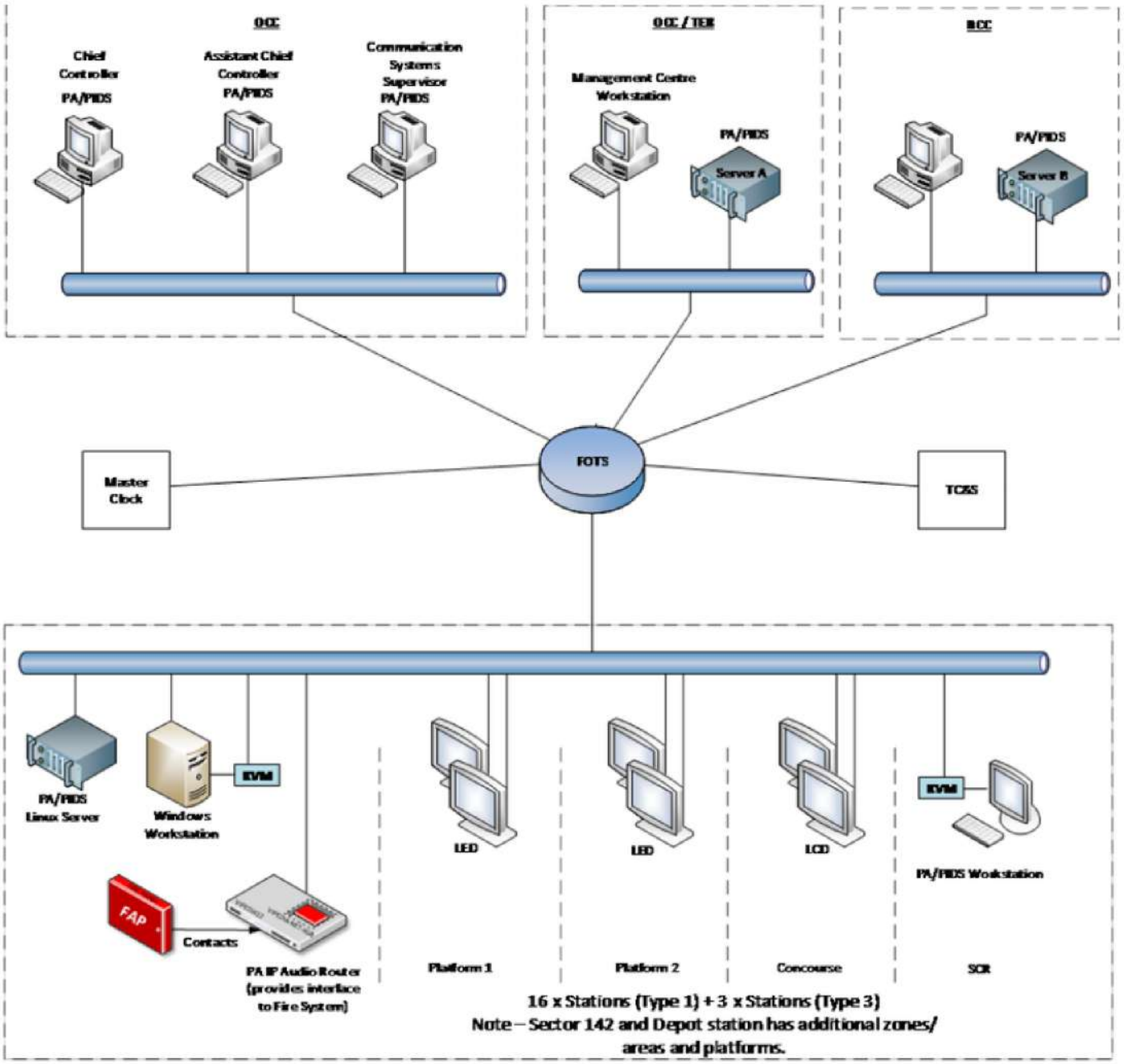
SYSTEM ARCHITECTURE

Public Address System (PAS)

- The Public Address System is designed to provide clear communication to the travelling public, along with automatic travel information and emergency evacuation
- announcements.
- The PAS will be provided to broadcast voice messages
- (includes emergency, fire and evacuation messages) to passengers/staff in all stations and to staff in the depot, OCC and NMRC HQ.
- The following PAS zones will be provided for each station as mentioned below:
- 1. Concourses and entry/exits
- 2. UP Platform
- 3. Down Platform
- 4. Staff areas including Office rooms, equipment rooms, plant rooms, staff toilets mainly for emergency / fire announcements.
- 5. All common area in between Property Development and Station area used for passenger movement.
- The PAS will support message announcement in Hindi and English or a combination of these languages.
- The PAS will be capable of maintaining the required intelligibility at all times regardless of the changing environment including noise level.
- PAS announcement will be capable of being originated from designated hand portable radios also to a set of pre-defined PAS zones at each station.
- PAS zones will be fully coordinated with fire protection zones in all stations, OCC & Depot to make announcements to alert passengers and staff and broadcast evacuation messages.

  The PAS/PIDS NMS will monitor system alarm status on real time basis. Alarm data will also stored for future inquiries.

Passenger Information Display System (PIDS)

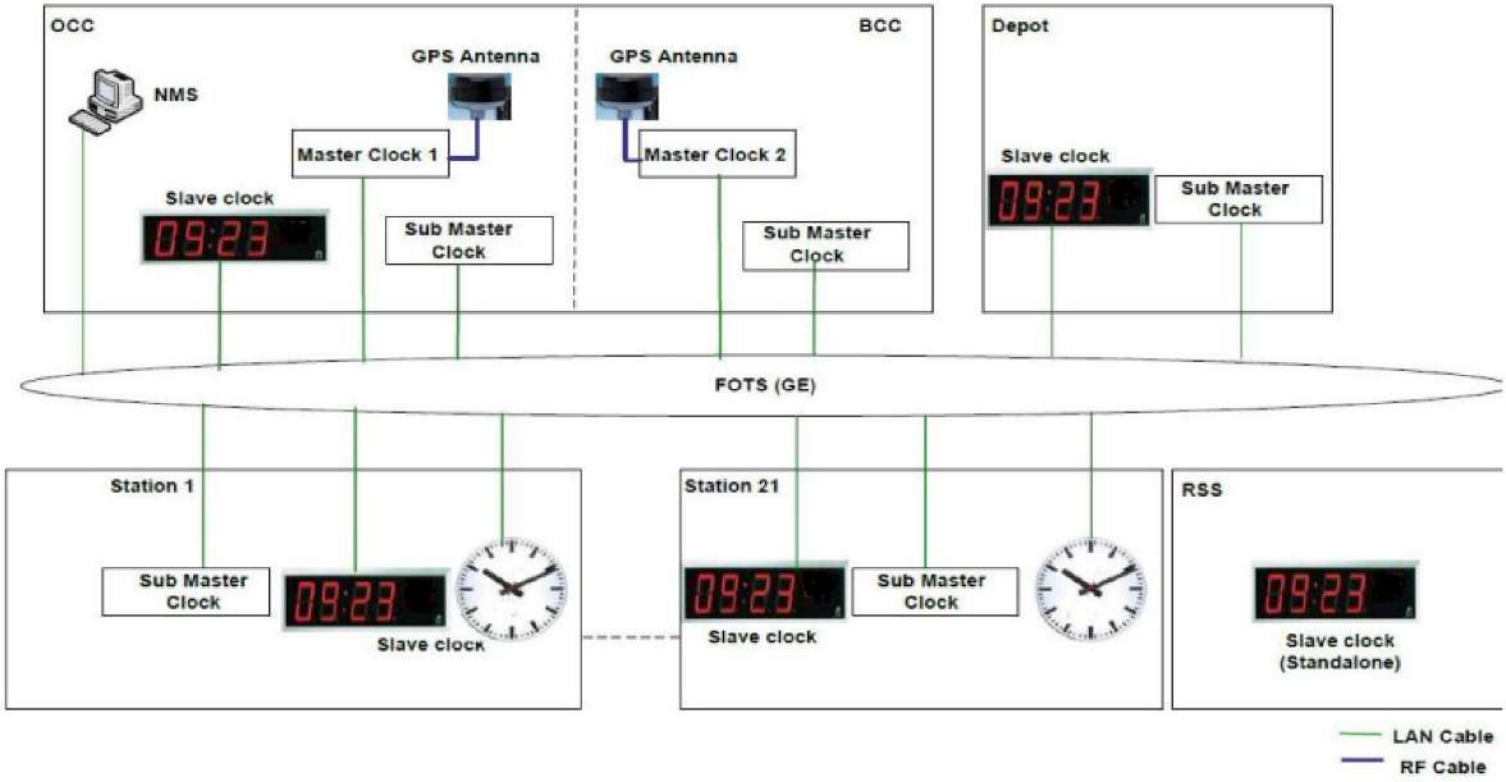


SYSTEM ARCHITECTURE

Passenger Information Display System (PIDS)

- The Passenger Information Display System is designed to provide clear visual information to the travelling public, along with automatic travel information, pre-determined, fixed, pre-formatted messages, free-entry messages regarding safety, train delays and emergency evacuation messages.
- The PIDS displays will comprise:
- 1. Platform Visual Information Displays; LED based display Boards
- 2. Concourse (Paid / Un Paid) visual Information Displays;
- LED Panel/Screens capable of showing video. All information displayed will be presented in time sequence, with a set dwell time first in English and then in Hindi. However, facilities will be provided for the station and OCC operators to display messages in one language or the other, as per the requirement.
- The PIDS management system will monitor system alarm status on a real-time basis. The PIDS management system will store alarms in the database for future enquiries and to access the fault alarm history database for retrieval of alarm history data in the alarm memory.
- The PIDS management system will have necessary facilities to produce reports based on user programmable time schedule on the overall performance of the PIDS including traffic reports, fault reports, alarm history, display board usage statistic reports and message usage statistic reports.
- The PIDS will be capable of creating and displaying passenger information in any combination of characters, numerals, animated graphics, punctuation & symbols.
  Indoor display boards will be suitable for operating in an indoor environment with or without air-conditioning. Indoor housing will be IP54 compliant. In open areas where display boards will expose to rain or sunlight, the display boards will be dust-proof and water-proof to IP65 standard.

Master Clock System (MCS

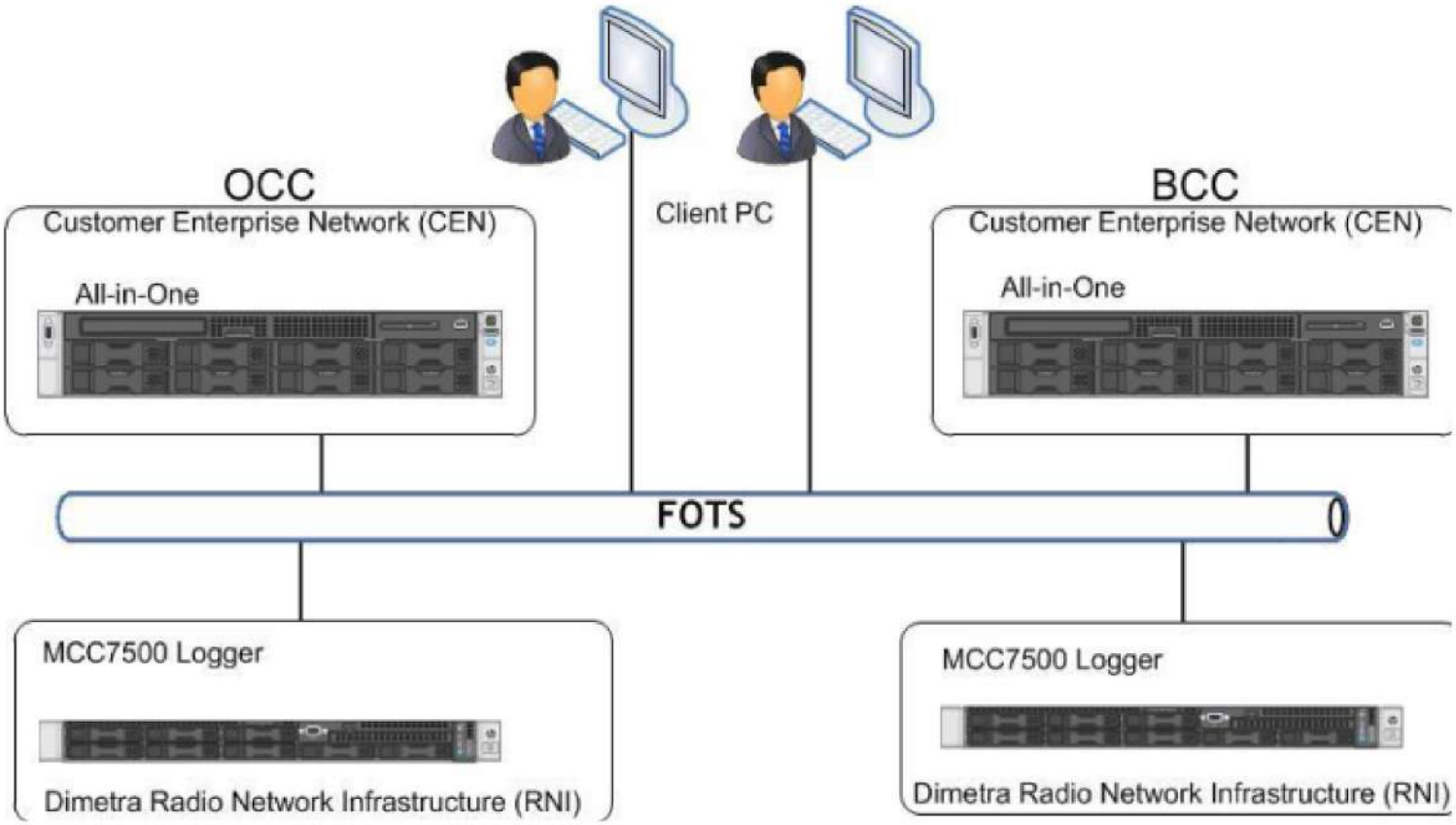


SYSTEM ARCHITECTURE

Master Clock System (MCS

- The Master Clock System is designed to provide accurate time information as well as for time synchronization for all telecommunication systems and other designated external systems.
- In order to assure uniform and reliable time information, the MCS uses GPS synchronized Central Master Clock. The MCS is designed with required redundancy so that no single point failure in the system.
- A Master Clock Server to deliver Network Time Protocol (NTP) or Precision Time Protocol (PTP) as required by other subsystems.
- Master Clock system will be synchronized to GPS with Date/time. In the absence of valid GPS signal, the Master Clock system will operate in free running mode with internal clock supplying the time signal. On restoration of the GPS Signal the receiver validates the GPS signal automatically without any manual intervention.
- Master Clock system synchronized to GPS with Date/Time distributes the signal to Sub-Master clocks. In the absence of valid Master Clock signal, the Sub-Master clocks will be operated in free running mode with an internal
- Clock supplying the time signals. On restoration of the master clock signal the sub-master clocks validates the signal.
- Sub-Master Clocks further distributes the synchronized signal to all slave clocks. In the absence of valid Sub-Master
- Clock signal, the Slave clocks operates in free running mode with an internal clock supplying the time signals. On restoration of the Sub-Master clock signal the Slave clocks validated the signal.
- Alarm and status monitoring of the Master Clock System will be connected to the NMS of PAS/PIDS in OCC. In addition, MMI will be provided at CSS OCC for supervision and maintenance of all stations/depot/OCC clocks provided.
- Display Clocks exposed to outdoor environments will be designed, manufactured and installed to survive the environment with IP65 standard and those used in Indoor environment with IP54 standard.

Central Digital Recording System
(CDRS)



SYSTEM ARCHITECTURE

Central Digital Recording System
(CDRS)

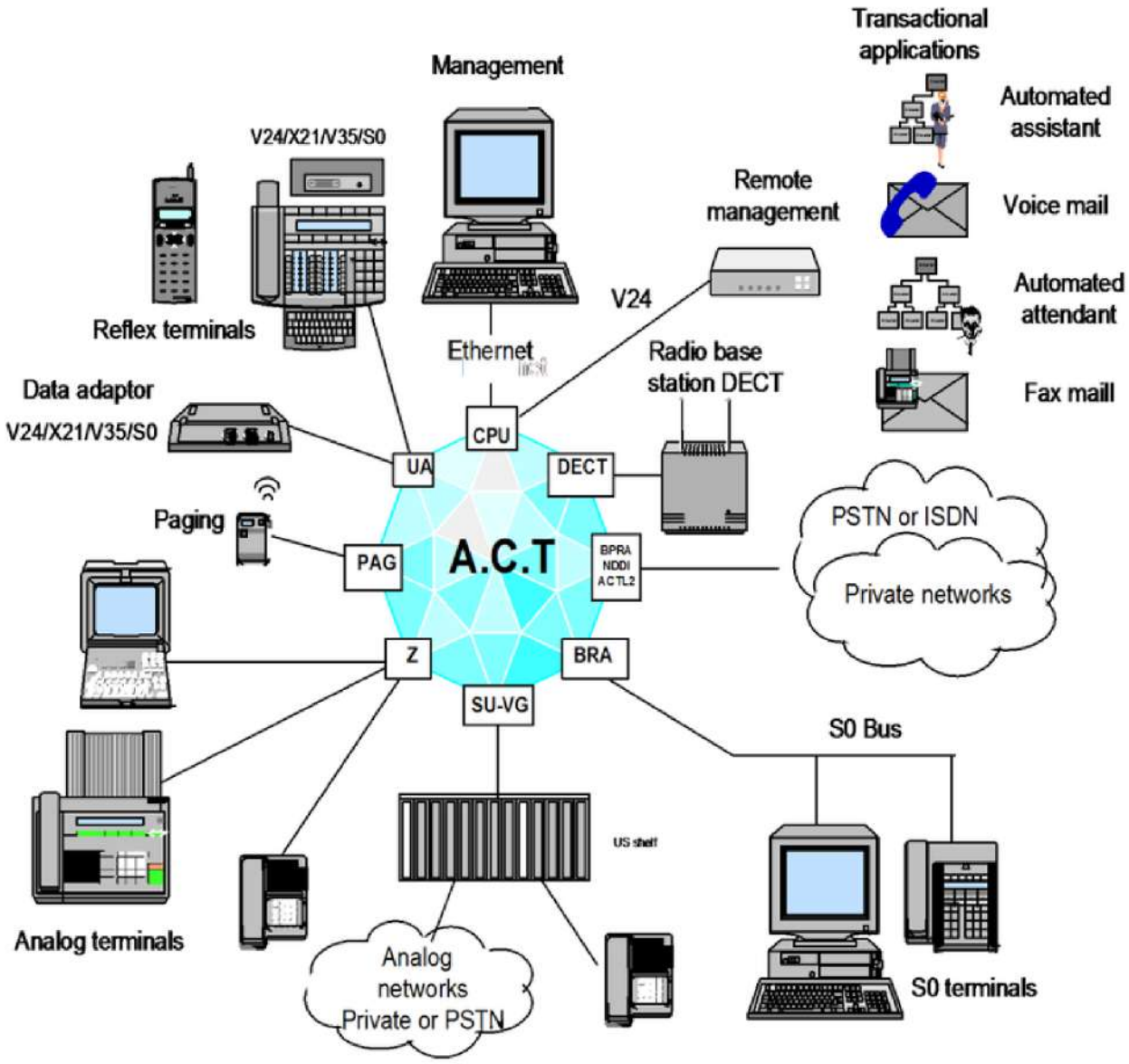
- CDRS facility will be provided in OCC. CDRS will provide multichannel voice recording and indexing of direct line communication including communication from all direct line consoles and emergency telephone lines, two way radio communications, emergency or fire messages broadcast on station PAS initiated from OCC and on train borne PAS initiated from OCC.
- Integrated recorder will be provided for recording all calls on the corridor. The recorder will be highly reliable and Secure and will be provided with redundancy and comply with ITU-T recommendation and Indian regulations.
- The CDRS will provide search function for user to locate any part of the recording medium in terms of:
- 1. date and time;
- 2. by channel; and
- 3. search by marker placed by the user.
- 4. By User ID

A redundant Centralized Digital Voice Recording System is to be provided at the OCC & redundant/parallel at the BCC for recording multichannel voice recording of direct line communication, two way radio conversations, emergency messages broadcast on station PAS and train borne PAS initiated from OCC. Distributed recording units will be installed in DCC and in each SCO to record analog Help Points & ambient sound also known as FSR (Free Space recording). Those distributed recording can be expended to record digital phones if required Fault tolerant design with protections against failure will be provided in order to achieve the system availability.

Radio (TETRA) System

- Dimetra IP is the product name for Motorola Solutions TETRA radio system for voice and data communications according to the ETSI standard Dimetra IP is a digital Trunking TETRA radio system. The Dimetra IP system is based on a constant IP technology. This ensures maximum availability, makes possible highest flexibility during build up Or extensions of the network, and an easy integration of future technological applications.
- The Dimetra IP system provides services to three groups of users: Radio Users: Mobile users can roam throughout the radio coverage area provided by the system. The radio users access the system using radio terminals, which in TETRA terms are known as Mobile Stations (MSs).
- RCW Dispatchers: Fixed users have access to advanced features and facilities provided by the system.These features enable controllers to efficiently communicate with and manage fleets of mobile users.Controllers access the system using Dispatch Consoles (RCW).
- Network Managers: They are responsible for managing and maintaining the Dimetra IP system. The Network
- Management subsystem provides numerous applications that allow the network managers to efficiently manage the system. The network managers access these applications using Network Management Terminals (NMTs).
- Train-borne mobile, hand-portables and Control Centres (OCC & DCC) will be permitted to initiate emergency call.
- An emergency call can be either a group call or an announcement/broadcast call. When the system is busy,emergency calls are set up immediately by ruthlessly pre-empting the lowest priority call in progress. The lowest priority call is dropped and the required resources immediately granted to the emergency call.
- There shall be two types of emergency calls
- 1. Train Emergency call: The train emergency call will be automatically routed to the designated jurisdiction control Traffic Controller.
- 2. Shunting emergency call: The Shunting emergency call will be sent to all users involved in shunting operations.
- The Radio system will interface with the Telephone system to permit selected Hand-portable radios to initiate radio-to telephone calls and vice versa without the ntervention OCC and also for Radio to PAS call through EPABX link
- The availability of the Radio Management System will be better than 99.95%.

Telephone and 48V DC Power System



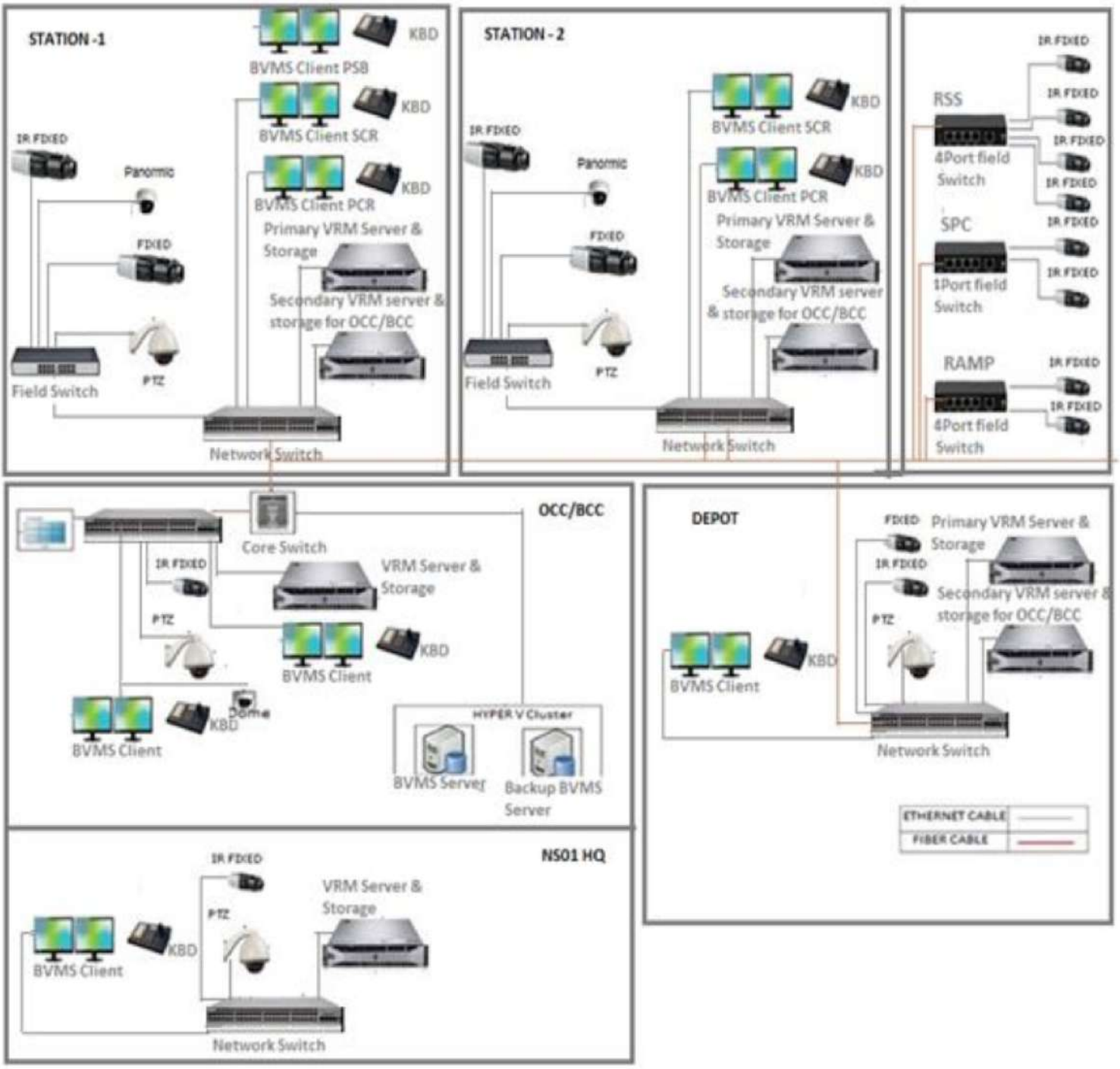
SYSTEM ARCHITECTURE

Telephone and 48V DC Power System

- The Telephone system is design with one VOIP System in OCC which will acts as a centralized System as well as BCC and one sub system of IP PBX system. One IP-PBX system will be installed at each station. Another one sub system will be installed at staff quarter. In this project there are 21 elevated stations, 1 HQ and 1 Depot/OCCs and 1 for Staff Quarter. Each Station, HQ, Depot/OCC has 1 IP PBX system and For Staff Quarter 1 EPABX System at depot building. OCC/Depot has one more VOIP and Unified communication system. The Depot/OCC will be the main node of the Noida – Greater Noida Project. In order to provide Noida Metro with the state of the art product in the Private Telephone Network equipment, solution based on the ALCATEL OMNI PCX ENTERPRISE (OXE) PABX has been designed. This solution will permit both, IP PBX Telephone Network & Direct Line Network System to work independently over the same Telephone system Network. In fact, a single fixed automatic network will support all fixed telephonic communications. This equipment will operate on -48 Volts DC supply.
- Help telephones are provided at Platform level for the help required by passengers. The network management system will be provided with a, self-diagnostic, fault and alarm management of all Elements of the operational Telephone Network and associated interface.
- Interfacing with traffic to and from the PSTN (MTNL/BSNL) exchange. All incoming calls from BSNL/MTNL system will be received via PRI Trunks. All outgoing calls to PSTN (BSNL/Private Operator) system will utilize PRI/CO outgoing trunks individually equipped.
- The Radio system will connect to the Te lephone System and the Telephone System will provide necessary circuits and facilities so that user can make telephone call through the hand portable/train mobile radios and call to handportable/train mobile radios.

  The availability of Network Management System for the Telephone System will be better than 99.95%.

Closed Circuit Television System
(CCTV)

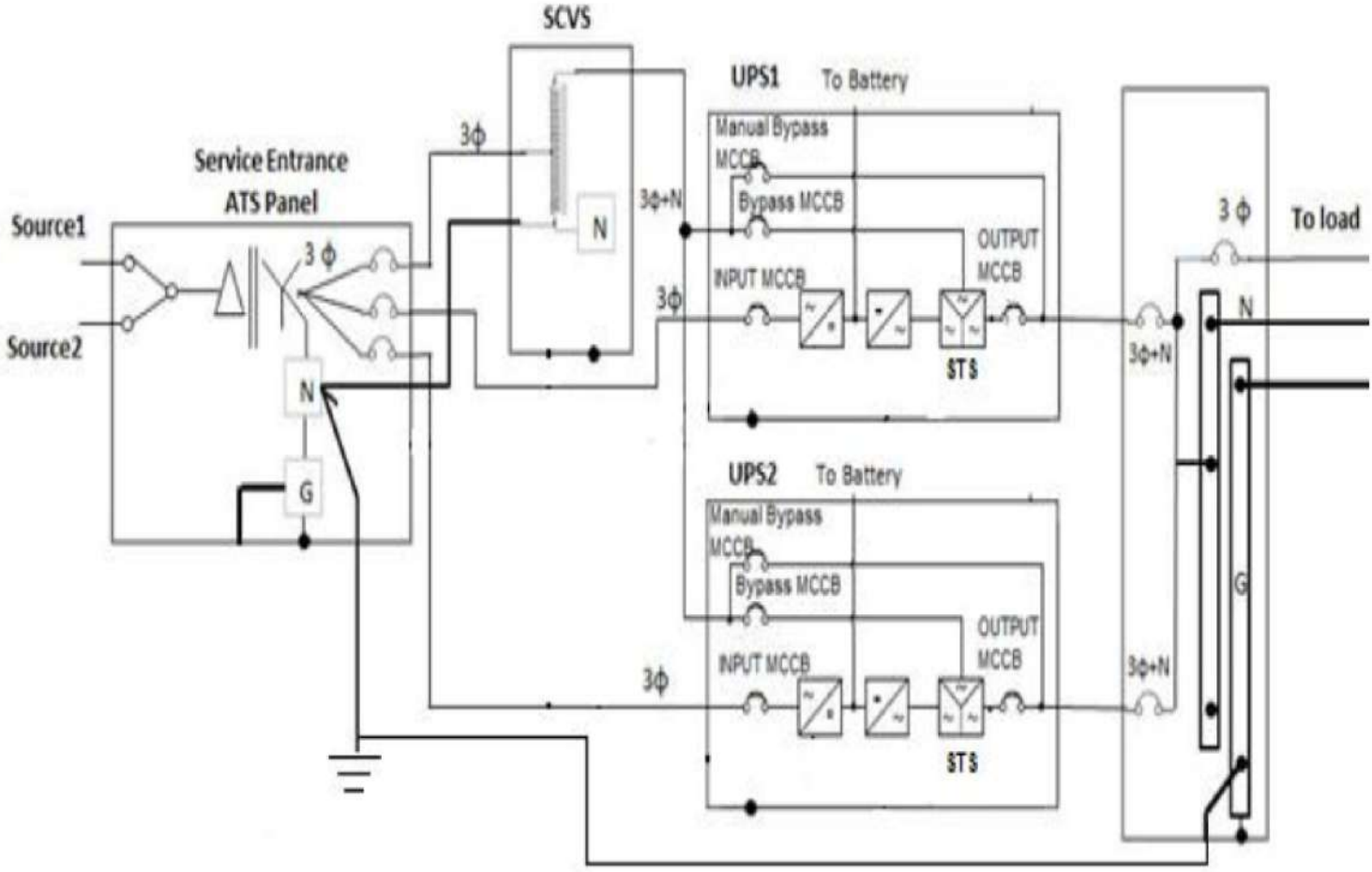


SYSTEM ARCHITECTURE

Closed Circuit Television System
(CCTV)

- The CCTV system will provide effective surveillance of an area as well as also provide temper proof video recording for post event analysis. Video surveillance system will be end to end IP based with Full HD IP cameras.
- The CCTV system will consist of the following principal subsystems:
- Platform Surveillance - CCTV system for monitoring of entraining and detraining of passengers at all platforms of all stations of NMRC.
- Station Surveillance – CCTV system for monitoring entire station area locally from concerned station and Remotely from OCC/BCC.
- CCTV surveillance system for monitoring important locations in all Depots of NMRC both locally and remotely from OCC/BCC. CCTV surveillance system for monitoring important locations outside the stations like RSS, Ramp, Parking and specifically identified theft prone areas etc, from adjacent station and remotely from OCC/BCC. Night Vision (IR illuminated) cameras will be used at these locations.
- CCTV surveillance system for monitoring of the signalling point crossing at tracks (interlocking station).Night Vision (IR illuminated) cameras will be used for this purpose.
- LED Video wall of 5x2x70" size will be provided in Security Control Room at OCC to view all cameras of Noida- Greater Noida corridor.
  Video recording system will provide primary recording locally at the stations itself and mirror recording at adjacent station for all NMRC stations. For Depot, only the local recording will be provided in the depot itself. The primary recording of OCC will be done at OCC and the mirror recording will be at the Depot/ BCC. Station entries, parking's, specifically identified theft prone track areas, Signalling point crossings, RSS, Ramps will be covered by providing cameras with IR illuminator at the pole/wall keeping in view the lighting conditions.

UPS System



SYSTEM ARCHITECTURE

UPS System

- The UPS System is designed to provide power backup solution for Stations (Interlocking & Secondary) and Depot.
- UPS system will provide clean and healthy power load for smooth operation in online and backup mode.
- In Online mode, system will work on the mains power available and provide constant Voltage to the load free from the input voltage fluctuations. Dual mains source selection will increase the redundancy.
- In Backup mode, system will work in case if both mains power fails, system will feed the load through the batteries available. In any abnormal condition, system will automatically transfer in the bypass mode through static by pass switch inbuilt in the UPS. An external Servo Stabilizer will be used to control and regulate the voltage on bypass mode.
- Parallel configuration (1+1) of the UPS will further increase the redundancy. Batteries will be charged by UPS in online mode & Standby mode.
- The UPS system will be monitored and controlled through Network Management Application system. This UPS NMS system will perform remote device configuration and management for UPS System at Stations (Secondary & Interlocking) and Depot. This NMS have an intuitive GUI (Graphical User Interface) and includes well known features such as Drag and Drop.

1. The battery cells are 2V, heavy duty; rechargeable, maintenance-free valve regulated lead acid and type (MFVRLA).

- Major Advantages of VRLA Batteries:
- 1. Supplied in factory filled, charged and ready to use condition.
- 2. No topping up is required.
- 3. Spill proof and leak proof.
- 4. No corrosive fumes are emitted, hence user friendly.
- 5. Safe and Explosion proof.
- 6. Easy to install.

INTRODUCTION TO PSC (PLATREFPRM SCREEN DOORS)

- Platform screen doors and platform edge doors at train or subway stations screen the platform from the train. They are a relatively new addition to many metro systems around the world,some having been retrofitted to established systems.
- It prevents unauthorised entries onto track,minimizing service disruption due to track intrusion. In addition, full-height platform screen doors act as an environmental screen to cut down air-conditioning energy by up to 50%.
- All platform screen doors have an interlocking system with the signalling system to prevent the train from departing when any door is not closed and locked.Each bi-parting door also has an emergency release mechanism to allow passengers on board the train to manually slide open the bi-parting doors in case of a system failure
- Each bi-parting door also has an emergency release mechanism to allow passengers on board the train to manually slide open the bi-parting doors in case of a system failure

.

- Newer platform screen doors have been designed with a modernised look, incorporating more glass surfaces and sporting an ergonomic design. They also produce less noise when the doors operate.
- The newer platform screen door systems have green summary indicator lamps located at both ends of the platform, which illuminates when all doors are fully closed and locked.

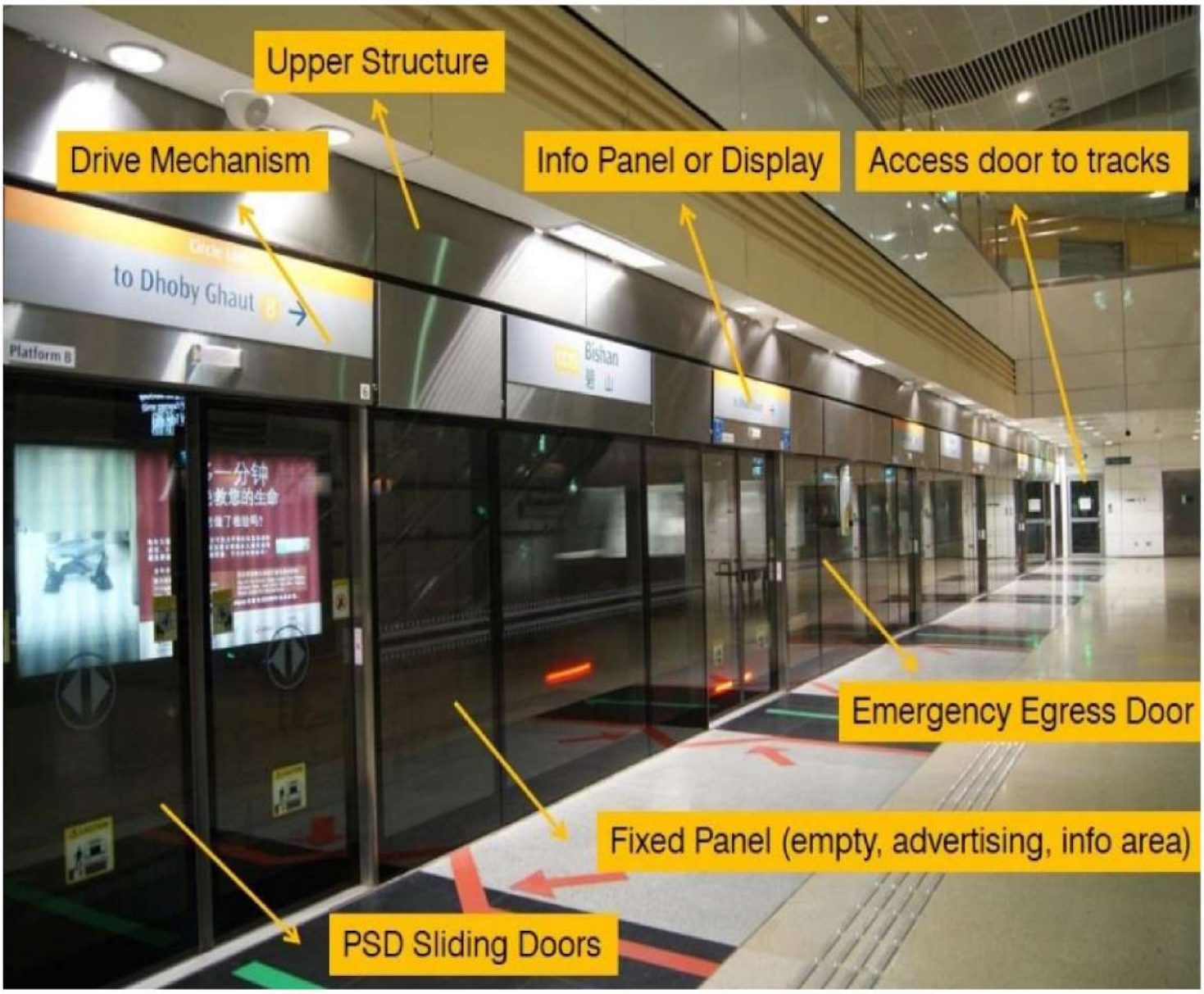
FUNCTION OF PSD

These doors help to:

- Prevent people from accidentally falling onto the tracks, getting too close to moving trains, and committing suicide (by jumping) or by pushing.
- Prevent or reduce wind felt by the passengers caused by the piston effect which could in some circumstances make people lose their balance
- Improve safety—reduce the risk of accidents, especially from trains passing through the station at high speeds.
- Improve climate control within the station (heating, ventilation, and air conditioning are more effective when the station is physically isolated from the tunnel).
- Improve security—access to the tracks and tunnels is restricted.
- Lower costs—eliminate the need for motormen or conductors when used in conjunction with Automatic Train Operation, thereby reducing manpower costs.
- Prevent litter buildup on the tracks, which can be a fire risk.
- Improve the sound quality of platform announcements, as background noise from the tunnels and trains that are entering or exiting is reduced.

At underground or indoor platforms, prevent the air from being polluted by the fumes caused by friction from the train wheels grinding against the tracks.

PSD SYSTEM



SYSTEM ARCHITECTURE

3. INTRODUCTION

What is AFC ?

AFC = Automatic Fare Collection Systems

- It is a system that supports the Fare Collection Service of the Passenger Transport Business.
- It is a service that obtains the compensation from passengers for over travel, ithout ticket and other penalties by reaching them through system.
- Based on contact less technology.
- System mainly consists of semiautomatic Ticket Vending

Machines (TOM), Ticket Vending Machines (TVM), Add Value Machines (CC), Automatic entry-exit Gates, Station Computer and Central Server.

At present AFC of NMRC is provided in joint share between three company:

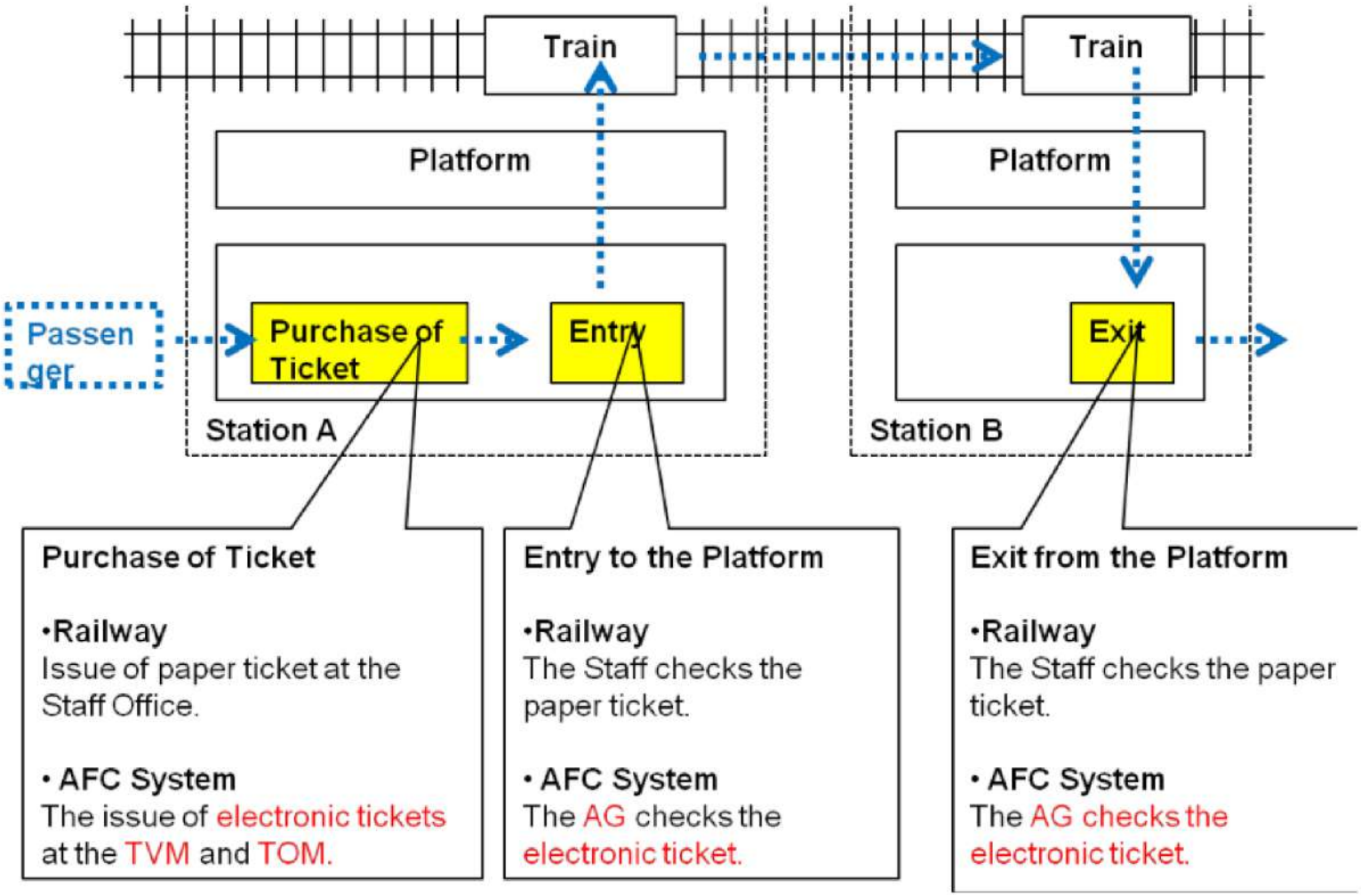
- 1)- AurionPro (Installation support)
- 2)-ScSoft (Software support)
- 3)-State bank of India (Stake Holder in AFC Project for Open Loop system) AFC Gate Cabinet provided by Gunebo, company of Singapore.

AFC System Application

- Access control.
- Ticket reading/writing.
- Revenue transaction collection and reports.
- Equipment supervision.
- To make it easy for the staff to monitor the sales data

AFCVS & TRADITIONAL RAILWAYS

Movement of the Passenger (Comparing the Railways and the AFC System)



SYSTEM ARCHITECTURE

ELECTRONIC TICKET SYSTEM IN NMRC

EMV Card(contactless cards/SBI City one) card)

QR Code

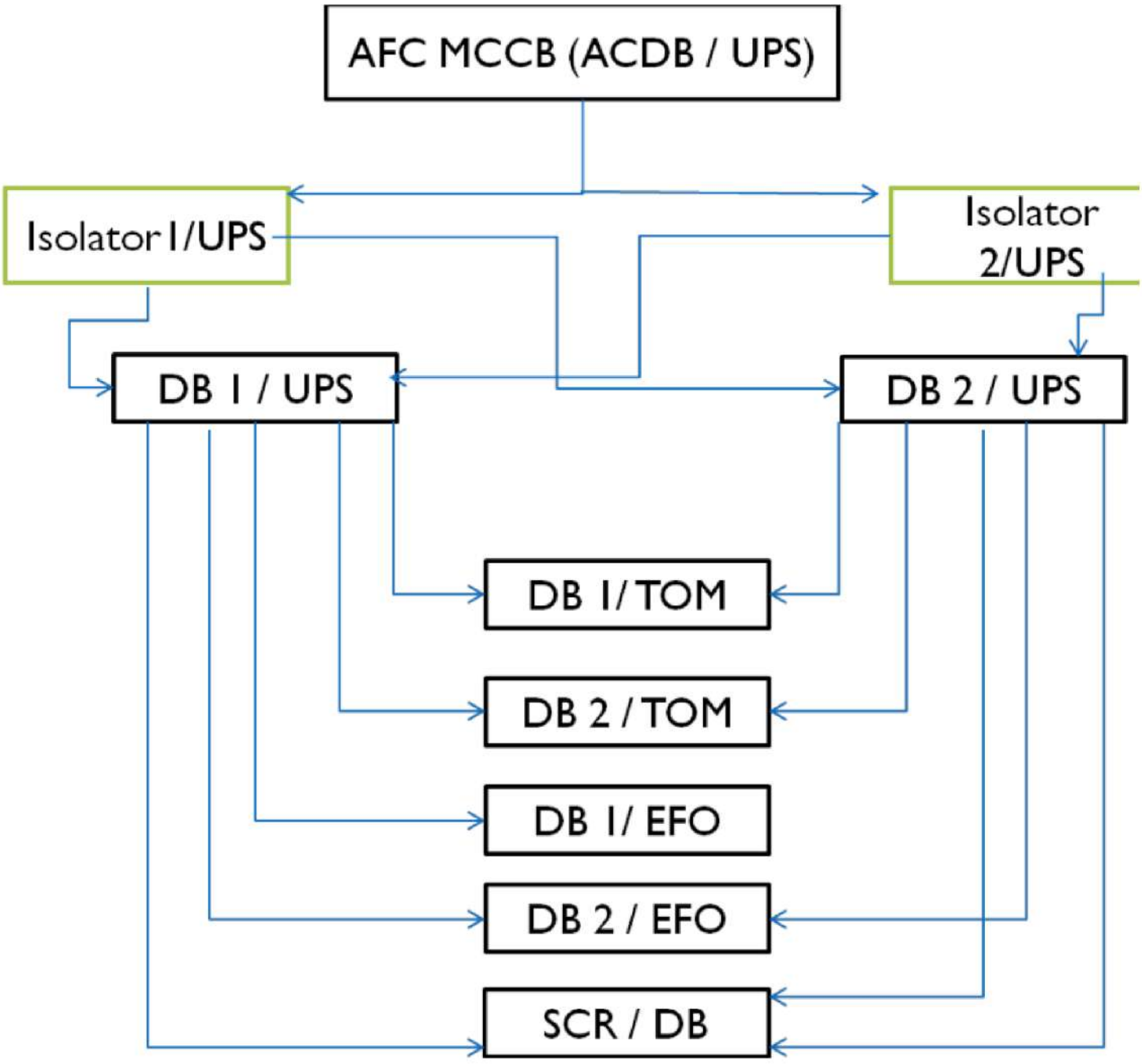
What is an Electronic Ticket?

- CST（Contactless Smart Token）• P-CSC（Paper Contactless Smart Card）
- CSC（Contactless Smart Card）
- EMV Card
- QR Code

STATION LEVEL EQUIPMENTS

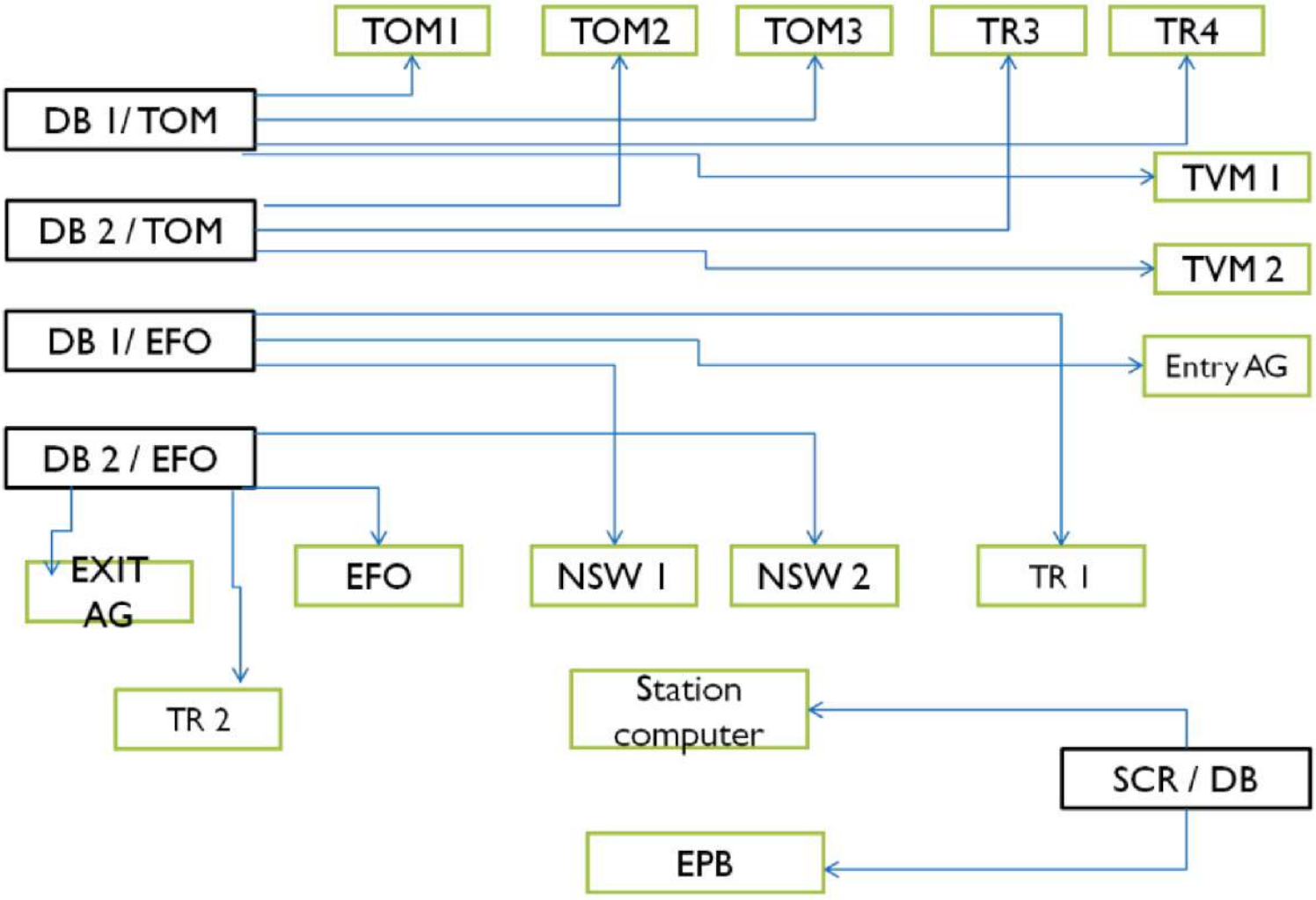
- TOM – Ticket Office Machine
- EFO / CCC – Excess Fare Office or Customer care Office
- AG – Automatic Gates
- TVM – Ticket Vending Machine
- TR – Ticket Reader
- ETM – Electronic Ticketing Machine

Power distribution for AFC system



SYSTEM ARCHITECTURE

Power distribution for SLE's(Single phase)



SYSTEM ARCHITECTURE

Isolator and DB

DB 1 & 2/ UPS

Isolators

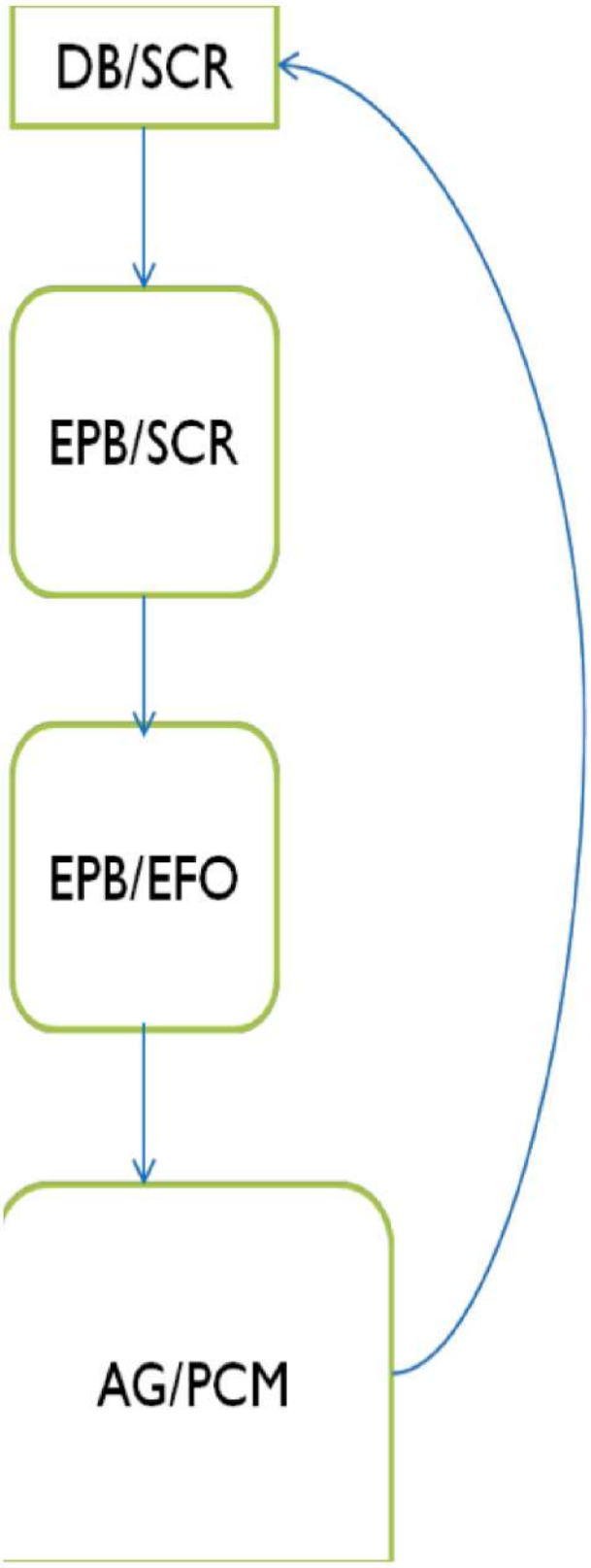
Power Distribution

- Power for AFC system taken from S& T UPS room.
- Two 3-phase 50 hrz. supply taken by single 3 phase supply from ACDB by tapping.
- Two 3-phase supply given to AFC isolators.
- One 3-phase supply from each isolator given to each DB(Distribution box) and then further single phase supply given to DB of TOM, EFO and SCR by load balancing.
- All SLE,s Given single phase supply with load balancing from each DB of that particular room.

EPB(Emergency push Button)

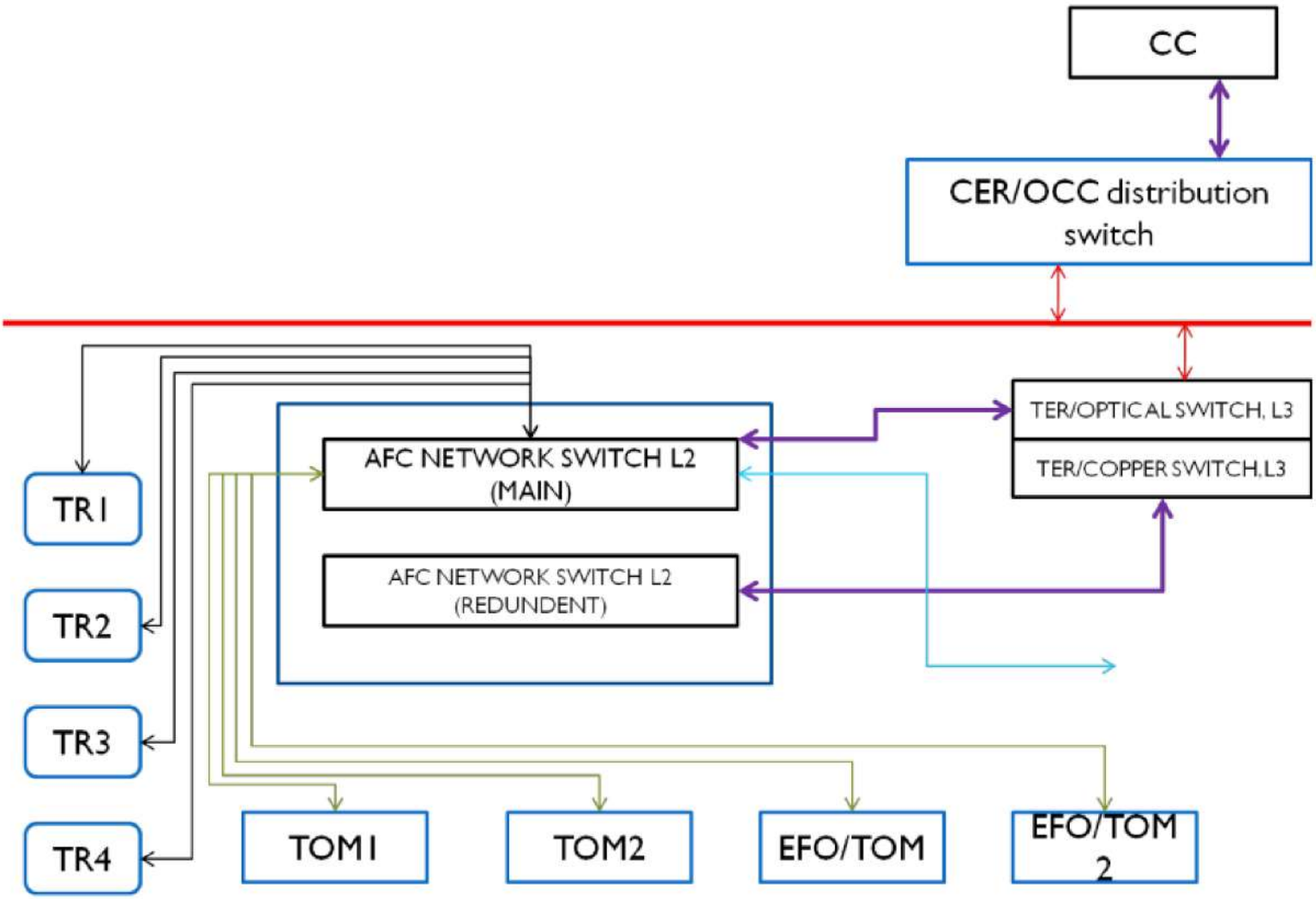
- Location: SCR and EFO
- In EPB there is inverter convert 220 volt AC to 24 volt DC coming from DB/SCR
- This the hard button to put the AFC gates on emergency when any emergency evacuation situation arise.
- When operated all the flaps of AG(Automatic gates) remain open.
- Operated when pushed and released when rotate.
- It is an 24 volt DC supply loop with two buttons placed in SCR and EFO with end point on PCM board of AG. Soft command can also be initiated from Station computer as station mode and from NMS centrally on mainline.

EPB



SYSTEM ARCHITECTURE

NETWORK ARCHITECTURE



SYSTEM ARCHITECTURE

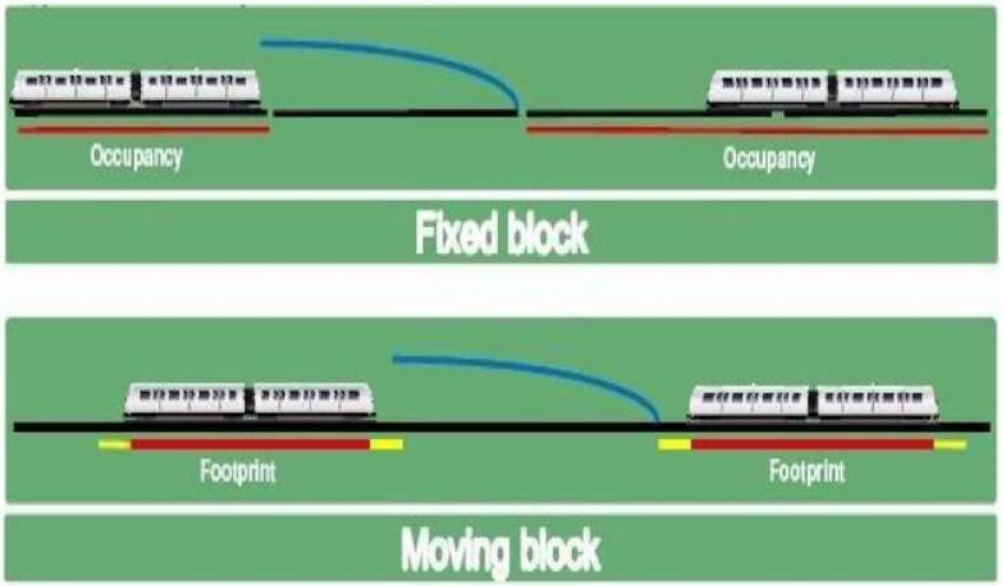
4. Introduction

- Communication based train control(CBTC) is a railway signalling system that makes use of the telecommunications between the train and track equipment for the traffic management and infrastructure control.
- It uses Radio communication to transfer train control information between train and wayside.
- More efficient and safe way to manage the railway traffic.
- It utilizes high-resolution train location, high-capacity.
- Automatic train supervision (ATS) is a system is installed to facilitate the monitoring of train operation and also remote control of the station.
- The train supervision will log each train movement and display it on the workstations with each Traffic Controller at the OCC and on one workstation placed in the Station Control room (SCR) with each Station Controller
- Automatic train protection (ATP) is a type of train protection system which continually checks that the speed of a train is compatible with the permitted speed allowed by signalling .
- ATP activates an emergency brake to stop the train.
- Automatic train operation (ATO) is system which operate the trains automatically from station to station while remaining within the safety envelope of ATP & open the train doors.
- ATO can control dwell time at stations and train running in accordance with timetable.

Background & Origin

- The aim of CBTC system is to increase capacity by reducing the time interval between train travelling along line.
- In Signal System based in the detection of the trains in discrete sections of the track called blocks.
- Each block is protected by signals that prevent a train entering an occupied block.
- Since every block is fixed by the infrastructure, these systems are referred to as fixed block systems.
- Moving Block is used now a days. Unlike, traditional Fixed Block each block is not traditionally defined by the infrastructure.

  Besides, the trains themselves are continuously communicating their exact position to the equipment in the track by means of a bi-directional link through Radio Communication.

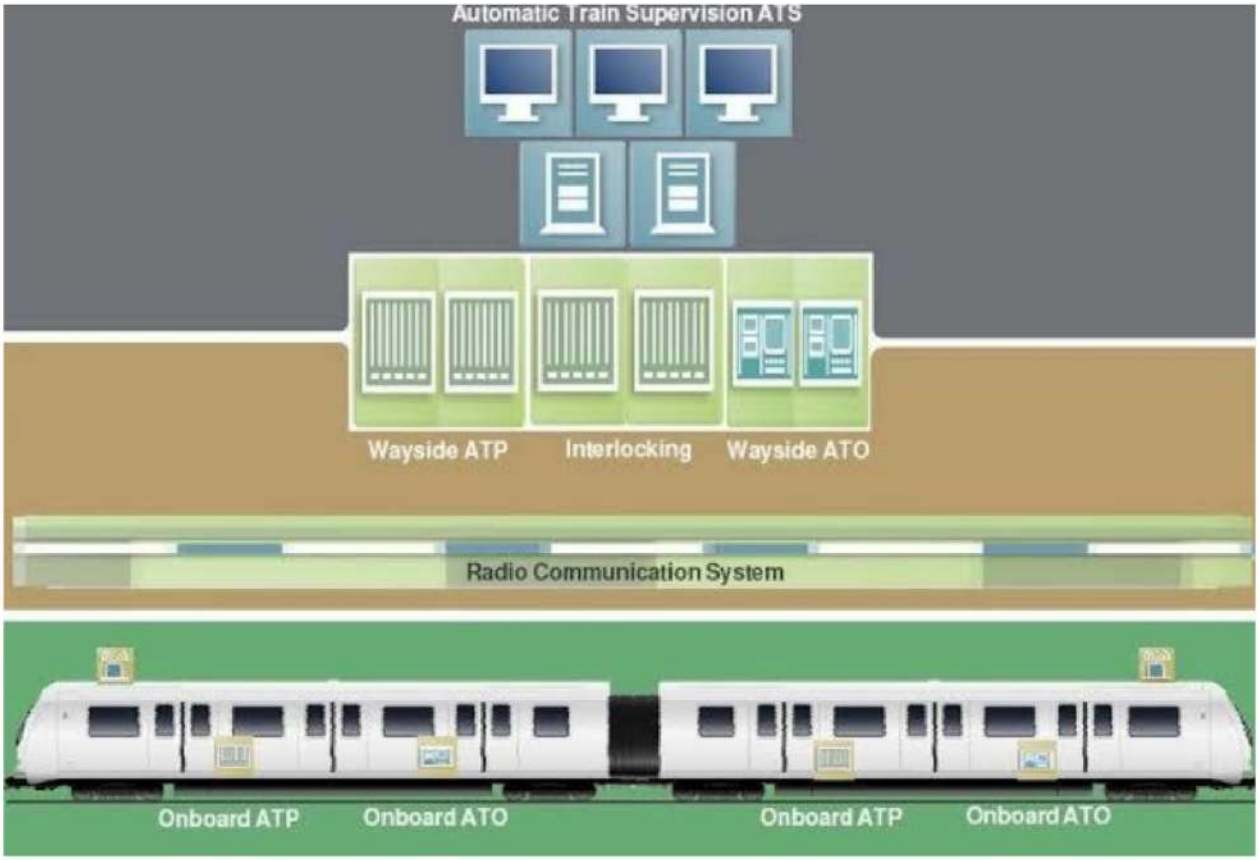

Occupancy
Occupancy
Fixed block
Footprint
Footprint
Moving block

DIAGRAM

Architecture

- The architecture of a modern CBTC system comprises the following main sub systems:
- Wayside equipment : which includes the interlocking and the subsystems controlling every zone in the line or network (containing wayside ATP and ATO functionalities).
- CBTC onboard equipment : including ATP and ATO subsystems in the vehicles.
- Train to wayside communication subsystem : currently based on radio links.
- Zone Controller(ZC): The ZC architecture guarantees immediate transfer of control with no impact on the availability ofthe system in the unlikely event of a failure. More importantly,maintenance operations can be carried out during revenue service with no impact on the performance of the system. Each ZC unit is integrated with adjacent ZC's and communicates with interlockings and carborne controllers to guarantee that all aspects of operation and controls are safely managed.
- Car-borne Controller: Carborne controller uses safe, reliable and compact 2 out of 3 architecture, which vitally determinesthe vehicle position with the highest accuracy. This information is then relayed back to the ZC. Based onthe moving authority limits received from the ZC, the CC calculates its braking curves and enforces speed restrictions. The Carborne controller also integrates two ATO processors to provide full automatic operation.

RADIO LAYOUT

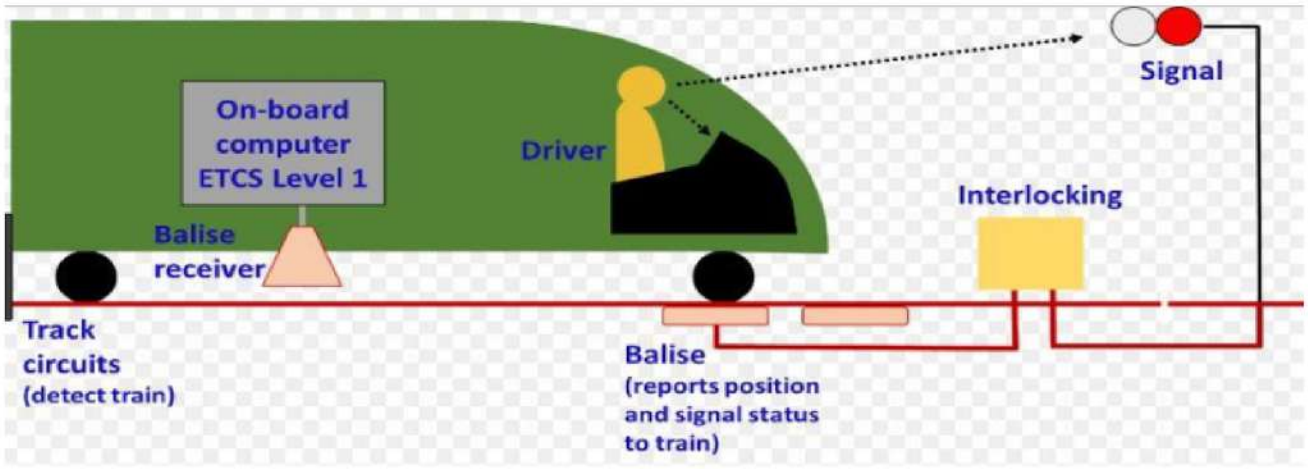


SYSTEM ARCHITECTURE

The following logical components may be found generally in a typical CBTC architecture:

- Onboard ATP system : This subsystem is in charge of the continuous control of the train speed according to the safety profile, and applying the brake if it is necessary.
- Onboard ATO system : It is responsible for the automatic control of the traction and braking effort in order to keep the train under the threshold established by the ATP subsystem.
- Wayside ATP system : This subsystem undertakes the management of all the communications with the trains in its area. It also calculates the limits of movement authority that every train must respect while operating in the mentioned area.
- Wayside ATO system : It is in charge of controlling the destination and regulation targets of every train. It also provides all the trains in the system with their destination.
- Communication system : The CBTC systems integrate a digital networked radio system by means of antennas for communication between the track equipment and the trains. The 2.4GHz band is commonly used.
  ATS system : The ATS system is commonly integrated within most of the CBTC solutions. Its main task is to act as the interface between the operator and the system, managing the traffic according to the specific regulation criteria.

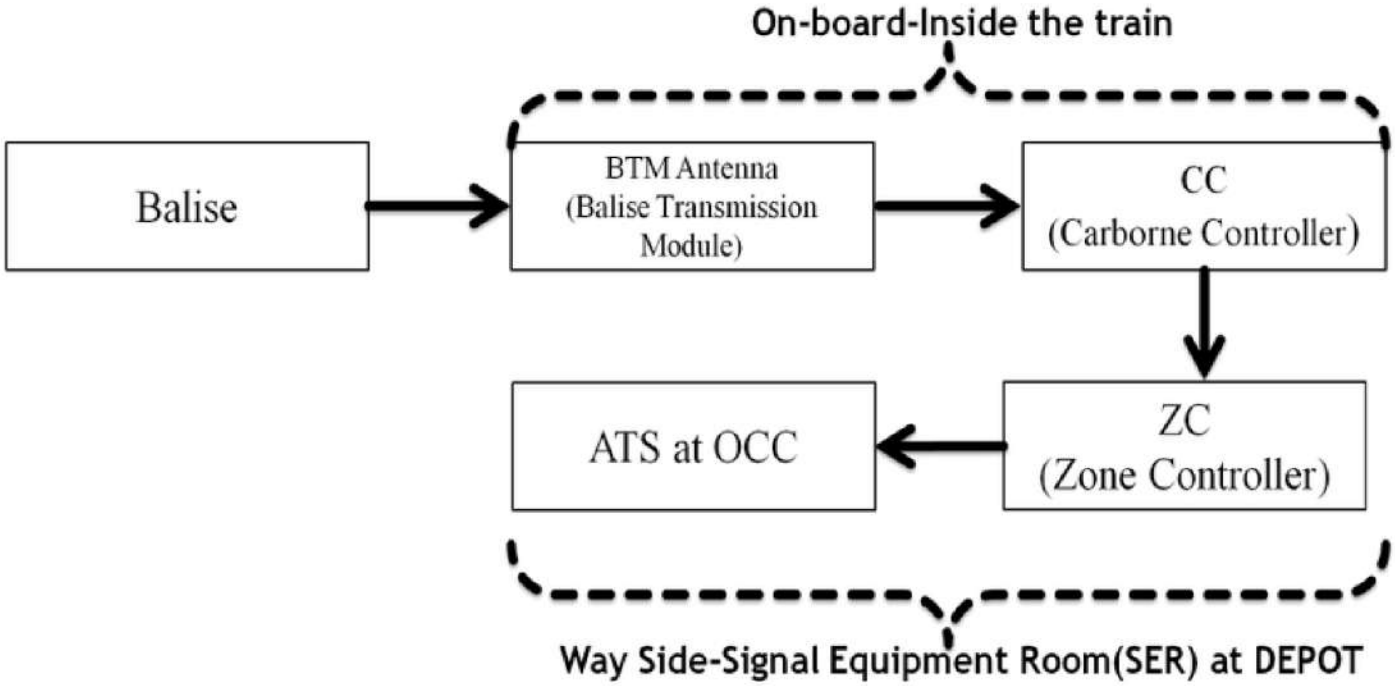
How CBTC knows Train Location?



SYSTEM ARCHITECTURE

- Balise-Balise is an electronic beacon or transponder placed between the rails of a railway as part of an automatic train protection (ATP) system. Transmission device (passive transponder) that can send telegrams (or tele-powering) to an on-Board subsystem passing over it. The on-board system tracks the train's location by counting wheel rotations, and correcting at fixed locations known as balises.It is laid on track at every 150 meters.
- Interlocking(IXL)-It provides occupancy data of a particular block.

Flow Diagram



Automatic Train Protection(ATP)

• Automatic train protection (ATP) is a type of train protection system which continually checks that the speed of a train is compatible with the permitted speed allowed by signalling, including automatic stop at certain signal aspects. If it is not, ATP activates an emergency brake to stop the train.

Features of ATP:

- To provide protection to passengers.
- To apply Emergency brake if the train exceeds the moving authority limit provided by the zone controller or train exceeds the advisory speed.
- In case of ATP no train can cross the dead end signal unless it is in degenerative mode.

Features of Zone Controller:

- Train Detection.
- Activation/Deactivation of wayside CBTC.
- Train Separation Information.
- Train Integrity.
- PSD Interface
  Hold(MAL-0)/Skip(MAL-Advisory Speed)

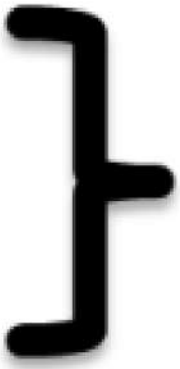
Features of Car-borne Controller:

- Direction Detection.
- Speed Determination.
- Over speed protection.
- Emergency brake application.
- Door control.
- CBTC modes and operation.
- Roll back/Slide protection.
  Driver Interface(TOD).

Modes of operation:

- UTO-Monitoring,anouncement,door control in a train is automatic.
- ATO-train operator can only close the door.
- ATD-Verifies passengers safety,TO can open and close the doors.
- ROS-When signal is lost,it automatically switches to ATP automatically(Speed is less than 25Kmph).
- RM-In this mode,the train has to be restarted and switched to ATP mode automatically.
- Reverse-Use to move the train in reverse direction(Not greater than 10 meters).

- UTO
- ATO
- ATD
- ROS



ATP Mode

- RM
- REVERSE

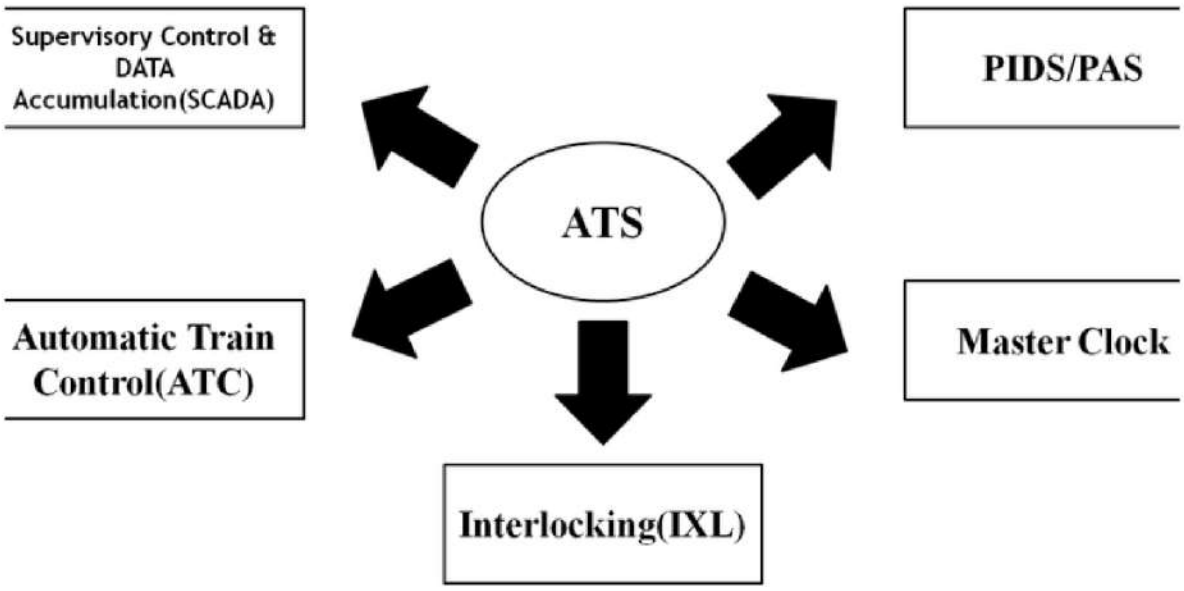
Degenerative Mode

Automatic Train Supervision(ATS)

- Automatic Train Supervision is a train supervision system to facilitate the monitoring of train operation and also remote control of stations.It will log each train movement and display it on workstations with each Traffic Controller at OCC(Operational Control Center) and on the workstations placed in Station Control Room(SCR) with each Station Controller.

Functionalities:

- Automatic route Setting
- Automatic train Regulation
- Continuous tracking of train position
- Display Panel and workstations interfasce
- Link to Passengers Information Display for online Information
- Computation of train schedules and timetables



DIAGRAM

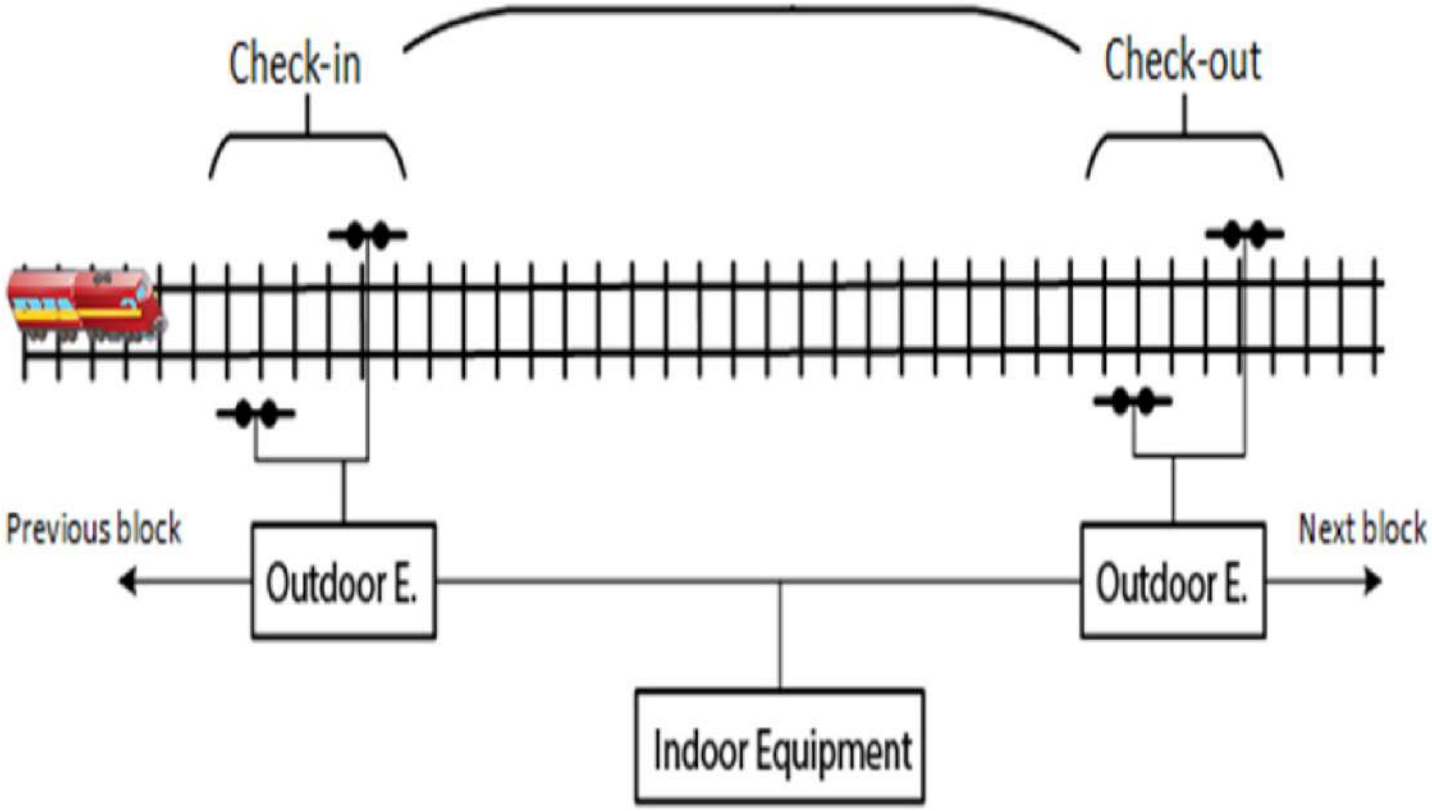
- SCADA-Used to detect logs
- ATC-Automatic train control is a general class of train protection systems for railways that involves a speed con
- PIDS/PAS-Used to display train information like train times of arrival.Works according to time table
- IXL-It provides information about occupancy of track to the zone controller.
- Master Clock-If any system lags by 1 sec,it generates error.Connected to GPS.

Axle Counter

DIAGRAM

- An axle counter is a device on a railway that detects the passing of a train between two points on a track.
- A counting head (or "detection point") is installed at each end of the section, and as each train axle passes the counting head at the start of the section, a counter increments.
- A detection point comprises two independent sensors, so the device can detect the direction and speed of a train by the order and time in which the sensors are passed.
- As the train passes a similar counting head at the end of the section, the system compares count at the end of the section with that recorded at the beginning. If the two counts are the same, the section is presumed to be clear for a second train.

Components of Axle Counter



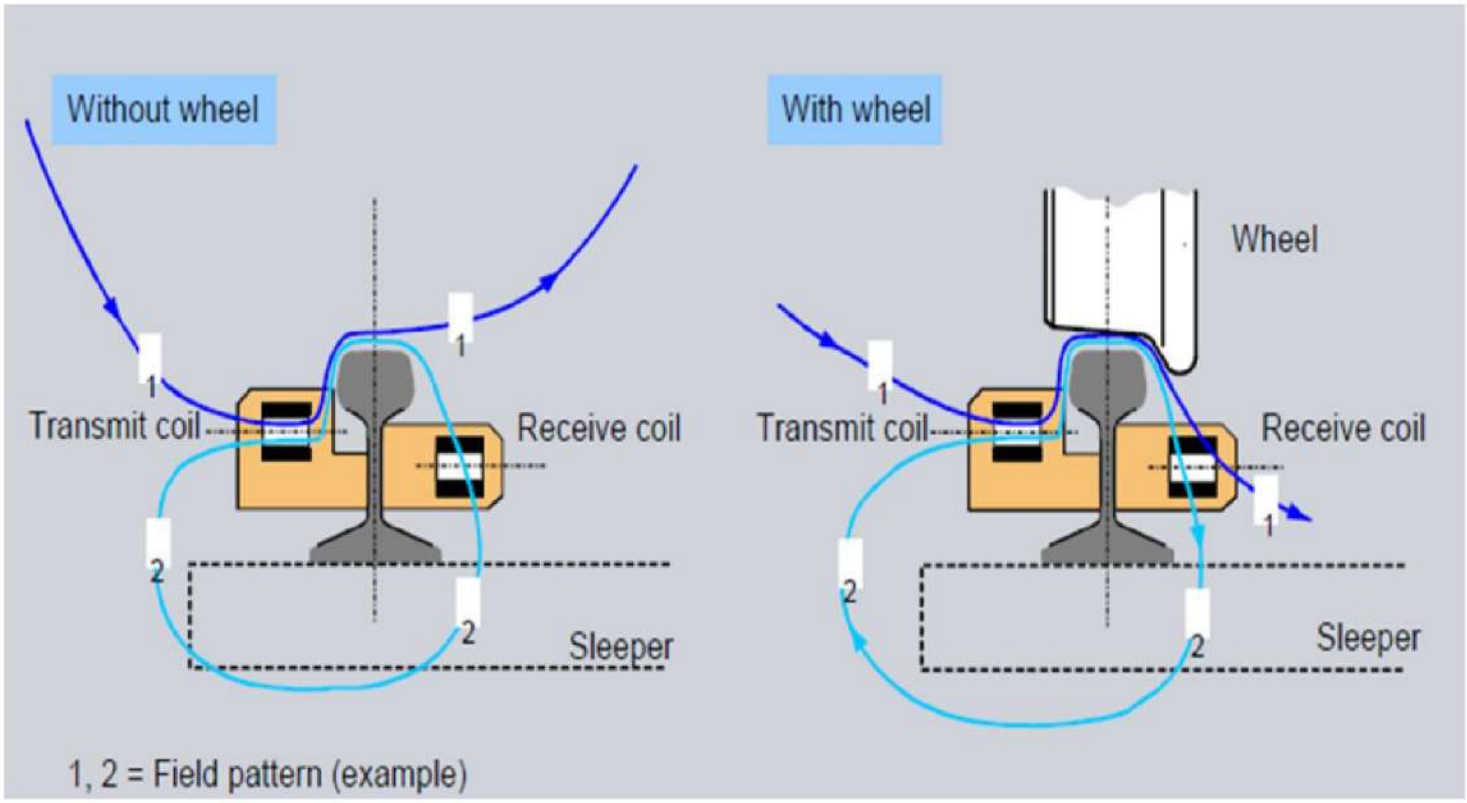
SYSTEM ARCHITECTURE

The main components of the system are:

- Outdoor equipment (detection points in the track area)
- Information transmission equipment (cables)

  Indoor equipment (evaluation, indication & resetting)

Counter



SYSTEM ARCHITECTURE

Advantages of CBTC

- Moving block instead of fixed block hence Optimized train speeds to gain best line capacity
- Ease of upgradation to Driverless system
- Ease of maintenance ;
- Easy expansion;
- Ease of Obsolescence management;
- Minimum trackside equipment.

Risks

- The primary risk of a CBTC system is that if the communications link between any of the trains is disrupted then all or part of the system might have to enter a failsafe state until the problem is remedied.
- Communications failures can result from equipment malfunction, electromagnetic interference, weak signal strength or saturation of the communication medium.
- CBTC systems that make use of wireless communications link have a much larger attack surface and can be subject to various types of hacking.

4. Conclusion

- **CBTC Delivers**
- **Reliability-**
- Proven technology and components from a global leader in Mass Transit signalling and turnkey systems
- Compliance with the IEEE Standard 1474.1™ for CBTC
- Performance and Functional Requirements
- Central Office System used by major Rail and Mass Transit operations around the world
- Distributed architecture ensuring redundant operations
- Encrypted wireless communications providing secure data transmission

- **Flexibility-**
- Modular, component-based architecture that easily adapts to existing systems
- Scalable solution accommodating future growth and network modifications
- Interoperable system compatible with other supplier's devices
- Overlay solution for upgrading existing systems
- Optimized vehicle energy consumption

Results

- Highest standard in passenger satisfaction
- Increased traffic capacity and improved on-timeperformance
- Improved operational headway down to 60 seconds andlower, constrained only by turnbacks and line layout
- Reduction or elimination of track circuits and signals
  Less and easier maintenance