Users´ System Requirement Specification (SRS)

Consultancy Services for Design of Radio Telecommunication System for Sri Lanka Railways

Colombo Suburban Railway Project

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Contents

Section 1 Introduction

Rail transport systems require an efficient communication system to make its services more reliable and attractive for passengers. A well planned, uninterrupted communication service could help in meeting the modern services and facilities needed by rail passengers. Therefore, provision of a new Telecommunication systems with modern facilities is an essential step to be taken along with the modernization of the Sri Lanka Railways (SLR). All communication requirements of SLR regarding voice and data, will have to be considered when modernizing the Telecommunication System and should provide common technological and operational features for the entire railway network.

Also, it is important that the selection and acquisition of the related technology to be done after careful considerations of all factors; for ensuring the high level of services availability under normal and emergency situations and ability to sustain the service requirements for the next 20 - 30 years.

Section 2 Purpose

The purpose of the System Requirement Specification (SRS) document is to specify a set of technology independent user requirements for new Islandwide Communication System for Sri Lanka Railways (SLR). The System covers all the railway Stations and Trains in the Three Operating Divisions and shall fulfill current and future requirements of the operating, maintenance, commercial and administrative needs under normal and emergency conditions for SLR for the next twenty, up to 30 years.

Some of the below mentioned Systems are not directly covered by the Railway Communication System but their impact needs to be considered, for example in the data communication capacity considerations.

The System Requirements in this document have been collected from SLR reports, documents and materials and from SLR personnel according to the TOR documents. Also, the global Railways´ Communication Systems development and future standards have been analyzed, UIC User Requirements Specification in Future Railway Mobile Communication System (FRMCS) have been included in relation to SLR situation.

It should be noted that this document is not part of the Bidding Documentation, but it could be included as a ´Supporting Document´ - if so decided. More detailed technical system requirements will be defined in the bidding documents.

Section 3 Present System of Telecommunication in SRL

Present Telecommunication System consists of cable based systems and analog VHF/UHF radio system as summarized in the table below.

	Line	From	To	Telecommunication		General
				Train Dispatching	Maintenance	
1	Coastal	Maradana	Matara	OFC based ATM system (Wenzel)		Public Telephones
2	Main	Maradana	Rambukkana	Copper cable based system Station call type	Copper cable based system Generator ringing code type	
		Rambukkana	Badulla	UHF/VHF Radio Communication		
3	Puttalam	Ragama	Negambo	Copper cable based system Station call type	Copper cable based system Generator ringing code type	
		Negambo	Puttalam	UHF/VHF Radio Communication		
4	Kelani valley	Colombo	Avissawella	Public Telephones		
5	Matale	Peradeniya	Matale	UHF/VHF Radio Communication		
6	Northern	Polgahawela	Maho			
		Maho	Anuradhapura			
		Anuradhapura	Kankesanturai	OFC base System + Radio Communication		
7	Talai Mannar	Medawachchiya	Talai Mannar			
8	Batticoloa	Maho	Batticoloa	Radio Communication + Public Telephones		
9	Trincomalee	Galois Junction	Trincomalee			

Summarized Details of Present Telecommunication System in Sri Lanka Railways

Copper Cable based Telephone System

This system has been installed in mid 1960s with the introduction of CLS system to SLR. Performance of this system is poor and the system does not have capacity to meet the present needs nor any of the future needs. Complete replacement with modern communication facilities is needed.

Sections from Maradana to Pallewela and from Ragama to Negambo are provided with omnibus type communication facilities using paper insulated, copper cables as follows:

- Train dispatcher's system connecting stations and the Signal Post Telephones.
- Station call bell system is used by the Train despatcher to originate a call and the despatcher can hear through the speaker phone when a station master is calling
- Maintenance Telephone system – Generator ringing code type

Optical Fibre based Telephone System

Optical Fibre Cable based ATM telephone system (Wenzel, Germany) is in operation from Colombo Fort to Marata. This system provides the facilities for train dispatching, maintenance and other operational purposes with selective dialing and includes the train radio system. SLR is facing difficulties for maintaining the signal post telephones due to lack of weather proof telephones. This system is performing well except the Train Radio system.

Twenty-four core Optical fibre cable has been laid from Anuradhapura to Kankasanturai and from Medawachchiya to Talai Mannar Pier in 2013/2014 under the rehabilitation of Northern Railway lines. This OFC based system is used for voice communication and backup connection for Block instruments.

Existing Radio Communication

UHF/VHF Radio communication system is in operation for stations areas shown in Table 1 since early 1980s. This system operates in 430MHz range and 160MHz range. SLR is using the Sri Lanka Telecom towers as repeater stations for its backbone network. Main antenna tower is located near Maradana station. Presently three operating consoles are assigned for Mainline, Northern line and Puttalam line to communicate with the stations beyond the Centralized Traffic Controlling area.

Main switching equipment of this system has been completely damaged due to a heavy lightning strike in 2007. Damaged equipment was replaced in 2008/09 and the system has been brought back to normal.

However, this system is not in operation for some station due to lack of spare parts and aging of equipment. Modern radio communication facilities are essential for the CTC area as well in order to have more effective train operation directly with train drivers, leaving the fixed cable system as a backup system.

The recently installed radio communication system for northern lines too does not provide continuous communication with the operating staff and the expected operational features have not been met.

Problems and Drawbacks with the existing Systems

I. Performance of the existing telecommunication facilities are poor; and the system is very old, outdated and unable to maintain due to lack of spare parts

II. The above system does not provide train communication facilities which is essential for effective Train controlling. Today the train communication is handled through third party (mainly via Station Master) or using private mobile phones.

III. Not having a proper system to communicate with all sub stations (Train halts) causing inconvenience to passengers.

IV. Existing magneto telephones system to communicate with level crossing gates do not function properly due to lack of spare parts, and contribute for train delays.

V. Even though the existing ATM communication system serves train operation (if the driver stops the train to the signal post) and maintenance purposes, the train radio system is inoperative and most of the signal post telephones also not functioning due to lack of suitable weather proof telephones.

VI. Existing UHF/VHF radio communication system is unable to maintain and expand the system due to lack of spare parts and does not have the capacity for providing train radio system and data transmission.

VII. Voice recording facilities are not available.

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VIII.   Proper mobile communication system for the field staff (shunting operation, Technical, security etc.) not available and provision of such facilities will enhance the operational and maintenance efficiency.

IX.   Present system does not provide communication facilities for all technical divisions for effective maintenance management.

X.   Inability to transmit data.

Section 4   General System Requirements

4.1   Major System Capabilities

Major System Capabilities specified in collected SLR reports, documents and materials and from the Project Documents and Reports, for example TOR Documents.

- Islandwide Railway Communication System, Fixed and Radio Networks
- Cover all the Railway Stations and Trains in the three Operating Divisions
- Fulfill current and future Operating needs of SLR for the next 20 years
- Compatibility for the Future Expansions (Modular Design)
- Scalable System to cope with changes in Train Traffic and changes in the Communication needs of the Railways
- Clear Prioritization of the System Components for Implementation due to the urgent need of the Radio Communication System
- Minimum disruption of ongoing operation
- Increase the attractiveness of the Railway System (Passengers)
- Preferable 450 MHZ Frequency Band, depending of the Telecommunication Regulatory Commission of Sri Lanka (TRC)
- Capacity, reliability, availability, maintainability, quality of services are characteristics to be used to meet the operational needs of the railways
- The End-to-End performance shall be better than in the legacy systems
- The system shall be flexible to support new created apps in the future

4.2   Major System Functionalities

Major System Functionalities specified in collected SLR reports, documents and materials and from the Project Documents and Reports, for example TOR Documents.

- Voice, Data and real-time transmission of Video images
- Utilize the existing Optical Fiber Network for the Backbone when possible
- Wireless Transmission or leased out fiber options when SLR Fiber Network not available
- Network Management
- Radio Telecommunication
- Telephone Switching for Mobile and Fixed Telephone Network (PSTN)
- System shall be capable of working with 120 km/h or higher Train speed
- System shall meet the International Standards
- All Equipment included shall be in accordance with the requirements of stipulated by the Telecommunication Regulatory Commission (TRC) of Sri Lanka
- Communication between near-by devices shall be possible in the event of loss/lack of infrastructure
- The System shall be able to prioritize data or voice communication to ensure that eligible communication is able to be established when required.

Section 5   User Requirements

User Requirements collected according to the TOR Documents and Guidelines from the ADB and the Ministry of Transport & Civil Aviation and specially from the **Meetings held with all SLR User Groups / Departments**.

5.1   General Requirements

- Reliable, Robust, Safe and User Friendly
- Optimal Voice Clarity, Data and Video Stream, SMS/MML
- Dedicated Network for SLR
- Wireless System, Reliable Handheld Devices with a Good Coverage
- Number of communication instruments to be minimized
- Ensure availability of signals inside Tunnels
- Backup Channel available within SLR or from Service Providers
- Meet the Operational Requirements under Normal and Emergency Conditions
- Interconnection between all three Divisions

5.2   Physical Requirements

- Power Feed, Charging available in Locomotives
- Long Life Batteries with extra batteries
- Headsets & Microphones for Locomotive Devices
- Light Handhelds
- Fixed Devices with Touch Panels
- Mobile Devices with Touch Panels

5.3   Feature Requirements

- Automated Frequency/Channel change, only one Configuration needed at the beginning of the Train Trip
- Automatic, and where required controlled, transition with no interaction required by the user; no interruption in the usage of the application during a transition
- Language: English
- Real-Time, suitable accurate Train Position information, Delays and Changes available (GPS location feature)
- Onboard Information
- Onboard CCTV
- Functional Addressing
- One-to-One, Group and Emergency Calls with Priority Categories
- Various configurable Incoming Call Tones
- All Voice and Data conversations and Call History Recorded (Missed, Answered, Dialed) to support analysis
- Interface to Locomotive Management / Failure System
- Audiovisual Alarm for Incoming Calls / Messages
- Different Audiovisual alarms to indicate Priority Levels
- Driver to be able to Connect Other Train Drivers in the Area
- Maintenance Supervisory System
- Self-fault diagnostic analysis for faulty to utilize possible alternative routing
- Over-the-air software updates, configuration changes, fault diagnosis and rectification

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5.4 Connection Requirements

Voice Telecommunication connections for Train Operation. Point-to-point, Group and Emergency Calls including Prioritization Categories and Functional Addressing. OCCs of the three Divisions to have an interconnection available.

Any authorized user shall be able to set up an emergency communication to other users within an automatically configured area or group, which is based upon the originator´s location or characteristics and those users likely to be affected by the emergency.

Any authorized user shall be able to establish public emergency call to national public emergency number.

- Train Controllers (Dispatcher) – Drivers, all level Stations´ Masters, Shunters, Maintenance Staff, Staff Officers, Level crossing Gatemen, Security Officers, General Manager, Operating Superintendent and deputies, etc.

    Controllers have the highest Priority with All Call Priorities available. Controllers shall have a voice communication available to the Controllers in other Divisions. In some operational situations, a controller has to provide vocal information to all the drivers located on the same track/line(s), for example to provide confirmation that an emergency situation is closed and that trains are authorized to restart.

    A Controller shall be able to set up a data communication to the Train, for example to confirm the closure of an emergency situation, confirm the readiness of the train to start, level crossing instructions, etc.

- Drivers – Train Controllers, Guards and all Train Staff, Shunters, Other Train Drivers in the area

    Drivers have a high Priority rights including Group Call within a Train. Depending on driver input, the system shall automatically route voice communications to the controller responsible for the train movement (Long distance trains changing the division / controller).

    A Driver shall be able to set up a voice communication with entitled ground user(s) and/or other drivers. The selection could be based on the location of the train using a functional identity.

    A Driver shall be able to set up a multi-user voice communication to all drivers within an automatically configured area that is based upon the originator´s location. There may be circumstances when a Driver is required to pass or request relevant information to or from other drivers within an area with unknown functional identity.

    Drivers of different locomotives within the same train shall be able to set up voice communication. The driver shall be able to initiate voice communication to other driver(s) involved in the banking operation. An entitled Controller can join the voice communication without any action of the driver(s).

    A member of a Train Staff shall be able to initiate a voice communication with one or multiple other members of the train staff (of the same train).

- Station Masters – Train Controllers, Level Crossing Gatemen, Signalling Cabin, Shunters, Maintenance Staff, Security Officers, Other Stations

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- Staff Officers (Specified) – Station Masters, Maintenance Staff, Security Staff, Drivers
- Maintenance Staff – Controllers, Station Masters including a Group Call within the Maintenance Team

> Trackside workers to have access to a secure voice communication system that enables them to communicate with others, including Controllers for example to enable a possession of the line to be taken and subsequently given up once the maintenance activity is complete.

- Shunters – Controllers, Drivers including a Group Call within the Shunting Team

> The shunting user shall be able to set up an uninterrupted voice communication with other shunting users, driver and/or with the entitled Controller(s) in order to provide information required to perform safe shunting movements of trains.

- Level Crossing Gatemen – Nearest Stations, Controllers
- Outside Interfaces: Police, Ambulance, Fire Brigade etc. in an Emergency Situation
- Trolleys on the Track, Marshall Yards, Workshop Teams, Patrolmen, etc. need to have Communication Devices
- Security – Drivers, Loco Sheds, Onboard Security Staff, Field Staff, etc.

5.5   Passenger Information Requirements
- Wireless internet on-train for passengers
- Wireless internet for passengers on platforms
- Passenger Information System Onboard and on Stations
- Electronic Ticketing and Seat Reservation System
- Self-Parking Ticketing System
- Public Feedback & Complain System Online

5.6   ICT Requirements
- SLR Intranet
- SLR SMS
- SLR e-mail
- Interconnection: ICT & MI

5.7   Marketing Requirements
- SLR Intranet with connection to Internet
- Public Info Advanced System (Railway Services available, Marketing on Internet, etc.)

5.8   Other Requirements
- Management Information Processing
- Accounting and Pay-Roll
- Human Resource Management
- Rolling Stock Maintenance
- Stores Management
- Operating Information Processing
- Tracking System / Parcels and empty Wagons
- Logistics and Tracking for Freight Trains
- Leased out land fee – Manage Leasing System

Section 6   Voice Requirements

Where the SLR Optical Fiber Network is available a Fixed Switching Telephone Network could be utilized to connect fixed locations, and utilize it as a backbone for the Radio Telecommunication Network as well.

Areas where there are no Optical Fiber Network available there are various options to build the backbone.

- Train Controller´s Interface / Dispatcher Console
- Train Drivers´ Console and Mobile
- Voice Recording with minimum of 3 months archive for all communication
- One-to-one, Group and Emergency Calls
- Prioritization Categories
- Programmable Functional Addressing (One-Touch-Calls)
- Dial Pad for dialing other phone numbers
- Push-To-Talk (PTT/PTV/PoC) Devices to work in the entire Network
- Caller identification
- The initiation of a voice communication shall be achieved with the minimum of interaction (for example, a single button press or selection from list).

Section 7   Data Requirements

Data Communication requirements are coming more important and the capacity requirements are increasing due to the Train Operation Safety needs and the more sophisticated Services Applications for Train Operations and Passenger Services.

Both Fixed Switching Telephone Network and the Radio Telecommunication Network need to be ready for high data communication demand, for example the Signalling and Train Controlling Systems.

- Centralized Traffic Management System
- Power Controlling for Railway Electrification
- Data for Operation Planning
- Train Time Table Management and Display
- Messages with Acknowledgement feature
- CCTV Real Time Surveillance System
- Support the Future Signalling System
- Passenger Information System
- Electronic Ticketing and Seat Reservation System
- Automatic Ticket Vending machines and gates
- Position Tracking available in all devices and available in OCC
- Document Transport
- Operation Management Information System
- Freight Information System
- Maintenance Management Information System (Track, S&T and Rolling Stock)
- Management Information System (Finance, Stores, Human Resources)
- A user shall be able to send and receive non-critical messages like text, recorded voice, data, pictures, video, etc.

Section 8   Security Requirements

All the Communication shall be secure encrypted to avoid outside access.

- CCTV Real Time Surveillance System
- Passenger Information System
- Intranet Connection between OCCs
- Vehicle fixed Devices and Mobile with Touch Panels
- "Kill Feature" Security of data in case of a loss of a mobile equipment
- Security Office to be able to contact all Offices Islandwide
- Cash Vehicles need Communication with Group call features for Guards
- Access to applications shall be configured within the system and based upon the permissions associated with each authorized user
- The system shall be able to mitigate (cyber) security threats
- The system shall be able to monitor the status (location, movements, etc.) of the trains and users working on the track area

Section 9   Technology, Training and Knowledge Transfer

In order to achieve successful Transfer of Technology, following steps are to be adopted and a comprehensive training for SLR Management, Operation and Maintenance Staff and all the Users of the Systems should be provided.

If the requested services and features will be outsourced and provided by "Public Operators" the scope of Training changes having focus on the user training.

9.1   Supply of Training Communication System Set, Components and Tools

The Supply should include the following Items (Minimum)

- All Hardware, Software and Applications Components of the Communication System
- SW Upgrades, Change Notes, etc.
- Tools and Testing Equipment
- Programming and Fault Diagnostic Tools

9.2   Training of SRL Personnel

The Training of Personnel to be arranged for the following areas:

- Communication System General Introduction – for the SRL Higher Management (to be included to all the Training)
- Training of the Trainers, Complete Training of the Systems – for the officers involved in the further training in SLR
- User Training including all the features – for the officers involved in the Train Operation
- Technology Training (Equipment) – for the officers and technicians involved in the maintenance activities
- System Management Training – for the officers involved in maintenance management

9.3   Expert On-Site Services for Knowledge Transfer

The Knowledge Transfer shall take place on the stages defined below. A detailed Knowledge Transfer Plan to be provided in the offer.

- Design
- Installation
- Testing & Commissioning
- Operation and Maintenance Period

9.4   Technology information

All the needed documentation of the whole System to be provided in order to be able to Operate and Maintain the System successfully.

- Installation Manuals
- Operating Manuals
- Maintenance Manuals
- System Descriptions
- Layout Diagrams
- Circuit Diagrams
- Specification Details
- Original Technical Brochures of the Equipment

Section 10   Operation and Maintenance Requirements

An Operation and Maintenance Organization shall be built with sufficient resources and skills to gain knowledge in System Operation, Maintenance and Modifications for the modern Communication System. The proposal shall include also a recommended number and heads and a period required for gathering the System Knowledge at desired level.

- Network Management System
- System and Failure Monitoring 24/7
- Tools, Instruments and Equipment as well as Transport Facilities
- Local Spare Parts included for next 5 years
- Supply of the Spare Parts available for the next 20 years
- Defect Liability period of 1 year and followed by a 3 years Warranty period
- Hardware & Software Support, Updates and Repair
- As Build Drawings and their updates
- Knowledge Transfer period for Operation, Maintenance and Modifications
- External alarms to be included, available for example with a SCADA / PLC System
- Roadmaps, Upgrades, Updates, Technical Notes, Change Notes, etc.

If the requested services and features will be outsourced and provided by "Public Operators" the scope of Operation and Maintenance of the Radio Communication System changes having focus on managing and controlling the Service Provider´s performance. Monthly Meetings are proposed to be tackled all the issues and development.

Section 11   International Standards

Relevant International Standards should be provided and followed regarding the Safety and Quality when designing and manufacturing the system and components.

Section 12   User Requirements for Connections

Table 1: Requirements for Telecommunication Connection

From	To													
	Train Despatcher	Station Master	Locomotive driver	Guard	Level crossings	Signal cabin	Shunting staff	Substation /Train Halts	Track Maintenance offices	S & T Maintenance	Loco Maintenance	S & T Equip. room	Security Staff	Staff Officers
Train Despatcher	X2	X1	X1	X1	X2	0	X2	X3	X2	X2	X2	X2	X2	X3
Station Master	X1	X2*	X1	X1	X2	X1	X2	X3	X2	X2	X2	X2	X2	X3
Loco. Driver	X1	X1	X2*	X1	0	0	0	0	0	0	X2	0	X2	X3
Guard	X1	X1	X1	X2*	0	0	0	0	0	0	0	0	X	X
Signal Post (one way)	X1	X1	0	0	0	0	0	0	0	X2	0	X2	0	0
Level crossings¹	X2	X2	0	0	0	0	0	0	0	0	0	0	0	0
Signal cabins	0	X1	0	0	0	0	0	0	0	0	0	0	0	0
Shunting staff²	X2	X2	X2	0	0	0	0	0	0	0	0	0	0	0
Substations³ / Train Halts	X3	X3	0	0	0	0	0	0	0	0	0	0	0	0
Platform Emergency Call (one way)	X2	X2	0	0	0	0	0	0	0	0	0	0	0	0
Onboard Emergency Call (one way)	0	0	0	X2	0	0	0	0	0	0	0	0	0	0
	For selected trains / All trains													
Track Maintenance	X2	X2	0	0	X2	0	0	X2	X2	X2	X2	0	X2	X2
S & T Maintenance	X2	X2	0	0	X2	X2	0	X2	X2	X2	X2	X2	X2	X2
Loco Maintenance	X2	X2	X2	X2	0	0	0	0	X2	X2	X2	O	X2	X2
S & T Equip. Rooms	X2	X2	0	0	X2	X2	0	X2	X2	X2	X2	X2	X2	X2
Security staff	X2	X2	0	0	X2	0	0	X2	X2	X2	X2	0	X2	X2
Staff Officers	X3	X3	0	0	0	0	0	X3	X3	X3	X3	0	X3	X3

Abbreviations

X	-	Connection required
0	-	Connection not required
1 or 2 or 3	-	Indicates the Priority Level
<u>Underline</u>	-	Indicates the requirement of message Transmission and Acknowledging facilities
All X1	-	Requires voice recording
*	-	Restricted facilities
		Station Master: Station Masters on the same line only
		Loco Drivers: Loco Drivers in the area only
		Guards: Guards in the area only

Superscripts

1	-	Level crossings in Colombo region connect to Train Despatcher and the nearest Station
		Level crossings in other regions connect to the nearest station only
2	-	Shunting staff connection to be done as required
3	-	Substations/Train Halts in Colombo region connect to Train Despatcher and the nearest Station
		Substations/Train Halts other regions connect to the nearest station only

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Table 2: List of User Equipment

	Item	Type	Number of Telephones			Total	Type Total
			Colombo Region	Nawalapitiya Region	Anuradhapura Region		
Fixed Telephones							
1	Train Despatcher	FT1	13	04	03	**20**	**20**
2	Station Master	FT2	75	38	52	**165**	**165**
3	Substations/Train Halts		137	52	53	**242**	**1500**
4	Level crossings	FT3	669	133	361	**1163**	
5	Signal cabins		17	32	46	**95**	
6	Signal Post (one way)	FT4	250	-	110	**360**	**655**
7	Platform Emergency (one way)		100	40	55	**295**	
8	Track Maintenance		26	12	20	**58**	**300**
9	S & T Maintenance		30	09	10	**49**	
10	Loco Maintenance	FT2	13	03	07	**23**	
11	S & T Equip. Rooms		64	-	27	**91**	
12	Security staff		15	03	04	**22**	
13	Staff Officers		46	05	06	**57**	
	Total					**2640**	**2640**
Mobile Telephones							
14	Locomotives/DMUs (Train Radio)	MT1				**275**	**275**
15	Onboard Emergency (one way)	MT2				**-**	**-**
16	Guard (Handheld)					**200**	**557**
1	Shunting staff (Handheld)		60	15	25	**100**	
18	Track Maintenance (Handheld)		26	12	20	**58**	
19	S & T Maintenance (Handheld)	MT3	30	09	10	**49**	
20	Loco Maintenance (Handheld)		13	03	07	**23**	
21	Staff Officers (Hand held)		46	09	12	**67**	
22	Security staff (Handheld)		35	10	15	**60**	
23	Staff Officers (Vehicle Radio)	MT4	27	03	04	**34**	**34**
	Total					**866**	**866**

Note:

1. See Tables A, B, C, D and E for details, Numbers can be amended as per SLR requirements
2. All Train Halts have been counted under Substations. Number to be reviewed, if housing facilities not available for any location
3. Number of Level Crossing include all Level crossing with Fully protection, Bells & Lights and No protection. Number to be reviewed
4. Number of onboard emergency telephones not estimated at this stage, to be decided later after discussion with SLR

Table 3: Special Features of Fixed and Mobile Telephones

	Type	Description
1	FT1	• Consist of a console which indicates all destinations marked so that the Operator can dial with one button. • Should be able to operate either with a Key board or Mouse • All incoming calls to be displayed in a list indicating origin and the time so that the Train despatcher can select any caller as per operational requirements. • Audio Visual alarms to be provided accordingly. • Incoming messages to be displayed on request. • Handset should be available including facilities for Hand free operation. • Facilities for Group calling, Call forwarding, Call baring Emergency calling should be available. • All conversations to be recorded.
2	FT2	• Shall be desktop type telephone with a reasonable display to read messages • Priority button should be provided for dialing the Tran despatcher. Dialing facilities to contact others • Different alarms to be provided for different priority levels for incoming calls • Priority level should be programmed according to the User.
3	FT3	• Desktop Type • Few buttons to be provided to contact as per the connection Table and shall not be able to dial any other destination. (Restricted dialing facilities)
4	FT4	• Shall be weatherproof type • Should be housed in a strong case with a lockable cover • To be mounted on a Wall or Post • Few buttons to be provided to contact as per the connection Table. • One-way telephone • Location identification to be transmitted when dialing.
5	MT1	• Train Radio – Should be a fixed equipment at convenient place for the Loco driver • Hand free operation required, Handset also to be provided • Should have a reasonable display to read messages • GPS features should be available • Train ID need to be programmed • Automatic channel changing facilities to be available.
6	MT2	• One-way Telephone to communicate with the Guard, • One button dialing. • Location identification to be transmitted when dialing.
7	MT3	• Hand Held, Push to Talk -type, Light weight • Should have display for receiving messages • Automatic channel changing facilities to be available. • Officers ID to be programmed
8	MT4	• Vehicle radio Type – Shall have other features of MT3. • To be fitted in Road vehicles

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Table A: Fixed Telephones for OCC, Main Stations, Substations and Train Halts

		1	2	3		4	5	6	7	8	9	10	11	12	13
Line	From/To	Train Despatcher	Main Stations	Sub Stations	Train Halts	Level Crossings	Signal cabins	Signal Post	Platform Emer. Tel.	Track Maintenance	S & T Maintenance	Loco Maintenance	S & T equip. Room	Security Office	Staff Officers. W/S, Other operations
Colombo OCC Region															
	OCC/Maradana/Dematagoda	02	-	-	-	-	--	-	-	-	-	-	-	-	41
1 Coastal	Maradana/Matara	06	30	38	-	319	-	130	45	09	10	2	31	07	07
2 Kelani Valley	Maradana Avissawella	01	11	19	07	111	-	40	11	03	3	1	11	01	-
3 Puttalam	Ragama/Puttalam	01	16	25	-	164	12	20	16	04	4	2	05	01	01
4 Main	Maradana/Rambukkana	02	13	24	01	48	-	60	23	07	12	08	17	05	01
5 Northern	Polgahawela/Maho	01	05	06	17	27	05	-	05	03	01	-	-	01	-
	Sub Total	13	75	112	25	669	17	250	100	26	30	13	64	15	50
Nawalapitiya OCC Region															
	OCC/Nawalapitiya	01													04
6 Main	Rambukkana/Badulla	02	33	08	25	105	30	-	35	10	07	02	-	01	01
7 Matale	Peradeniya/Matale	01	05	07	12	28	2	-	05	02	02	01	-	02	
	Sub Total	04	38	15	37	133	32	-	40	12	09	03	-	03	05
Anuradhapura OCC Region															
	OCC/Anuradhapura	01													05
9 Northern	Maho/Kankasanturai	01	27	20	05	117	29	80	30	10	07	04	20	01	
10 Talaimannar	Medawachchiya/Talaimannar		07	04	-	34	07	30	07	02	01		07	01	
11 Batticoloa	Maho/Batticoloa	01	14	17	04	122	10	-	14	06	02	02	-	01	
12 Trincomalee	Galoya Junc./Trincomalee		04	02	01	88	-	-	04	02	-	01	-	01	01
	Sub Total	03	52	43	10	361	46	110	55	20	10	07	27	04	06
	Grand Total	20	165	163	72	1163	95	360	295	58	49	23	91	22	61

Table B: Fixed Telephones for Level crossings

	Line	From / To	Level Crossings			
			Fully Protected	Bells & Lights	Un-protected	Total
Colombo OCC Region						
1	Coastal	Maradana/Matara	72	21	226	319
2	Kelani Valley	Maradana Avissawella	39	14	58	111
3	Puttalam	Ragama/Puttalam	42	29	93	164
4	Main	Maradana/Rambukkana	21	24	03	48
5	Northern	Polgahawela/Maho	9	-	18	27
		Sub Total	**183**	**88**	**398**	**669**
Nawalapitiya OCC Region						
6	Main	Rambukkana/Badulla	25	-	80	105
7	Matale	Peradeniya/Matale	16	2	10	28
		Sub Total	**41**	**2**	**90**	**133**
Anuradhapura OCC Region						
9	Northern	Maho/Kankasanturai	39	25	53	117
10	Talaimannar	Medawachchiya/Talaimannar	9	5	20	34
11	Batticoloa	Maho/Batticoloa	9	2	111	122
12	Trincomalee	Galoya Junc./Trincomalee	3	0	85	88
		Sub Total	**60**	**32**	**269**	**361**
		Grand Total	**284**	**122**	**757**	**1163**

Table C: Fixed Telephones for Staff officers attached to Main Offices

	Officer/Office	Fixed
1	GMR + 4 Addl. GM	05
2	OPS, DOPS GI/DIB/WC/DM/ SSMDA/ AOT/CCTV/CLY/SS FOT /Parcel/ Bookings	13
3	COM, Mkt. Mgr.	02
4	CAR	01
5	SRS MDA + RGM +RML	03
6	W & W (MDA 5+ PLG1+DMA2+ GLE1)	09
7	S & T	12
8	CEM	03
9	CME RML	02
	Sub Total	**50**
10	Nawalapitiya Region (SE, DS, DIB, GIB, DE U)	05
11	Anuradhapura Region (SE, DE, DS, DIB, GIB, DE TCO)	06
	Total	**61**

Table D: Vehicle Radios for Staff Officers

	Officer	Vehicle Radio Phones
1	GMR + 4 Addl. GM	05
2	OPS, DOPS	02
3	COM	01
4	CAR	01
5	SRS	01
6	W & W	05
7	S & T	06
8	CEM	02
9	CME	01
10	RPF	03
	Sub Total	**27**
10	Nawalapitiya Region	
	SE, DS, DE U	03
11	Anuradhapura Region	
	SE, DE, DS, DE TCO	04
	Total	**34**

Table E: Hand Held Radio Phones for Staff Officers attached to Main Offices

	Officer	Hand Held Radio Phones
1	GMR + 4 Addl. GM	05
2	OPS, DOPS + DTII	05
3	COM	01
4	CAR	01
5	SRS	01
6	W & W	10
7	S & T	10
8	CEM	02
9	CME	01
10	RPF	10
	Sub Total	**46**
10	Nawalapitiya Region	
	DS	03
	SE	03
	DE	03
11	Anuradhapura Region	
	DS	03
	SE	03
	DE ANP + TCO	06
	Total	**67**


# Section 13   Initial System Architecture

Initial System Architecture examples for a modern Railway Communication Systems today.

The example figures below and in Appendices Section show the complexity of the communication needs in the railway environment, and illustrates only a certain number of relationships between the actors (users) and equipment (trackside and on-board).

In case if SLR decides to build their own dedicated Railway Communication System, these are good references how it has been accomplished in many railways.

In case if SLR decides to outsource the services, these examples give good references which kind of services shall be included to the services agreement.
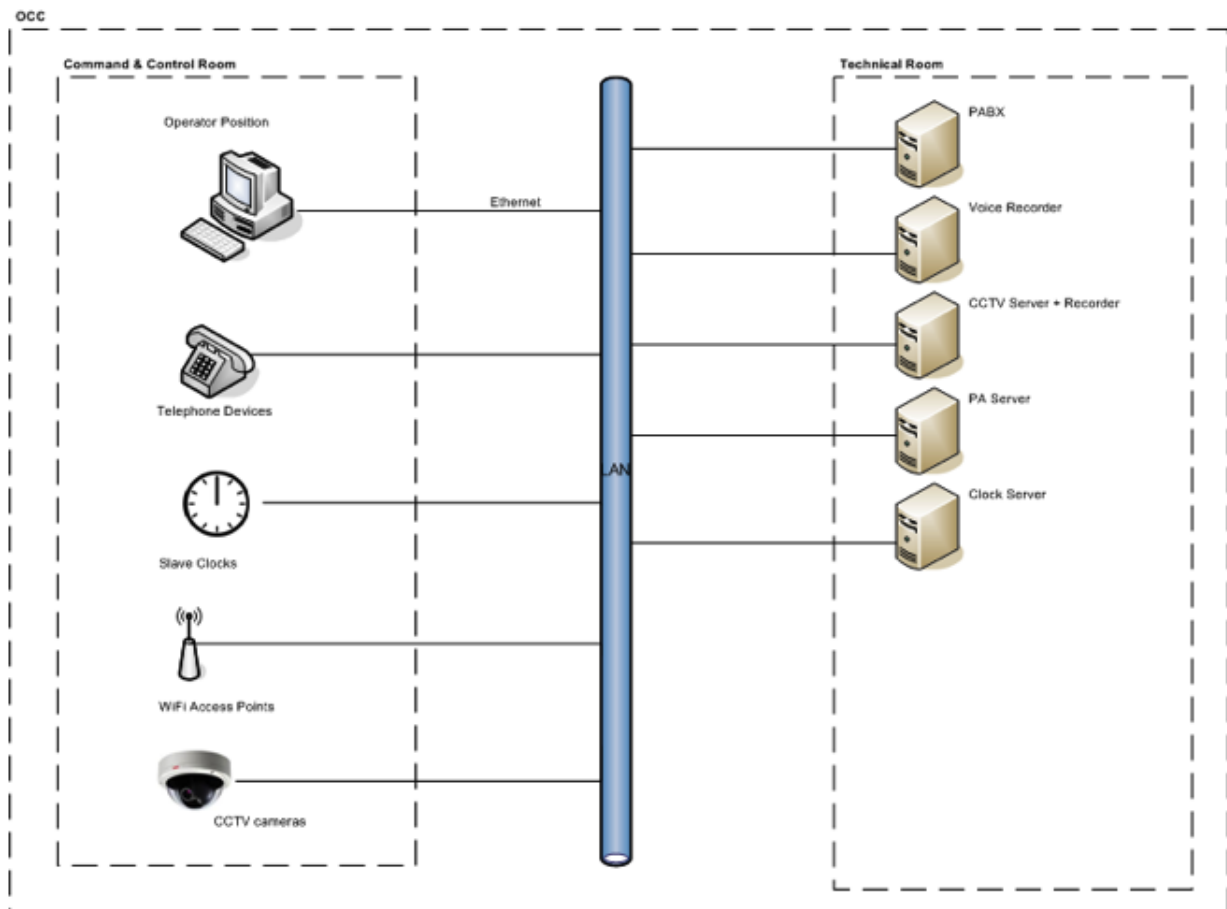

Application Layer Relationship Diagram from the user point of view.
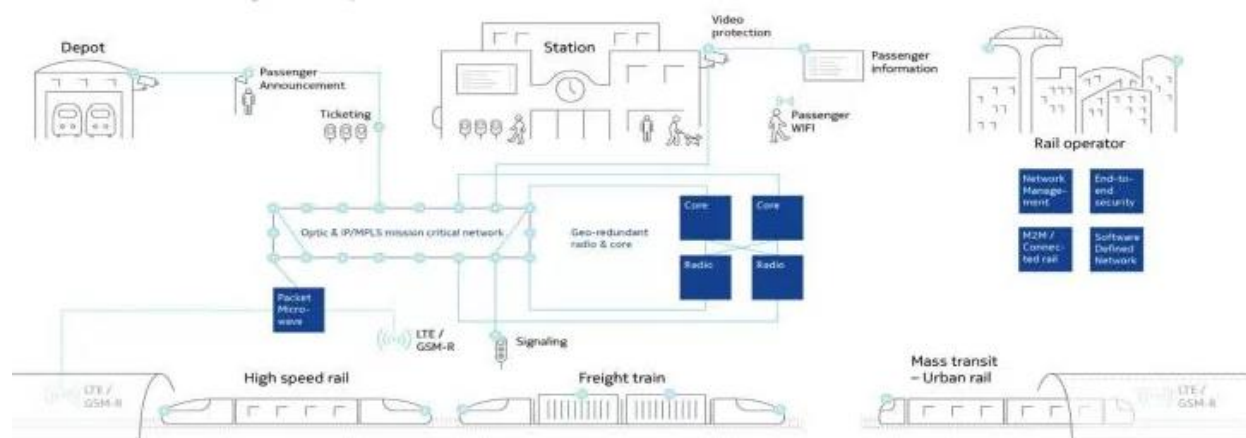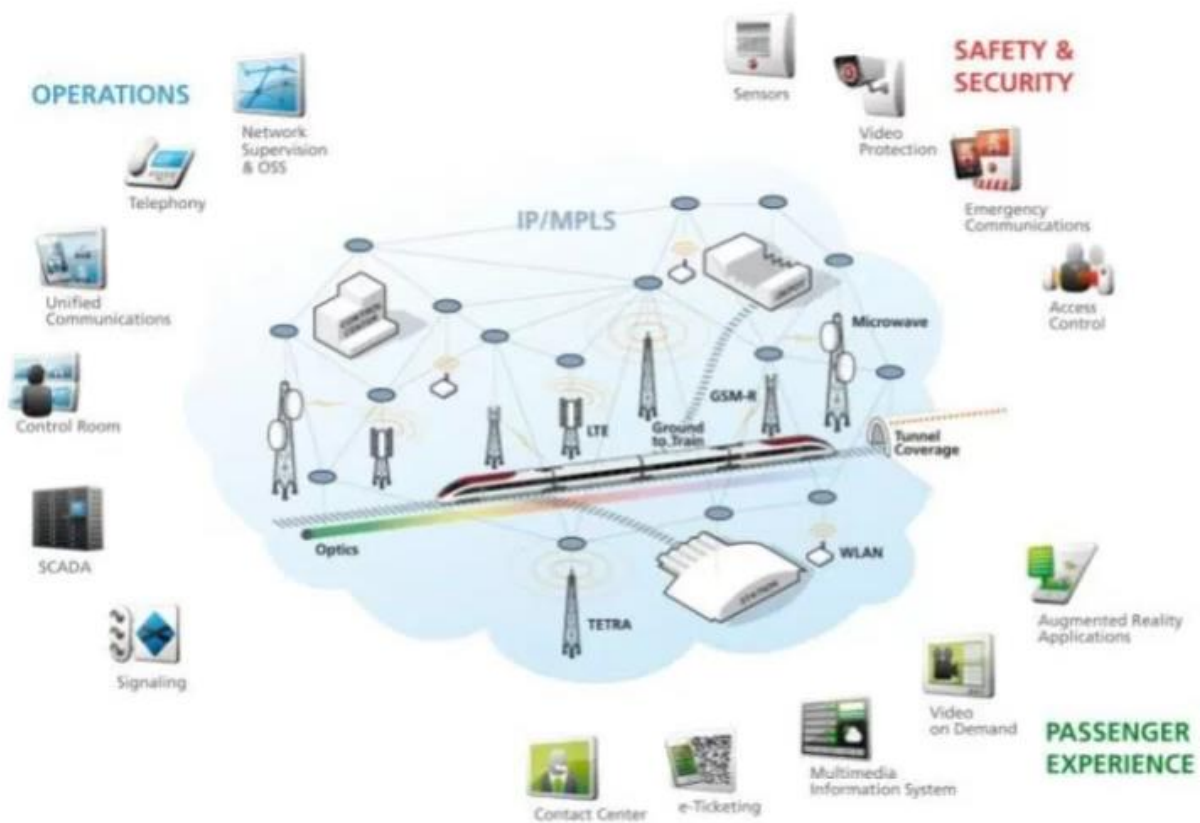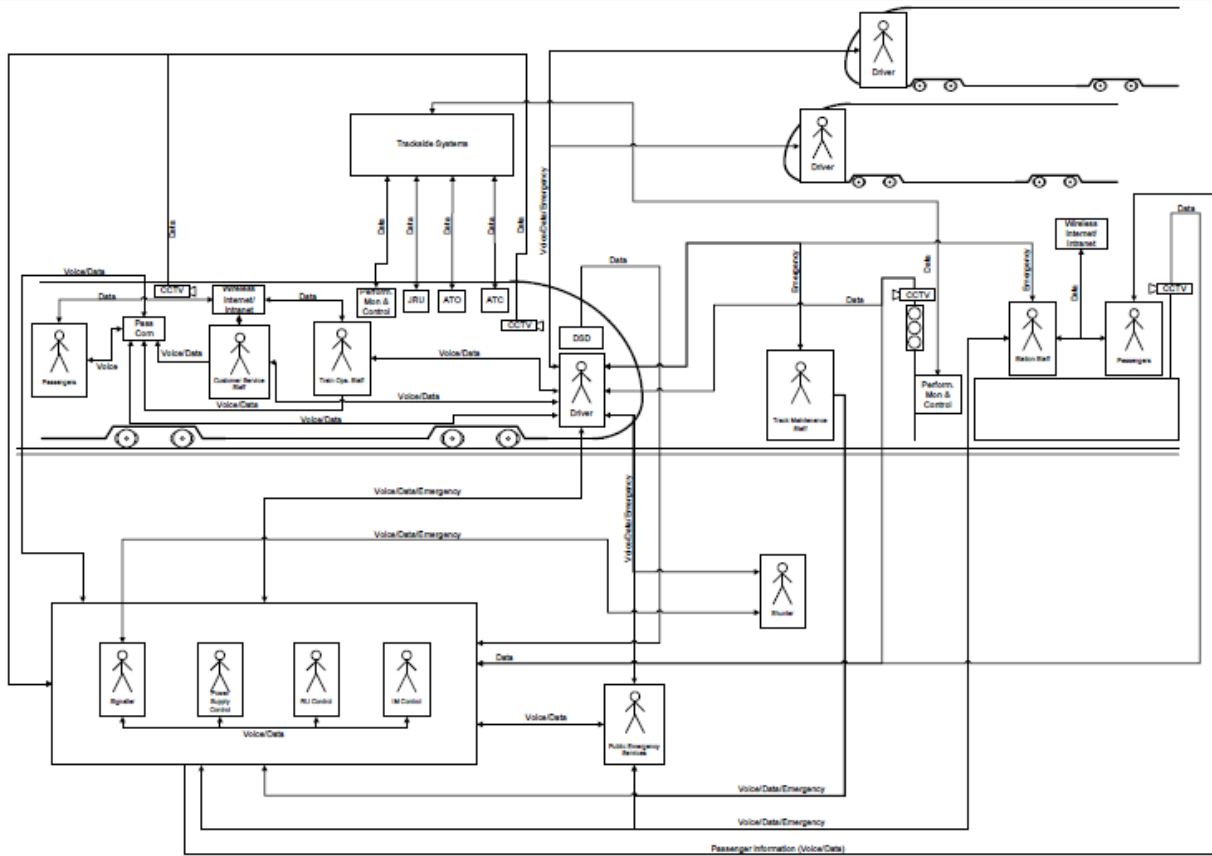
Section 14 Appendices

## 14.1 Telecom System Examples

Telecom System Overview

In the following Figure is depicted an overview of the Telecom System and its sub-systems.

Telecom system for OCC (Operational Control Center)

Egis Consultants
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Consultancy Services for Design of Radio Telecommunication System
for Sri Lanka Railways
Colombo Suburban Railway Project

System Requirement Specification (SRS) v3.0
19.10.2017

The following Figure depicts an overview of the Telecom System and its sub-systems, as well as how they interface each other in a Site.
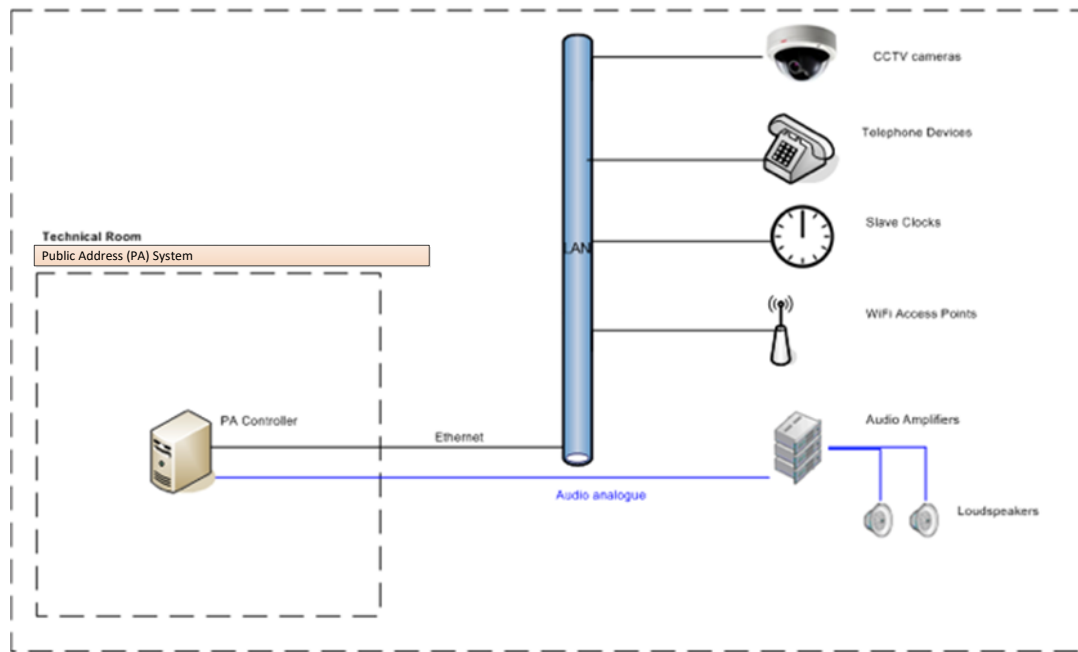
CCN Backbone

The content centric networking (CCN) solution is based on Multi-Protocol Label Switching-Transport Profile (MPLS-TP), with one (1) Gbit/s capacity for each Line. CCN physical infrastructure consists of an optical transmission medium designed and planned to transport communications and data services from Sites along the railway line. (e.g. voice, video, data signaling) to the corresponding OCC / BOCC, as well as management traffic.

CCN backbone solution based on Ethernet IP/MPLS consists of the following hardware: fiber optical (FO) cable, cable ducts, splicing enclosures, patch panels and connectors.

Operational & Administrative Voice Communications

The Voice Communication System is based on a common IP-PBX technical platform for Operational Voice Communications (OVC) and Administrative Voice Communications (AVC).

The OVC System is a highly reliable IP-PBX (VoIP) technology and PABX architecture, which provides voice communications in order that operational staff communicates for the train movement coordination on a safe and reliable way. The OVC System allows voice communications between OCC / BOCC dispatchers and staff for O&M purposes in sidings, train line crossing, passing loops and level crossing along the track lines.

The shelters located at sidings, train line crossings, passing loops and level crossings shall be equipped with two (2) operational phone terminal sets. Additionally, the radio base stations shall be equipped with one (1) operational phone terminal set.

OCC / Headquarters shall be equipped with operational dispatcher and operational phone terminal.

IP Phones shall be PoE.

Example of Indoor Desk IP Phone   *Example of indoor wall mounted IP Phone*   *Example of wireless indoor and outdoor phone*

More Examples of PTT mobile devices

Examples of Vehicle PTT devices

Example of Train Driver Console   *Examples of Train Dispatcher Consoles*

LAN / WAN System

The LAN/WAN solution is based on an IP/MPLS backbone (with ring topology) designed and planned to concurrently carry production traffic such as signaling, voice, video and other railways data services. IP/MPLS backbone is used to ensure high speed and reliable connectivity between Sites located along the track line: sidings, radio base stations, line crossing, passing loops, level crossings, OCCs and BOCCs.

Wi-Fi System

The WI-FI System provides WI-F coverage to sidings, radio base stations, line crossing, passing loop, level crossings located along the line. The WI-FI System is composed of multiple access points (APs) assuring radio coverage of the Sites and required areas.

Master Clock System

The Master Clock System is there to provide an accurate time synchronization signal for the other Systems. The Master Clock System consists of redundant Master Clock in OCC / BOCC and associated Slave, Digital and Analogue Clocks and Sites.

Closed Circuit Television (CCTV) System

The Closed Circuit Television (CCTV) System provides video surveillance and recording functionalities in order to monitor sidings, radio base stations, train line crossings, passing loops, level crossings, etc.

The System consists of control and management equipment, monitors and video recording located in OCCs and BOCCs, and cameras located to the referred Sites along line track.

Additionally, the CCTV System includes the Access Control Sub-system in order to manage and control the Staff access to Site shelters located along line tracks.

Example of IP Cameras

Voice Recorder (VR) System

The Voice Recorder (VR) System provides recording, archiving, searching and playback the Operational Voice Communications, both fixed and mobile communications.