Spec. Code	Specification Description
K_LV_DP270000	DESIGN, PERFORMANCE, MATERIALS AND WORKMANSHIP SPECIFICATION OF TELECOMMUNICATIONS AND LOW VOLTAGE SYSTEMS

ΠΕΡΙΕΧΟΜΕΝΑ

PART A GENERAL REQUIREMENTS

1 Introduction

1.1 This specification shall be read and shall apply in combination with the Technical Description, the Conditions of Contract, the General Specifications and the other Contract documents.

1.2 In the event of discrepancy between the requirements included in the Specifications and in any other documents, their order of prevelance shall be set in the Conditions of Contract. In the event of discrepancy between the requirements of this document, the strictest requirements shall prevail.

1.3 The purpose of this document is to specify the main requirements and specifications of the telecommunications and low voltage systems to be designed and installed for the Thessaloniki Metro extension to Kalamaria, from 25 MARTIOU crossover up to MIKRA forestation.

1.4 This Project shall supplement the Telecommunications and Low Voltage systems installed by the main Contractor of the Metro Extension to Kalamaria Project, in order to provide a fully operational Metro Project with high control and safety level for the passengers at the stations and the trains.

2 General Information

2.1 The effective and reliable operation of of the telecommunication and low voltage systems in an underground urban railway system is of primary importance for the operation of the entire system. The fact that telecommunication systems acceptable for a broad spectrum of uses are available should be taken into consideration. Nevertheless, suitable for use in the Metro systems are only those which meet the highest standards for contruction and reliable operation. These systems should meet special requirements concerning the operation of the railway system and the associated facilities. Moreover, the driverless Metro operation increases the technical requirements.

2.2 The telecommunication systems for Thessaloniki Metro Extension to Kalamaria shall be designed so as to ensure homogeneous operation in relation to the existing equipment of Thessaloniki Metro Base Project. Moreover, the appropriate interface points at operational and technical level should exist.

2.3 The Contractor shall examine the interface points and shall make the relevant provisions at design stage and during the installation of the equipment of Thessaloniki Metro Extension to Kalamaria, so as to ensure its full compatibility with the existing equipment of Thessaloniki Metro Base Project, and that no problems whatsoever are caused to the existing operation and that no technical or operational restrictions whatsoever are raised.

2.4 Part A of this Specification includes general information about all systems included in this Contract and the abbreviations used.

2.5 Part B of this Specification sets the required performance requirements and technical characteristics for the following telecommunication systems.

- Digital Transmission System (DTS)
- TETRA Radio System
- Public Address System (PA)
- Closed Circuit Television (CCTV) System
- Security and Safety System (SMS)
- Access Control / Intrusion Detection System (ACC/IDS)
- Passenger Information System (PIS)
- Integrated Central Communications System (ICCS)

2.6 Part C of the existing Specification includes the description of the respective existing telecommunication systems of Thessaloniki Metro Base Project, to be connected with the systems foreseen in this Tender in technical terms and in terms of operation.

2.7 Part D of this Specification includes the Special Requirements of the Specifications for the remaining equipment required for the completion of the Project, as well as supplementary requirements for all systems of the Contract.

2.8 The entire equipment and all works should respond to the respective International / European standards and must have been used in the past in a Metro system and/or by a Railway Organization. In this case, the term "equipment" means the machinery and facilites, as well as the hardware and software.

2.9 The Contractor should state the specifications that he shall observe and should describe in detail any inconsistencies/deviations of the specifications or any terms of the specifications that are not observed and should manage them either via technical and operational solutions equivalent at least or even better, or via the Technical Deviation procedure.

2.10 The Contractor should take into account the fact that the proposed telecommunication systems shall have the capacity of a future extension in relation to the central equipment (hardware and software).

2.11 The Contractor shall guarantee that the spare parts and technical support for reasons of maintenance, modification and extensions hall be available for a 15-year period from the date of commissioning of the system.

2.12 All drawings, time schedules and sketches shall be prepared in the form to be agreed with AM. All symbols, names and abbreviations shall be described in detail on the drawings and in the documents and shall comply with the ones used in the Base Project.

2.13 All drawings, diagrams and wiring tables, sketches etc. shall be documented by clear presentations of automation tables, flow charts and written descriptions explaining the operation of the proposed systems. Moreover, they shall be prepared based on AM's Planning Manual. All symbols, names and abbreviations shall be fully described in the drawings and shall comply with the ones used by AM.

3 Abbreviations

ACC	Access Control
ACELP	Algebraic Code-Excited Linear Prediction
AF	Acoustic Frequency
AFC	Automatic Fare Control System
AFNOR NFS	Association Française de Normalisation (code widely used in Europe)
AM	ATTIKO METRO
ATC	Automatic Train Control
ATIM	Automatic Ticket Issuing Machines
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
BACS	Building Automation Control System
BR	Base Radio
BRI	Basic Rate Interference
BTS	Base Transceiver Station
CCIR	Comité Consultatif International pour la Radio
CCITT	Comité Consultatif International Télégraphique et Téléphonique (new: ITU-T)
CCTV	Closed Circuit Television
CEI	Centralized Electronic Interface
CIE	Console Interface Electronics
CELENEC	European Committee for Electrotechnical Standardization
CIF	Common Intermediate Format
CLID	Calling Line Identification
CNID	Calling Number Identification
CPU	Central Processing Unit
DCF	German long-wave transmitter for time synchronization / 77,5kHz
DID	Direct Inward Dialing
DHCP	Dynamic Host Configuration Protocol
DLT	Direct Line Telephone
DLP	Digital Line Protection
DMO	Direct Mode Operation
DMT	Degraded Mode Terminal
DOD	Direct Outward Dialing
DSU	Diagnostic Services Unit
DTMF	Dual-tone Multi-frequency Signaling
DVR	Digital Video Recorder
EBTS	Dispatcher consoles
ECS	Environmental Control System
ECR	Emergency Control Room

EDP	Emergency Driving Position
EETT	National Telecommunications and Post Commission
EIA	Electronics Industries Association
EIS	Electronic Interlocking System
EMC	Electromagnetic Compatibility
EMP	Electromagnetic Pulse
EN	European Norm
ETSI	European Telecommunications Standards Institute
FDDI	Fiber Distributed Data Interface
FIADS	Fault Identification and Diagnostics System
FO	Fiber Optic Cable
FOBOT	Fibre Optic Break Out Terminal
GMT	Greenwich Mean Time
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
HVAC	Heating, Ventilation, Air Conditioning
IC	Inspection Chamber
ICS	Intercommunication System
ID	Identification
IEC	International Electrotechnical Commission
IP	Protection Index
IP	Internet Protocol
IREG	International Range Instrumentation Group
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector (formerly CCITT)
KHz	Kilo Hertz
LAN:	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LCX	Leaky Feeder Cable (Leaky Coaxial Cable)
LTE	Long Term Evolution
KHz	Kilo Hertz
Mbps	Mega bit per sec
MDF	Main Distribution Frame
MIS	Management Information System
MMI	Man Machine Interface
MTBF	Mean Time Between Failures
MPEG 4	Motion Picture Experts Group, Group of Methods for Image Coding

MVP	Medium Voltage Power
NFPA	National Fire Protection Association
nm	Nanometer
NMS	Network Management System
OBMS	On Board Maintenance System
OCC	Operations Control Centre
ODF	Optical Distribution Frame
OF	Optical Fiber
PA	Public Announcement System
PABX	Private Automatic Branch Exchange
PAMR	Public (Private) Access Mobile Radio
PCM	Pulse-code Modulation
PMR	Public (Private) Mobile Radio
PIS	Passenger Information System
PRCS	Power Remote Control System
PSD	Platform Screen Doors
PSL	Platform Screen Local Control Panel
PSN	Lift for Persons with Special Needs
PSTN	Public Switched Telephone Network
PTZ	Pan–tilt–zoom Camera
QoS	Quality of Services
RAID	Redundant Array of Independent Disks
RASTI	Rapid Speech Transmission Index (quality parameter for Announcement Systems)
RBS	Radio Base Station
RFID	Radio Frequency Identification
RPR	Resilient Packet Ring Technology
RS	Rectifier Substation
RTU	Remote Terminal Unit
SAP	Station Announcement Point
SDTS	Short Data Transport Server
SEP	Signaling End Point
STP	Shielded Twisted Pair
SCADA	Supervisory Control and Data Acquisition
SM	Station Master
SMR	Station Master Room
SMS	Security Management System
SNMP	Simple Network Management Protocol
STM	Synchronous Transport Module
TCP	Transmission Control Protocol
TCR	Traction Current Removal

TFT	Thin-Film Transistor (Flat Screens)
TETRA	Terrestrial Trunked Radio
TS	Transmission System
UGA/MUM	Central Unit (Control Unit)
UIC	International Union of Railways
UMS	Unified Messaging System
UPS	Uninterruptible Power Supply
VDE	Verband Deutscher Elektroingenieure
VDU	Visual Display Unit
VLAN	Virtual Local Area Network
VoIP	Voice Over Internet Protocol
VPN	Virtual Private Network
WAN	Wide Area Network
ECR	Emergency Control Centre
OCC	Operations Control Centre

PART B: DESIGN, PERFORMANCE, MATERIALS AND WORKMANSHIP REQUIREMENTS

1 General Assumptions

1.1 The following sections of these specifications provide a description of the performance requirements and technical characteristics applicable to the various telecommunication and low voltage systems to be installed in Thessaloniki Metro Extension to Kalamaria.

1.2 The entire equipment and all the works shall meet the corresponding ITU Specifications and shall have been used in the past by a Union of Railways/Metro. Here, the term "equipment" covers both the machinery, the devices, the facilities and the programs (software and hardware).

1.3 All drawings, diagrams and wiring tables, sketches etc. shall be documented by clear presentations of automation tables, flow charts and written descriptions explaining the operation of the proposed systems.

1.4 The telecommunication equipment and systems, in total and in part, shall meet any requirement or practice currently applicable or proposed to be applied which concerns the operation of an underground raiway for the transport of passengers in Greece.

1.5 Where applicable, all materials shall comply with the acceptable fire-safety standards, Greek and international.

1.6 All telecommunication systems, materials and equipment should be compatible and must continue to operate smoothly and safely in combination with the existing traction system and under the conditions and with the signalling equipment of Thessaloniki Base Project Line, as well as those implemented for Kalamaria Extension by the main Contractor of the Extension Project.

1.7 All designs, materials and equipment shall be of state-of-the-art, while their suitability in railway transport applications must be proven or, at least, they should have been efficiently used in acceptable applications.

1.8 All designs, materials, equipment and fittings to be supplied in the framework of this Contract shall be subject to AM's approval.

1.9 Power supply for normal operation shall be ensured by a 230 VAC. In case of power failure, all systems shall operate by means of the Uninterrupted Power Supply System, which shall ensure their continuous operation for 8 hours as regards radio communication, automatic telephones, direct telephone lines and the fiber optic network. The UPS system shall ensure continuous operation of 4 hours for PA, CCTV, Clocks system, PIS and ACC/IDS systems. The UPSs of the low voltage systems of this Project shall be provided by the main Contractor of Kalamaria extension.

1.10 The entire main equipment shall bear a serial number, in accordance with the Drawing Office Manual, the Project Breakdown Structure and the Equipment Modification.

1.11 The location, type and color of the materials and method for the installation of the Public Announcement System loudspeakers, the cameras of the Closed Circuit Television, the clocks, the Passenger Information Points to be installed in public areas shall be coordinated with the architecture of the station and shall be fitted with the station's architectural items for aesthetics. At the same time, the above must be coordinated with the lighting designs of the main Contractor of Kalamaria extension.

1.12 The design of the Public Announcement System and the distribution of the loudspeakers in the concourse level, the platforms and in the other public areas shall be based on a acoustic simulation design compiled using 3D models, which will use the noise and reverberation times values corresponding to the visible materials, the civil works items and the architectural finishes of the stations, while they shall take into account the locations of structures and equipment that have resulted from the coordination designs of the main Contractor of Kalamaria extension.

1.13 The Contactor shall prepare, as required, the Designs (Detailed Final Design) shall take all necessary measures and shall ensure all necessary interfaces at local and central level (OCC level) so that all Low Voltage – Telecommunications Systems of the Project, as described in the present specification, may be connected in a complete, reliable, normal and operational manner with the ones of the operating Metro network.

2 Scope of the Specification

2.1 This Performance Specification covers the basic principles of the design, supply, factory testing, transmission, in situ delivery, installation, in situ testing, setting into operation, training, start of operation and responsibility for defects during the guarantee period concerning the communication sub-systems and the related systems.

2.2 The specification presents the operation related requirements of the following communication systems required for this specific project:

- Digital Transmission System (DTS)
- TETRA Radio System
- Public Address System (PA)
- Closed Circuit Television (CCTV) System
- Passenger Information System (PIS)
- Security and Safety System (SMS)
- Access Control / Intrusion Detection System (ACC/IDS)
- Integrated Central Communications System (ICCS)

The equipment areas - rooms constructed by the main Contractor of the Extension, including all Civil Works, as described in detail in the drawings of the extension projects, shall be provided for the installation of equipment of the aforementioned Telecommunication and Low Voltage systems.

2.3 In this specification reference is also made to the main operational points of interface of the above with other systems of Kalamaria Extension, such as trains, signalling – ATS, power supply, UPS, fiber optic network, structured cabling, PSDs etc. The Contractor should configure and implement the full interfaces of his systems with those of other Contractors of the Extension Project.

2.4 The Contractor shall provide the systems and equipment described in this Specification. The Contractor shall also provide systems, additional equipment and operations not mentioned or clearly specified in this Performance Specification, but required for the safe

and reliable operation of the aforementioned systems, taking into account the fact that the Project operation is ensured via automatic trains.

2.5 The Contractor shall design and implement the communication systems which shall serve the needs of the gradual commissioning of the line to Kalamaria. The Contarctor shall ensure that the connection of the extension shall cause the minimum possible impact on the Base Project during commissioning, trail operation and training at the new section of the network. Similarly, the Contractor shall ensure the above in case of new future extensions, in addition to Kalamaria extension.

2.6 During the design and installation of the equipment, provisions shall be made for minimizing the need for conversions, as these shall be required in the framework of future extensions of the Line, in addition to Kalamaria extension. However, based on the present Contract, there is no equipment or software to be provided for the future extensions and connections. If, in the framework of implementation of the systems provided for in the subject extension, modifications are made in the central systems at the OCC and the ECR, these shall be implemented taking also into account the eventual future extensions.

3 General Operation Requirements

3.1 The Thessaloniki Metro Base Project under construction includes one line from the "New Railway Station" up to "Nea Elvetia" station (approximately 9.6km long, with 13 stations) and one Depot at Pylea connected via a double track with Nea Elvetia Station.

3.2 The extension of the line to Kalamaria, which is the scope of this Contract, consists in one Line approximately 4.78km long, starting right after the end of the trumpet shaft of 25 MARTIOU Station in the Metro project under construction, and ending at the forestation of MIKRA Station; it includes the tunnels, five (5) stations, five (5) shafts, three (3) crossovers and one recess, as shown on the alignment drawings and the other drawings of this Specification. Moreover, provision is made for the future construction of a Depot at the end of the extension to Mikra, not included in the scope of this Contract.

3.3 The extension to Kalamaria shall be constructed almost concurrently with Thessaloniki Base Project. All stations shall be constructed using the Cut & Cover method with a central platform.

3.4 The Thessaloniki Metro network shall operate as a driverless system, i.e. without any human intervention being necessary from the On Board Personnel (Train Attendants) during normal operation. For more information, please refer to the Planning Manual of the main contract for the extension to be provided to the bidders as information document, in the framework of this Tender. The Telecommunication and Low Voltage sub-systems should meet the aforementioned operation requirements.

3.5 The Metro Base Project, the extension to Kalamaria, Pylea Depot and all possible future extensions and Depots shall be supervised and controlled by the OCC in Pylea.

3.6 Trains shall consist of maximum four vehicles. Each train shall be equipped with one Emergency Driving Position (EDP) at each end. Service trains shall be equipped with the required communication facilities. For more information, the Contractor can refer to the Performance Specifications for signalling and rolling stock.

3.7 The traction power is supplied by a third rail right next to the running rails. The nominal traction power is 750V DC. For more information, the Contractor can refer to the Performance Specifications for Traction Power and Tracwork.

3.8 All station platforms are central platforms and the tunnels between stations are single track tunnels, except for the forestations of the New Railway Station and Nea Elvetia Station in the Base Project, the forestation of MIKRA Station, as well as the line crossover sections which are double/triple track tunnel sections.

4 General System Specification Requirements

4.1 In the following sections of this Specification, description is made of the required performances of the various Telecommunication and Low Voltage systems to be installed.

4.2 Information provided by these Specifications should in no way be considered as overall technical determination of a specific system or part of a similar system.

4.3 All materials should be in accordance with the accepted fire safety standard NFPA 130 and where this is applicable.

4.4 The Telecommunication and Low Voltage sub-systems shall be suitable for a Metro Project and shall meet the following requirements:

- Easy maintenance
- User-friendly configuration software
- Flexibility (open interface)
- Possibility for further extension to meet the future extensions of the Line

4.5 The designs, materials, equipment and spare parts to be provided in accordance with this Contract should be approved by AM.

4.6 All important parts of equipment under construction shall bear labels with serial numbers, as well as equipment marking. In the stations, shafts and tunnels, all cables shall be suitably marked. The labelling system should be approved by AM and should be in accordance with the respective ones used in the Base Project.

5 Digital Transmission System (DTS)

5.1 Scope and Objective

5.1.1 The Contractor shall supply, install and commission a modern Digital Transmission System (DTS) to be used for real-time data transmission (Video, Voice, Data) in all areas of the project pertaining to the Extension to Kalamaria of Thessalonki Metro. The Contractor of this Extension shall be also responsible for the design, planning, changes, upgrading of systems and devices of the aforementioned system into the existing Thessaloniki Metro network, should this be required.

5.1.2 The DTS is considered to be one of the integrated parts that are required to cover all telecommunication needs along the entire extension in order to support the sound operation of the Thessalonki Metro Extension to Kalamaria.The main purpose is also to provide an upgrading of the DTS system of the Base Project as compared to the system that will be installed by the Contractor of the Extension to Kalamaria.

5.1.3 The Contractor should also incorporate the new DTS system of the Kalamaria Extension into the respective system of the Thessaloniki Metro Base Project and guarantee for the smooth operation of the entire system.

5.1.4 The DTS constitutes the back-bone of all system's communications of the Extension to Kalamaria, i.e., this system provides a bidirectional transmission of voice, videp and data among the remaining systems of the new stations, the depot, tunnels, OCC, ECR, and the management building.

5.1.5 If the communications' main backbone through the DTS system in the Extension to Kalamaria is ensured, then safe shall be the transfer of passengers through the support of the passengers' communication activities with the operation personnel and the maintenance personnel in case of an incident or an accident. This requirement becomes stronger due to the existence of other operation requirements, such as driverless operation, unmanned station platforms and utilization of Platform Screen Doors System (PSD).

5.1.6 The Contractor shall submit a risk and threats' analysis, which is required for the design of the safety, protection and communication systems for the passengers, the personnel and the items of equipment as a whole, including those in the extensions. The aforesaid analysis shall be approved by ATTIKO METRO.

5.1.7 The Contractor shall prepare a safety design to ensure all telecommunication systems, with particular emphasis on the Digital Transmission System. This design shall be based on real data from the operation of similar Metro systems, the international experience and practice and the risk analysis procedure.

5.2 Functional Requirements of the Digital Transmission System

5.2.1 In all telecommunication equipment rooms (3.4t) of the stations and in selected locations of the extension, such as tunnels and shafts, the appropriate equipment for the DTS system shall be provided, aiming at serving all installations of the Kalamaria Extension, while, through the appropriate fiber optic cabling, the Kalamaria Extension shall be interconnected with the Thessaloniki Metro Base Project. This system shall provide bi-directional transmission of information related to the operation of the Telecommunications systems of the Base Project (Thessaloniki Metro) and the Kalamaria Extension Project.

5.2.2 In every new station of the Metro extension, in selected locations of the extension and the Base Project, in selected shafts, in Tunnels, and in the OCC and the ECR, the Digital Transmission System to be installed shall be state-of-the-art technology and shall serve as a minimum the communication needs of the following sub-systems of the Extension to Kalamaria, namely:

- Automatic telephone system – PABX
- Direct Line Telephony (DLT), including Traction Current Removal (TCR)
- Intercommunication System
- TETRA System
- Closed Circuit Television (CCTV)
- Safety (and Protection) Management System (SMS)
- Access Control / Intrusion Detection System (ACC/IDS)
- Public Announcement System (PA)
- Power Remote Control System (PRCS)
- Building Automation Control System (BACS)
- Automatic Fare Collection System (AFC)
- Time Distribution and Clocks System
- Passenger Information System (PIS)
- Stations' IT Infrastructure System
- Management Information System (MIS), including Access to Internet and the Wideband VPN services
- Separation Logic Application, using VLAN
- LAN – WAN, etc.

5.2.3 The Digital Transmission System shall be provided as LAN "Local Area Network TCP/IP", i.e. all aforementioned sub-systems shall be supported by the "Area Network of the entire Metro system of the Base Project". DTS of the new stations of Kalamaria Extension shall be made available for the transmission of voice, data, video, LAN (local are for P/C connection) - through the Fiber Optic Cables System - to the OCC, ECR and Pylea Depot.

5.2.4 The equipment of the DTS system shall be installed in the telecommunications equipment room of each station, so as to accommodate communication needs related to automatic telephones, direct telephones, data, PA / CCTV / PIS / AFC and other systems. To this end, all necessary interconnections shall be also provided. The transmission system shall not be utilized for the transmission of data concerning Signaling and Train Control Systems.

5.2.5 The Telecommunication Nodes of the DTS, operating as switching elements to forward and transmit data packages in the optimum way, shall be installed indoor and outdoor –

in not guarded areas – such as in tunnels, or in the field, possibly in shafts and train stabling/repairing areas, should this be required. The entire quantity of the Telecommunications Nodes to be installed in each of the aforesaid areas shall constitute the scope of a separate design and shall depend on the quantity of the required distribution interconnections.

5.2.6 Within the new stations, the required "active" data of the network, such as switching elements, routers, etc., shall be installed in properly configured locations in the telecommunications equipment room 3.4t. Properly configured racks, sufficiently dimensioned by the Contractor, along with the necessary positions for the connection with the fiber optic and copper cables shall be installed on an as-needed basis.

5.2.7 Throughout the passengers' and the operating personnel's route from their entering the station up to their boarding the train and their circulation in concourses, platforms and ticketing areas, all systems serving telecommunications shall be supported by the DTS.

5.2.8 Moreover, the DTS system must support either directly or indirectly the Kalamaria Extension trains at stopping points or if they are standstill. This way, the smooth operation of the Base Project and Kalamaria Extension and is ensured and problems that may occur during the Metro operation are dealt with.

5.2.9 The LAN TCP/IP shall support the interconnection with the TCP/IP Ethernet-based networks, which will be installed in the entire system, i.e. every new station and selected shafts shall be equipped with a "Sub-Ethernet switch". These switches shall be interconnected via a modern digital transmission technique based on the state-of-the-art fiber optic system.

5.2.10 The precise dimensions, the exact positions and the number of devices shall be included in a design that the Contractor must prepare and submit to ATTIKO METRO for approval.

5.3 General Summary of the Digital Transmission System

5.3.1 The Digital Transmission System in the form of "Local Area Network (LAN)-TCP/IP" of Kalamaria Extension shall be connected to the OCC central node to the ECR node, as well as to all peripheral locations of the Extension to Kalamaria, i.e. Telecommunication nodes along the line within each station, at selected shafts and in the platforms. Each such node shall include all necessary interconnections/ interfaces, communication portals and devices in view of supporting the aforesaid several communication sub-systems and data networks. If deemed necessary, the OCC central node and the node in the ECR shall be upgraded and re-dimensioned.

5.3.2 The Digital Transmission System units of the "Local Area Network (LAN)-TCP/IP" shall be as required for a Metro system and shall meet the following requirements, namely:

- Articulated architecture of the system;
- Fully redundant and available;
- Re-configurable;
- Flexible (all types of interconnections / communication portals);
- Equipped with a user-friendly software for its configuration and integration into the ICCS system of the Thessaloniki Metro Base Project, and
- Expandable to serve the future extensions/connections/modifications of the line

5.3.3 All terminal units of the aforementioned communiation systems shall be compatible with the Ethernet and/or TCP-IP networks and shall be connected with the Network Area TCP/IP through special interfaces, communication portals and – if required – through P-gateways.

5.3.4 The Cabling System shall consist in the Fiber-Optic Network and IT infrastructure System, installed by the main Contractor all along the facilities of the extension to Kalamaria, while the same systems shall be available in the entire Base Project and shall be utilized by the Digital Transmission System as a physical means to transmit data.

5.3.5 The TCP/IP LAN shall be the appropriate one to transfer data, voice and video through the fiber optic cable ring topology. The broad band network shall gather, transfer and route all voices, data and videos in a unified integrated network.

5.3.6 The DTS of Kalamaria Extension, similarly to Thessaloniki Metro Base Project, shall be based on a Full IP 10GE technology through main and back up switching devices (Telecommunication nodes) supporting Layer 2 and Layer 3 with a 10 Gbit/s backbone connection based on 10 Gigabit Ethernet (10GE) technology, achieving, thus, a fully integrated network transmission easy to apply, control and manage and offering a network back bone of high capacity / availability easy to expand and to be configured in such a way so as to be connected to future systems.

5.3.7 In general, the DTS shall not require any particular handing to be able to operate. Its customization shall be feasible only through the workstation for the network management system (NMS,) which shall be installed within the DTS equipment rack in the telecommunication equipment rooms in the OCC and the ECR. Through the workstation for the DTS management network, the operator shall be able to view in real time the operation status of the entire active DTS equipment of the extension and shall have full access in order to program and customize the entire active DTS equipment.

5.4 General Requirements of the Digital Transmission System

5.4.1 The Digital Transmission System shall utilize widely-known communication protocols applied to the Telecommunication market. The interfaces of the Digital Transmission System with the systems whose data are tranferred shall be based on the Transmission Control Protocol over Internet Protocol (TCP/IP) technology.

5.4.2 DTS shall offer a high level of data transmission safety and shall guarantee the integrity of the data transferred from one end to the other. In view of the best utilization of the re-routing option, the DTS system shall be designed in such a way so as alternative routing methods – both at physical and logical levels – be foreseen.

5.4.3 The DTS shall be designed in such a way so as to provide fully redundant operation and to ensure immediate (automatic) self-healing and auto-reconfiguration in case of failure. No single fault or failure shall be able to prevent its normal operation. Even in case of a complete failure of the entire equipment in a geographical area, the DTS system shall be able to perform its entire functions against no failure, as far as its entire performance is concerned.

5.4.4 All terminal devices of the above mentioned telecommunication sub-systems shall be Ethernet- and /or TCP/IP compatible and shall be interconnected with the "Common TCP/IP Network" through special interfaces, ports and if necessary with IP-gateways.

5.4.5 The "Common TCP/IP Network" shall provide transfer and switching services through digital packages transmission operation, it shall support time-series sensitive communications along with voice and videos, but it shall not support time sensitive communications, such as explosion data.

5.4.6 The network nodes shall be installed in cabinets / racks that will meet the requirements per IEC 60297-3.There shall be the option for redundancy in power supply, in the processing unit, and in the cooling fans.

5.4.7 The network shall provide a multi-level safety through a series of options that can be implemented in the network from one end to the other. These include user certification, VLAN, access control lists, authenticated access switching devices.

5.4.8 The DTS system shall apply quality services characteristics that will ensure classification and processing of cable speed packages for all packages in a flow of data and shall guarantee a decisive transmission response time.

5.4.9 The architecture between the central node in the OCC and the node in the ECR in Pylea Depot and the telecommunication nodes in the Extension to Kalamaria shall be interconnected as a transmission loop, while its physical implementation shall be based on the fiber optic ring topology. Reconfiguration of the ring due to the addition of telecommunication nodes (switching devices) shall be implemented by the Contractor.

5.4.10 Fault flexibility of both rings of the "Common TCP/IP Network" shall be based on Ethernet Ring Protection (EPR) protocol that defines switching devices protection mechanisms and on Ethernet Layer (ETH) ring protocol for constant protection.

5.4.11 The Contractor shall estimate the required bandwidth in each location separately for the extension and for the entire extension, in connection with the Thessaloniki Metro Base Project. The Contractor shall determine anew the sufficient number and capacity of all network components, such as interfaces/ ports, switches, firewall/routers and gateways. In order to protect the metro-wide network and to separate users, firewalls/routers shall be installed in each location.

5.4.12 The DTS system shall be equipped with the appropriate firewalls to ensure interconnection with an external network, on an as-required basis. Any eventual interconnection of any external user or a terminal equipment shall be fully controlled as regards access to the Metro network internal data, while it shall be guaranteed that the internal data network of the Metro system will not be visible, accessible and controllable under any circumstances.

5.4.13 In case of an interruption of the fiber optic cable link or node failure as well as after "Plug and Play" operation, i.e. a new node is added to or taken from the transmission loop, an automatic self-healing, restoration and auto-reconfiguration of the metro-wide "Common TCP/IP Network" is required. The time limit for the auto-reconfiguration (or re-routing) of the network shall be within 50ms.

5.4.14 The Telocommunication Nodes of the Kalamaria Extension DTS system shall be interconnected through the central fiber-optic cabling; they shall also be connected to the respective DTS nodes of the Thessaloniki Base Project, via dual fiber optic connections (of the Central Cabling System). The DTS telecommunication nodes to be installed within stations shall be connected to the above and shall perform the Base Project relating to the final interconnection of the field equipment of the Systems or Sub-systems that are using the DTS System.

5.4.15 The Telocommunication Nodes of the DTS system shall be designed in such a way, so as, being the switching devices, to forward and transmit the data packages in the optimal way, as regards both performance and safety. The Telecommuication nodes of the DTS system shall support Layer 3 and Layer 2 operations, per OSI, and depending on the purpose they serve.

5.4.16 Each new Telecommunication node shall be provided with the following interfaces / ports according the ITU T (former CCITT) as well as IEEE recommendations and regulations which are valid today:

- Ethernet Interface cards compatible with IEEE 802.3xx series standards for Ethernet networks
  ports for Ethernet / 10 Mbit/s
  ports for Fast Ethernet 100Mbit/s,
  ports for Gigabit Ethernet 1000Mbit/s
- Parameters for the transmission on single mode fiber optic cables
- Operating wavelength: 1260 nm - 1360 nm
- Line bit rate: app. 10Gbit/s (10GbE Ethernet technology and/or higher)

5.4.17 The Central Nodes of the Digital Transmission System shall be industrially designed, of chassis type. The manufacturer/supplier shall be internationally acknowledged, with certified experience in respective Metro projects. The Nodes of the Digital Transmission System shall accept various types of cards/interface units, providing flexibility as regards their material customization. Their final configuration shall be based on the data transfer requirements of the Project, in accordance with the Detailed Final Design

5.4.18 The Central Nodes of the Digital Transmission System shall be extremely reliable, shall never require any preventive maintenance related activity and the environmental conditions (as specified in detail in the General Specifications) for their operation shall be as follows:

- Temperature: - 5^{o} C to +50^{o} C
- Relevant moisture: > 85%

5.4.19 The Telecommunication Nodes of the Digital Transmission System shall be equipped with the proper type and number of Ethernet interconnection portals, in accordance with the requirements for data transfer from the interconnected systems and in line with the Detailed Final Design. Upon delivery of the Project, a redundant number of portals shall be provided, equal to 25% of all portals, per type of portal and location where these shall be available.

5.4.20 The LAN TCP/IP of Kalamaria Extension shall be controlled by the existing Network Management System (NMS) of the Base Project. If it is deemed necessary, it shall be upgraded and re-dimensioned, and shall be able to perform the following functions as far as the Extension to Kalamaria is concerned:

- network configuration,
- control,
- diagnostics, and activation – deactivation of interface modules,
- bandwidth allocation, alarms and fault management,
- event logging and
- graphical network presentation.

5.4.21 The existing NMS that has been installed in the OCC should be properly upgraded and allow to the System Administrator to manage and monitor the extension of the network in Kalamaria section in the most efficient way. The NMS screen located in a DTM work station shall display information about the settings and the operation of the network, the encasing of the node and the interface cards.

5.4.22 The DTS system shall utilize the central fiber optics network as a physical means for the tranfer of data between the telecommunication nodes of the stations and the respective nodes within tunnels. The Structured cabling shall be utilized as a physical means to tranfer data between the DTS telecommunication nodes within the same station, etc. In addition, Structured cabling shall be utilized as a physical means to interconnect DTS equipment with any other items of equipment that belong to the inteconnected systems using the DTS system to transfer data. It is stressed that both the fiber optic network and the structured cabling along with their supporting equipment in the entire project of Karamaria Extension shall be installed by the main Contractor of the Extension to Kalamaria.

5.4.23 The IT Infrastructure System to be installed by the main Contractor of Kalamaria Extension shall interconnect the central transmission equipment, such as Ethernet swiching devices, routers, firewalls, to the peripheral equipment, i.e. all users and terminal devices of the communication sub-systems and peripheral P/Cs.

5.4.24 It is stressed that the IT Infrastructure System shall be installed by the main Contractor of the Extension to Kalamaria and shall be able to support the following telecommunication sub-systems, namely:

- Telephones by use of voice over Internet Protocol (voIP)
- CCTV cameras by use of video over IP protocol
- Access Control (ACC) and Intrusion Detection Systems(IDS) units over IP
- Clocks
- PC's for BACS and PRCS connected via Ethernet cards
- Terminal Units of Passenger Information System (PIS) connected via Ethernet cards
- PC's of Management Information System (MIS)

5.4.25 The systems's architecture shall be based on telecommunication nodes to provide a "distributed" architecture and links. Nodes shall include the following:

- Structured Cabling
- Work position (station), to include the telecommunications input, the work area cable (cable) and the equipment of the work area
- Buildings Distributor (main distribution center)
- Intermediate distributor (if the distance between the building distributor and the remote output RJ45 to which it will be connected, exceeds 90 meters)
- Fiber Optic distribution panel (for the termination of the backbone network fiber optic cables and the structured cabling of the building's fiber optics)
- Ethernet distribution panel
- Socket/wall

5.4.26 Links shall include the following:

- The main fiber optic backbone (that constitutes a part of the network required for the connection of all locations and consists in the fiber optic cables which are utilized for the ring network implementation)
- The fiber optics cabling (which includes the inner fiber optic cables installed within the building for the Eth/F.O. converters to cover distances over 90 meters)
- Structured cabling (IT infrastructure system (which includes Cat 6 cables installed between the Ethernet panel patches and the sockets of the floor / wall of the work position (station). Cables shall not be over 90 meters long.

5.4.27 The generic cabling network shall meet the highest standards, as far as the electrical and mechanical characteristics of cables are concerned. Moreoever, fiber optic cable, copper cable and hybrid fiber optic and copper cables can be utilized.

5.5 System Availability

5.5.1 The technical requirements for the optical fiber rings are described in the Specification concerning Cabling.

5.5.2 The system availability shall be at least 99,998 %.

5.5.3 In order to ensure the highest level of availability – to the extent possible - of the entire transmission network, at least the following measures shall be realized as a minimum in the individual transmission nodes:

- 1+1 redundancy for internal ventilator modules
- 1+1 redundancy for common part of the nodes, like CPU, synchronization clock etc.
- 1+1 redundancy for power supply

5.5.4 The Contractor shall supply all details about the Digital Transmission System. The high reliability shall be proven by submitting a study indicating MTBF values of each individual module of the system and by overall MTBF calculations of the system.

5.5.5 As regards the environmental conditions and requirements, kindly refer to the General Specifications. The specific environmental conditions in the city of Thessaloniki shall be taken into account, such as temperature, wind speed, corrosion of outdoor equipment, etc.

5.6 DTS System Interfaces

5.6.1 The DTS shall feature at least the appropriate interfaces in view of ensuring smooth coordination with the following systems and transfer of their data:

- Private Automatic Branch Exchanges – PABX
- Direct Line Telephone System (DLT), in connection with Traction Current Removal System (TCR)
- Digital Radio System (TETRA) – two back up 1Gb/sec. connections shall exist between the TETRA and the DTS Node
- Closed Circuit Television System (CCTV)
- Safety Management Systems (SMS), Access Control (ACC) and Intrusion Detection Systems (IDS)
- Public Address Systems (PA)
- Power Remote Control System (PRCS) and Building Management System (BACS)
- Automatic Fare Collection System – AFC
- Time Distribution and Clocks System
- Passenger Information System (PIS)
- Management Information System (MIS) including Internet Access and Wideband VPN
- Implementing separation at a logical level using Virtual Local Area Networks (VLANs)
- Local Area Networks (LAN) - Wide Area Networks (WAN) etc.
- Any other current system or sub-system – as installed by the main Contractor of Kalamaria Extension – that requires transmission of digital data.

5.7 Digital Transmission System Installation Requirements

5.7.1 The spare bandwidth capacity for the system operation shall be 25%.

5.7.2 The proposed transmission system shall have capacity for future extensions. In relation to the central equipment (hardware and software), the future extensions to the airport and to the western suburbs of Thessaloniki shall be taken into account.

5.7.3 The digital transmission cabinets shall be standard 19″, ETSI or similar devices and the option shall be given for them to be mounted on the same rack or cabinet accommodating telecommunications systems' items of equipment.

5.7.4 If there is the requirement for the DTS nodes to be installed within tunnels and other outdoor areas, they shall be mounted in a cabinet suitable for outdoor areas, non A/C, with IP66, which shal be properly earthed and shall feature lightning protection.

5.7.5 For it to be installed in all locations, the system shall provide for 25% expansion.

5.8 Power Supply, Electromagnetic Compatibility (EMC) & Earthing

5.8.1 All nodes, units, etc., of the Digital Transmission System shall be powered by the common Uninterrupted Power Supply (UPSs) Units for the entire telecommunications system. Kindly refer to the chapter entitled "Power Supply".

5.8.2 The subject system shall be connected to the earthing system and shall satisfy the needs relating to electromagnetic compatibility (EMC). Kindly refer to chapter entitled "Power Supply and Electromagnetic Compatibility".

5.9 Measurements and Testing Procedure

5.9.1 When delivering the Digital Transmission System, the Contractor shall incorporate the required measurement and testing equipment or special tools that will enable the maintenance and operation personnel to correct any defects and make the necessary measurements. The aforesaid instruments and devices shall perform the following functions, as a minimum:

- Generation and analysis of transmission frames
- Measurement of errors with adjustable threshold values, like bit error, code error, frame error
- Simulation of transmission errors/ faults
- Jitter generation
- Jitter measurement
- Measurement of optical fibres (according to ITU-T Rec. G.709)

5.9.2 Should the registration and filing of the measuring results require a PC, a suitable notebook shall be offered too. The proposed testing devices and measuring instruments shall be described and reasons given as to their selection.

5.10 Standards

5.10.1 State-of-the-art electronic equipment shall be provided. The system's design, shall comply with Standards CENELEC, ETSI, ITU T (former CCITT) and ISO/IEC, as well as with the pertinent recommendations. The following standards shall be met by the network, namely:

- EN 50159-2 (Railway applications - Communication, signalling and processing systems - Part 2: Safety related communication in open transmission networks)
- EN 50173-1 Information technology - Generic cabling systems – General requirements anf Office Buildings)
- Standards Series IEEE 802.3xx for Ethernet networks (interface cards compatibility)
- IEEE 802.1w Rapid Reconfiguration of Spanning Tree
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1P Protocol Prioritization
- IEEE 802.1Q VLAN trunking and Tagging
- IEEE 802.1x Port Based Access Control
- IEEE 802.1s Multiple Spanning Tree
- IEEE 802.3ad Link aggregation
- RIP Routing Information Protocol
- OSPF Open Shortest Path First
- RFC 768 User Datagram Protocol (UDP)
- RFC 791 Internet Protocol(IP)
- RFC 792 Internet Control Message Protocol (ICMP)
- RFC 793 Transmission Control Protocol (TCP)

- RFC 826 Address Resolution Protocol (ARP)

5.10.2 The manufacturer's standards of shall be accepted only if they are equal or higher than those mentioned above.

5.10.3 The Contractor shall state the applicable standards used.

6 Radio Communication System (TETRA)

6.1 Purpose and Scope of Works

6.1.1 The Contractor shall design, supply, install, test and commission a modern TETRA Radio Communication system which shall be used for full duplex communication and transfer of any type of data (Audio, Data) in real time in all areas of the extension to Kalamaria. The Contractor of this extension shall also be responsible for the design, planning, modification, upgrade of systems and components of the existing system operating on the Base Project and mainly in the OCC and the ECR, to the extent that this is required, so that this system shall be fully functional on the extension project.

6.1.2 The supplied TETRA radio system shall provide radio coverage in the stations, the tunnels, the shaft areas along the extension to Kalamaria. The radio system shall be used to provide voice and data communications between the OCC / ECR of the Base Project and the radio users (mobile or portables); to transmit to the OCC / ECR on demand continuous train – OCC/ECR data transmission as required by signalling and the vehicle diagnostic system.

6.1.3 The Contractor shall also integrate the new TETRA system of the Kalamaria extension into the system of the Base Project of Thessaloniki Metro and shall guarantee the necessary smooth operation of the system as a whole.

6.1.4 The Contractor shall provide a digital trunked radio system designed to operate in accordance with the international TETRA standards for Private Access Mobile Radio (PAMR) systems and with these specifications.

6.1.5 Ensuring full coverage of communications via the TETRA system, in relation to the operation and maintenance staff in the event of an incident or accident, becomes imperative because of the driverless train operation, unmanned station platforms and use of platform screen door system (PSD)

6.1.6 The Contractor shall provide the risk and threat analysis which is needed to design the security and safety systems to protect passengers, operators and equipment. This analysis shall be approved by the AM.

6.1.7 The purpose of this specification is to define the overall functional requirements for the supply of a radio system based on the TETRA international standards.

6.2 Radio Coverage Requirements

6.2.1 In all facilities of the Kalamaria extension, in all tunnels, shafts and stations the appropriate TETRA equipment shall be provided, which shall be interfaced via the appropriate wiring with the existing system of the Base Project. This system shall provide data transmission related to the communication of the security, operation and maintenance personnel, as well as of the personnel of other authorities (Fire Department, Police, Emergency Services), in case and emergency occurs either on the extension to Kalamaria or on the Base Project.

6.2.2 The TETRA radio system must be designed to provide reliable radio coverage inside the tunnels, the new stations (including station entrances and shaft structures) and in the depot yard(s). Inside the stations the radio system must cover the station entrances and emergency stairs, the public access areas and the major staff rooms and technical rooms, while in the shafts the radio system must allow communications inside the technical rooms and the emergency exit corridors and stairs. There is no requirement for providing radio coverage in the over-ground areas along the line alignment.

6.2.3 To achieve adequate levels of RF signal inside the tunnels it is necessary to utilize radiating coaxial cables (LCX) with the proper connectors and power splitters.

6.2.4 The supplied TETRA radio system shall be designed to provide radio coverage for trainborne (mobiles or portable radios) that operate along the tunnels, including connecting tunnels.

6.2.5 For the station, the supplied TETRA system shall be designed to provide radio coverage inside the station public areas, the staff rooms and equipment rooms, as detailed below:

- Public Areas
  - Station Accesses
  - Access to platform level
  - Public passageways-subways
  - Escalators and stairs
  - Concourse level,
  - Platforms
  - PSN lift areas

- Staff Areas
  - Ticket Office
  - Station Master's Room (SMR)
  - Staff Rest Room
  - Cash Counting Rooms
  - Police Room

- Technical Rooms
  - Ventilation Rooms
  - Lighting and Auxiliary Substation and Switchgear Room
  - Signalling and Telecom Rooms
  - ATIM Room
  - Pump Room and Sump
  - Cooling Plant Room
  - Rectifier Substation (RS) Room
  - Fire Fighting Room
  - 20 KV MVP Room
  - Fire Brigade – Water supply Room
  - Switchboard/switchgear Room in Shafts
  - PSD-technical Room

6.2.6 Radio coverage in Ventilation Shaft Structures shall be provided for the technical rooms, as well as passageways and stairs when they can be used for emergency evacuation of passengers and staff as specified above.

6.2.7 The radio coverage availability factor of the TETRA system in these areas (without any system performance degradation due to equipment failure) shall be no less than 95% of time and space. The radio coverage in the tunnels shall include a system level margin grater than 10 dB.

6.2.8 In the event of total failure of one of the Enhanced Base Transceiver System (EBTS) sites, the radio coverage availability factor of the TETRA radio system in the tunnels and the access track areas shall be 95% of time and space. The radio coverage inside the tunnels and the access tracks shall not be affected by the failure of one or more of the RF repeaters.

6.2.9 Regarding the trains running on the extension to Kalamaria, they shall also be covered by the TETRA system of the Base Project and the Kalamaria extension, for the sake of proper operation but also for the case problems or incidents occur.

6.2.10 The precise dimensions, the exact positions and the number of devices shall be included in a design that the Contractor must prepare and submit to ATTIKO METRO for approval.

6.3 TETRA system Overview

6.3.1 The TETRA system equipment shall be suitable for the Metro System and shall meet the following minimum requirements:

- Modular system architecture
- Fully Redundant with high availability
- Flexible and reconfigurable (all types of interfaces / communication ports)
- User-friendly software-aided configuration and integration into central Dispatcher (DMT) of the Base Project and ICCS of the Base Project
- Expandable for future line extensions / junctions and modifications.

6.3.2 The Contractor shall perform a detailed traffic study to develop the requirements for number of TETRA carrier frequencies to satisfy the operational requirements of the system and to meet the high standards of quality of service required for the safe operation of the Metro.

6.3.3 The Contractor shall be responsible to complete a traffic study to determine the number of frequencies (channels) required for the operation of the system, shall perform the necessary frequency planning studies and shall coordinate via the ATTIKO METRO with National Committee of Telephone and Telegraph (EETT) and any other Government Office for obtaining the necessary frequency licensing. All the above shall be in compliance with the requirements of the Base Project.

6.3.4 The traffic study should be based on the following initial parameters:

Number of Stations:	5
Number of voice and data mobile radios:	50 as a minimum
Number of Handheld portables:	100 as a minimum
Number of simultaneous video image ransmissions:	10
Refresh rate of Video Image Transmission on demand:	1 image every 5 sec
Data Transmission Rate:	9.6 Kb/s as a minimur

6.3.5 Furthermore, following Reliability – Availability - Maintenance and Safety (RAMS) analysis for the supplied system, the Contractor shall be responsible to develop and provide appropriate operations and maintenance training to personnel for the part concerning the extension to Kalamaria, as well as develop a list of spare parts necessary for the reliable operation of the TETRA radio system.

6.3.6 The transmission of all TETRA data will be alternatively achieved via the DTS digital transmission system, the Structured Cabling and the main fiber optic trunk network. All necessary TETRA equipment shall be connected to the above equipment.

6.3.7 The hardware and software (DMT and ICCS) of the workstations in the OCC and the ECR shall be upgraded, where necessary, in order to incorporate the TETRA system related to the new stations, while the existing functions and capabilities of the (local and central) DMT system and those supported by the ICCS shall continue to be supported. The Contractor shall also coordinate the requirements for the full operation of TETRA system on the Basic Project trains, as well as on the new trains to be supplied by a new contract.

6.3.8 The TETRA system shall be synchronized with the real-time mater clock of Thessaloniki Base Project.

6.3.9 The proposed system shall be expandable to incorporate future expansion and shall compatible with central equipment (hardware and software).

6.4 TETRA System General Requirements

6.4.1 The Contractor's TETRA communication system for the extension to Kalamaria shall be based on the technology defined in the relevant standards. The supplied system shall be centrally integrated in the DMT of the TETRA system of the OCC of the Basic Project.

6.4.2 The TETRA system for the extension to Kalamaria shall be centrally integrated in the DMT of the TETRA system in the OCC of the Base Project. If deemed necessary, the transmission center in OCC shall be upgraded and re-dimensioned.

6.4.3 The Base Project Master site which will comprise the Network Dispatch Centre shall be properly configured to carry out the following main functions for the TETRA system of the extension, as well:

- System Management: workstation based network containing System Databases and providing intuitive Graphical User Interface (GUI) for configuring the system and the radio subscribers.
- Group Switch Controller, which shall provide very fast call control for group communication in a wide-area network. The Group Switch Controller controls private calls, interconnect calls and circuit data calls; provides mobility information for other communication types such as Short Data Service.
- Group Switch: High speed digital switch, which shall be specifically designed for wide-area systems with console dispatchers. Among the functions of the Group Switch shall be the capabilities to route any bit pattern to one or multiple destinations, which shall be a unique requirement in wide area group communication systems.
- Dispatch Consoles: Highly advanced dispatch system, which shall provide fixed dispatch capabilities to both the Radio trunked system as well as conventional Public Mobile Radio (PMR) radio systems including the ability to connect calls between these systems. The dispatcher may also connect calls to a telephone system. The Contractor shall examine the case of incorporating one additional dispatcher console to those of Base Project.
- Telephone Gateway: Computer Telephony based Telephone Gateway shall provide easy adaptation of current and new analogue and digital line interfaces.
- Transcoder: Converts audio streams between TETRA Algebraic Code Excited Linear Prediction (ACELP) compressed voice and 64 kbps Pulse Code Modulation (PCM) voice. PCM voice shall be used for the Dispatch Consoles and the Telephone Gateway.

6.4.4 Remote sites also known as Base Radio Stations shall be installed in each station of the extension to carry out the following main functions:

- 2 carriers for the TETRA system
- Connection to an IP network via Ethernet protocol
- Each BR shall be equipped with a minimum of two receivers for diversity reception, which shall increase the coverage area and reception quality.
- In case of site link failure the site controller shall provide local trunking capabilities for continued communication within the site coverage area.
- Interface with the local PABX
- Hubs for RF/Optical Conversion.

6.4.5 The interconnection of the Master site and the remote sites shall be designed to utilise the optical fiber cable system that shall be installed for the System. The design of the site interconnection

network shall use the proper redundancy features to ensure availability of the TETRA radio system and radio coverage in the tunnels.

6.4.6 The Contractor shall be responsible to develop a frequency plan that shall not cause interference with other radio systems operating in the area. The supplied TETRA radio system shall operate in the frequency range of 410 to 430 MHz, which is reserved for public use.

6.4.7 The supplied radio system shall be designed to provide the following functions as defined in the TETRA and Base Project standards:

- Trunked radio system operation
- Group organisation
- Registration and roaming
- Trunked call
- One-to-many in wide-Area Private Mobile Radio/ Private Access Mobile Radio PMR/ PAMR systems
- Fast call set-up
- Late entry
- Caller ID
- Busy handling
- Priorities
- Dynamic tracking of location
- Busy override
- Critical locations and users
- Automatic location selection
- Preferred location
- Speech calls (group calls, private calls, emergency calls, broadcast calls)
- Telephone interconnect calls
- Data calls (status calls, short data service calls)
- Packet and circuit switched data

6.4.8 The TETRA radio system supplied by the Contractor shall be designed and configured to provide the communication capabilities listed below. It shall be possible to increase the TETRA system communication features by reconfiguring the system operating software without the need for additional major hardware.

6.4.9 The supplied TETRA system shall provide radio communication for the following users of TETRA Radio Communication system:

6.4.9.1 Voice and data communications between the Controllers at OCC/ECR, the Train Attendants operating in the station platforms or on-board the trains, the Stationmasters, the ticket office attendants and any other Metro employee equipped with TETRA portable radios that may operate in any of the stations and the depot. The OCC/ECR Controllers shall be capable of broadcasting voice and data messages to a single radio user equipped with TETRA portable, a group of users or all users as a single group, as necessary. Radio calls to individual radio users shall be initiated using the Caller ID.

6.4.9.2 Provide voice and data communications between the OCC/ECR and a Train Attendant operating the train via the active Emergency Driving Position (EDP). A separate TETRA mobile radio shall be installed in each EDP of each train. Calls to these radios shall be initiated using the Train Identification number (train number) assigned to the individual train. In the event of radio calls to the OCC/ECR the above mentioned train identification number (train number) of the calling radio shall be displayed on the radio control panel of the appropriate OCC /ECR Controller (Line Controller). The Line Controller shall have the possibility to transfer a call to other workstations within the OCC/ECR control room.

6.4.9.3 Provide voice and data communications between the Maintenance Manager and all trains and portable radios that are operating. The Maintenance Manager shall be capable of initiating voice and data communications individually or in groups with all the trains and portables that are operating the line of the extension to Kalamaria.

6.4.9.4 By selecting a special mode of operation of the supplied TETRA radio system, via the ICCS system, the Station and Train Supervisors located in the OCC/ECR shall be capable of broadcasting public announcements to passengers travelling on a single train or passengers of all trains in one direction or on all trains travelling in both directions.

6.4.9.5 Visual information to Passengers in trains via the on board PIS displays. The real time data shall be triggered by the central ATS equipment and transmitted via radio to the on board PIS displays.

6.4.9.6 The on board TETRA mobile radios shall also be interfaced with the on board ATC and FIADS systems so as to allow data exchange between the on-board ATC and FIADS systems with the central ATS and the train diagnostic system located at the OCC. At the OCC the received data messages shall be managed directly by the respective server through the TETRA data router. It is anticipated that the rate of data polling between OCC and FIADS and the data exchange between central ATC at OCC on-board ATC equipment shall be 1 every 10 seconds.

6.4.9.7 Radio communications between Metro staff personnel carrying portable radio units in all Metro areas and on-board, namely Driver, Attendant, maintenance personnel, security personnel, etc. as necessary.

6.4.9.8 Voice and data communications between the Engineering and Power Controllers located at the OCC/ECR and the Metro maintenance personnel, including maintenance personnel of various subcontractors. Members of each maintenance group shall be able to use their portable radios to initiate a call to the Engineering and Power Controllers located at the OCC/ECR and to call other maintenance employees of the Metro or subcontractor that operate in the same calling group.

6.4.9.9 The extension Contractor shall consider specific maintenance groups of the Base Project, as a minimum:

- Telecommunications and Fare Collection
- Power Supply (Traction and facilities)
- Signalling
- Electro-mechanical
- Track works
- Building Facilities
- Rolling Stock
- Maintenance Sub-Contractors

6.4.9.10 Voice and data communications between special emergency groups, consisting of Metro personnel, police officers and fire department personnel that can be formed to handle various emergency situations (assume a minimum of 5 such groups) and are equipped with TETRA radio communication devices.

6.4.9.11 The supplied TETRA system shall be designed to accept emergency calls initiated by a Train Attendant or a portable radio user. The emergency calls shall have the highest priority and the identification number of the caller, i.e. Train Identification number or portable identification number shall be displayed on the appropriate TETRA radio console.

6.4.9.12 All radio voice communications received at the OCC/ECR shall be recorded. The recorder of the OCC shall record all calls for at least 48 hours without intervention and the recordings shall be kept for at least 15 days before erasure. The GDRP data protection requirements shall be adhered to.

6.4.9.13 The Base Project System Manager shall provide the system operator with an interface to the TETRA system for Kalamaria extension, as well. The System Manager shall have a graphical user interface with on-screen windows, icons, and menus and it shall include a pictorial

representation of the system configuration for the extension to Kalamaria. An icon that can display the current status of the component shall represent each managed system component, such as a site. The System Manager functions, also for the extension to Kalamaria, shall be divided into five major categories:

- Security management
- Configuration management
- Performance management
- Accounting management
- Fault management

6.4.9.14 Direct Mode Operation (DMO) allows two or more Mobile Subscribers to communicate directly with each other without the need for any intervention by the system infrastructure and may be used both inside and outside of trunked mode coverage areas.

6.4.9.15 All direct mode communications shall be half-duplex and shall be conducted on a single radio frequency carrier.

6.4.9.16 The Direct Mode services supported by the supplied system shall be:

- Group call. This shall be set up using simple PTT operation where traffic is transmitted immediately after call set-up signalling has been sent.
- Emergency group call. Where a radio operating in DMO is outside trunked mode coverage and the user activates an emergency call, the radio shall set up an emergency group call with emergency pre-emptive priority level on the currently selected direct mode channel.

6.4.9.17 All voice transmissions via the TETRA radio system shall be recorded and shall be available for immediate replay by the Services whenever required. The Contractor shall undertake all necessary actions to ensure that the recorded voice messages remain confidential and accessible only to authorized personnel of the Department or the Operation Company.

6.5 Specifications of TETRA Terminal Units

6.5.1 The supplied TETRA radio system shall be configured using the following major components as necessary and in accordance with the detailed design of the radio system which shall be carried out by the contractor:

6.5.1.1 Remote Site Configuration where each EBTS Site shall as a minimum be equipped as follows:

- Base Station Units (number to be defined in accordance with traffic study, with a minimum number of 3 BRs)
- Two (2) TETRA Site controllers operating in redundant configuration
- One (1) Environmental Alarm System
- One (1) RF distribution system and TX combining
- One (1) RX branching
- One (1) GPS antenna
- Hubs for RF/Optical Conversion
- One (1) ODF Panel

6.5.1.2 Repeater Site Configuration

- Optical Fibre Repeater (One per site)
- One (1) RF Power Amplifier
- One (1) ODF Panel
- One (1) RF distribution system (cables, splitters, power dividers, antennae, etc.)

6.5.1.3 TETRA Terminal Units

- TETRA Mobile radios
- TETRA Desk Top Radios

6.5.2 The quantities show above are indicative and should be confirmed during the detailed design phase.

6.5.3 The Contractor shall supply at least (20) portable radios (also named as mobile radios, since they are located on-board the trains), which shall be installed in each of the Emergency Driver position in the trains. Installation of the radios in the trains shall require close coordination with the manufacturer of the trains to ensure proper integration of the radio equipment into the design layout of the train.

6.5.4 With reference to the general specifications the supplied TETRA mobile radios shall meet the following technical specifications:

Equipment located outside the train:	
Operating temperature range	-10 ^{o}C to +58 ^{o}C
Humidity	90 % at 50 ^{o}C
Equipment located inside the train:	
Operating temperature range	-10 ^{o}C to + 58 ^{o}C
Humidity	80 % at 40 ^{o}C
Operating mode	Full duplex TDMA, 25 KHz channel width with 4 time slots
Power Input	12 V DC (nominal)
Antenna impedance	50 Ohms
Radiating pattern	Omni directional
Antenna type:	Low profile, enclosed inside protective cover

6.5.5 The Contractor shall supply a minimum of 1 desktop radios to be installed in the Base Project's OCC, if deemed necessary.

6.5.6 TETRA Portable Radios

6.5.6.1 The Contractor shall supply at least 50 portable radios, which shall be configured for operation in talk groups predefined by the Service.

6.5.6.2 Each portable radio shall be equipped with Li Ion battery, charger, carrying case and carrying clip.

6.5.7 Dispatch Consoles

6.5.7.1 The radio dispatch positions shall be capable of initiating calls to all mobile and portable radios associated with each particular dispatch position. Dispatch consoles shall be capable of initiating dynamic regrouping of the System TETRA users, in coordination with the main TETRA Operating and Maintenance Dispatch Centre.

6.5.7.2 As a minimum the TETRA dispatch consoles shall be equipped with the following features:

- Call Patching
- Multiselect
- Broadcasting
- Monitoring
- Displaying of calling user ID or group call ID
- Emergency calls

6.5.8 Radiating Coaxial Cable

6.5.8.1 The Contractor shall supply and install low foam density type radiating coaxial cable

6.5.8.2 The Contractor shall supply all cable support hungers, connectors and other hardware required for the proper installation and operation of the LCX cable.

6.5.8.3 The supplied LCX cable and cable supports shall be suitable for use in tunnels and stations and shall be made of low smoke halogen free, flame retardant material (according to NFPA 130).

6.5.8.4 The Contractor shall supply and install flame redundant, low smoke halogen free low loss coaxial cable, omni directional antennae for indoor use, connectors, power splitters, directional couplers and other miscellaneous hardware that is necessary for achieving the required radio coverage inside the stations and their associated ventilation shaft structures.

6.6 System's Availability

6.6.1 The supplied TETRA radio system shall be designed to meet the following system availability figures:

- The unavailability figure of the TETRA network due to loss of radio coverage in tunnels, or concurrent loss of radio coverage in the platform areas of more than 3 stations or concurrent loss of 2 or more dispatch consoles shall be less than 0.01% per annum.
- The unavailability figure of the TETRA Network due to failure in the Network Dispatch Centre shall be less than 0.01% per annum for failures that affect radio coverage in tunnels and less than 0.5% per annum for failures that result in reduced system functionality.
- The unavailability figure of the TETRA system due to loss of radio coverage in the station concourse and/or entrances in one station or due to loss of one dispatch console shall be less than 0.5% per annum.

6.6.2 The supplied TETRA system shall be designed to provide a completely fault tolerant radio network which shall remain operational at all times except in the event of a catastrophic failure, i.e. fault of more than 3 major system components failing independently.

6.6.3 The design of the system shall employ equipment redundancy for all major hardware modules and/or software components of the network that in the event of a failure will cause single point failure of the system.

6.6.4 Furthermore, the design of the supplied system shall use path redundancy for the RF and optical transmission components. The system shall employ self-healing features so as to automatically recover in the event of a single failure of any of the hardware or software components.

6.6.5 The TETRA radio system shall be covered by the appropriate supervisory control system in the OCC/ECR of the Base Project, which shall include self-diagnostic features, as required to minimize the repair time and return the system to proper operation as quickly as possible.

6.6.6 The Contractor shall submit full details of the TETRA system. High reliability will be demonstrated by submitting the Mean Time Between Failure (MTBF) values for the system, as well as the general system MTBF calculations.

6.7 TETRA System's Interfaces

6.7.1 In order to support, enhance and meet the requirements pertaining to the safety and protection of the system of the extension to Kalamaria, the TETRA System shall have at least the appropriate interfaces to smoothly cooperate with the following systems:

- Integrated Communications Control System (ICCS).

- Portable devices in the trains (initial and new)

6.7.2 The TETRA system equipment on the trains shall be provided by the Rolling Stock Contractors and it is not related to the present contract, except at the level of interface with the respective systems in the new stations and in the OCC and the ECR.

6.8 TETRA System Installation Requirements

6.8.1 For open area equipment installations (station and tunnel entrances) the Contractor shall foresee the necessary protection measures, which must be applied to the radio equipment and cabling in order to avoid damage and interruption of service in case of direct lightning strikes or as a consequence of severe induction effects.

6.8.2 The proposed transmission system SHALL have spare capacity for future expansions.

6.8.3 The racks of the transmission system shall be the usual 19" racks, ETSI or similar, and they will be placed on the same rack or cabinet as the fiber optics connection panel.

6.8.4 For reasons of installation at all locations, provision shall be made for system expandability by 25%.

6.8.5 All installation, testing and commissioning activities in all stations and the depot shall be carried out in accordance with safety regulations.

6.9 Power Supply, Electromagnetic Compatibility (EMC) and Earthing

6.9.1 All TETRA system components, nodes, etc., shall be powered by a common Uninterruptible Power Supply (UPS) for the entire telecommunications system.

6.9.2 This system shall be connected to the earthing system and shall meet the EMC requirements.

6.10 Measurements and Testing Procedure

6.10.1 The delivery of the network nodes shall include and appropriate testing equipment and measuring instruments enabling the maintenance staff to remedy any defects and take the necessary measurements. These instruments and devices shall be suitable to fulfil at least the following functions:

- Generation and analysis of transmission frames
- Measurement of errors with adjustable threshold values, like bit error, code error, block error, frame error
- Simulation of transmission errors/ faults
- Measurement of optical fibres (according to ITU-T Rec. G.709)

6.10.2 Should the registration and filing of the measuring results require a PC, a suitable notebook ´shall be offered, too. The proposed testing devices and measuring instruments shall be described and reasons given as to their selection.

6.11 Documentation

The contractor shall supply system documentation in accordance with the requirements specified in the General Specifications. As part of the contract the following documentation shall be provided as a minimum:

- Standard Manufacture documentation for any item of hardware and software. This item also covers standard test procedures, installation recommendations, equipment drawings and layouts and any generic documents.
- Project specific conceptual and architectural design. This documentation covers also any surveys, calculation estimations or system design specifications.
- Standard manufacturer documents
- Project - specific documentation

- All the documentation shall be in Greek and English
- A complete set of operation, management and configuration manuals for all radios that shall be added as part of the extension to Kalamaria
- A complete set of maintenance manuals for the entire network and for its individual components.
- Complete technical descriptions and specifications for the entire equipment used on the network.
- Complete set of the "As-Built" drawings with details on the terminations, wiring and terminal blocks of the equipment.
- Procedures and test results and commissioning.
- Complete technical description of the system operation, accompanied by a complete set of drawings and diagrams for the entire scope, specifically designed to meet the special requirements of AM.
- Equipment configuration documents and hardware datasheets.
- Radio coverage analysis of new Metro areas.
- All software applications that have been developed to meet the specific requirements of AM.
- All documentation shall be in Greek and English.

6.12 Training for TETRA Radio System

6.12.1 The contractor shall develop a detailed plan for providing comprehensive training to the system users and to the maintenance personnel. The proposed training plan shall be developed in accordance with the requirements specified in the General Specifications.

6.12.2 Two types of training courses are foreseen:

- System Operation and
- System Maintenance

6.13 Training

6.13.1 The Metro maintenance staff shall receive technical training in order to maintain and operate the TETRA radio communication system of the Metro. The required training will include the following topics:

a) Basic Training on Technical Matters.
These training courses shall be provided to the technical staff of the Metro. The level of training shall be high enough to permit personnel to operate, maintain and manage the radio communication system, including mobile and portable radios, base radios and RF repeaters.
Training shall include the following item, but not limited to them:

- Detailed description of the TETRA radio communication network of the Metro, including system layout, design principles and general ideas, functional analysis and operating principles.
- System security and description of network functions and capabilities.
- Detailed training on the major components of the network, Repeaters, ballises, etc.
- Training on the trainborne radio equipment, portable and mobile units, messaging units, trackside equipment and all other terminals used by the Metro staff.
- Maintenance and troubleshooting procedures for all types of equipment used in the Metro radio communication system.

- Training on the use of the measuring and testing equipment required for maintenance work, system programming and equipment / network layout.

Training shall theoretical and practical. Training shall cover all concepts related to the operation and maintenance, as well as to the planning, layout and management of the system and equipment. Training shall also be provided on all available tools and equipment related to Network Management.

b) Users' Training

Training shall also be provided to the Metro staff for the proper use of the units (portable and mobile units, etc.). The following Metro personnel is required to receive this training:

- Metro staff using TETRA units. All Metro staff handling portable radio devices shall be trained in the proper use of these devices.
- Their training shall be for a minimum period of two days with the possibility of repetition if deemed necessary.

6.14 Security of Radio communications

The Contractor shall take all appropriate measures to ensure that voice communications within the Metro operational radio network are not accessible to unauthorized persons.

6.15 Standards

6.15.1 Generally, the system shall conform to all applicable national and international codes and regulations. Where codes (local or international) do not exist the system shall conform to sound engineering practices.

6.15.2 The following minimum standards shall be complied with:

- UIC 751-3 standards (for what regard communication quality and radio coverage)
- ETSI standards
  - ETS 300 392 TETRA Voice & Data
  - ETS 300 393 TETRA Packed Data Optimised
  - ETS 300 394 TETRA Conformance Testing
  - ETS 300 395 TETRA Speech Codec for Full Rate Traffic Channel
  - ETS 300 396 TETRA Direct Mode Operation
  - ETS 300 086
  - ETS 300-394
  - ETS 300-113
  - ETS 300 342-2
  - ETS 103 564 TETRA Plugtest scenarios MCPTT
  - TR 103 565 TETRA 3GPP mission critical services
  - ETS 103 269-2 TETRA Critical Communications Architecture
  - EN 300 392-7 TETRA Security
  - EN 300 396-6 TETRA Security
  - TR 102 300-7 TETRA Enhanced Data Service (TEDS)
  - EN 300 392-5 TETRA Peripheral Equipment Interface (PEI)
  - TR 103 414 TETRA Speech services over QAM channels
  - EN 300 392-2 TETRA Air Interface (AI)
  - EN 300 392-12-4 TETRA Supplementary services; Call Forwarding
  - EN 300 392-3-5 TETRA Inter-system interface; Add. feature for Mobility
  - TR 102 300-6 TETRA Air-Ground-Air
  - ETS 100 392-5 TETRA DMO Peripheral Equipment
  - ETS101 052 TETRA Standard Authentication, key management algorithm

- ETS 101 053-1-3-4 TETRA Standard Encryption algorithms
- EN 300 392-3-1 TETRA ISI General design
- ETS 100 392-18-4 Air Interface; Net Assist protocol 2

- Electrical and Radiating Cables in underground areas
  - IEC 332-1
  - IEC 332-3
  - IEC 754-1/2
  - IEC 1034-2
  - IEC-801-2
  - EN 50575
- EMI/EMC standards
  - EN 61000-4-8

6.15.3 The manufacturer's standards shall only be accepted if they are equivalent to or higher than the above.

6.15.4 The Contractor shall declare the applicable standards to be utilized.

6.15.5 Should a Standard referred to the contract is updated during the course of the Contract, the Contractor shall provide it to ATTIKO METRO.

7 Public Announcement System (PA)

7.1 Purpose and Scope of Works

7.1.1 The Contractor shall design, supply, install, test and commission a modern Public Announcement (PA) System, which will be used to make announcements and issue on time warnings to passengers in all areas of the Thessaloniki Metro extension to Kalamaria. The Contractor shall be also responsible to design, plan, modify, upgrade systems and devices of the existing PA system of the Base Project, mainly in the OCC and the ECR, to the extent required to ensure full operability of the system in the extension.

7.1.2 The main objective of the system is to inform the public in real time during the transport and movement of passengers, so as to ensure the smooth operation of the Metro, as well as to inform the public in case of emergency. This requirement becomes more imperative due to other operational requirements such as driverless operation, unmanned station platforms and the Platform Screen Doors system (PSD).

7.1.3 Installing a broad-band Public Announcement System offers significant assistance in the operation of the Metro and is of outmost importance for the control of the main stations and the stations of the extension to Kalamaria in case of circulation disruption.

7.1.4 In addition to the daily operation requirements, such as the transmission of live or pre-recorded audio messages and background music, the PA system shall also meet the requirements for a complete and unified system for the Base project and the extension in case of emergency.

7.1.5 The Contractor shall ensure that he possesses all necessary protocols enabling smooth integration in the existing public announcement system of the Base project and in view of integrating all required modifications and additions to both hardware and software. Moreover, he shall also ensure that the requirements of the new PA system are adequately met by the existing central PA system in the OCC and the ECR, and he shall warrantee that the required smooth operation of the system in general shall be met.

7.1.6 The PA system shall be of high reliability and availability, suitable for use in the Metro areas. It shall be of open architecture/ open interface with third parties to the extent possible and shall also have redundancy.

7.2 Area Coverage Requirements

7.2.1 The Public Announcement System shall take into account the architecture of each public area/sub-area, so that the audio message received by the passengers is clearly audible. The Contractor is required to provide for all public areas in the new stations an acoustical simulation study. This acoustical simulation study in combination with the architectural design and the corresponding architectural finishes materials in floors, walls, ceilings, Platform Screen Doors, etc., and with the corresponding reflection/ absorption coefficients shall specify the final locations where loudspeakers shall be installed in areas ensuring the delivery of audible and clear announcements.

7.2.2 Each new station shall be fitted with the appropriate equipment receiving the necessary messages and information on the operation status of the Metro Base project in general and the Kalamaria extension and shall inform passengers through the appropriate loudspeakers of the PA system in platforms, public areas and concourse areas.

7.2.3 The equipment of the PA system shall be installed in all public areas of the new stations of the Kalamaria extension. Each area (i.e. platforms, concourse areas, etc.) shall constitute a specific zone of the public announcement system while aach zone shall be individually selectable.

7.2.4 There will be sound coverage throughout the passenger path from the moment they enter the station up to the moment their enter the train in all doors used by the operation and maintenance personnel (including excape routs) and in all doors easily accessible by the public.

7.2.5 The Public Announcement System shall offer sound coverage via loudspeakers to all passenger areas, concourse areas, escalators and lifts in stations, in the escape routes, tunnels, or elsewhere.

7.2.6 Based on the results of the aforementioned acoustical study, a sufficient number of loudspeakers shall be installed in each zone intended for the public so as to compensate environmental noise and ensure clear audible announcements in combination with the architectural finishes and the acoustics of the specific area.

7.2.7 Loudspeakers in station areas shall be integrated and harmonized with the architectural finishes. They shall have a steel casing suitable for use in Metro projects, their finish shall be coated while the colour of the coating shall be defined based on the needs. The location, type and colouring of the materials and the installation method of the public announcement system in public areas shall be coordinated with the station architecture and shall be harmonized with the architectural elements of the station, so that the aesthetics of the new station are preserved.

7.2.8 The quantity, layout and type of the loudspeakers shall depend on the acoustical study. Moreover, the loudspeakers design shall be harmonized with the architectural design of the new station.

7.2.9 All local functions of the PA system shall be controlled via the central console of the system in the SMR of the extension to Kalamaria.

7.2.10 Local messages shall be emitted either by a station announcement point (SAP) located at the platforms or by the consoles in the Station Master Rooms. On either side of the platform a Station Announcement Microphone shall be installed in combination with the DLT service intended for passenger alarms, the personnel, the PSL and the SEP at the central communication point.

7.2.11 The listening microphones of the PA system located on each platform and in the ticketing area, combined with specified CCTV cameras at the platform and concourse levels, shall be connected to the CCTV system and be used to monitor the area, whenever the specific camera is selected to provide image feedback from the specific location and an announcement in necessary to be made.

7.2.12 The announcement console together with the DMT for the local central management of the PA shall be integrated in the ICCS (Integrated Communications Control System) workstation located at the SMR. Nevertheless, it shall not be possible to interfere during or interrupt announcements made by the OCC and the ECR. Thus, the console of the announcement system located in the Station Master Room shall have lower priority. Respectively, management shall be ensured by the OCC and the ECR via the ICCS system and the corresponding central console of the PA system of the Thessaloniki metro Base Project.

7.2.13 For the exact dimensioning of the system, the exact positions and the number of the devices, the Contractor shall have to prepare and submit at first a Final Design and then a Detailed Final Design to AM. The aforementioned design shall be subject to AM.

7.3 Equipment requirements for the Public Announcement System

7.3.1 The Public Announcement System shall be suitable for use in Metro projects and shall broadcast audio messages perceivable by all passengers and personnel under all operation modes.

7.3.2 The Public Announcement System shall be of digital technology. It shall include the following equipment in each individual station and shall meet the following requirements as a minimum:

- A local point for central management (DMT) of the Public Announcement System at the new station and a central point at the OCC and the ECR, integrated into the Integrated Communications Control System (ICCS) and into the central DMT of the Base Project. Central Management shall be exercised as described above.

This system shall also undertake signal distribution. The signal shall distribute different zones in different areas of the new station.

- Loudspeakers at all necessary points for the installation of a high impedance line (100V) to broadcast the sound of the announcement. In view of satisfying all needs, the loudspeakers shall:
  - False ceiling type
  - Sound projector type
  - any other suitable type required

  All loudspeakers to be used shall be fire-rated in line with EN 54-24.
- System of high impedance amplifiers (100V) to distribute the sound signal of the various zones to the loudspeakers.
- Announcement consoles, distinguished as a minimum to:
  - SMR - Master Announcement Station
  - Platform Station Announcement Point - SAP
- Microphones for interfacing with the CCTV system.
- Noise compensation system fitted with the appropriate measurement microphones.
- Cable networks, cable trays and cable ducts.
- Fully redundant with high availability.

7.3.3 The equipment and the devices of the PA system to be installed at the new stations shall be compatible and fully integrated with the existing equipment of the OCC by implementing all necessary modifications or additions.

7.3.4 The modular architecture of the system shall permit future extensions and replacements, enhancements, upgrades, or changes to discrete software or hardware segments.

7.3.5 The Contractor shall incorporate the software of the system to be installed at the extension to Kalamaria into the central unit (DMT) of the Public Announcement System and into the central unit of the ICCS at the OCC of the Thessaloniki Metro Base project. The DMT central unit of the PA system in the OCC and the ECR shall process, collect, prepare and transmit the audio messages to the new stations of the extension to Kalamaria.

7.3.6 The Contractor shall ensure possibility for units of workstation type in all new stations of the Kalamaria extension having the same characteristics and functions with the ones of the central units (DMT) of the PA system located at the OCC, which are integrated into the ICCS workstation of the new station.

7.3.7 The transmission of all the data of the PA system shall be ensured through the Digital Transmission System, Structured Cabling and the main fiber optics backbone network. All PA system devices shall be connected to the above.

7.3.8 The ICCS in the OCC shall be possible to record any new warnings and incidents as well as all pre-recorded messages used on a per case basis by the PA system at the new stations of the Kalamaria extension.

7.4 Acoustical Study Requirements

7.4.1 The Contractor shall submit an acoustical design prior to the installation of any PA system equipment in each individual station. The subject study shall be submitted the soonest possible at the DFD level and shall be approved by ATTIKO METRO.

7.4.2 This acoustical simulation study shall take into account the architectural finishes with the corresponding reflection/ absorption coefficients and the acoustic characteristics of the stations, and shall be based on noise and sound reverberation measurements obtained by the Contractor

in co-ordination with the other disciplines, such as civil works and finishes. The calculations cannot be based on hypothetical values; the values must be properly calculated for each case.

7.4.3 The true sound of the loudspeakers perceived by the listeners must range between 6 to 10dB above disturbing ambient noise generated by the public, machinery and unwanted reflections of the loudspeakers.

7.4.4 Loudspeakers in areas with high noise levels (e.g. platforms) shall be possible to generate sound pressure of the oder of 90 dB at a height of 1.37 meters from floor level,

7.4.5 The nominal sound reverberation time in platforms, passageways, passenger and other areas where announcements must be made shall be as follows:

- 2.5 sec between 200 Hz and 400 Hz
- 1.8 to 1.5 sec between 400 Hz and 2000 Hz

7.4.6 The design guidelines on permissible or maximum noise levels at the station platform shall be as follows:

- Noise level at platforms during entering/exiting trains: 75 dBA
- Noise level at platforms during train crossing: 75 dBA
- Noise level at platforms when trains come to a standstill: 65 dBA
- Conditions at passenger areas shall be similar the only difference being the reduction of noise levels by 3 dB.

7.4.7 The articulation index ranging between 0.5 and 0.7 must respond to a clear syllables signal. The Rapid Speech Transmission Index (quality parameter for PA-RASTI systems) shall range between 0.45 and 0.6 and sentence clarity shall be 95%.

7.4.8 The design of the Contractor shall take into consideration the required contact points, such as the location of the announcement points in stations, the cable routes, loudspeakers. etc. The design shall particularly take into account the installation of the platform screen doors in each individual station. The details of the proposed installations shall be submitted to ATTIKO METRO for approval.

7.5 Operational Requirements of the Public Announcement System (PA)

7.5.1 The Public Announcement System as a whole shall be of digital technology, designed and implemented to provide high level of availability and reliability. As a minimum, announcements shall be made even in any case of failure or loss of system module.

7.5.2 The Public Announcement System shall enable either the creation/ management of messages or the selection of pre-recorded messages related to an incident:

- locally (from each new station) via the ICCS workstation and
- from the OCC or the ECR via the ICCS workstation and the central DMT unit of the PA system to any new station of the Kalamaria extension.

7.5.3 The announcements of the PA system shall be heard in all public areas of a station. Each area (i.e. platform surface, passenger circulation area, etc.) shall constitute a special zone of the announcement system and shall be individually selectable.

7.5.4 When specific stations/zones are selected, an indication shall be shown when the selected zone is occupied. Normally, this area shall not be selected. Nevertheless, if the announcement must be heard to zones already occupied, then Station/Train Supervisors shall intervene and shall interrupt the local system. These priorities shall be programmable.

7.5.5 All local functions of the announcement system, such as workstations, consoles and microphones, shall be controlled by the equipment and modules of the PA system in the Station Master Room.

7.5.6 In each new station, the cabinet of the public announcement system shall be connected to the LAN "Common TCP/IP Network" to provide local services and services for the entire system. The

consoles of the PA system and the central cabinets shall be compatible with the Ethernet and/or TCP/IP networks.

7.5.7 At the platform of every station Station Announcement Microphones (SAP) shall be installed, namely one at each Integrated Emergency Control Unit (ECU) accommodating other emergency systems. Every SAP shall be manufactured in a fixed and vandal-proof manner. The SAP shall have a lock so as to prevent its non authorized use.

7.5.8 Every standard SAP module shall have two key switches; one key switch shall set into operation the announcement system of the specific zone for which the announcement is intended where speech shall be delivered through the use of a microphone eliminating or reducing ambient noise and installed at the front part of the module. The second key switch shall activate the intercommunication between SAP and SMR through the use of a microphone of the module and of a loudspeaker integrated into the module.

7.5.9 In addition to the management of the PA system by the ICCS workstation of the new station, an announcement system console shall be also available at the Station Master Room equipped with a microphone eliminating noises, installed at the end of a rode. This module shall be equipped with a sufficient number of switches to enable the transmission of announcements to every station zone and intercommunication. Adjacent to every switch there will be a light signal activated when the circuit is in operation. Switch activation occurring when a message is emitted to an area shall allow users to listen to the announcement made during at that specific time via the module microphone.

7.5.10 The Station Master console microphone must be of directional type, and through an acoustic filter, it shall ensure noise reduction and sound insulation and close-talk conditions. A compressor/pressure limiter card shall be installed at the public announcement console or at the cabinet for maintaining stable output levels.

7.5.11 A listening device shall be installed in each zone. Its output shall be used to monitor the intensity of the ambient sounds and to activate an automatic sound intensity equalizer which will automatically adjust the average level of the sound pressure to the average level of the ambient noise sound pressure. Using the loudspeakers as listening devices is prohibited.

7.5.12 The individual settings of each station module shall be automatically stored enabling thus the Station Master to restore the previous settings without any time or function losses in the event to failure, defect or other interruption of the operation.

7.5.13 All functions of the PA system in the OCC and the ECR related to the extension and the Base Line shall be controlled by the PA consoles of the Station and Train Supervisors in the OCC and the ECR. The central unit of the PA system of the Kalamaria extension must be integrated in the central DMT point of the PA system of the Base Project and the ICCS central point. The Contractor shall be responsible to ensure their full integration.

7.5.14 Announcements made by the OCC and/or the ECR via the PA system ICCS and DMT workstations shall use the DTS system of the Structured Cabling and of the main fiber optics backbone network (connecting each new station to the OCC or the ECR). The PA consoles and the central cabinets shall be compatible with the Ethernet and/or TCP/IP networks.

7.5.15 Announcements made by the OCC and/or the ECR to the new stations of the Kalamaria extension shall intervene during and interrupt the local announcements of the new stations whenever required. It shall be possible to provide the following functions as in the case of the Base Project, namely:

- Announcements to specific new stations by selecting specific zones within a station (i.e., platforms, passenger circulation areas, etc.). Each zone shall be individually selectable.
- Announcements to groups of new stations, selecting all or any combination of zones within each new station. These zones could be the ones used in the Base Project and the Extension project.

- Announcements to trains shall be ensured via the Radio Communication system (as the case is in the Base project)
- Installation of an automatic announcer which will have the possibility to store digital messages (the number and their duration shall depend on the capacity of the hard disc they are recorded).
- It shall be possible to set the automatic announcer to replay any recorded or pre-recorded message automatically and to replay background music at pre-determined intervals to any number of zones/ stations as necessary.
- Station and Train Supervisors (2x):
  - they shall be able to select a message from a list of pre-recorded messages and transmit it.
  - In addition to the CCTV, they shall be able to listen to the monitoring microphones in stations, also selectable from the console controllers.

7.5.16 Announcements made by the OCC and the ECR shall use the same microphone amplifier in each station as in the case of local announcements and, thus, automatic sound intensity control shall apply to all announcements.

7.5.17 In case of fire alarm, scheduled messages i.e. announcements for evacuation in case of emergency, etc.) shall be announced at the new stations. The Station Master or the Controller at the OCC and the ECR shall be able to start the transmission of scheduled general content messages.

7.5.18 Loudspeakers should be fully coordinated with the supplier as regards their features and manufacturing.

7.5.19 Amplifiers (100V) shall be supplied with flat frequency response over the range of frequencies from 100Hz to 11kHz.

7.5.20 The operation of the announcement system shall be centrally and locally scanned at all times. The same applies to power amplifiers. Moreover, the microphone series used shall be monitored on a permanent basis against short-circuiting, earth leakage or electrical power shut down. Failing lines should be disconnected without rebound.

7.5.21 To increase reliability an auxiliary power supply amplifier (with automatic changeover controlled by a processor) shall be installed. In case of failure, the auxiliary amplifier shall be substituted by the failed unit.

7.5.22 Loudspeakers in each area shall be configured in crossed power layout, i.e. two power supply amplifiers shall power each zone, one shall power the loudspeakers with an odd number and the other the loudspeakers with an even number. Thus, the redundancy of the microphone line and power supply amplifiers is increased.

7.5.23 Failures in any cabinet with PA system equipment shall be shown on the boards of the PA system in the OCC (Station/ Train Supervisor) and/or at the ECR and shall be checked from other stations as well.

7.5.24 The software of the PA system and the relevant equipment (either fixed or on board the trains) of the Kalamaria extension shall be fully intercompatible and compatible with the software of the existing equipment of the PA system in the OCC and the ECR, which will be upgraded accordingly. A development plan shall be delivered ensuring that this software has undergone thorough tests.

7.5.25 The software of the PA system shall be of open architecture and shall be able to compatible with the respective devices of all major recognized manufacturers. Open software protocols shall enable full integration with the ICCS and the DMT of the Base Project.

7.5.26 The basic function of the software shall consist in controlling and recording the status of all PA system units. In each workstation of the software the necessary diagnostic tests shall be performed and the relevant information shall be displayed, depending on the needs, the

corresponding system's operation status and the announcements made by the operators to the public.

7.6 System Availability

7.6.1 The PA system availability shall be at least 99,96%.

7.6.2 In order to ensure the highest degree of availability of the PA system, the following measures shall be introduced in relation to the central PA unit, namely:

- Redundancy 1+1 for the interior fans for the common sections of the unit, such as the processor and
- The Contractor shall provide warrantees for the supply doors.

7.6.3 The Contractor shall submit full details of the proposed PA system. High reliability will be demonstrated by submitting a design showing the Mean Time Between Failure (MTBF) values for each card of the system, as well as the general MTBF calculations of the system.

7.7 PA System Interfaces

7.7.1 The Public Announcement System of the Contractor of the extension to Kalamaria of the Thessaloniki Metro shall have the appropriate interfaces to smoothly cooperate with the following systems as a minimum:

- Operation of all PA system functions via tha ICCS system
- CCTV
- Fire Protection system
- PA system on the original trains of the Base project and the new trains to be added in the framework of the extension to Kalamaria
- Central real time clock of Thessaloniki Base Project and of the new stations.

7.7.2 The Contractor's design shall take into consideration the required interface points between the PA system on board the train and the ATS System/ Signaling, Public Announcement and Radio Communication – TETRA.

7.7.3 On board the trains, passengers shall be audibly informed for the next station. Therefore, in addition to the indications of the PIS system, the vehicle shall be equipped with the PA system.

7.7.4 The PA system equipment on the trains, shall be made available by the Rolling Stock Contractors only concerns the present contract at interface level with the corresponding systems at the new stations and the OCC and the ECR.

7.8 Installation requirements for the PA System

7.8.1 All PA system cables shall be fire-rated, of low smoke emission, halogen free and given that the cablings of the PA system constitute part of the Fire Alarm System they shall be fire rated for 3 hours and capable of maintaining electric circuit integrity under fire for at least 30 minutes (FE 180/E30). These cables may use the same trays and/or cable ducts with the other communication cables.

7.8.2 For the connections between PA cabinet and loudspeakers normally shielded cables shall be used since this connection shall use 100V technology.

7.8.3 The cabling for the PA call stations and PA cabinets shall be TCP/IP compatible.

7.8.4 The central PA cabinets within new stations shall be housed in a 19'' ETSI cabinet or similar. The cabinets shall be located within the respective telecommunication rooms and the technical equipment rooms.

7.8.5 The proposed system shall be expandable and compatible with the central equipment (hardware and software).

7.9 Power Supply, Electromagnetic Compatibility and Earthing

7.9.1 All PA system components shall be powered by a common UPS for the entire telecommunications systems. UPS units shall be supplied by the main contractor of the extension and are not included in the scope of the present project. Cabling for the UPS up to the PA system is included in the scope of the present contract.

7.9.2 The PA system system-wide shall be connected with the earthing system of the stations which is supplied by the main contractor of the extension.

7.9.3 The PA system shall meet the EMC requirements, as these are set in the corresponding European Standards EN.

7.10 Measuring and Tests Procedure

7.10.1 The delivery of the PA system shall include testing and measuring equipment enabling the maintenance staff of ATTIKO METRO or the Operations personnel to remedy any defects and make the necessary STI-PA (standard) measurements in line with Standard IEC60268-16. These instruments and devices shall be suitable to fulfill at least the following functions:

- Measurements at concourse and platform level
- Measurements conducted using the standard STI-PA signal in line with IEC 60268-16
- Measurements conducted using the appropriate instruments in line with IEC 61672-1:2002

7.10.2 Internal function test automatically performed at regular intervals during night shift shall enable full availability of the system.

7.10.3 Should the registration and filing of the measuring results require a PC, a suitable notebook shall be offered. The testing devices and measuring instruments shall be described and justification for their selection shall be given.

7.11 Standards

7.11.1 The public address (PA) system and its parts must comply with the requirements of the standards or their respective European equivalents. Namely:

- IEC EN 60849 – Sound systems for emergency purposes
- IEC EN 60286 – Sound system equipment
- IEC EN 60850
- IEC EN 60664
- IEC 60268-16
- All parts of EN 54 – Fire detection and fire alarm systems
- All parts of ISO 7240 – Fire detection and alarm systems

7.11.2 The loudspeaker cables shall be complying with VDE 0815 or the respective European standard.

7.11.3 Standards of the manufacturer shall be accepted only if they are equivalent or higher than those mentioned above.

7.11.4 The Contractor shall state the applicable standards to be used. Should during the execution of the Contract, a Standard is revised, then the Contractor shall provide ATTIKO METRO with the revised Standard.

8 Closed Circuit Television (CCTV)

8.1 Purpose and Scope of Works

8.1.1 The Contractor shall design, supply, install, commission and test a modern Closed Circuit Television (CCTV) System to be used for real time visual surveillance and monitoring of all public areas of the Project of the new Thessaloniki Metro extension to Kalamaria. At the same time, the system shall ensure video recording in specific locations of these areas.

8.1.2 The new CCTV system shall be integrated into the existing central equipment of the OCC and of the ECR at Pylea, following the implementation of the necessary modifications or additions.

8.1.3 The Contractor of the present contract, shall be responsible for the design, planning, modifications, upgrading of systems and devices of the CCTV system at the OCC and at the ECR, as well as for the supply, installation, testing and commissioning of the aforementioned equipment and software.

8.1.4 The Contractor should ensure that all necessary protocols are in place for the smooth integration into the existing CCTV system of the Base Project and for incorporating all required modifications and additions in hardware and software. Moreover, the Contractor should ensure that the capacity of the new CCTV system is sufficiently covered by the existing central CCTV camera system.

8.1.5 The main objective of the CCTV surveillance system is to support the safety of transportation for passengers. The requirement will be increased caused by the operational requirements such as driverless train operation, unmanned station platforms and use of platform screen door system (PSD). The CCTV system also be also used for surveillance purposes and for protection against non-authorized entrance to all necessary areas of the new stations and extensions.

8.1.6 The Contractor shall submit a risk and threat analysis, necessary for the design of the systems related to the safety and protection of passengers, personnel and equipment as a whole, along with the equipment provided for in the extensions. The aforementioned analysis shall be subject to AM's approval.

8.2 Operation Requirements and Area Coverage

8.2.1 At each new station, cameras shall be provided to give colour pictures of platforms, platform screen doors, circulating areas, concourses and ticketing areas, escalators, lifts and emergency exits in the stations. The cameras will provide surveillance and assist in control of the station.

8.2.2 All station public areas and the entire journey of any passenger from station entrance to train boarding shall be fully observed (including escape route) by the CCTV system.

8.2.3 At entrances/exits of technical rooms or of other rooms of particular importance for the Metro operation, at the points where Automatic Ticket Issuing Machines (ATIM) and Ticket Validators are located, as well as at the gates, fixed cameras shall be maily used for surveillance. Similar cameras shall be also installed for the surveillance of entrance/exit lift doors for Persons with Special Needs (PSN), as well as at the staircases and escalators.

8.2.4 The Closed Circuit Television System shall survey the emergency exits in stations, and shall have access to all escape routes in case of evacuation, and to tunnel accesses from shafts and platforms.

8.2.5 As a means of support, rotating cameras must be placed to play an auxiliary role -at some points- to the fixed cameras, as well as to the control of the new stations, especially at peak hours and especially in case of special events. These cameras should be manually operated and be placed at a pre-determined location (PTZ) from the SMR of the new station and from the OCC.

8.2.6 All points of the public areas of the new stations of the extension, where Direct Telephone Line (DLT) devices shall be placed, could be covered by at least one camera. In case of activation of the device for communication between the passenger and the operations staff of Thessaloniki Metro, at least one camera shall be able to transmit an image from this point.

8.2.7 As regards platforms, the CCTV system should cover all PSDs, while the option shall be given for this system to cover the train doors when the train is stopped at the platform.

8.2.8 The number of the cameras of the systemn in all zones, such as platforms, concourse level, shall be such so as to provide complete surveillance for safety and protection reasons, the passengers, the personnel and the equipment.

8.2.9 In general, the coverage rate shall be as follows:

- Platform level 100% - CCTV coverage
- Concourse level 95% CCTV coverage, but 100% coverage for all lifts and escalators, stairs, ticketing area (ATIM and ticket offices) and the escape routes Platform level 100% - CCTV coverage

8.2.10 The Contractor shall provide drawings of the vertical and horizontal coverage according to the lenses for fixed and dome cameras. The minimum size of a standing human of 1.8 meter displayed on the picture shall be defined by the resolution (digital zoom).

8.2.11 The CCTV system shall ensure a reliable and effective surveillance of the operation and the passenger traffic in the stations, as well as inside trains (initial ones of the Base Project and new ones to be added in the framework of Kalamaria extension). The surveillance of the train interior and exterior through the CCTV constitutes a scope described in the Rolling Stock Specifications. The Contractor shall be responsible for the overall integration and management of the CCTV system at Kalamaria extension and on board the trains (18 trains of the Base Project and 15 new ones of Kalamaria extension).

8.2.12 The design and the exact locations of cameras at the new station and at the remaining points of Kalamaria extension for sufficient surveillance of all critical areas shall be specified during the Contractor's Detailed Final Design phase.

8.3 Overview of the Closed Circuit Television System (CCTV)

8.3.1 The Closed Circuit Television System (CCTV) of Kalamaria extension provided shall be of IP technology and shall consist of the following parts:

- Fixed IP cameras ensuring the overall surveillance
- Rotating (auto dome PTZ IP) cameras for auxiliary use
- Connection ports with the LAN network
- Suitable software (video management system) for image and camera management, of open architecture, compatible with the respective software of the Base Project
- Servers, workstations, screens
- Cables and other materials.

8.3.2 The management software should be in a position to be integrated into the existing software of the Base Project for the overall control and management of cameras of the Base Project along with the ones of the extension to Kalamaria. It should be in a position to record and store images from all cameras installed at the extension. As a minimum, it shall be of open architecture type and shall support internationally acknowledged standards, such as for example ONVIF.

8.3.3 Servers/storage of the CCTV system to be used shall operate at least in RAID5 layout for video data and in RAID1 for O.S. and the application software, while they shall be equipped with twin power supply units.

8.3.4 All system devices shall be connected to the local LAN. The local communication network of the system shall have the appropriate bandwidth capability for image transfer and recording.

8.3.5 The transmission of all data and real image of the CCTV shall be achieved via the DTS, the Structured Cabling and the main backbone fiber optics network. All CCTV cameras shall be connected to the above.

8.3.6 The hardware and software (DMT and ICCS) of the workstations of the OCC and the ECR shall be upgraded, where required, in order to integrate to the above the digital image recording system of the new stations as well, while the existing functions and capacities of the (local and central) DMT system, as well as those supported via the ICCS shall continue to be supported.

8.3.7 The CCTV system shall be synchronized with the real time central clock of Thessaloniki Base Project.

8.3.8 The proposed system shall have the capacity of future extension to and compatibility with the central equipment (hardware and software). Moreover, it shall have the apporpriate capacity and redundancy for adding cameras.

8.3.9 For the exact dimensioning of the Closed Circuit Television System, the exact locations and number of the cameras, the Contractor shall utilize the appropriate simulation and customization software and shall prepare and submit the relevant design to AM. The aforementioned design shall be subject to AM.

8.3.10 The CCTV system shall be able to cooperate with cameras from all well-known manufacturers and shall comply with respective international standards.

8.4 General Requirements for CCTV

8.4.1 The CCTV system of the Extension to Kalamaria shall be integrated into the existing CCTV system at the OCC at Pylea. Therefore, a CCTV system shall be installed in each station, to be connected to the central control via the fiber optics transmission system. The CCTV system shall be able to transmit a coloured video signal, selected through a link of each station, at the existing screens of the Control Centre at Pylea and at the ECR.

8.4.2 The "distributed" architecture of the CCTV system for the local network and the "server client", with local recording per station, shall be ensured in accordance with the characteristics of Thessaloniki Metro Base Project as wel. Moreover, the safety of communication (secure layer) shall be ensured up to the camera.

8.4.3 The selection of specific cameras in each station room shall be effected both from the existing installation of the ICCS workstation and the existing DMT workstation and the set of screens in the OCC and the ECR. The Contractor shall consider adding another workstation and screens at the OCC and the ECR for better management and control of cameras both of the extension and of the Base Project.

8.4.4 Controls shall allow the operator to select an area and, subsequently, any of the cameras in this area. Controls shall allow the operator to control the station's rotating cameras as well. The CCTV system shall be used to specify the selected area and the camera required. The system shall ensure that the response time to any command given by an operator, under any circumstances, shall not exceed 1sec.

8.4.5 The type of the selected cameras shall ensure the necessary coverage and shall meet the security and protection criteria. The entire surveillance shall be ensured by fixed digital MegaPixel cameras and rotating PTZ cameras for auxiliary use only. The following types of cameras shall be installed, namely:

- Fixed IP CCTV indoor cameras in stations
- Panoramic rotating IP (PTZ IP) indoor CCTV cameras, ceiling mounted, in stations.

8.4.6 Οι Cameras shall allow video transmission via a safe TCP/IP connection by using the apporpriate safety protocols, in order to transmit entrance signals to the screens in the operators' rooms. Cameras shall be remotely controlled from each SMR of the new stations, the OCC and the ECR, as mentioned above.

8.4.7 Colour, high resolution cameras shall be equipped with a sensor: progressive scanning CCD, with minimum illumination: 0.74lux, offering clear view. Moreover, they shall be of high sensitivity, providing full coverage for night and day vision. Cameras shall be auto-focus and shall feature

automatic switching to night/day mode. All necessary actions shall be performed to prevent light-induced reflection or disturbance.

8.4.8 All cameras shall be equipped with auto-adjustable iris lenses and zoom, they shall be equipped with automatic and manual infrared filter for day/night operation, when the camera shall operate as black-and-white camera when the illumination levels are lower than the schedulled level.

8.4.9 The possibility for auto adjustment of the contrast of the projected image, in case of digital zoom on the image of a camera on a live or recorded video, shall be provided for the supplied system.

8.4.10 The dome rotating IP (PTZ-IP) cameras to be provided shall have a high-speed head. They shall have the possibility for remote control, motion (rotation/inclination), manual focus from the SMR, from OCC and ECR. For this reason, virtual PTZ remote controls shall be provided through the software and the management of the recorded video to the operators at least in the OCC and the ECR.

8.4.11 The CCTV system shall have the possibility for recording digital images as well from IP cameras. The type of the recorded image signal shall be PAL, 4CIF (704 x 576 pixels) codified per H.264 (ISO/IEC-14496 – 10 MPEG-4 Part 10). The image quality and the recording rate shall constitute the scope of customization, but the required average recording rate shall be at least 30 fps at maximum quality adjustment, while recording shall be effected in real time. The timestamp shall be equal to 1sec, deriving from the synchronization with the signal from the central clock of each station.

8.4.12 The image of all cameras shall be recorded without any further processing (e.g. Transcoding) to keep all information included in the video signal, without requiring any specialized hardware. The video recording should be synchronized, irrespective of the resolution, speed or frame rate, while all recordings shall be executed in real time and shall have the Date and Time recording stamp on a per second basis, as well as the title of the camera at frame level.

8.4.13 In order to achieve the maximum possible utilization of the available bandwidth of the communication network during the transmission of a live or recorded image, especially in case of remote users, the system shall be automatically and dynamically adjusted to the resolution of the transmitted image, depending on the size of the screen or part of the screen (number of pixels), in case of picture-in-picture (PiP), selected by the user for the display of the image to be transmited.

8.4.14 In addition to the video signals, data to and from the cameras shall be transmitted through the TCP/IP common transmission network. Data transmitted to/from the cameras shall be available in all Station Master Rooms and in the OCC/ ECR. It shall be possible to transmit the following data:

- Roof cameras control data (such as rotation/ tilt commands, parameters setting) and
- Data concerning non-authorised operation.

8.4.15 Cameras shall be suitable for overall management from the video recording and management software (NVMS) in the OCC and the SMR and shall be compatible with the ONVIF standard. The CCTV system shall impose no limitation as regards to the number of cameras to be viewed at the same time by the user on his/her screen; this shall be defined only from the screen's resolution for the "view" function to be operational.

8.4.16 Cameras shall operate, as a minimum, within an operating temperature range from -20^{o}C to +50^{o}C and humidity conditions ranging between 10% and 90% RH.

8.4.17 Cameras shall be powered either directly from the main power supply, or through the network's communication cable (PoE).

8.4.18 Cameras shall be housed inside a closed casing ensuring protection against dust, humidity and ambient conditions and a certain degree of protection against vandalism. The protective casing shall be equipped with a heating element and a thermostat to prevent humidity concentration behind the front glass.

8.4.19 In particular, cameras in lifts shall be protected against vandalisms (IK-10) and the appropriate equipment shall be provided for their interconnection with the remaining system via a twisted pair, while a cooperation must be established with the lift supplier for reasons of installation/integration.

8.4.20 All supports and ducts, cable ducts and cable trays shall be of the highest quality so as to be harmonized with the architectural design of the station and to withstand local weather conditions, such as temperature and humidity.

8.4.21 The Contractor shall provide, as part of the CCTV system, an image digital recording system in all new stations of Kalamaria extension. The image digital recording system to be installed shall be fully compatible with the image recording system operating in the Metro network of the Base Project and, in particular, in the OCC and the ECR.

8.4.22 The pictures of cameras shall be recorded locally, within the respective new stations of Kalamaria extension. The pictures to be recorded shall be selected by the respective Station Master(s) and/ or the Controller(s)/ Supervisor(s). As a minimum the following digital recorders to be connected to the existing recording system of the Base Project shall be provided:

- Within stations for each Station Master
- Within OCC and ECR, where the storage area must be re-dimensioned for reasons of modification, increase or addition of equipment items.

8.4.23 The digital image recording system shall consist of individual digital recorders of industrial type images to be installed in the CCTV cabinet in each station. The number of image recorders shall be such that it is deemed sufficient for the recording of optical signals of all cameras for each station.

8.4.24 The hard disks of the system shall be connected to RAID array type 1 or 5 and shall be able to be replaced during hot plug-in. Due to the limited life cycle of the heavy duty hard disks, a minimum 3-year guarantee shall be granted for the replacement of disks.

8.4.25 Each digital recorder shall have the capacity to record and store at the same time 16 image signals of continuous flow per H.264, while the required time to keep the file of the stored image shall be 7 days. Any image file dated prior to the aforementioned time shall be automatically overwritten by a new image in the old file in a cyclic logic.

8.4.26 The image recording system shall enable the selection of a station, camera, date and time of recording of the file. The system shall support the following functions: image reproduction, reproduction in slow and fast motion, frame by frame motion, rear reproduction, image freezing, cyclic repetition and recording to exterior storage means.

8.4.27 Recorders shall support the concurrent operation that includes the following:

- Live display of images transmitted by cameras on the screens
- Recording
- Retrieval, review and playback of earlier recordings
- Filing of hard disk files
- Digital recorder management

8.4.28 The new or additional recorders shall be installed in the respective telecommunications equipment rooms and shall be powered by common UPSs for telecommunications.

8.4.29 In case of system failure, signal loss and end of service life of the hard disks for optional replacement (as a minimum), an appropriate alarm signal shall appear at the work positions. At the same time, alarm signals shall be transmitted through a free interface to be accessible and incorporated in the BACS system. The image recording system shall have a diagnostics, self-diagnostics capacity.

8.4.30 In order to connect the image recorders with the work positions and, in general, to transfer data, the DTS digital transmission system of the Structured Cabling and the main backbone fibre optics network shall be used. In order to ensure the necessary resources for data transfer from both

systems, the Contractor shall customize the entire backbone network of the Metro system with AM's approval.

8.4.31 The types of software of the CCTV system, of the SMS system and of the related equipment (either fixed, or on-board) at Kalamaria extension shall be fully compatible between each other and with the software of the existing CCTV equipment in the OCC and the ECR, which shall be properly upgraded. A development plan shall be delivered ensuring that this software has been thoroughly tested.

8.4.32 The software shall enable the user to select a camera to display either a live or a recorded image in a user-friendly manner, either through a Tree-View hierarchical menu, or a MapView hierarchical menu.

8.4.33 The option to select the display of a live video, as well as to select the display of recorded material shall be provided on the basis of the following combination specified by the operator: Station – Camera. Especially as regards the display of recorded material, the option shall be provided to determine either the date and time of start and end of an event, or the date and time of start and its duration.

8.4.34 The option shall be provided to authorized users to share the image displayed on their screen with other operators, for reasons of cooperation in surveys via a live or recorded video. The option to display at the same time the same selected images in the OCC or the ECR, as well as in the relevant SMR shall be necessary.

8.4.35 The option to handle PTZ cameras in a user-friendly manner shall be provided to properly authorized users. If such a user undertakes the control of a PTZ camera, then all the other users not having a PTZ camera control authorization shall see in this camera the image selected by the authorized user. Assuming the PTZ camera control shall be either exclusive (in such a case, the authorized user shall lock the motion of the specific camera), or common (in such a case, the camera can be set into motion by any other authorized user with the appropriate rights).

8.4.36 The possibility to support VIDEO ANALYTICS functions shall exist in the future by using the appropriate software; these functions can be distributed in part to limit the volume of information transferred to the OCC and the ECR. The analytics software should be compatible with the applicable legislation for safeguarding personal data and shall handle additional functions and alarms to be agreed upon with AM.

8.4.37 The entire software of this system would have already been developed and the related development plan should be submitted in case supplementary designs are required.

8.5 Technical equipment within the OCC and the ECR

8.5.1 The new CCTV systems shall be integrated into the existing OCC and ECR equipment, by making all necessary modifications or additions.

8.5.2 All necessary upgradings or extensions both in hardware and software of the central CCTV system in the OCC and the ECR to be required for the smooth and proper operation of the system constitute the scope of this Project.

8.5.3 Irrespective of any other camera, each CCTV camera shall transmit its images to the OCC and/or the ECR. The OCC and the ECR shall have full access to all images concerning the extension to Kalamaria. The capacity of the system shall enable it to concurrently transmit to the OCC or to the ECR at least 16 images from each station.

8.5.4 An additional CCTV console with 4 screens for the extensions shall be installed in the OCC for the second operator, enabling both operators to properly survey the stations, especially during peak hours or during an accident. Moreover, two (2) screens of the CCTV system shall be added at the ECR.

8.5.5 Every image will be identified by station name and camera locality, by insertion of an alphanumeric message on the video in Greek or English language.

8.5.6 The Contractor shall confirm the response time to provide a picture, as a maximum 200ms is required, when requested by the OCC and/or the ECR. This shall be subject to approval by the AM.

8.5.7 All necessary devices such as amplifiers, repeaters and parts of the system shall be integrated inside telecom rooms, on 19 inch rack and wired properly, labelled and physically protected by front and rear doors.

8.5.8 The necessary remote control installations shall be provided exclusively to the respective Controllers/Supervisors in the OCC and the ECR.

8.6 CCTV Equipment within Station Master Room (SMR)

8.6.1 Every station shall be connected to the OCC and the ECR to provide live images.

8.6.2 The station equipment shall be similar to that in the OCC/ECR but limited to local CCTV monitoring (2 flat screens, each 21" minimum).

8.6.3 The first screen shall include a "mosaic function", i.e. a mosaic with 16 small pictures shall be superimposed on the main picture. The most sensitive areas shall be shown. The selection of pictures shall be done through touch screen and the choice of pictures (cameras) to be approved by AM. The mosaic pictures in total shall not use more of a quarter of the screen. By selecting of one of these 16 small mosaic pictures the "active" background picture shall switch to the selected one.

8.6.4 The second screen shall be provided with screen splitter functionality (two pictures on the screen).

8.6.5 At each station, each camera shall be connected, through a CCTV link or through another technically compatible solution, with the common TCP/IP network, in order to transmit entry signals on the screens within the operators' rooms.

8.7 Availability of the System

8.7.1 The availability of the system shall be at least 99.75 %.

8.7.2 The Contractor shall submit full details of the system. High reliability will be demonstrated by submitting a design showing the Mean Time Between Failure (MTBF) values for each part of the system, as well as the general system MTBF calculations.

8.7.3 The Contractor should examine whether the targeted high availability of the system is now covered by the additional equipment of Kalamaria extension, mainly in relation to the dual equipment in the central systems –where required in the Base Project- (recorders-servers-power supply devices) or redundant recording, in the sense of two independent recordings at different points, as well as the location of the installation of the redundant equipment.

8.8 CCTV Interfaces

8.8.1 In order to support, improve and cover the safety and protection of the system at Thessaloniki Metro extension to Kalamaria. The CCTV System shall have at least the appropriate interfaces to smoothly cooperate with the following systems:

- Upgrading of the Safety Management System (SMS) for the collection and processing of all alarms in relation to the additional equipment to be installed by the Contractor for the extension.
- Via the Access Control and Intrusion Detection System (ACC/IDS), so that selected points are supervised by the CCTV system as well.
- Via the DLT system so that, upon activation of the DLT emergency devices, the respective camera that surveys an area is activated.
- Via the ICCS
- All the remaining systems, such as BACS, UPS and Telecommunications

- Via the CCTV system on the initial trains of the Base Project and the new trains to be added in the framework of the extension to Kalamaria.

8.9 CCTV System Installation Requirements

8.9.1 The central CCTV racks in the stations, the Depot and the OCC shall be installed in ETSI 19" rack or similar one, air-conditioned, to be properly earthed, equipped with lightning protection.

8.9.2 The various installations of CCTV system shall be designed so as to withstand temperature and humidity variations at the locations of the new stations at the extension to Kalamaria.

8.9.3 Any equipment not installed in the technical telecommunications room shall be fanless industrial and shall be powered by double controlled power supply units.

8.9.4 The CCTV on-board equipment shall be Solid State fanless industrial PC type.

8.9.5 The use of "off the shelf" products and of the open architecture platform for release by a single supplier should be ensured by the Contractor. All devices shall have an at least 3-year guarantee by their manufacturer.

8.10 Power Supply, EMC and Earthing

8.10.1 The CCTV system spare parts shall be powered by UPSs for the entire telecommunications system. Additional information as regards the power supply means shall be provided in the respective chapter entitled "Power Supply".

8.10.2 The CCTV system shall be connected to the earthing system and shall meet the EMC related requirements. Additional information as regards the earthing systems shall be provided in the respective chapter entitled "Earthing and EMC", as well as in the applicable Standards.

8.10.3 The on-board CCTV and safety/protection system shall be powered by a UPS unit with 1-hour autonomy.

8.11 Measuring and Tests Procedure

8.11.1 The delivery of the CCTV System shall include a piece of the measurement and testing equipment mentioned below, which shall enable the Service's maintenance staff of the Department or the Operation Company to correct any defects and make the necessary measurements. The following instruments and devices must carry out at least the following functions:

- Measurement of the quality of the image which arrives from the network to the telecommunications room in the OCC and the ECR.
- Display on a portable screen of any image for use in the OCC, ECR, SMR or the telecommunications room and the platform.

8.11.2 During the delivery of the CCTV system, a suitable laptop will be provided. Testing devices and measurement instruments shall be described as necessary and their selection shall be properly justified.

8.12 Πρότυπα

8.12.1 The CCTV equipment to be provided shall comply with the following standards:

- NFC 15-100 Low-voltage Electrical Installations ENGLISH EDITION/ Date: 05/12/2002.
- EN 62 262 General Requirements for Electrical Equipment - Classification of Degrees of Protection provided by Enclosures / Date: 01/10/86.
- EN 60 332, NFC 32-070 Flamability tests for electrical cables / Date: 01/07/92.

- EN 50 081-1 Electromagnetic Compatibility / General Emission Standard / Part 2 / Industrial Environment / Date: 2002.
- EN 50 081-2 Electromagnetic Compatibility / General Emission Standard / Part 2 / Industrial Environment / Date : 01/03/95 Update.
- 2014/30/EU EMC DIRECTIVE As modified on 29/10/2015
- EN 50 083-1 Cabled Distribution Systems for Television, Sound and Interactive Multimedia Signals
- EN 50155/EN 45545 Standard concerning emissions related to on board the train installation

8.12.2 The manufacturer's standards shall be accepted only if they are equal to or higher than the aforementioned standards.

8.12.3 The Contractor has the obligation to declare the applicable Standards to be used.

9 Safety Management Systems (SMS)

9.1 Objective and Scope of Works

9.1.1 The Contractor shall design, supply, install, test and commission a modern Safety Management System (SMS) which will be used for the supervision, control, synchronization and coordination in real time of the telecommunication subsystems described below. These systems shall concern the security and safety in all station areas of the Thessaloniki Metro Extension to Kalamaria.

9.1.2 The Contractor of this extension shall be also responsible for the design, planning, modification, upgrading of systems and equipment for the existing SMS system at the OCC and the ECR of the Base Project to the extent required, so that the system may be in its totality fully functional in the extension.

9.1.3 In order to support, improve and cover the security and safety of the system in the Thessaloniki Metro Extension to Kalamaria, the Safety Management System (SMS) of the Base Project must be upgraded for collecting and processing all alarms from the additional equipment to be installed by the Contractor at the following systems:

- Access Control System (ACC)
- Intrusion Detection System (IDS)
- Closed Circuit Television System (CCTV)
- ATS subsystem (Signaling system)
- All others systems, such as Building Automation Control System (BACS), Power Remote Control System (PRCS), UPS and telecommunications

9.1.4 The main objective of the SMS system is to support and coordinate the telecommunication systems so as to ensure the unhindered safety of the transportation for passengers. The system shall mainly support functions related to the integration of the two subsystems (Access Control System - ACC and Intrusion Detection System – IDS). The requirement is further increased due to other operational requirements, such as driverless train operation (including depot), unmanned station platforms and use of the Platform Screen Doors (PSD) system.

9.1.5 The Contractor shall possess all necessary protocols for smooth integration of all required modifications and additions in hardware and software into the existing SMS system of the Base Project. Moreover, he shall also ensure that the requirements of the new SMS system are fully met by the existing central SMS system in the OCC and the ECR and shall guarantee the necessary smooth operation of the system in general.

9.1.6 The SMS system shall be of high reliability and availability, suitable for use in Metro areas. The Contractor shall integrate a flexible (open interface) new SMS system with redundancy features.

9.2 Functional requirements and area coverage

9.2.1 In every new station the appropriate equipment shall be made available to receive all necessary alarms and messages on the status of all the above telecommunication subsystems installed in platforms, Platform Screen Doors, circulating areas, concourse level, escalators, shafts and lifts. The cameras allowing surveillance and assisting in the control of the new station shall be interfaced with the SMS system for actions coordination.

9.2.2 All doors used by the operation and maintenance personnel (including escape routes) and all doors easily accessible by the public located on the entire journey of any passenger from station entrance to train boarding in each station shall be observed by the SMS system.

9.2.3 The SMS system shall receive messages and alarms by all public areas necessitating security and safety in stations, as well as from escape routes, shafts, tunnels or elsewhere where telecommunication systems related to the security and safety of the Kalamaria extension infrastructure are installed.

9.2.4 With regard to platforms, the SMS system must cover all platform doors of the new station and the Platform Screen Doors intended for the boarding of the passengers on the trains.

9.3 Overview of the SMS system

9.3.1 The Kalamaria extension SMS system shall be suitable for railway projects and especially for Metro systems. The SMS system shall concern the location of access control and intrusion detection in station, shafts and the cash counting room. The following minimum requirements must be adhered to:

- Fully automated display and alarm system
- Real time information
- Flexible display design of the controlled areas (characters and graphics)
- Modular system architecture
- Possibility of operational interface at the central SMS facilities in the OCC and ECR for central control with high availability (hot standby)
- User-friendly software-aided configuration and integration into the central SMS system and the central ICCS system of the Base Project
- SCADA type software and OPC interfaces
- Easy to maintain
- Expandable for future line extensions/ junctions and modifications.

9.3.2 The Contactor shall incorporate the software of the system of the Kalamaria extension into the central unit (DMT) of the SMS and into the ICCS system central unit located at the OCC and the ECR of the Thessaloniki Base Project. At the SMS system central unit (DMT) information originating from the new stations of the Kalamaria extension shall be collected, processed and transmitted.

9.3.3 The Contractor shall also provide a workstation type unit in every station of the Kalamaria extension having the same characteristics and functions with the ones of the SMS system central DMT unit located at the OCC and the ECR. The workstation shall be of industrial type with SCADA client features. Moreover, it shall be connected with the existing OPC server of the OCC and the ECR. The Contractor shall test the capacity of the existing equipment and the need for additional equipment in relation to the OPC server. The SMS system shall be installed at the same workstation that the ICCS system is installed at the OCC and the ECR.

9.3.4 The transmission of all SMS system data shall be ensured via the DTS system, the Structured Cabling system and the main fiber optics backbone network. All devices and the equipment of the ACC and IDS subsystems shall be connected to the above while via the same transmission means the necessary information shall be received by the SMS system.

9.3.5 It shall be possible to record at the ICCS in the OCC or the ECR the SMS status and any operational problems of the system in the Kalamaria extension.

9.3.6 The SMS system shall display incidents on its own monitor, supplementary to the monitor of the CCTV system, as described in the table below indicating the number and the location of the workstations monitors of the SMS and CCTV systems

Table 1 - Number and Size of Equipment

No	Position	Name of Position Number of Controllers	Number			Size of TFT screens (CCTV)
			SMS workstations	Printers	CCTV monitors	
1	New SMR Stations	Station Masters (1)	1	1	2 (1 x touch screen)	21"

2	OCC Control Room	Operation Supervisor/(1) Station & Train Supervisor/(2)	1 1 -	1 -	- 4+4 1	21" 21" 21"
3	OCC Safety Management Room	Safety Controller	1	1	4	17"

The first row of the above table shows the new equipment. Rows 2 and 3 include the existing equipment that the Contractor will test to verify whether it needs to be upgraded or whether additional monitors and other equipment must be added.

9.3.7 The SMS system equipment to be installed at new stations shall be compatible and fully integrated with the existing equipment of the OCC and the ECR while all necessary modifications or additions shall be made.

9.3.8 The SMS system modular architecture shall allow for future extensions and replacements, integrations, upgrading or changes to individual parts of the software or equipment.

9.3.9 The SMS System on the OCC shall have the option to record any notifications, incidents and alarms used on a per case basis of the SMS of the Kalamaria Extension new stations.

9.3.10 In order to serve the functionality of the alarm management and reporting extensions, the SMS system shall feature interfaces with the Building Automation Control System (BACS), the signaling subsystem (ATS), the telecommunications system, the Power Remote Control System (PRCS), etc. (only input signals shall be considered by the SMS) which are related to the extensions.

9.4 General Requirements of the SMS System

9.4.1 The SMS system shall support in an integrated manner the functions of the new equipment of the two subsystems of the extension (Access Control System - ACC and Intrusion Detection System – IDS).

9.4.2 The SMS system shall prepare the management and reporting of significant alarms on the status of all systems, and it shall also handle alarms entailing a possible impact on the operation. Via the SMS system alarms shall be collected, grouped and reported. Grouping of alarms shall be defined during GFD phase.

9.4.3 Each Station Master Room shall be equipped with a control keyboard, a printer, and a workstation with a 21" monitor, equipped with the necessary software for the graphic display of the station plan views and the representation of the respective surveyed locations (alarms, indications, etc.). It shall be possible to handle all functions and customize the system from the workstation. Alarms, events and logs shall be shown on and recorded in the workstation of the Station Master Room and the workstation in the central system of the OCC and the ECR.

9.4.4 The SMS new workstation shall receive all the relevant data from the Operators/ Controllers/ Supervisors of the entire system. The details on the alarm lists, including the correspondence of the alarms with the corresponding Operators/ Controllers/ Supervisors shall be agreed upon with ATTIKO METRO.

9.4.5 Every alarm signal delivered to the SMS shall provide a message or a blinking pictogram showing clearly there is an alarm to be treated immediately.

9.4.6 All the events shall be displayed in live, with less than 200 ms of transmission for picture, text and data.

9.4.7 In parallel, all alarms and the necessary events shall be printed. Therefore, the SMS workstations shall be equipped with printers.

9.4.8 The SMS new workstations shall ensure that every Operator/ Controller/ Supervisor receives the alert message simultaneously. The display of the SMS workstation shall be able to show according to task to be assumed, the necessary information of the access control system, the intrusion detection system and eventually CCTV video picture.

9.4.9 The other SMS workstations shall receive all the information but will be limited in display, print and other operations according to the relative task of each other. The identity of the SMS workstation shall be determined by the user profile and his relevant access rights. The toolbar and the menus appearing on the SMS workstation screen shall be dependent of the user rights when logging in.

9.4.10 In addition, the SMS shall provide the following functions:

- The SMS screen shall be able to support the opening of specific windows, if requested, to provide all necessary alarm information simultaneously.
- Broadcasting of selected alarm messages between SMS workstations; for example, in case an alarm message coming to the OCC Safety Controller via radio call, direct telephone line etc immediately the broadcast to all operational team shall be possible through writing messages to all concerned SMS workstations.

9.4.11 The SMS shall fully monitor and control the field equipment from the Controller's/ Supervisor's/ Operator's positions through a single and user friendly graphic interface.

9.4.12 Furthermore, this integration shall allow for:

- Highest Safety with redundancy and degraded operation modes
- Easier communication between the sub-systems
- Fully open architecture which shall not restrict the future growth of the Safety policy.

9.4.13 Each alarm from the systems shall provide the necessary information immediately by message on the right operation desks using a general mimic diagram of the line, new stations, depot for localisation of the alarms.

9.4.14 The SMS shall be fully time synchronized with all other systems by means of a central clock providing to every system the same time information.

9.4.15 For immediate analysis, later analysis or training support all alarms and the necessary events shall be recorded, stored in the existing database of the OCC where the Controllers shall have a synthetic and global display of the situation. The Contractor shall examine whether the size of the data base needs to be upgraded or whether additional equipment is required for increasing the size. Moreover, the database shall be able to support a minimum operation time of one month.

9.4.16 As a minimum on monthly basis all events shall be stored automatically in a separate "long term storage" device (hard disc, CD-ROM etc). The storage philosophy, the type and size of the storage device shall be agreed upon with ATTIKO METRO.

9.4.17 The components of the SMS network (type and size of redundant server, type and size of redundant database) shall be agreed upon with ATTIKO METRO.

9.4.18 The components of the SMS workstations (PCs, monitors, printers, etc) shall be agreed upon with ATTIKO METRO.

9.5 System Availability

9.5.1 The system availability for the SMS as well as for the security and safety system shall be at least 99.99 %.

9.5.2 The Contractor shall supply full information on the systems. The high reliability shall be proven by submitting a study indicating MTBF values of each individual module of the system and by overall MTBF calculations of the system.

9.6 SMS System Interface

9.6.1 The SMS system of the Kalamaria extension shall be integrated into the software of the Thessaloniki Metro Base Project in the OCC and the ECR. The Contractor shall make available all the appropriate interfaces for integration into the I3S platform of the ICCS of the Base Project.

9.6.2 The SMS system shall also possess as a minimum the necessary interfaces to ensure smooth cooperation with the following systems, some of which fall within the responsibility of other Contractors, Namely:

- Access Control System (ACC)
- Intrusion Detection System (IDS)
- Closed Circuit Television System (CCTV)
- All others systems, such as Building Automation Control System (BACS), Power Remote Control System (PRCS), UPS and telecommunications.

9.7 SMS System Installation requirements

9.7.1 The central equipment cabinets within stations shall be housed in a 19" ETSI air-conditioned cabinet or similar, fully earthed and protected from lightning.

9.7.2 The proposed systems shall provide for future extensions of the central equipment (hardware and software) of the OCC, the ECR and the new stations.

9.8 Power Supply, Electromagnetic Compatibility (EMC) and Earthing

9.8.1 All system components shall be powered by a common UPS for all telecommunications system.

9.8.2 Where necessary, the SMS system sections shall be connected with the earthing system and shall meet the EMC requirements.

9.9 Measuring and Testing Procedure

9.9.1 The necessary instruments to test and maintain the entire SMS system shall be provided, including portable testers for access control and anti-intrusion systems.

9.9.2 Should the registration and filing of the measuring results require a PC, a suitable notebook shall be offered. Testing devices and measuring instruments shall be described as required and reasons shall be given for their selection.

9.10 Standards

9.10.1 The Contractor shall state the applicable standards used. In the event that during the execution of the Contract a standard is revised, the Contractor shall make available to ATTIKO METRO the revised standard.

9.10.2 The standards of the Contractor shall be acceptable only if they are equivalent or higher than the ones mentioned above.

10 Access Control / Intrusion Detection System (ACC/IDS)

10.1 Purpose and Scope of Works

10.1.1 The Contractor shall design, supply, install, test and commission a modern Access Control / Intrusion Detection System (ACC/IDS) which will be used to control access and monitor entrance in real time in all critical areas of the Thessaloniki Metro extension to Kalamaria. All events from these areas shall be recorded at specific locations.

10.1.2 The new ACC/IDS system shall be integrated into the existing central equipment of the OCC and the ECR in Pylea with all necessary modifications or additions.

10.1.3 The Contractor of this extension shall be responsible for the design, planning, modification, upgrading of systems and devices for the ACC/IDS system at the OCC and the ECR, as well as for the supply, installation, testing and commissioning of the aforementioned equipment.

10.1.4 The Contractor shall ensure that he will make available (in cooperation with ATTIKO METRO and in relation to the systems which have been supplied by the Contractor of the Base Project) all necessary protocols in order to ensure smooth integration into the existing ACC/IDS system of the Base Project and inclusion of all required modifications and additions in hardware and software. Moreover, he shall also ensure that the capacity related requirements of the new ACC/IDS system are sufficiently met by the existing central ACC/IDS system of the Base Project.

10.1.5 The main objective of the ACC/IDS system is to support the safety and smooth operation of the Project by covering all station critical areas, shafts and their systems. The requirement is further increased due to other operational requirements, such as driverless train operation, unmanned station platforms and use of the Platform Screen Doors (PSD) system. This system shall be used supplementary to the CCTV system to ensure surveillance and protection against intrusions at all necessary locations of the new stations and extensions.

10.1.6 The Contractor shall provide a risk and threat analysis necessary to design the safety and security systems for the protection of passengers, personnel and, in general, of the equipment in the extensions. This analysis shall be approved by ATTIKO METRO.

10.2 Functional Requirements and Area Coverage

10.2.1 The ACC/IDS shall provide reliable information on the detection of unauthorized access in all Metro areas. The following locations shall be monitored in real time during operation:

- All outdoor openings of the Metro areas located within the boundaries of the Kalamaria extension project, including the areas jointly used by the Base Project presenting critical access points.
- Accesses from/to tunnels and escape routes.
- All technical rooms and their accesses from the Metro facilities.
- Rooms of a high operational importance, such as OCC/ECR, SMR, cash counting and safeguarding areas.
- Rooms for the installation and storage of expensive equipment

10.2.2 The two (2) ACC/IDS subsystems which will be by extension connected to the Integrated Security Management System (SMS) shall cover independently the following areas:

- Intrusion Detection (IDS) in shafts, Station Master Rooms, signaling and telecommunications equipment rooms, ATIMs and ticket offices and
- ACC for Station Master Rooms, technical rooms, tunnel accesses from shafts and platforms, access to shafts from street level.

The following table presents in summary the minimum requirements on the location of the check points for access control and intrusion detection in stations and shafts.

Safety & Security Equipment / Stations, Shafts / Locations	ACC Card Reader	ACC CCTV cameras	Intrusion Detection Door Opening Contact(s)	Intrusion Detection Motion Sensors
Station Entrance (Roller shutter etc. and/ or doors for staff use)		x	x	
Station Master Room	x	x	x	
Ticket Office	x	x	x	x
ATIM Room	x	x	x	x
Platform (platform end doors)	x	x	x	
Technical Rooms	x	x	x	
Tunnel Ventilation Plant Room	x			
LAS Room	x		x	
Signalling Room (only in selected stations)	x		x	
Telecom Equipment Room	x		x	
Battery Room	x		x	
UPS Room	x		x	
Rectifier Substation	x		x	
PPC (DEDDHE) Supply Station	x		x	
Fire Fighting Room (Inergen Room)				
Central Pump Room				
Sewage Sump Room				
Cooling Plant Room				
Platform Screen Door Room	x		x	
Spare Room				
Blast Shaft Opening - Street Level (hutch and/ or grills)			x	x
Emergency Exit Staircase Doors			x	
Technical rooms access doors from public areas	x	x	x	

10.2.3 The purpose of ACC system is to ensure simple access control for the main operation rooms within the System:

- Stations: SMR, telecom and signalling equipment rooms, technical rooms, UPS, LAS, rectifier, ventilation
- ATIM rooms and ticket rooms
- Platform door to the tunnel.

10.2.4 All doors used by the operation and maintenance personnel (including escape routes) and all doors easily accessible by the public located on the entire journey of passengers from station entrance to train boarding in every station shall be observed by the present system.

10.2.5 To activate the system only in specific areas, independently from others, areas under surveillance shall be divided and grouped into zones and levels.

10.2.6 To visually inform the Station Master in the event of intrusion, a rotating beacon shall be installed in the Station Master Room 2.3.

10.2.7 Beacons shall be installed in technical room corridors and staircases for intrusion prevention, while care shall be given so as to minimize disturbance in public areas.

10.2.8 The Contractor shall prepare and submit to ATTIKO METRO a design with the exact dimensioning, locations and number of the devices. The design shall be subject to the approval of ATTIKO METRO The exact number of the devices shall be finalized during the GFD phase in coordination with the architectural design and shall be approved by ATTIKO METRO.

10.3 Σύνοψη Συστήματος ACC/IDS

10.3.1 The ACC/IDS shall define the circulation rights of the personnel in specific areas of the new stations. The equipment shall be divided into two subsystems, namely the ACC and the IDS, integrated via the Integrated Security Management System (SMS) platform. The ACC/IDS shall consist of the central equipment installed in the OCC and the ECR and integrated into the existing equipment, as well as of the central control equipment to be installed locally in every new station.

10.3.2 The hardware of the ACC/IDS system shall be installed in every new station, including as a minimum door controllers, card readers, emergency plunger, magnetic contacts and door electromagnets. Every door shall feature a controller with an independent UPS which will ensure interconnection of the entire door-related equipment. Complementary to the access control system, glass-break detectors and door contacts for the protection of corresponding critical locations shall be also supplied.

10.3.3 The System Management Software (Supervising Software) at the central IDS/ACC server of the OCC and at the ECR shall be upgraded. The same shall also apply to the data base where all events, status and the interaction between the individual systems of the OCC/ ECR and the required software to ensure uniform management of all IDS/ACC systems of the stations of the extension are recorded. The data base of the Central Server shall be accessible through the appropriate protocol for communication of the system with the SMS system or with any other system required.

10.3.4 The hardware and software (DMT and ICCS) of the workstations of the OCC and ECR shall be upgraded, where required, in order to incorporate the ACC/IDS system of the new stations, while the existing functions and possibilities of the DMT system (local and central) and the ones supported through the ICCS shall continue to be supported.

10.3.5 Each alarm generated from the above systems shall provide the necessary information immediately using a general visual control panel of the shafts, the new stations at the existing locations in the OCC and the ECR in order to trace the alarms or at the new stations themselves. All alarms shall be displayed on screens via messages at the appropriate operation desks and shall be locally recorded as well as at the control centers. Surveillance shall be ensured by

exclusive means or a combination thereof properly designed for reliable information and alarm announcement.

10.3.6 The Access Control/ Intrusion Detection System shall ensure customization flexibility. Customizing different levels of access control at the monitored/ controlled opening shall be supported. In addition, the system shall be expandable through the addition of new units so as to increase or modify the surveillance/ access control points without central software upgrading required.

10.3.7 The Central Panel of the system equipped with the necessary software for uniform management of all IDS/ACC systems in every station shall have a two-way communication with the Central Server of the system at the OCC/ECR via the WAN/LAN of the Digital Transmission System.

10.3.8 The transmission of all ACC/IDS system data shall be ensured via the DTS system, the Structured Cabling system and the main fiber optics backbone network. All devices and the equipment of the system shall be connected to the above. For full compatibility with other subsystems, all data from and to this system will be fed by the common TCP/IP network.

10.3.9 All data shall be locally recorded at the new stations but also at the OCC. The Contractor shall ensure sufficient capacity for meeting the needs of the system. The Contractor shall ensure the appropriate sizing of the events recording system, including also the events recording equipment in the Depot, should this be required.

10.3.10 The Integrated Security Management System shall drive this subsystem from the SMR control rooms and shall be connected by the TCP/IP network to every new station to collect and answer to the access requests in all system areas. The entire information to be exchanged between the IDS/ACC and the SMS systems shall be absolutely compatible (literally identical) with the information of the Base Project.

10.3.11 The software for the SMS system and the software for the safety and security equipment of the extension shall be fully compatible with the software of the system of the Base Line and the new subsystems interconnected to it. A development plan shall be provided to ensure that this software was dully tested.

10.4 Intrusion Detection System Requirements

10.4.1 The following conditions and general requirements shall apply for the IDS system in view of ensuring safe circulation of personnel and passengers:

- Identify and detect any intrusion.
- Provide an intrusion detection alarm to prevent graffiti tagging of Metro facilities and trains and to detect threats which may lead to vandalisms, limit the operation of the metro, damage the interior of the train with dangerous materials and objects, such as explosive gas or weapons.
- Provide an intrusion detection alarm to prevent the placement of dangerous luggage inside tunnels from shafts and new stations.
- Detect any opening of ventilation louvers and/or grills/hutches of shafts to public areas.
- Prevent unauthorized access to technical rooms, tunnels and shafts.
- Detect any unauthorized access to cash counting areas, ticket rooms and ATIM rooms.
- Installation of fully protected switches. All data of alarms and sensors/ switches shall be fed to the control – alarm unit via the integrated TCP/IP Network system in less than 200ms.
- A message shall be sent to operators with the origin of the covered zone, the type of alarm (intrusion, unauthorized operation, etc.).

- The coverage of the system at various access detection points shall fit perfectly with the CCTV coverage, and the picture of the zone in alarm shall be identified automatically and shown on the alarm workstation.
- The tamper switch of the CCTV cameras shall be connected to the Security Management System (SMS).
- A diagram of the new station with flashing icons shall be available at same time as an image.
- The IDS system shall be recorded at the recording system locally at the SMR as well as at the OCC and the ECR of the Base Project.

10.4.2 To prevent unauthorized access of personnel and passengers in station areas, the following requirements shall apply:

- When a door contact detects unauthorized access, an alarm shall be generated which will be transmitted to the workstation of the ACC/IDS system and to the OCC and the ECR via the DTS.
- Doors leading from the station platform to the tunnel shall be equipped with intrusion/ controlled access devices and the necessary cabling.
- A diagram of the station areas with small flashing images shall be displayed as an image at the Station Master in the OCC simultaneously with the alarm.
- In every emergency exit door one additional local visual and audible alarm system (beacon type) shall be installed which will operate in parallel with the central intrusion detection system. If the system is activated (door opening) the controller's intervention shall be required for alarm identification and deactivation.

10.4.3 To prevent unauthorized access of personnel and passengers from the tunnel to the station the following requirements shall apply:

- The access to the tunnel from the new station shall be surveilled in order to detect unauthorised access.
- In every platform door leading to the tunnel one additional local visual and audible alarm system (beacon type) shall be installed which will operate in parallel with the central intrusion detection system.
- The alarm originating from the new stations shall be fed to the OCC (Security Controller, Maintenance Manager and Operation Supervisor) via the TCP/IP network and monitored by specific depictions on the screens of the SMS workstations.
- In addition to the intrusion detection signal, the CCTV camera(s) for the tunnel portal shall provide the necessary pictures. The pictures shall be shown on the monitors of the responsible station staff simultaneously.

10.4.4 To prevent unauthorized access of personnel and passengers in shafts the following requirements shall apply:

- Door contacts and tamper switch on the upper grills and/or hutches shall be supplied. If it is not possible to supervise the upper grills through a simple magnetic contact (e.g. large-sized electro-welded grids), they will be monitored by magnetic contacts in all doors adjacent to and communicating with the shaft.
- One door contact shall be installed at the door leading to the tunnel and at the exterior access to the shaft.
- When a sensor (door contact, tamper switch) detects an intrusion, it shall generate a message in the SMS workstation. The alarm shall be fed to the

OCC/ECR via the TCP/IP network and monitored by specific depictions on the screens of the SMS workstations.

- All events shall be recorded in the existing data base of the OCC/ECR or work station to provide daily, weekly and monthly reports.

10.5 Access Control System Requirements ACC

10.5.1 The following conditions and general requirements shall apply for the ACC system for ensuring safe circulation of personnel and passengers:

- Prevent unauthorized access to technical rooms and tunnels.
- Prevent unauthorized access to the operational control rooms.
- Protect storage rooms and critical areas to prevent robbery or equipment settings alterations.
- Protect the ticket offices and ATIM rooms.

10.5.2 The Contractor shall supply a recording system connected to the Access Control System. Card readers shall be installed in main entrances. The final location and number of card readers shall be defined during DFD.

10.5.3 The Integrated Security Management System shall be manage this sub-system via the control rooms and shall be connected by the TCP/IP network to every station to collect and answer to access requests in all system areas.

10.5.4 The system shall be based on the use of dual proximity card readers (badge more a second code/ or finger print). This proximity card reader shall provide opening of the door only if the badge is valid and if the code typed on the key pad is the same as the one recorded inside the badge itself or if the biometric data coincide with the ones of the card holder.

10.5.5 The procedure for personal data acquisition, badge personalisation, badge issuing shall be described by the Contractor and approved by ATTIKO METRO.

10.5.6 The data storage or retrieval procedure shall provide for procedures to update the list of activated badges and/ or the black list.

10.5.7 A zoning system shall be proposed for selective access depending on the authorisation of each individual user entering sensitive areas. The zoning system shall consider a minimum number of 500 employees.

10.5.8 Card readers shall be delivered at the office of the Safety Officer at the OCC of Pylea using the personal data acquisition and badge personalisation workstation, which will be connected to an ID badging station.

10.6 Technical Requirements of the ACC/IDS System

10.6.1 The ACC/IDS systems shall consist of the following main individual hardware as a minimum:

- Central alarm system panel
- Peripheral I/O controllers (I/O interface type) for the management of standard monitoring items or addressable control devices
- Control key pad for local control of the security system
- Card readers with a key pad, proximity type, for data entry and access to a controlled area
- Exit and emergency buttons
- Magnetic contacts for doors, roller shutters, hutches, surface trays
- Beacon for visual and audible alarm, motion sensors, door holding electromagnet with an integrated magnetic contact

- Local door controller, autonomous operation, to control the card reader with possibility to connect to a "BUS" type RS-845 network and/or an Ethernet communication port and an integrated power supply unit 230V AC/12V DC.
- Central computer, server type, in the OCC equipped with the appropriate software for uniform management of all IDS/ACC systems of the new stations. The integration into the existing equipment should be considered by the Contractor.
- Workstation, client type, at the SMR of every station, equipped with the appropriate software for the management of the Access Control data base, the operation of the printer and the readers and programmers for proximity card readers.

10.6.2 The central equipment shall be structured so as to include a server, a workstation (client type) and an event printer. The server shall store and manage the software and all users and system area data, while the client serves as the interface between the user/operator and the system enabling him to supervise the events of the system and execute all customization and instructions functions necessary for the smooth operation of the system and card printing. The Contractor shall examine the possibility of its integration in the corresponding existing systems.

10.6.3 In all new stations a central ACC/IDS panel shall be installed to which all I/O units equipped with an autonomous power supply unit shall be connected. Interfaced with these units shall be all peripheral hardware of the ACC/IDS system, such as magnetic contacts, motion radars and beacons. In addition, all I/O units shall be used for the interconnection of signals by the ACC controllers, in order to arm and disarm the IDS areas. In the SMR of each station a system key pad shall be installed from where the maintenance personnel and operators shall be able to arm, disarm and customise the system locally.

10.6.4 Each individual system (of a new station) shall be able to operate even in the event of system failure. In this case, the central server shall be updated on all events, motions and conditions immediately after the serviceability of the telecommunications networks has been restored. During communication interruption, automatic arming/disarming of the areas via the ACC/IDS shall be out of operation. The ACC/IDS system shall be locally operated using the key pad in the SMR of each station.

10.6.5 The use of beacons shall be as limited as possible in technical rooms, while their simultaneous activation shall be avoided so as not to create panic. The beacon closest to the area/door where an intrusion is made shall be activated.

10.6.6 In the Station Master Room, an intrusion warning beacon without audio signal shall be installed. This beacon shall be activated upon every intrusion, while at the same time an alarm shall be announced on the screen on the SMS system informing the Station Master when he is not inside the SMR. The beacon shall be deactivated further to the acknowledgment of the alarm by the SMS system.

10.6.7 To exit a monitored area an exit button installed on the inner side of the entrance/exit door shall be used. In case of emergency or fault of the door controller, an emergency button inside a break glass box to be made available can be used.

10.6.8 The door holding electromagnets shall operate based on the fail safe logic, so that in the event of emergency (fire/ earthquake) all system electromagnets are deactivated by freeing all locked doors allowing safe circulation of station personnel or passengers. The command for the de-activation of the electro-magnets shall be transmitted by the SMS system to the central server of the ACC and IDS systems, via the appropriate protocol, which (server) shall ultimately transmit the command to each station locally.

10.6.9 In case of areas/rooms with more than one entrances, one of the entrances shall be characterized as basic and shall be equipped with a card reader, a door holder electromagnet, an exit button and a magnetic contact. The remaining doors of the area shall be locking using standard locks and shall be equipped with a magnetic contact only. All magnetic contacts and motion detectors used for monitoring a guarded area shall form an independent guarding zone addressed in a uniform manner by the system.

10.6.10 With regard to the ACC/IDS system, it shall be integrated into the SMR workstation (namely in the ICCS workstation), a workstation with the appropriate software to support the required functions (graphical display of station plan views, alarm/event indications, alarm/event recording, possibility for operator intervention where required). At the same time, via the interface with the Building Automation Control System additional functions shall be provided, such as the display of alarms at the OCC/ECR.

10.6.11 The management software shall been developed and shall be user friendly. For safety / security reasons and for developing the evacuation plan, the software shall list immediately the number of people inside a defined area, room or zone. This information shall be requested by the Station Master in case of evacuation.

10.6.12 All events shall be recorded through the software in the data base or work station in view of generating daily, weekly and monthly reports.

10.6.13 The software of this system shall developed, while the development plan must be submitted if supplementary designs are required. At the delivery date, the most recent edition of the relevant applications shall be submitted.

10.6.14 The equipment of the IDS to be installed at several locations of the Project will not require any preventive maintenance work and its ambient operating conditions shall be as follows:

Temperature: -5^{o}C up to +50^{o}C
Relevant humidity: > 95%

10.6.15 Scaffoldings/equipment boxes and card readers, in addition to the ambient operating requirements, shall be certified with an IP65 protection rate and shall have vandal proof features.

10.6.16 The IDS system shall be expandable. It shall be able to support control equipment by recognized third manufacturers and shall be based on open architecture and protocols.

10.7 ACC/IDS Availability

10.7.1 The availability of the ACC/IDS system and of the SMS system shall be at least 99.99 %.

10.7.2 The Contractor shall supply full information on the systems. The high reliability shall be proven by submitting MTBF values of each individual module of the system and by overall MTBF calculations of the system.

10.8 ACC/IDS System Interface

10.8.1 The ACC/IDS system shall possess as a minimum the necessary interfaces to ensure smooth cooperation with the following systems, some of which fall within the responsibility of other Contractors, namely:

- Safety Management System (SMS)
- Closed Circuit Television System (CCTV) to correlate surveillance locations
- Clock and Time Distribution System for time synchronization of the system and its data
- Integrated Communication Control System (ICCS) via the SMS
- Uninterruptable Power Supply System (UPS) for Telecommunications

- Fire Detection System (via the SMS)
- Building Automation Control System (BACS) (via the SMS).

10.9 ACC/IDS Systems Installation Requirements

10.9.1 The central equipment cabinets within new stations shall be housed in a 19" ETSI air-conditioned cabinet or similar, properly earthed and protected from lightning.

10.9.2 The ACC/IDS control equipment cabinets shall be housed in a cabinet suitable for outdoor installation with an IP66 protection rate, properly earthed and protected from lightning.

10.9.3 The proposed systems shall provide for future extensions of the central equipment (hardware and software) and compatibility.

10.10 Power Supply, Electromagnetic Compatibility (EMC) and Earthing

10.10.1 All ACC/IDS system components shall be powered by common UPSs for the entire telecommunications system. UPS units shall be supplied by the main contractor of the extension and are not included in the scope of this project. UPS cabling up to the ACC/IDS system are included in the scope of this contract.

10.10.2 The sections of the ACC/IDS system throughout the system shall be connected to the earthing system and shall meet the electromagnetic compatibility requirements, as these are set by the corresponding EN European standards.

10.11 Measurement and testing procedure

10.11.1 The Contractor shall include in the supply of the ACC/IDS system the required measurement and testing equipment or special tools enabling the maintenance personnel of the Department or the Operation Company to reinstate any defects and perform the necessary measurements.

10.11.2 For the registration and filing of the measurement results, a suitable notebook shall be offered. The testing devices and measuring instruments shall be described and justification for their selection shall be given.

10.12 Standards

10.12.1 The Contractor responsible for the design, supply and installation of the ACC/IDS system of the extension to Kalamaria shall ensure that the entire system and its sections comply as a minimum with the following standards or the respective European equivalent standards. Namely:

- ELOT HD 384 Network protection and security measures NT and TT
- EN 60 529 Degrees of protection provided by enclosures (IP Code)
- EN 50 575 Power, control and communication cables. Cables for general applications in construction works subject to reaction to fire requirements
- EN 50.081-1 Electromagnetic Compatibility - Generic Emission Standard Part 2: Industrial Environment / Date: 01/01/94
- EN 50.081-2 Electromagnetic Compatibility / Generic Emission Standard / Part 2: Industrial Environment / Date: 01/03/95 Update.
- EN 50.083-1 Cabled distribution systems for television and sound signals
- EN 50.131-1 Alarm Systems. Intrusion Systems. General Requirements. Date: 01/07/97
- EN 50 131-6 – Alarm systems. Intrusion and hold-up systems. Power supplies. Date: 2017

- EN 50 133 1/2/7 - Alarm systems. Access control systems for use in security applications. Date: 01.01.01

10.12.2 The manufacturer's standards shall be acceptable if they are equivalent to or higher than the aforementioned standards.

10.12.3 The Contractor shall state the applicable standards to be used. If during the Contract a standard is revised, the Contractor shall make the revised standard available to ATTIKO METRO.

11 Passenger Information System (PIS)

11.1 Purpose and Scope of Works

11.1.1 The Contractor shall design, supply, install and commission a modern Passenger Information System (PIS), which shall be used for informing and warning the passengers in real time in all selected areas (mainly platforms and elsewhere as specified herein) of the extension to Kalamaria. The Contractor of this extension shall also be responsible for the design, planning, modification, upgrade of systems and components of the existing system operating on the Base Project and mainly in the OCC and the ECR, to the extent that this is required, so that this system shall functions as a whole on the Base Project and the extension project.

11.1.2 The PIS is considered as one of the integral parts for the precise and immediate information that aims at improving the services provided to the passengers. In order to support and meet the requirements for the smooth operation of the extension to Kalamaria of the Thessaloniki Metro, an upgrade of the PIS system shall be provided, to collect and process all the necessary information (which will be reconfigured because of the extension) in relation to the following situations:

- Any technical problems in Stations or in the Trains
- Changes in the times and hours of the itineraries.
- All irregular situations that affect the smooth operation of the Line.

11.1.3 The Contractor shall also integrate the new PIS system of the Kalamaria extension into the system of the Base Project of Thessaloniki Metro and shall guarantee the necessary smooth operation of the system as a whole.

11.1.4 For the correct and immediate provision of information to the passengers, it is necessary to install hardware and software in the extension project, as well as additional hardware and software in the Base Project, in order to enter, store, process and display data concerning the arrival of trains / information provided to the passengers and the operation staff at the platforms in real time.

11.1.5 The main objective of the Passenger Information System (PIS) is to provide appropriate indications so as to support the safe and comfortable transport of passengers. This requirement becomes imperative because of the driverless train operation, unmanned station platforms and use of platform screen door system (PSD).

11.1.6 The Contractor shall provide the risk and threat analysis which is needed to design / modify / upgrade the Telecommunication and security / safety systems to protect passengers, operators and equipment along the entire Base Projects and on the extension to Kalamaria. This analysis shall be approved by AM.

11.2 Functional Requirements / Space

11.2.1 The PIS information screens, as specified in this specification, depending on the location, shall be designed and constructed of such dimensions and materials as to be integrated aesthetically with the architecture of the surrounding space and the corresponding finishes in the platform areas.

11.2.2 The PIS shall display on the screens basically the information of the train itineraries in operational combination with the train signalling and control system and especially with its ATS subsystem.

11.2.3 The PIS screens shall basically display general information ensuring that passengers are immediately informed on matter related to their safety. There shall also be the possibility of displaying emergency messages, as in the case of a station evacuation, in order to prevent more additional passengers from entering the station from the surface.

11.2.4 Each station shall be fitted with the appropriate equipment that will receive the necessary messages and information about the operation of the Base Metro Project and the extension to Kalamaria and will inform the passengers via the appropriate electronic screens of the PIS system located on the platforms, the public areas and the concourse areas.

11.2.5 Along the entire route of the passengers, from the entrance to the station to the train boarding, all the doors destined to be used by the operation and maintenance personnel (including the escape

routes), but also any door easily accessible to the public shall have PIS screens at appropriate critical points.

11.2.6 All platform of the extension stations shall be equipped with PIS system screens. At least one information display unit shall be installed per track, approximately at the center of the platform's length. PIS screens shall normally be in visible places, enabling the passengers to be readily informed.

11.2.7 As regards the trains travelling on the extension to Kalamaria, they shall also be fitted with PIS screens, in order to inform passenger at boarding time about the operation status at the Base Project and at the extension, including also visual notifications in case of delays or problems. These screens are provided by the train manufacturers and are not included in the scope of this contract.

11.2.8 The Contractor shall prepare and submit to AM an DFD level design about the exact system sizing, locations and number of devices and screens. This design shall be approved by AM.

11.3 PIS System Overview

11.3.1 The Passenger Information System of the extension to Kalamaria shall be suitable for railway projects and especially for a Metro System. It shall meet at least the following requirements:

- Fully automatic system for indications.
- Real-time information.
- Flexible design of the indication (fonts and graphics).
- Modular system architecture.
- Possibility for functional connection with the central PIS facilities in the OCC and the ECR for the central control, with high availability (hot stand-by).
- User-friendly software for configuration and integration in the central PIS system and the central ICCS system of the Base Project.
- Software based on a standard operating system and database.
- Ease of maintenance.
- Expandability to accommodate future line extensions / connections / modifications.

11.3.2 The Contractor shall integrate the software for the PIS screens to be installed on the extension to Kalamaria in the central unit (DMT) of the PIS and that of the ICCS, located in the OCC of Thessaloniki Metro Base Project. The central unit (DMT) of the PIS shall carry out tasks related to the collection, preparation and transmission of the information coming from the new stations of the extension to Kalamaria.

11.3.3 The Contractor shall also provide a workstation type unit in each new station of the extension to Kalamaria with the same features and functions as the unit located at the central unit (DMT) of the PIS in the OCC.

11.3.4 Transmission of all PIS data shall be achieved via the DTS digital transmission system, the Structured Cabling and the main fiber optic trunk network. All PIS information screens shall be connected to these systems.

11.3.5 At the ICCS in the OCC or the ECR, it shall be possible to record any PIS notifications and incidents along the extension to Kalamaria, as well as all the pre-recorded messages used depending on the case.

11.3.6 The information to be displayed shall originate from the train control, signalling and other operation-related systems, such as: Clock System, Public Address System (PA), Fire Detection System.

11.3.7 The design of the PIS screens shall be harmonized with the station's design. For this reason, the shape of the screens shall be designed according to the architectural requirements and in coordination with this discipline, while their layout shall be coordinated with the architectural aspects and shall be submitted to AM for approval.

11.4 PIS System Requirements

11.4.1 All new stations of the Metro extension to Kalamaria shall be equipped with the appropriate infrastructure in order to support all functions of the Passenger Information System.

11.4.2 The central unit of the PIS system in the OCC must automatically transmit the information to the new screens for the passengers along the extension, without the intervention of the workstation from the OCC or the Station Master Room. Overall management of the system should also be possible from the ICCS system of the Base Project.

11.4.3 The normally operating PIS central unit in the OCC shall be fed with the relevant information fully automatically from the central ATS signalling system, i.e. real-time data (in terms of train itineraries and departures from the scheduled itineraries).

11.4.4 In the framework of the new PIS system, the Contractor shall offer at least one workstation for each new station of the extension to Kalamaria, which shall have the same capabilities and characteristics as those of the central unit in the stations of the Base Project; these capabilities and characteristics shall be made available to the Contractor. For the operation of the PIS screens the option must be provided to locally control the information from this workstation.

11.4.5 Each PIS unit in every new station of the extension to Kalamaria shall be connected to the PIS central unit (DMT), via the "TCP / IP Common Network", to provide local services and system-wide services. Therefore, all PIS system components shall be compatible with Ethernet and / or TCP / IP networks.

11.4.6 The subject PIS system shall be activated fully automatically, but it shall also be able to operate in semi- automatic mode. Information related to train itineraries, train location, date, time, operation messages shall be displayed automatically, without the operator's intervention. The PIS system shall be fed with the relevant information from the central ATS system, with real-time data (related to itineraries and trains).

11.4.7 In the semi-automatic mode, it shall be possible to display messages that have been entered manually via the software either from the workstations of the Unified Central Telecommunication Control System (ICCS-I3S) in the OCC, or from the PIS workstations in the SMR.

11.4.8 Further facilities for message control and for PIS data input shall be provided in each station. It is envisaged that a single message to be displayed in the event of communications failure or other emergency. This PIS facility, together with local public address, telephone and radio, shall be accommodated in the Station Master Room.

11.4.9 The PIS workstation environment shall allow the generation and selection of instant messaging and predefined messages by means of the appropriate software. Pre-defined messages must have different priority levels.

11.4.10 The PIS environment must permit the generation of user-defined display groups, including the creation, editing and deletion. It shall also permit the selection of the graphic display, and the cancellation of active messages.

11.4.11 Any manual intervention to the PIS system by local staff in any SMR shall be displayed to the Station and Train Supervisors in the OCC.

11.4.12 All indications shall be permanently monitored through the ICCS. Failures in any components of the PIS system equipment and / or i its indications shall be displayed to the Stations / Trains Supervisors, as well as in the Engineering and Power Controller in the OCC.

11.4.13 Messages to passengers shall be defined by AM. All alarms and fault messages as well as manual interventions shall be recorded automatically.

11.4.14 The PIS system screens shall display at least the following indications:

- Arrival times of next trains
- Train departure times
- Train direction
- Next station
- Train arrival at the station

11.4.15 The design shall allow the PIS system to deal with all situation of normal and downgraded operation, such as:

- Provisional Operation
- Non-stop Train

11.4.16 The PIS system screens to be installed in the stations of the extension to Kalamaria will have at least the following technical characteristics:

- Displays with LED technology shall be used
- Displays shall be double faced
- They shall be combined with double faced clocks, or alternatively, they shall directly display the time
- The screens shall be mounted to the ceiling, according to the architectural design
- Resolution will be at least 640x480pixel
- The height of the characters shall be about 80mm
- The viewing angle shall be 180°
- Only one screen type shall be used for the extension to Kalamaria
- The screens shall be legible to passengers under the prevailing lighting levels, from a distance of up to 30 meters away
- The screens shall have the optimal viewing distance along each platform.

11.4.17 The screen shall permit an information capacity of three lines. The display lines shall contain the following information:

- Display of two successive trains with the following information:
  - Destination including temporary terminals (the number of characters shall support the longest station name and shall be finalised during DFD).
  - Digits for the number of minutes to the arrival of the next train (2 digits each for the indication of minutes).
- Remarks for downgraded situations, such as:
  - Non Stop trains
  - Service train – "DO NOT ENTER"

11.4.18 Line 3 will be used to indicate downgraded operation, as well as unusual situations such as:

- Temporary operation
- Emergency status indication
- Station evacuation

11.4.19 The messages shall be in two languages (Greek and English). The language shall be switch over after an adjustable time between 2 and 10 seconds.

11.4.20 All PIS system screens to be installed along the extension to Kalamaria shall be of very high reliability, requiring minimal optional maintenance work, while their environmental operating conditions shall be as follows:

- Temperature – 5° C up to +60° C
- Relevant humidity: > 70%

11.4.21 The screens shall be of industrial type, suitable for installation in places such as Metro stations, flat and fully digital screens, unaffected by magnetic fields, providing excellent readability under very wide angle, even when lighting conditions change. The surface of the screens shall receive proper anti-glare treatment.

11.5 PIS Indications On-Board Trains

11.5.1 The PIS display system on-board the trains is not included in the scope of this contract, but for reasons of operational completeness it is mentioned in this specification.

11.5.2 In addition to audio-information inside trains the passengers shall be informed visually about destinations and the next train stops, as well as about unusual train operation and emergency operation. Therefore all trains shall be equipped with the PIS system.

11.5.3 The train-based data (stored text messages) shall be synchronised with the real-time data.

11.5.4 The on board PIS unit shall be triggered directly by the central ATS, which will be located in the OCC or the ECR. For more details please refer to performance specification for signalling.

11.5.5 The real-time data shall be transmitted via radio from the OCC central PIS unit to the on-board PIS unit. For more details please refer to radio system.

11.6 System's Availability

11.6.1 The system availability shall be at least 99,98 %.

11.6.2 The Contractor shall supply full details of the PIS to the Service. The high reliability shall be demonstrated by submitting the MTBF values for each individual module of the system and the overall MTBF calculations for the system.

11.7 PIS System's Interfaces Συστήματος

11.7.1 The Passenger Information System of the extension to Kalamaria shall be integrated into the software of the Basic Project OCC and ECR. All the appropriate interfaces shall be offered by the Contractor, so as to be integrated in the I3S platform of the Base Project ICCS. The following interfaces will be implemented via the ICCS.

11.7.2 The PIS shall be interfaced with the ATS train control and signalling system

11.7.3 The PIS shall be interfaced with the Radio Communication-TETRA system.

11.7.4 The PIS shall also be interfaced with the Fire Detection and Public Address (PA) system.

11.7.5 The Contractor's design shall take into account the required interfaces between the trainborne PA system and the ATS / Signalling / PA / Radio Communication-TETRA systems.

11.7.6 The PIS shall be interfaced with the PIS systems on-board the original trains of the Base Project and on-board the new trains to be added in the framework of the extension to Kalamaria.

11.8 PIS System Installation Requirements

11.8.1 At each station of the extension to Kalamaria a uniform backbone - "Common TCP/IP Network" shall be provided. Therefore the cabling for the PIS units shall be Ethernet and /or TCP/IP compatible (CAT 6).

11.8.2 Standard flame retardant telecommunications cables shall be used for the connection from the PIS display to the PIS station unit, which shall be located in the telecom room.

11.8.3 All PIS cables shall be low smoke and zero halogen design. For more details refer to the "Cable Systems".

11.8.4 The PIS units/ cabinets within OCC and the stations shall be housed in a 19", ETSI racks or similar. These racks shall be located within the telecommunications and technical equipment rooms.

11.8.5 For the installation in all locations, the system shall be capable of accommodating future extensions and connections. As regards the central equipment (software and hardware) and its new dimensioning, the Contractor shall take into account the extension of the Line to the Airport and to the west suburbs of Thessaloniki.

11.9 Power supply, Electromagnetic Compatibility (EMC) and Earthing

11.9.1 All PIS components shall be powered by a common UPS for all telecommunications sub-systems.

11.9.2 Furthermore, the PIS system-wide shall be connected with the earthing system and shall meet the EMC requirements.

11.10 Measuring and Tests Procedure

11.10.1 The delivery of the PIS system shall include testing and measuring instruments enabling the maintenance staff of the Department or the Operation Company to remedy any defects and take the necessary measurements. These instruments and devices shall be suitable to fulfil at least the following functions:

- Measurement of the synchronization level and quality transmitted to the PIS system by the digital data transmission system (DTS) in the telecommunications room of the OCC.
- Smooth recording of incidents and any notifications in the storage system.
- Smooth interface among the systems as defined in the interface chapter. Mainly its fully functional integration into the ICCS.
- Measurement of the basic voltage and intensity using portable instruments.

11.10.2 Should the registration and filing of the measuring results require a PC, a suitable notebook shall be offered. The testing devices and measuring instruments shall be described and the reasons for their selection shall be given.

11.11 Standards

11.11.1 The PIS system, including the telecommunications cables shall conform to the required industrial standards.

- UIC 176 Specs for Passenger Information displayed elctronically in trains
- UIC 556 standards –Information Transmission in the Train
- IEC 61 375-1 standards Electric Railway Equipment

11.11.2 The manufacturer's standards shall only be accepted if they are equivalent to or higher than the above.

11.11.3 The Contractor shall declare the applicable standards to be utilized. Should a Standard referred to the contract is updated during the course of the Contract, the Contractor shall provide it to ATTIKO METRO.

12 Integrated Central Communications System (ICCS)

12.1 Purpose and Scope of Works

12.1.1 The Contractor shall design, supply, install and commission a modern integrated central communications system (ICCS), which will be used to supervise in real time the telecommunications sub-systems in all areas of the Extension to Kalamaria Project.

12.1.2 In order to have a complete management and provide support to the overall supervision and surveillance of the telecommunications systems, the Contractor of the Base Project has provided an Integrated Central Communications System (ICCS), which shall be able to remotely control to an extent these systems as an integrated software platform.

12.1.3 In view of the above, the Contractor of the Extension to Kalamaria shall provide a similar Integrated Central Communications System (ICCS) for the collection and processing of all modes, alarms, indications and data from the additional equipment to be installed by the Contractor himself for the following systems:

- Radio Communication System - TETRA
- Automatic Telephone System
- Direct Telephone Lines
- Public Announcement System
- Visual Surveillance - CCTV
- Time Distribution System and Clocks
- Passenger Information System
- Cabling System
- IT infrastructure
- Intercommunication system
- Safety Management systems (SMS)
- Digital Transmission system
- UPS for telecommunications equipment
- Access Control / Intrusion Detection system
- Signalling / ATP/ ATS/ ATO / AFC
- ECS / BACS.

In addition, the ICCS system shall enable remote control at different levels of the above telecommunication systems in order to improve the overall operation and security of the systems and to give more flexibility and convenience to operators.

12.1.4 The Extension Contractor shall be responsible for the design and planning new ICCS system, as well as for the modifications and upgrades to the equipment and devices of the existing central ICCS in the OCC and the ECR, as well as for the overall design, supply, installation, testing and commissioning of all relevant equipment.

12.1.5 The main objective of the ICCS is the unified management and supervision of telecommunications systems, so as to enhance and support the safety of passenger trips and staff movements along the facilities of the extension to Kalamaria. The ICCS system shall be compatible with the ICCS of the Base Project. This requirement becomes imperative because of other operation requirements such as the driverless train operation, unmanned station platforms and use of platform screen door system (PSD).

12.1.6 The ICCS will be of high reliability and availability, suitable for use in Metro areas. The contractor shall install a redundant and flexible system (open interface).

12.1.7 The Contractor shall ensure the expandability of the ICCS to accommodate future uses, equipment and systems related to New Metro Lines.

12.1.8 The Contractor shall provide the risk and threat analysis which is needed to design the security and safety systems to protect passengers, operators and equipment. This analysis shall be approved by AM.

12.1.9 The main objective of the ICCS is the unified management and supervision of telecommunications systems to enhance and support the safety of passenger trips and staff movements along the facilities of the extension to Kalamaria. The ICCS system shall be compatible with the ICCS of the Base Project. This requirement becomes imperative because of other operation requirements such as the driverless train operation, unmanned station platforms and use of platform screen door system (PSD).

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12.1.11 The Contractor shall ensure the expandability of the ICCS to accommodate future uses, equipment and systems related to New Metro Lines.

12.1.12 The Contractor shall provide the risk and threat analysis which is needed to design the security and safety systems to protect passengers, operators and equipment. This analysis shall be approved by AM.

12.2 Functional Requirements / Space

12.2.1 Each new station shall be fitted with the appropriate equipment and interfaces that will receive the necessary alarms and messages about the status of telecommunication sub-systems from the platforms, the PSDs, the public areas, the concourse areas, escalators, shafts and lifts. The system shall permit the station's supervision and control.

12.2.2 Throughout the passengers route, from entry into the station until the boarding, all telecommunication systems used by the operating and maintenance personnel (including the telecommunication systems along the escape routes), as well as at any location easily accessible to the public, shall transmit data and shall be monitored by the ICCS system.

12.2.3 As regards the platforms, the ICCS system shall cover all telecommunications systems of the new stations' platforms and PDS doors to ensure the unified control of the systems and the protection and safety of passengers trips and the movements of the operation personnel.

12.3 Overview of the ICCS System

12.3.1 The ICCS system shall be suitable for the Metro System and compatible with the respective Base Project system. The Cntractor shall provide a system that meets the following minimum requirements:

- Modular system architecture
- Fully automatic indications
- Real time information
- Flexible display design (characters and graphics)
- User-friendly software-aided configuration
- Software based on standard operating system and data base
- Easy to maintain
- Expandable for future line extensions / junctions and modifications.

12.3.2 The architecture of the ICCS system shall guarantee the operation in the event of server unavailability, by means of the physical interface management provided by each subsystem (DMT terminals for a system's downgraded operation) located both in the OCC, as well as centrally in the respective rooms of each station.

12.3.3 The Contractor shall ensure a state-of-the-art ICCS system as a subsystem in the OCC and ECR, for better monitoring and control by operators at central level and coordinated, as well as the individual components of the telecommunications systems as described below.

12.3.4 The Contractor will design and implement the upgrade of the existing ICCS system of the Base Project and shall provide all the appropriate interfaces for the new telecommunication systems to be installed in the extension to Kalamaria. If necessary, the Contractor shall customize, program and deliver in full operation a unified ICCS system for the Base Project, including the extension to Kalamaria.

12.3.5 The ICCS shall continuously monitor and be updated in real-time by the following telecommunications subsystems:

- The Passenger Information System (PIS) for the management of text messages to be displayed on Passenger Information Screens (PID), located in both in the station areas and onboard the trains.
- The Public Announcement System (PA), for the management of voice announcements at stations, warehouses and trains.
- The CCTV System, for video surveillance of stations, warehouses and trains and everywhere else defined in the base project.
- The Direct Telephones (DLT) / Intercom system, handling service calls received by the METRO staff of the Base Project and the extension to Kalamaria, as well as emergency calls received by passengers in the stations and the trains.
- The TETRA radio communication system, including the communication devices used in the facilities, the stations and the trains and the portable devices.
- The Time Synchronization and Clock System
- The SMS System for Access Control / Intrusion Detection in areas of the extension to Kalamaria.
- Local ICCS Network (LAN) via NMS.

12.3.6 The ICCS shall provide the high level management functions described above, via the appropriate hardware and software interfaces with the specific control units of each system (e.g. DLT management units, radio system), located either in the OCC and remotely in the stations. It is also configured for data exchange with other Metro control subsystems (ATC, SMS etc.).

12.3.7 The transmission of all data shall be achieved via the DTS digital transmission system, the Structured Cabling and the main fiber optic trunk network. All necessary equipment shall be connected to the above systems for the smooth operation of the ICCS.

12.4 ICCS Requirements

12.4.1 The ICCS shall be integrated into the application platform (as the ICCS (I3S) of the Base Project) and shall be specially designed for installations and uses that require effective management, supervision, monitoring, safeguarding and protection and shall be " heart "of the unified system, as well as of the individual telecommunication systems. The platform shall generally offer combined functionality among systems such as:

- Data collection from different telecommunications systems.
- Simultaneous recording of incidents and their image and the interfacing of incident image and other alarms.
- The smart and conditional activation of alarms with a combination of incidents.
- Utilizing the collected information to make decisions and to plan the management measures.
- Performing actions and commands for telecommunication systems.
- Direct reporting of incidents.
- Supervising the incidents handling procedures.
- Optimizing system parameters based on the collected information.
- Enabling security policies against all types of natural threats

12.4.2 The ICCS system of the extension to Kalamaria shall primarily incorporate commercially available software with the appropriate technical specifications and the necessary technical equipment and interfaces to provide smooth supervision and management and to integrate the software for the respective telecommunications and low voltage systems of the Metro Base Project.

12.4.3 The ICCS system shall be able to support the following functions:

- Integration of the new equipment of telecommunications subsystems for this extension.
- The ICCS system shall prepare the management and reporting of critical alarms related to the status of all systems, and shall handle alarms possibly affecting the operation.
- Alarms shall be collected, grouped and reported via the ICCS system. The grouping of alarms shall be determined during the GFD design level.

12.4.4 In order to serve the alarm management and reporting functions for the extension, the ICCS system shall be equipped with interfaces with the Building Automation Control System (BACS), the signaling system, telecommunications system, PRCS system etc. (only input signals shall taken into account by SMS) relating to extensions.

12.4.5 Every new SMR shall be equipped with an ICCS workstation. The ICCS workstation will be fitted with a 21" flat screen.

12.4.6 The new ICCS workstations shall receive all relevant information from the Operators / Controller/ Supervisors of the entire system. Details regarding alarm lists, including the assignment of alarms to the respective Operators / Controller / Supervisors shall be agreed with AM.

12.4.7 Each alarm signal delivered to the ICCS system shall generate a flashing message or pictogram, making it clear that there is an alarm that needs to be addressed immediately.

12.4.8 All incidents will appear in real time. At the same time, all alarms and necessary incidents shall be printed. Therefore, the ICCS workstations shall be equipped with printers.

12.4.9 The new ICCS workstations shall ensure that every Operator/ Controller/ Supervisor in charge receives the alert message simultaneously. The screen of the ICCS workstation shall be able to show according to the task to be assumed the necessary information from the access control system, the intrusion detection system and eventually the CCTV video picture.

12.4.10 The other ICCS workstations shall receive all the information but will be limited in the display, print out functions and other operations according to their relative individual tasks. The identity of the ICCS workstation shall be determined by the user profile and his relevant access rights. The toolbar and the menus appearing on the ICCS workstation screen shall be dependent of the user right when logging in.

12.4.11 In addition, the ICCS shall provide the following functionality:

- The ICCS screen shall be able to support the opening of specific windows, if requested, to provide all necessary alarm information simultaneously.
- In case an alarm message coming to the OCC or the ECR Security Controller via radio call, direct telephone line etc., the broadcast to all concerned operational team shall be immediately possible through message display to all ICCS workstations concerned.

12.4.12 The ICCS shall fully monitor and control the field equipment from the Controller's/ Supervisor's/ Operator's positions with a single and user friendly graphic interface. Furthermore this integration shall allow:

- Highest security with redundancy and degraded modes,
- Easier communication between the sub-systems,
- Fully open architecture which shall not restrict the future growth of the security policy.

12.4.13 The ICCS shall be fully time synchronized with all other systems by means of a central clock providing the same time information to every system.

12.4.14 For immediate analysis, later analysis or training support all alarms and the necessary events shall be recorded and stored in the existing database where the Controllers shall have a synthetic and global view of the situation. The Contractor shall examine whether the size of the database needs upgrading or whether additional equipment must be made available to increase its capacity. In addition, the size of the database shall be able to support a minimum operation time of one month.

12.4.15 The graphic user interface shall be designed so as to ensure easy and manageable system control. Operation management shall be based on a topographical representation of the entire layout of the Metro areas in Kalamaria extension with station and train image. The representation of each device forming part of a telecommunications subsystem shall be ensured by a small graphic icon on a large-scale mapped area. Each icon shall function as a key, which upon activation, shall allow access to the specific control panel from where the registered user shall be able to interact with the corresponding subsystem using all functions provided.

12.4.16 The overview page of the Thessaloniki Metro line shall include the stations of the Kalamaria extension. The status of each station shall be displayed on this page and the OCC operator shall be able to choose from the navigation tree or the main page a new station for viewing its detailed page.

12.4.17 The station's overview page shall include all telecommunications devices and their status. The OCC/ECR operator shall be able to select from this page each telecommunications device, gain access to the Control Panel and activate the relevant functions.

12.4.18 The train overview page shall include all telecommunications devices and their status. The OCC/ECR operator shall be able to select from this page each telecommunications device, gain access to the Control Panel and activate the relevant functions.

12.4.19 The following telecommunications systems, as already stated, shall be supervised by the ICCS where all the functions shall be managed, as set by the I3S system of the Base Project of Thessaloniki Metro.

12.4.20 The PIS system to be used to generate information for passengers in stations and trains. The ICCS system of the Kalamaria extension shall be able to transmit the following data to the stations and the trains. Namely:

- Pre-recorded automated messages based on the messages for estimated train arrival or departure time generated by the ATC.
- Real time non-automated messages providing information on the status of stations (alarm, warning, general information).
- Pre-recorded non automated messages transmitted in configurable time intervals. The operator selects a message from a specific group of messages and sends it to a predetermined database.
- Real-time broadcast/multicast messages. The operator sends a message to more than one stations or to all stations in real-time.
- Pre-recorded broadcast/multicast messages. The operator sends a pre-recorded message to more than one stations or to all stations.
- Via the ICCS system of the Kalamaria extension it shall be possible to develop pre-recorded messages, deactivate automatic messages and supervise the status of every PIS device.
- The SMR operator shall be able to send real-time non automated messages, pre-recorded non-automated messages transmitted in configurable time intervals from all new workstations and supervise the condition of every PIS device in his station.

12.4.21 The PA system shall be used to generate voice information for passengers in stations and trains. Such information mainly includes messages on the estimated train arrival or departure at the stations. These messages shall be generated by the PA system using messages on the estimated arrival time originating from the ATC which shall be routed to the PA devices. Moreover, the PA system shall allow the OCC and ECR operation staff to also transmit pre-recorded messages for the information of passengers in real-time.

12.4.22 Through the ICCS system, the PA system of the new stations shall be able to transmit to the stations and the trains:

- Pre-recorded automated messages based on the messages for estimated train arrival or departure time generated by the ATC.
- Real time non-automated messages providing information on the status of stations (alarm, warning, general information).
- Pre-recorded non automated messages transmitted in configurable time intervals. The operator selects a message from a specific group of messages and sends it to a predetermined database.
- Real-time broadcast/multicast messages. The operator sends a live message to more than one stations or to all stations.
- Pre-recorded broadcast/multicast messages. The operator sends a pre-recorded audio message to more than one stations or to all stations.

12.4.23 Using the CCTV system via the ICCS system, the OCC and ECR operators shall be able to operate the cameras installed at the Thessaloniki Metro extension to Kalamaria and have the relevant images displayed on the available screens.

12.4.24 It shall be possible to monitor all sensitive areas or events in the Thessaloniki Metro extension to Kalamaria (e.g. trains during a critical operation as arrival/departure to/from stations, platforms, shafts, safety zones, lifts, DLT etc) by upgrading the Base Project ICCS. The following functions shall be ensured:

- Real-time display of images and video on the workstation screens
- Real-time display of images and video from the cameras connected to the DLT and SMS
- Real-time display on the OCC screen of images and video in the event of an emergency incoming call
- Real-time display on the OCC screen of images and video from the respective camera in case of intrusion detection.

12.4.25 The DLT system shall allow passengers of the new stations of the extension to communicate with the SMR/OCC operators and inform them on incidents and emergencies or request information. It shall also allow train passengers to communicate with the OCC operators. In general, the DLT system shall provide telephone connections between service and operation staff inside the stations and the OCC and between the OCC and stations/ tunnel substations, storage rooms/technical areas.

12.4.26 With regard to the DLT system in the new stations, the ICCS system shall be able to handle incoming calls, supervise the status of the system and have access to the recorded calls registry.

12.4.27 In addition, the ICCS system shall be connected to the CCTV system in order to display on the OCC and the ECR live images and video from the cameras in the event of an emergency at the DLT system.

12.4.28 Via the ICCS system, the TETRA radio system shall be possible to provide the following functions:

- PIS messages from the OCC or ECR workstation onboard the train
- Alarms on board the train
- Announcements from the OCC workstation on board the train

- Answering a DLT call from the OCC/ECR workstation
- Diagnostics of tetra system status and its equipment at the new sections of the Thessaloniki Metro Kalamaria extension.

12.4.29 Provision shall be made for a diagnostic panel to monitor the status of every telecommunications subsystem in real time at the graphic interface of the ICCS user and in every communication device (PID, PA, camera, TETRA, DLT).

12.4.30 Access to the ICCS system functions shall be controlled by a connection – access code mechanism. It shall be possible to configure the system to set the available functions for every connection account – access code.

12.4.31 The ICCS system shall provide all the configuration procedures required for identification of users, roles and resources. From the main video configuration page, it shall be possible to access the safety configuration page and access three different sections, namely: users, roles and resources.

12.5 System's Availability

12.5.1 The ICCS system shall be properly designed so as to facilitate the implementation of the individual performance objectives of the systems. Even though the ICCS system performance criteria will be developed in detail during the detailed design stage, the following performance-related issues shall be taken into account during system planning, so as to ensure a quick response time to meet the standard, downgraded and emergency conditions, taking into consideration:

- The time required for an image/video to be displayed to the operator
- The cyclic updating rate of the ICCS system
- The number of active operator workstations
- The status of the modifications processed by the system per sec
- The time required to display a status modification and to generate an alarm
- The time on which a command was received and the number of commands issued.

12.5.2 The availability of all HMI must be higher than 99.9%.

12.5.3 The Mean Time to Repair (MTTR), not including travel time, the objective for all HMIs must be less than one (1) hour. Despite the MTTR, the counter party shall ensure that the availability parameters are met.

12.5.4 The Contractor shall supply full information on the systems. The high reliability shall be proven by submitting a study indicating the MTBF values of each individual card of the system and by overall MTBF calculations of the system.

12.6 ICCS Interfaces

12.6.1 The ICCS system of the Kalamaria extension shall be integrated into the software of the Thessaloniki Metro Base Project in the OCC. The Contractor shall make available all the appropriate interfaces for integration into the I3S platform of the Base Project ICCS.

12.6.2 The ICCS system shall also possess as a minimum the necessary interfaces to ensure smooth cooperation with the following telecommunications systems (PABX, DLT, INTERCOM) of the Base Project and of the main Contractor of the extension to Kalamaria.

12.6.3 Interface with the CCTV, PA and TETRA systems on the initial trains of the Base Project and the new trains to be added in the framework of the Kamalaria extension.

12.7 ICCS System Installation Requirements

12.7.1 The central equipment cabinets within the new stations and the OCC or the ECR shall be housed in a 19" ETSI air-conditioned cabinet or similar, fully earthed and protected from lightning.

12.7.2 The proposed systems shall provide for future extension and compatibility with the central equipment (hardware and software).

12.7.3 With regard to the environmental terms, the specific environmental conditions of Thessaloniki should be taken into account, such as temperature, wind speed, corrosion of outdoor equipment.

12.8 Power Supply, Electromagnetic Compatibility (EMC) and Earthing

12.8.1 All ICCS system components shall be powered by a common UPS for the entire telecommunications system.

12.8.2 The ICCS system sections shall be connected with the earthing system and shall meet the EMC requirements.

12.9 Measuring and Testing Procedure

12.9.1 The necessary instruments to test and maintain the entire ICCS system shall be provided, including portable testers.

12.9.2 In order to record and file the measuring results, a suitable notebook shall be provided. Testing devices and measuring instruments shall be described as required and reasons shall be given for their selection.

12.10 Standards

12.10.1 The Contractor shall state the applicable standards used. In the event that during the execution of the Contract a standard is revised, the Contractor shall make available to ATTIKO METRO the revised standard.

12.10.2 The standards of the Contractor shall be acceptable only if they are equivalent or higher than the ones mentioned above.

PART C: CURRENT TELECOMMUNICATIONS AND LOW VOLTAGE SYSTEMS

This unit describes the current Telecommunication and Low Voltage Systems in their final delivery and installation phase by the Contractor of Thessaloniki Metro Base Project. The proposed state-of-the-art technology systems meeting the strictest specifications demonstrate the operational characteristic provided, without detailing their analytical design. In brief, the proposed solution of Thessaloniki Metro Base Project includes the following, as related to the telecommunication and low voltage systems requested in this Tender. More specifically:

- Closed Circuit Television (CCTV): A central system providing video coverage in the Metro network, as well as recorder / repeater features.
- Digital Transmission System (DTS & IT INFR): a wired network based on active switching devices and fiber optic cables, providing digital connection among the Metro several sub-systems and locations.
- Public Announcement System (PA) / Passenger Information System (PIS): A System featuring facilities in stations and on-board the trains, permitting transmission of information to Metro passengers through an audible announcement and/or video projection.
- Radio communication System (RADIO): A Radio-network providing wireless communication between the OCC/ER operators, the superintendents/drivers of trains and the operation personnel along the entire network Thessaloniki Metro Base Project.
- Safety and Security System (SMS): Equipment related to the supervisions and management of the Access Control and Detection Intrusion devices.
- Access Control / Intrusion Detection System (ACC/IDS) in all critical areas of the Metro stations and facilities.
- ICCS System: Integrated Central Control System for the supervision of all Telecommunications and Low Voltage Systems of Thessaloniki Metro network.

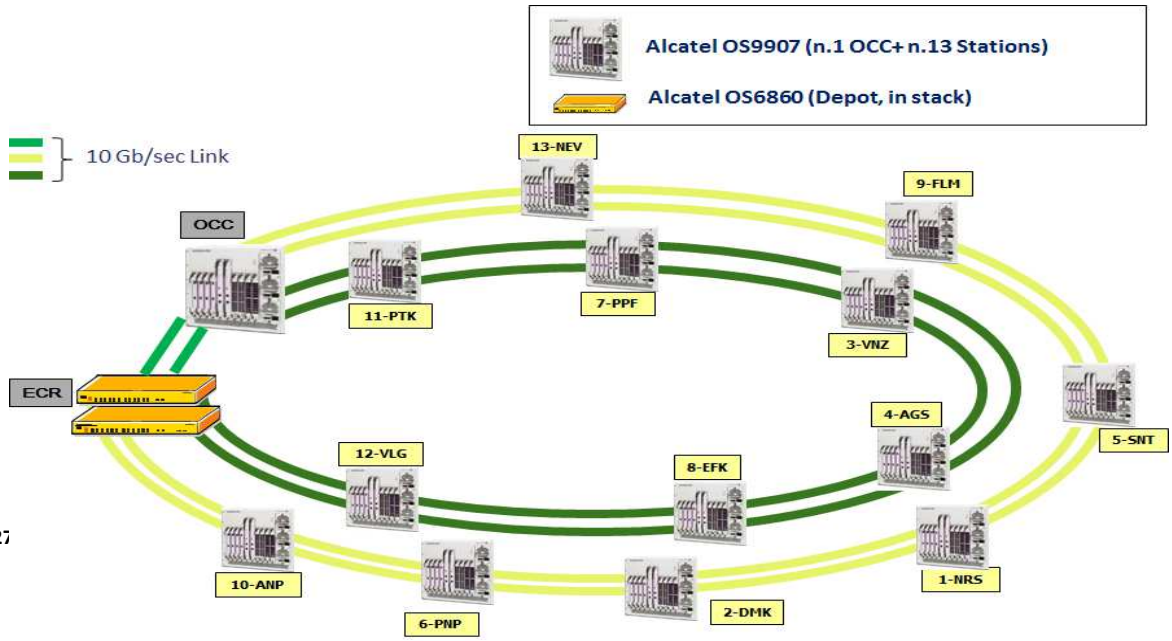
1 Digital Transmission System (DTS)

1.1 The existing Digital Transmission System (DTS) of Thessaloniki Metro Base Project constitutes the backbone for all communications of the Metro Systems, i.e. it shall provide a two-way audio (voice), video and data transmission between stations, the Depot, the OCC, the ECR and the Management Building.

1.2 The DTS system shall be connected to the following telecommunications system, as a minimum:

- Radio- communiation System - TETRA
- Automatic telephone system – PABX
- Direct Line Telephony (DLT)
- Public Announcement System (PA)
- Closed Circuit Television (CCTV)
- Time Distribution and Clocks System
- Passenger Information System (PIS)
- Cabling System
- Information Technology Infrastructure (IT) - MIS
- Intercommunication System
- Safety and Security Management System – SMS
- Building Automation Control System (BACS)
- Power Remote Control System (PRCS)

1.3 The following figure presents the general architecture of the DTS system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR:



1.4 The LAN TCP / IP network offers transmission (transfer) and switching services, through the technical transmission of data. The subject network can support both time-sensitive communication, such as voice and video, as well as communications not depending on time, such as dissemination of information.

1.5 In Thessaloniki network, the Network's architecture expands in the core and at the end, through the IP / IPX layer-3 (OSPF) routing, along with Standards IEEE 802.1Q VLAN tagging and aggregation link apply in the entire network. QoS functions ensure classification of traffic and prioritization for the correct implementation of converging multi-media applications.

1.6 The DTS system shall be provided as "TCP / IP Network" and it shall be equipped with the NMS management system.

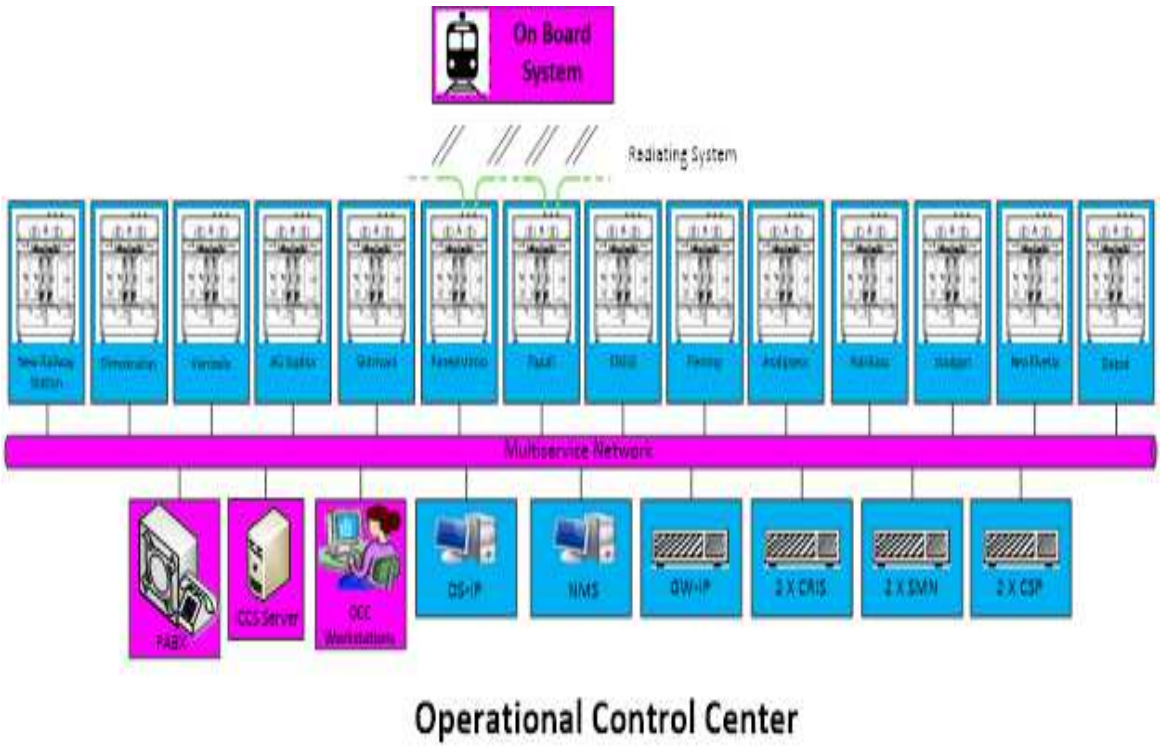
1.7 The type and manufacturer of the main parts of the DTS system items of equipment for Thessaloniki Metro Base Project are presented in the following table.

Item	Manufacturer	Type
Layer 3 Network Switch	Alcatel-Lucent	OmniSwitch 9907
Network Management System (NMS)	Alcatel-Lucent	OmniVista 2500
Layer 3 Network Switch (Depot)	Alcatel-Lucent	Omniswitch 6860

2 TETRA Radio System

2.1 The TETRA system shall provide radio-coverage in stations, tunnels, in the shafts' areas, depots' areas and trains. It shall be used to provide voice and data communication between the OCC and mobile / portable radio users.

2.2 The general architecture of the TETRA System for Thessaloniki Metro Base Project is presented below along with the implementation of the interconnection of all stations with the OCC and the ECR.



2.3 The necessary frequency programming should be coordinated with the Hellenic Telecommunications & Post Commission (EETT) in order to obtain the necessary frequency permit.

2.4 All radio voice communications received in the OCC and the ECR shall be recorded.

2.5 The type and manufacturer of the main parts of equipment of the TETRA system for Thessaloniki Metro Base Project are presented in the following table.

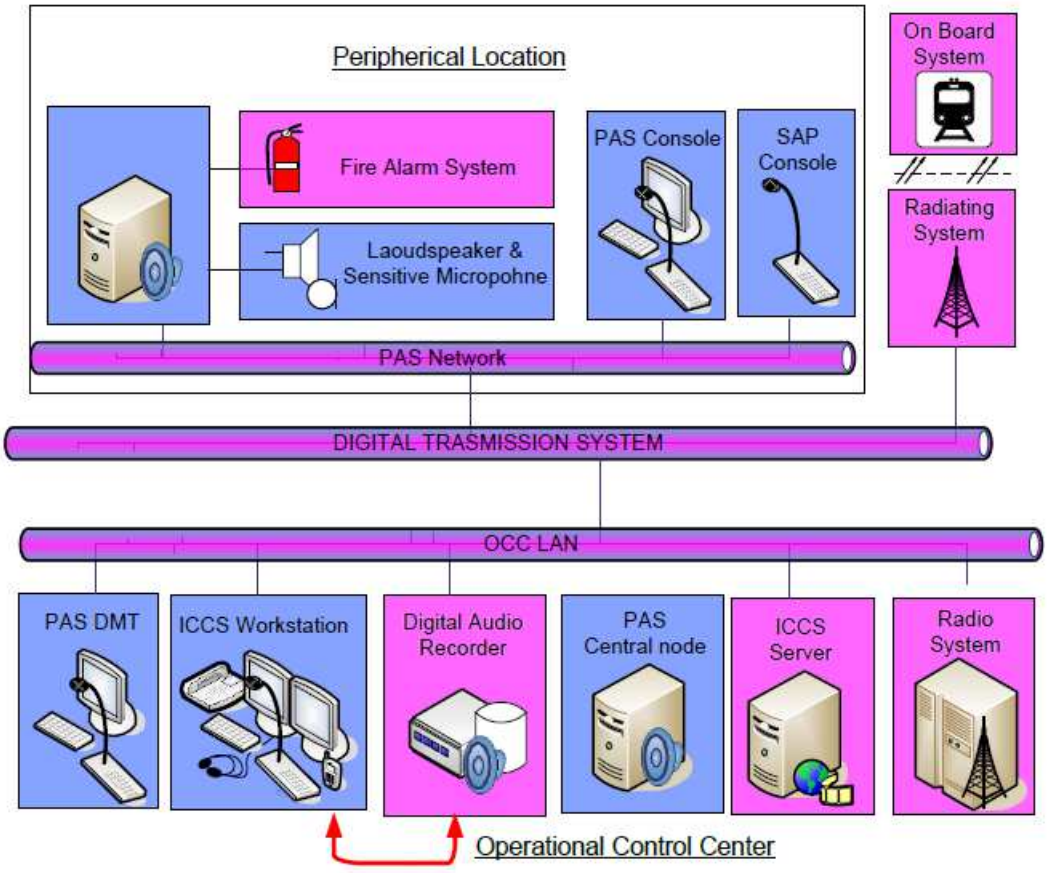
Item	Manufacturer	Type
CSP, SMN, CRIS, GW-IP	Selex ES	ElletraSuite IP Core elements ADAPTANET
Radio Base Station BS-Node	Leonardo	BS NODE-C
Network Management Server	Selex ES	ElletraSuite

		NMSx 50
Network Management Client, Dispatcher System DS-IP	Selex ES	CSP-DS platform
Mobiles - VS3000	Leonardo	Mobile radio-ElettraSuite VS 3000
Portable Radios - PUMA T3	Selex ES	Hand portable Radio Puma T3
Portable Radios - PUMA T3 Plus	Selex ES	Hand portable Radio Puma T3-Plus
RF Indoor Antenna	KATHREIN	Indoor omnidirectional Antenna
RF Outdoor Antenna	KATHREIN	Outoor omnidirectional Antenna
Leaky Cable 1-1/4" Eupen RMC 114-T "A series"	EUPEN	RMC 78-T A SERIES RMC 114-HLFR A SERIES
Directional Coupler CN20	Microlab	Directional Coupler,CK-20N Series Db
Splitter K 63 20 22 1 &K 63 20 23 1	KATHREIN	Outdoor and Indoor use Splitter 450
Power Splitter	Microlab	Block Style, Reactive Power Dividers Super wideband 380 - 2,500 MHz, N
Coaxial Loads	Microlab	Medium & High Power Terminations
Distribution Unit	BENNING	Distribution 4500

3 Public Address System (PA)

3.1 The existing Public Address System (PA) of Thessaloniki Metro Base Project shall be used for every-day activities (such as transmission of live or programmed messages and music playing in the background for passengers); however, it shall be very critical in case of emergencies (fire alarms).

3.2 The following figure presents the general architecture of the PA system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.



3.3 The PA system allows the transmission of audio messages or music playing in the background in all public areas of each station and in the depot. Each area shall be determined as a separate zone in the PA System and the option shall be given to be separately selected.

3.4 Announcements shall be used for supporting operation, safety and management of the circulation of passengers and trains. The option shall be given for the transmission of either live or pre-recorded messages either in automatic operation mode or in operator - controlled mode of operation.

3.5 Moreover, the PA system must fulfill the special requirements foreseen for the Depot area. Thus, there shall be voice announcements in the Train Stabling and the Operation and Maintenance Personnel area, providing information about the train departure from its stabling facilities.

3.6 The type and manufacturer of the main parts of equipment of the PA system for Thessaloniki Metro Base Project are presented in the following table:

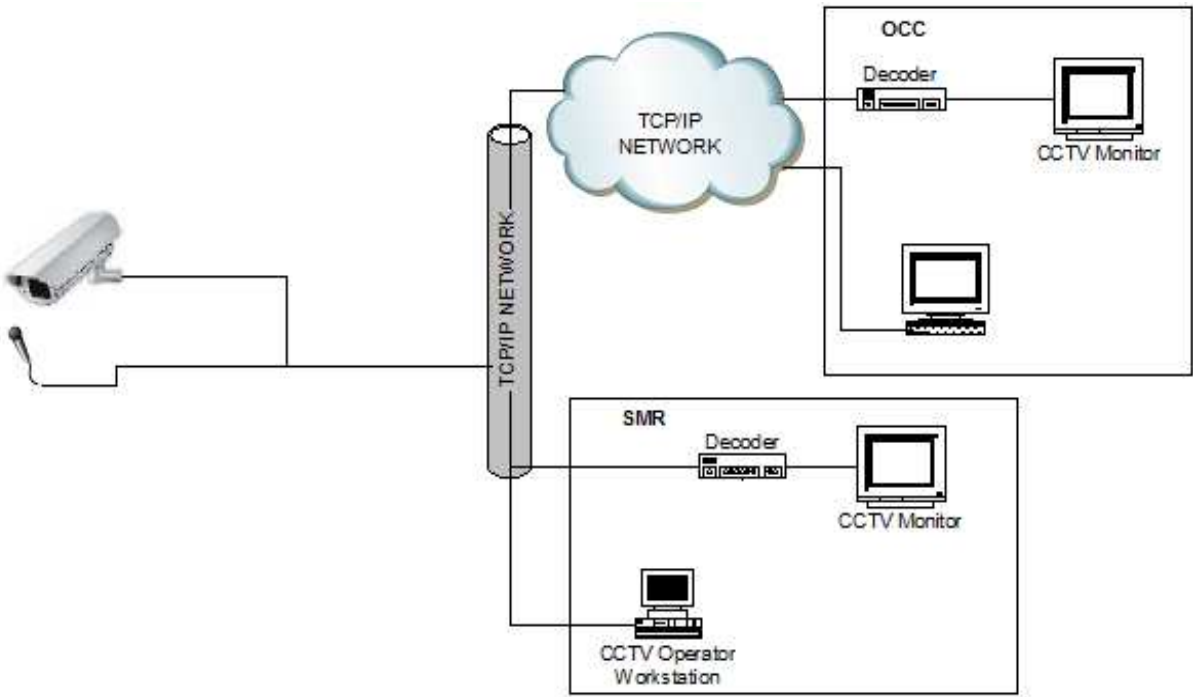
Item	Manufacturer	Type
Network Controller	BOSCH	PRS-NCO3
Cobranet Interface	BOSCH	LBB 4404/00
Power Amplifier 4x125W	BOSCH	PRS-4P125
Call Station Remote	BOSCH	PRS-CSR
Call Station Interface	BOSCH	LBB 4430
Call Station basic keyboard	BOSCH	LBB 4432
Supervision Control Board	BOSCH	LBB 4440
End of Line (EOL) Supervision Board	BOSCH	LBB 4443
Horn Loudspeaker	BOSCH	LH1-10M10E
Ceiling Loudspeaker	BOSCH	LBC 3086/41
Sound Projector	BOSCH	LBC 3941/11
AVC Microphone	IDEAS	BM14/01
Battery Chargers EN54	BOSCH	PRS-48CH12
Audio Manager	IDEAS	DAM-8800

4 Closed Circuit Television System (CCTV)

4.1 The protection and safety of the Metro Base Project shall be provided by the CCTV, being a supporting system.

4.2 The camera in each station should be connected through the central control unit (CCTV). The video images of the cameras should be recorded locally and the recorders must be fed by the telecommunication system's UPSs.

4.3 The following figure presents the general architecture of the PA system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.



4.4 In the SMR, the controller has two screen monitors for live projection. The first one is connected to the CCTV workstation and provides up to 16 camera views. The selection of images is effected through the mouse. The second monitor is connected to the decoder that gives the option for the display of up to four images per camera simultaneously.

4.5 The operators in the OCC and the ECR are able to manage the entire infrastructure of the CCTV by using the ICCS system server. The required number of the CCTV system monitors is provided separately for each controller.

4.6 The simultaneous display of the same selected images (videos) in the OCC, ECR and SMR is feasible.

4.7 The images (videos) deriving from each camera are locally recorded in the network's hard disks. Video recording in the hard disk shall be configured on an as-needed basis. The main storage functions are as follows:

- Storage using linear operating model or ring operating model
- Continuous or programmed activation
- Settings recording
- Correspondence of cameras "names/number" to recorded videos
- Quality rate of image and video
- Parameter – based search option: time, date, incident and camera
- Playback through the IP network in the CCTV workstation
- Simultaneous recording, playback and backup

4.8 The operators in the SMR, the Depot, OCC and ECR have the option to listen to the sound deriving from microphones for sound monitoring purposes. Microphones can be relocated depending on the installation requirements. Each microphone is linked to a camera, so that audio and video monitoring of the covered zone is ensured.

4.9 In addition, twelve (12) cameras must be installed in each train-vehicle. These signals (CCTV and remote data) shall be transmitted through WiFi (DCS system).

4.10 The type and manufacturer of the main parts of equipment of the CCTV system for Thessaloniki Metro Base Project are presented in the following table.

Είδος	Κατασκευαστής	Τύπος
Varifocal Lenses	BOSCH	SR MPIXEL & HD Lenses
CCTV DMT Software & Hardware	BOSCH	BOSCH Video Management System (BVMS)
Digital Video Recorder	BOSCH	DIVAR IP 7000 2U
CCTV Monitors 21.5"	Fujitsu	E22-8 TS Pro
Video Decoder	BOSCH	VJD-8000
Audio Surveillance microphone	Ideas	BM14/01
Outdoor fixed Camera	BOSCH	FlexiDome IP outdoor 4000i
Mounting Equipment	BOSCH	LTC 92xx/01
Mounting Equipment	BOSCH	LTC 92xx/00
Outdoor fixed Camera	BOSCH	Dinion IP 5000 HD
PTZ Camera	BOSCH	AutoDome IP outdoor 5000i
Outdoor fixed Camera housing	BOSCH	UHO Outdoor Camera housing
Modular camera mounts & access		VGA-IC_SP
Monitor E22 Touch	Fujitsu	E22 Touch

5 Safety Management System (SMS)

5.1 The SMS system shall allow surveillance and, on a per case basis, control of the equipment intended for the safety-related sub-system in stations, tunnels and along the railway line.

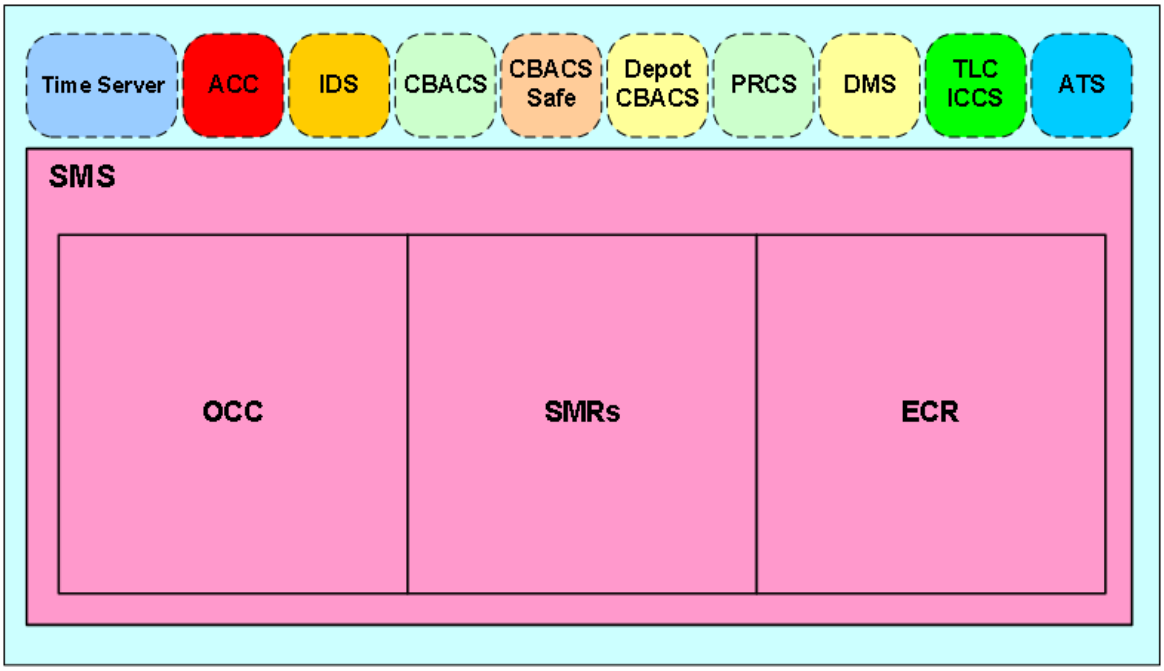
5.2 The sub-systems that are related to safety can be grouped in the three following categories, namely:

- Intrusion Detection System (IDS);
- Access Control (ACC);
- Closed Circuit Television (CCTV).

5.3 The SMS shall gather, manage and report significant alarms as regards the following sub-systems:

- Safety related sub-systems (IDS, ACC, CCTV);
- Signaling (ATC, ATO, ATP, ATS);
- Building Automation Control Systems (BACS and Depot-BACS);
- Power Supply (PRCS and DMS);
- Telecommunications (TETRA Radio, Automatic Telephone, DLT, PA, CSTD, PIS, Intercom-System, IT-Infrastructure, Digital Transmission System).

5.4 The following figure presents the general architecture of the PA system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.



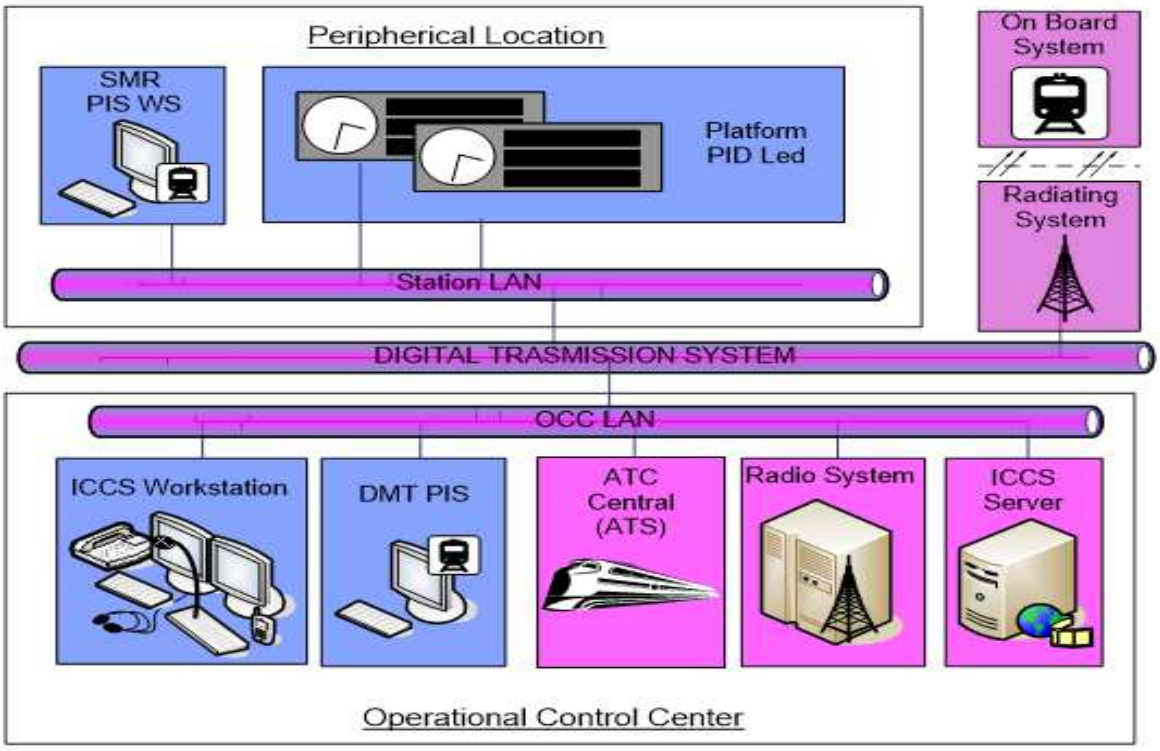
5.5 The type and manufacturer of the main parts of equipment of the SMS system for Thessaloniki Metro Base Project are presented in the following table.

Type	Manufacturer	Type
ICCS Workstation	See ICCS	
OPC (Server)		
SCADA software		

6 Passenger Information System (PIS)

6.1 The PIS system includes all items of equipment required for the input, storage, processing and projection of the trains' arrival and of the information pertaining to passengers and the operation personnel on the platforms in real time.

6.2 The following figure presents the general architecture of the PIS system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.



6.3 Within train vehicles, passengers receive visual information about the destinations and the subsequent train stops, as well as about any unusual or emergency train operation.

6.4 The option is given for the written messages to be classified in two categories, namely:

- Information related messages transmitted during normal operation of the Metro (e.g. arriving train destination and the relevant waiting time).
- Emergency messages about special emergency conditions (e.g. station evacuation).
- Emergency messages are of higher priority, as related to the normal operation messages.

6.5 Any message can be created by a different source, namely:

- Automatic messages are created by the ICCS of the OCC or by the DMT of the OCC or by the SMR workstation.

- Through the Client OCC or the DMT, the operator can transmit a pre-recorded message or type – manually – a specific (live) message.

6.6 The type and manufacturer of the main parts of equipment of the PIS system for Thessaloniki Metro Base Project are presented in the following table.

Item	Manufacturer	Type
Passenger Information Display	AESYS	MA5x5.3x240x161 T0420B
Workstation with PIS related software	Same as ICCS	-

7 Access Control/Intrusion Detection System (ACC/IDS)

7.1 The Access Control and Intrusion Detection sub-systems that are connected to the SMS system and are installed by the Contractor shall provide the following:

- Protection against unauthorized access to the Dept and the Shafts, as well as
- Access Control System (ACCA) for the OCC, the SMRs, the technical equipment rooms, accesses to tunnels from shafts and platforms from the street level and main access to the administration building.

7.2 The Access Control and Intrusion Detection systems consist in the following main materials, namely:

- Central IDS alarm system panel
- Peripheral I/O interface controllers for the management of standard surveillance items
- Remote arming terminal for local control of the security system
- Card readers with a key pad, of proximity type, for the input of data for access to be provided to a controlled area
- Exit buttons and emergency exit buttons
- Magnetic contacts for doors, roller shutters, hutches, surface trays
- Beacon for visual and audible alarm
- Motion sensors
- Door holding electromagnet with an integrated magnetic contact
- Local door controllers, autonomous operation, to control the card reader - locally interconnected one to the other in a network of "BUS" type RS-845 and/or an Ethernet communication port and an integrated power supply unit 230V AC/12V DC
- Central computer, of server type, in the OCC equipped with the appropriate software for integrated management of all IDS/ACC systems of a station.
- Workstation, of Client type, within the OCC, equipped with the appropriate software for the management of the Access Control data base, the operation of the printer and the readers and programmers for proximity card readers
- OPS Interface, for the two-way communication between the Central Server of the System with the SMS system.

7.3 The following figure presents the general architecture of the ACC/IDS system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.

7.4 The type and manufacturer of the main parts of equipment of the DTS system for Thessaloniki Metro Base Project are presented in the following table.

Item	Manufacturer	Type
Card readers with a key pad, of proximity type.	DDS	DK23
Central controller for access control reasons; connection: up to 2 card readers in 2 doors in a bus network, within a box with a 3.5 A feeder.	DDS	Controller:Open4 PSU:JX

Central controller for access control reasons; connection: up to 2 card readers in 2 doors in a bus network, within a box with a 3.5 A feeder and a battery with TCP/IP	DDS	Controller:Open-IP4 PSU:JX
Electromagnet 600lbs, featuring an integrated magnetic contact, with a base for an outward opening door	ELOCK	Elock-600L
One-contact exit button	CDVI	RTE001S
Emergency exit button	KAC	MCP1A
GALAXY DIMENSION Panel, Grade 3, 16 zones expandable up to 520, with a feeder, encoder, Ethernet, 4xRS485 data buses and a battery 12VDC 7Ah Grade 3	HONEYWELL	C520-D-E1
RIO unit: 8 inputs/ 4 outputs, with a feeder 2.75Amps, within a box and a battery 12VDC 7Ah Grade 3	HONEYWELL	GXPSU3ASMBEN
White magnetic contact, Grade 3	ELMDENE	EN3-QSC-GN
Outdoor magnetic contact, Grade 3	ELMDENE	EN3-RSA-GN
Magnetic contact for controlling the shafts' trays, Grade 3	ELMDENE	EN3-RSA-GN
1 PIR- based motion detector and 1 microwave motion sensor, covering an area of 16x22m, MaskAlert, tamper protection, Grade 3	HONEYWELL	DT8016AF4
2 PIR- based motion detectors and 2 microwave motion sensors for outdoor areas, IP65, pet immune, Grade 3	RISCO	RK325DT
Self-powered siren, featuring a flash and a battery, 118dB, Grade 3	KLAXON	XPRO-H/PREMIER
Remote arming terminal; LCD, GALAXY MK7 monitor, Grade 3	HONEYWELL	GXMK7

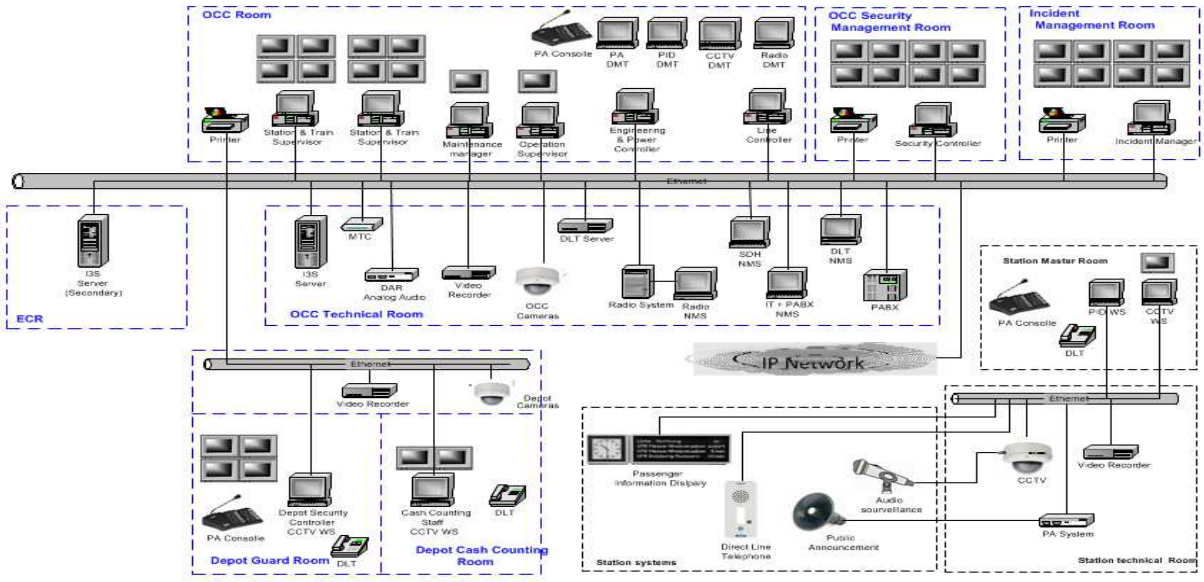
8 Integrated Central Communications System (ICCS)

8.1 The software application I3S is the product used in the Integrated Central Control System – ICCS, providing man-machine interface. The subject software shall be able to connect all telecommunications systems functions to the OCC and to the surveillance system of the general behavior of these systems and their faults – if any.

8.2 I3S shall provide the option to the OCC and the ECR operators to survey and operate – in a central, coordinated and remote way – the devices and items of equipment of the aforesaid telecommunications systems and to provide – mainly and in correspondence with these systems – the following, namely:

- Passenger Information system (PIS) for the management of text messages coming from the passenger Information Displays (PID) located in stations and in trains.
- Passenger Announcement System (PA) for the management of voice announcements in stations, in the Depot and in trains.
- Closed Circuit Television System (CCTV) for video surveillance in stations, in the Depot and in trains.
- Direct Line Telephony (DLT) / intercommunication system - management of services' calls received from the Metro personnel and emergency calls received from passengers in stations and on-board the trains.
- Radio communication system, including fixed communication facilities and communication facilities on-board the trains.
- Clocks and synchronization system.

8.3 The following figure presents the general architecture of the ICCS system for the Base Project of Thessaloniki Metro, showing the implementation of the interconnection between all stations and the OCC / ECR.



8.4 The ICCS Center provides the management operations described above at a high level, through the appropriate HW and SW interfaces and via specific control units for each system (I.E. DLT Management Units, radio - system), situated either in the OCC or remotely in several stations. It shall also feature the appropriate settings for exchanging information data with the remaining Metro control sub-systems, such as SMS.

8.5 The system's architecture guarantees continuation of the operation activities - in case of non-availability of the server – by means of the physical management interconnection provided by each sub-system separately (downgraded operation terminals for each telecommunication system) situated in the OCC and in the SMR.

8.6 The type and manufacturer of the main parts of equipment of the DTS system for Thessaloniki Metro Base Project are presented in the following table.

Item	Manufacturer	Type
Workstation (for ICCS Clients, NMS, DMT, CCTV Workstations)	FUJITSU	Celsius W550
Monitor (for ICCS Clients, NMS, DMT, CCTV Workstations)	FUJITSU	E22T7
I3S Server (ICCS Server)	FUJITSU	Primergy RX2520 M1
KVM Console for I3S Server (ICCS Server)	Schneider Electric	KVM
Digital Sound Recorder	Midas	Mida Rec
ECP Server	Ideas	ACP-4000/ECP

PART D: SPECIAL REQUIREMENTS

1. TELECOMMUNICATIONS AND LOW VOLTAGE CABLING SYSTEM

1.1 General Information

1.1.1 The communication cable system to be provided shall include all cables necessary for the perfect operational interconnection of the telecommunications and low voltage systems of this Contract.

1.1.2 The low voltage tray networks in stations, shafts and tunnels shall be provided by the main Contractor of Kalamaria extension. The Contractor can use them for the routing of the cabling that he shall install, after having coordinated his requirements at design level with the main Contractor of the extension, who also coordinates the remaining Contractors involved in the Project. Any additional requirements related to low voltage trays to meet the needs of this Contract shall be covered by the Contractor who shall proceed with the necessary installation.

1.1.3 The telecommunications and low voltage equipment rooms in the stations (3.4t) shall include a central distributor for the termination of copper cables FTP CAT 6 and an ODF of fiber optics cabling, to be installed by the main Contractor of Kalamaria extension. This Contractor can use them to serve the IT infrastructure systems that he shall install, after having coordinated his design requirements with the main Contractor of the extension, who also coordinates the remaining Contractors involved in the Project.

1.1.4 The central fiber optics network as well as the structured cabling at each station, crossover, shaft or tunnel shall be installed by the main Contractor of Kalamaria extension. The central fibre optics network of the extension shall terminate at ODF optical distributors at 25 MARTIOU Station, wherefrom all required operation related connections with the fibre optics network of the Base Project can then be effected. This Contractor can use the above to meet the needs of the systems that he shall install, after having coordinated his requirements at design level with the main Contractor of the extension, who also coordinates the remaining Contractors involved in the Project.

1.1.5 The main Contractor shall implement in each station, shaft, crossover and tunnel a completed "Common TCP/IP (LAN) Network" for data transmission. This shall interconnect (by using the aforementioned structured cabling as well) the central transmission equipment, such as switches and routers, with the peripheral equipment, i.e. all users and terminals of the telecommunication systems and the peripheral PCs/workstations. This Contractor can use the above to meet the needs of the systems that he shall install, after having coordinated his design requirements with the main Contractor of the extension, who also coordinates the remaining Contractors involved in the Project.

1.1.6 The remaining copper or fibre optics cabling (additional to the aforementioned ones) of the systems, between different equipment items in room 3.4t, between rooms 3.4t, the SMR rooms (room 2.3), the field equipment and where else required in view of providing the systems of the Contract fully operational, shall be designed, coordinated with the main Contractor of the extension, installed, tested and set into operation by the current Contractor.

1.1.7 All communication and low voltage cables installed in tunnels and stations should meet the low smoke emission, flame retardant and zero halogen related specifications. The proposed materials, as well as samples of cables, must be submitted during the required tests prior to their approval. The Contractor shall submit to ATTIKO METRO for approval

certificates providing details about these tests. He shall also notify ATTIKO METRO in due time about the date and place of execution of these tests, so that ATTIKO METRO can send a representative to attend the subject tests, if necessary.

1.1.8 All cables shall be resistant to corrosion, vermin (rodent) and insect attack.

1.1.9 The cable shall be suitable for continuous operation in a heavy rapid transit Metro railway under the environmental conditions prevailing in Thessaloniki.

1.1.10 The Contractor shall submit Material Submittal Sheets (MSS) for approval, supplying full information and specifications of all telecommunication and low voltage cables.

1.2 General Requirements for Cables' Installation, Layout and Routing

1.2.1 Cables shall be installed by competent staff, suitably trained and supplied with all necessary plant, equipment and tools.

1.2.2 Cables shall not be installed in a manner, or under conditions likely to cause corrosive action or damage to cables or be detrimental to the performance of cables during operation. Grounding of armouring and screening is to be suitably performed with regards to eventual EMC and DC operated conditions in the Metro network.

1.2.3 Cables installed through walls shall be in accordance with the fire protection and fire compartmentation regulations, to reduce the risk of fire spreading. Cable entry points shall be fireproofed and sealed for cables passing different fire compartments. The method shall be approved by ATTIKO METRO.

1.2.4 All telecommunication cables shall be physically separated from power cables by use of different trays or partitions. Especially among telecommunication/low voltage cables and traction power, MV – 20kV and power supply (230/400V) cables, the separation shall be achieved according to relevant international Standards and requirements and the EMC design.

1.2.5 The telecommunication/low voltage cables throughout the entire extension to Kalamaria shall be installed in heavy duty trays for low voltage cables installed by the main Contractor of the extension. The Contractor, if required or if he wishes so, can also use routing running in galvanized ducts to be installed by the Contractor himself in specific cases.

1.2.6 The cable layout for the telecommunications equipment shall follow the cable route (central conduits, ducts, trays etc.) at the various buildings of stations, crossovers, shafts and tunnels, in accordance with the coordination designs of the main Contractor of the extension.

1.2.7 All pipes or ducts or trays containing cables shall be effectively sealed where they enter substations, buildings, cabinets etc., to prevent the entry of vermin.

1.2.8 The arrangement of cables shall be planned to provide an orderly formation, free from unnecessary bends and crossings, permitting the removal of any one cable without undue disturbance to adjacent cables. The arrangement of cables and all methods of their installation shall be approved by ATTIKO METRO.

1.2.9 The cable routing design shall consider the deflection and bending radii. During installation, the mechanical properties of cables shall be respected and the cable manufacturer's instructions (for bending and forming cables with or without tensile forces) shall be followed.

1.2.10 The central optical fibre (OF) cables and the central copper cables (trunk cables) shall be terminated in independent stand-alone frames - distributors, which will be located in the telecommunication and low voltage rooms (3.4t). For copper cables, a Main Distribution Frame (MDF) shall be used for FTP CAT6 copper cables, while for OF cables, an optical distribution frame (ODF) shall be used. The MDF and the ODF shall be installed by the main Contractor of the extension at each station or in any other location where there is a telecommunications and low voltage room (3.4t).

1.2.11 All communication cables shall be clearly and indelibly labelled at: :

- Each end of every cable
- Along the line at regular intervals of 20m or in every change of area.

1.2.12 System-wide, all cable termination and distribution frames and units as well as metallic cable shields shall be connected with the earthing system and shall meet the EMC requirements.

1.2.13 After the final connections, the telecommunication cables shall be tested section by section in every station including the drawing-up of the relevant documentation. The tests shall be carried out in accordance with international Standards and Regulations.

1.2.14 For maintenance purposes, proper cable measuring devices for optical and copper cables shall be provided.

1.3 Fiber Optic Cables

1.3.1 The central optic fibers network along the entire extension to Kalamaria shall be installed by the main Project Contractor with four OF trunk cables (two in each tunnel), with 24 single mode fibers each. The termination of these fibres shall be the ODF optic distributors of each station and selected shafts/crossovers located at the respective telecommunications rooms 3.4t. It is stressed that the ODF shall be also used for the distribution of OF fibres, which are used by other systems of other Contractors, like signalling.

1.3.2 Optical ring topology for the "Common TCP/IP Network" shall be similar to the topology of the Base Project stations and shall have at least 4 fibres spare capacity within each OF trunk cable.

1.3.3 The Contractor can use new OF cables for connections between equipment items or between rooms 3.4t, SMR (2.3) and the field equipment, if and as required and provided that he coordinates the designs and the installation of his own OF cabling with the main Contractor of Kalamaria extension.

1.3.4 Technical Data – OF Cable Specifications (Outdoor Cables)

Any OF cables installed by this Contractor shall be single-mode and shall have the following characteristics:

SM Fibres Operating Wavelength	1310nm and/or 1550 nm
A - DF(ZN)2YB2Y	E 9..10/125 0,36 H 3,5 LG
A - DF(ZN)2Y(SR)2Y	E 9..10/125 0,36 H 3,5 LG
Mode field diameter (1310):	8.6 – 9.5 micron + 0.5 micron
Mode field diameter (1550):	10,5 – 9.5 micron +1,0 micron
Cladding diameter:	125 – 9.5 micron +2 micron
Σφάλμα συγκεντρικότητας πεδίου λειτουργίας:	≤ 1 micron
Cladding non-circularity:	≤ 2 %
1310 nm - 1360 nm	≤ 0,36 dB
Attenuation at 1550 nm :	≤ 0,23 dB
Chromatic Dispersion in the range	≤ 1285 έως 1330 nm:
Chromatic Dispersion in the range 1550 nm:	≤ 19 ps/nm x km

1.3.5 The Contractor shall state the advisable temperature range for the OF operation.

1.4 Copper Cables

1.4.1 All copper cables shall be designed to have 20% of their capacity spare at the time of initial system installation.

1.4.2 All copper cables to be installed shall meet the industry standards, shall be fire retardant E30, low in smoke and fumes, and halogen free.

1.4.3 All cables within tunnels, apart from those related to radio communication, shall be armoured.

1.4.4 All copper cables, materials and accessories shall be to the approval of ATTIKO METRO and shall comply with an accepted National or International Standards (ELOT, EN, IEC, NFPA etc).

1.4.5 Cables of the latest technology shall be provided.

1.4.6 The design of the system shall comply with the CENELEC, ETSI, ITUT (former CCITT) ISO/IEC and NFPA standards, as well as recommendations. Among other things, the network shall meet at least the following standards:

- EN 50159-2 Railway applications/ communication, signalling and processing systems - safety related communication in open transmission systems
- NFPA 130 Fixed Guide way Transit & Passenger Rail Systems
- EN 50173 Information technology / Generic cabling systems / General requirements and office areas
- ITU-T G652 Technical Parameters of Optical Fibre Cable
- IEEE 802.3xx Series standards for Ethernet
- EN 187 000, EN 188 000 Tests for OF cables
- CEI/IEC 60331-1,2,3 Fire resisting characteristics of electric cables
- CEI/IEC 60332-1,2,3 Tests on electric cables under fire conditions
- ISO / IEC 11801 Generic Cabling for Client Premises Cabling, 4th version, 2017

- TIA/EIA-568-A-1995 Commercial Building Telecommunications Wiring Standards
- TIA/EIA-568-A Updates (1998-1999-2000)
- TIA 568-B.1-2000 Commercial Building Telecom. Wiring Standard
- TIA/EIA-569-A-1995 Commercial Building Standard for Telecommunications Pathways and Spaces
- TIA 570-A-1998 Residential and Light Commercial Telecommunications Wiring Standard
- TIA/EIA-606-1994 Building Infrastructure Administration Standard
- TIA/EIA-607-1995 Grounding and Bonding Requirements.

1.4.7 Other Standards, which are recommended by the Contractor, shall be accepted only if they are at least equal with those mentioned above.

1.4.8 The Contractor shall state the applicable Standards to be used.

2. ELECTROMAGNETIC COMPATIBILITY, EARTHING AND LIGHTNING PROTECTION

2.1 Electromagnetic Compatibility

The Contractor shall install all telecommunications and low voltage systems in a manner to satisfy the requirements on electromagnetic compatibility, based on the National and International standards:

- ELOT EN 61000-6-3, 2001, Electromagnetic compatibility (EMC), General standards. Emission standard for residential, commercial and light-industrial environments.
- EN 61000-3-2, 2014, Electromagnetic compatibility (EMC), Limits. Limits for harmonic current emissions (equipment input current $\leq$16 A per phase)
- EN 61000, 2017, Electromagnetic compatibility (EMC), Testing and measurement techniques
- EN 61000, 2018, Electromagnetic compatibility (EMC).

In the design, the equipment location and the cable routing of the telecommunications and low voltage systems that he shall install, the Contractor shall take into account the existing electromechanical systems and, in particular, the related cable routings for power supply (Traction – 750V DC, MV – 20 kV and Power Distribution 230/400V) which potentially affect the new systems under installation of the current Contractor

2.2 Earthing

2.2.1 In order to ensure the safety of the personnel which operates or performs maintenance works to the equipment both under normal operating conditions and in the event of failure, the entire telecommunications and low voltage equipment to be installed should be properly connected to the earthing system.

2.2.2 All telecommunications rooms, hardware and software racks shall be properly earthed so as to prevent noise generation, causing damage or putting personnel at risk in case of accidental contact with the traction power and telecommunication cables. In each telecommunications room and in all technical rooms of the Kalamaria Extension Project, the main Contractor would have already installed locally an earthing bar, which should be used by the current Contractor to earth the systems that he shall install.

2.2.3 Moreover, for the sound operation of the telecommunications and low voltage equipment power supply shall be ensured through voltage reference. To reduce the cross-talk phenomenon, one of the poles of the sources shall be connected to the earthing system. In order to reduce voltage-generated noise, caused due to electromagnetic radiation, cable shielding shall be connected to the earthing system.

2.2.4 The earthing method shall also ensure that the smooth or problematic operation of any installation shall not cause any damage to the normal operation of any other installation or any interference what so ever to it.

2.2.5 The earthing system shall comply with the following basic principles:

- Central foundation earthing of the system and central earthing busbars have been installed at each station, at selected crossovers and at selected shafts, while local earthing busbars have been installed or shall be installed in all technical rooms of the above by the main Contractor of the extension to Kalamaria.
- All earthing connections shall be as short as possible.
- Earthing cables shall be of sufficient diameter.

- The earthing of the frames shall be ensured through "star-delta" connection.
- Connections shall be properly arranged so as to ensure that there is no circular current flow.
- All racks shall be earthed in the stations, along the line and in selected shafts.
- Cable shielding shall be earthed only at one point.
- The metal shielding and sleeve of all cables running from the technical equipment rooms shall be earthed to the earthing system of the technical room in question, otherwise earthing along their entire length shall be ensured.
- Equipment enclosures and frames shall earthed through the shielding or armouring of the cable powering the equipment or through a separate earthing cable.
- All steel boxes or boxes of similar material located at the underground section of the project shall be isolated from any steel structural items.
- In rooms with cables and equipment, the arm-span shall be taken into account

2.3 Lightning Protection

2.3.1 Lightning protection shall be ensured for the entire telecommunications and low voltage equipment to be installed on the ground surface,

2.3.2 Any basis of the wireless communication which is connected with the outer antenna shall be equipped with an EMP protector installed at the inlet of the uniaxial cable for protection of the wireless communication equipment.

3. POWER SUPPLY

3.1 The main Contractor of the extension shall provide the necessary infrastructure – equipment for the power supply system to be required for the entire telecommunications and low voltage equipment in room 3.4t at each station, shaft or crossover. The main Contractor of the extension shall provide two feeder cables starting from the LAS substation, supplying with power two UPS units for telecommunications equipment which, in their turn, shall supply a local sub-switchboard inside each room 3.4t, in which there shall be stand-by terminations to be connected with local feeder cables towards each new system to be installed by the current Contractor.

3.2 The current Contractor shall install the supply cables from the local sub-switchboard of room 3.4t up to the equipment of each system to be installed. Moreover, the current Contractor shall install the feeder cables towards the equipment located in the SMR (2.3) (workstations, screens, consoles etc), as required per case and per system, to ensure the smooth operation of all new systems and of their equipment.

3.3 The Contractor shall submit a power supply layout with all relevant information (switches, cables etc.) for the systems to be installed for a typical station and shall provide a list of the estimated power supply loads. This information shall be coordinated with the main Contractor of Kalamaria extension.

3.4 The power supply cables to be installed shall be fire resistant (E30), low smoke and halogen free.

3.5 The cables to be provided shall be of the latest technology.

3.6 Cables shall be properly arranged, without forming any curves and crossings, so that any cable can be removed without causing much disturbance to the adjacent cables. The cable routing shall take into consideration the deformation and the bending radii, while the manufacturer's requirements shall be adhered to as regards the mechanical properties of the cables during installation.

3.7 The power supply cables shall be in accordance with the following standards:

- IEC 60 228 Conductors of insulated cables
- IEC 60 331 Tests for electric cables under fire conditions - Circuit integrity
- IEC 60 332.3C Tests on electric and optical fiber cables under fire conditions
- IEC 446 Identification of conductors by colors or alphanumerics
- IEC 60 502 Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV)
- IEC 811 Common test methods for insulating and sheathing materials of electric cables
- IEC 60 754 - 1,2 Test on gases evolved during combustion of materials from cables
- IEC 61 034-1,2 Measurement of smoke density of cables burning under defined conditions

- VDE 0276 part 604 Distribution cables with extruded insulation for rated voltages from 3,6/6 (7,2)kV up to and including 20,8/36 (42)kV
- VDE 0266 Power cables with improved characteristics in the case of fire
- DIN 4102 part 12 : Fire Behavior of building materials and building components part 12 : circuit integrity maintenance of electric cable systems, requirements and testing
- ELOT HD 384, 2004, Requirements for electrical installations (Ministerial Decision Φ.7.5/ 1816/88/04-FEK 470 B'/5-3-04)
- ELOT EN 1363-1, 2012, Fire resistance tests. General requirements.
- ELOT EN 1366-3, 2009, Fire resistance tests for service installations. Penetration seals
- ELOT EN 1838, 2013, Lighting applications – Emergency lighting
- ELOT EN 14 187, 2017, Cold applied joint sealants
- ELOT HD 30852, 2004, Characterization of cable colors (Ministerial Decision Φ.7.5/ 1816/88/04-FEK 470 B'/5-3-04)
- ΕΤΕΡ 04-20-01-01, Electrical installation piping with steel conduits
- ΕΤΕΠ 04-20-02-01, Power Distribution conduits - cables

4. EQUIPMENT ROOMS AND CABINETS

4.1 Rooms for telecommunications and low voltage equipment (3.4t) shall be provided in each station, in selected shafts and in crossovers. These rooms shall have false floors and shall be air-conditioned.

4.2 Cable trays shall be installed by the main Contractor between the Main Distribution Frame (MDF) or Optical Distribution Frame (ODF) and the racks of the equipment; while they shall be routed either under the false floor or in room 3.4t. The Contractor can install them for the routing of cabling that he shall install after having coordinated his requirements at design level with the main Contractor of he extension, who also coordinates the other Contractors who are engaged in the Project.

4.3 The subject equipment shall be installed on 19" racks or similar equipment racks inside the telecommunications and low voltage equipment rooms (3.4t).

4.4 Any equipment which cannot be housed inside a room 3.4t shall be installed in suitable, sufficiently dimensioned and protected equipment racks properly arranged so as not to obstruct the operation of other systems or the passenger or personnel circulation and should be coordinated with the architectural design as well, if they are in public areas.

4.5 If it is required to install racks or equipment devices in the tunnels, their size and shape and the space intended for their installation shall ensure that doors, covers etc. shall not obstruct the train movement even when open and that the personnel shall have access to these racks/devices, a fact which should not limit in an inadmissible manner the free and safe circulation of personnel.

4.6 In any case, the equipment to be installed outside room 3.4t shall be easily accessible for the execution of the relevant maintenance works, when required. Equipment racks shall be designed, located and installed in such a way so that easy access of the maintenance personnel is ensured at all times whether the Metro system is operating or not.

4.7 Cable clips shall be provided in all cable entry points in racks. More specifically, all trackside equipment and device racks in tunnels shall be manufactured so as to block water and dust ingress through proper provisions in order to meet, at least, index IP 65 and to prevent humidity concentration through water condensation, while they shall comply with the relevant standards.

4.8 All hooks, brackets or other mounting devices and supports, including the drilling of holes relevant to the systems provided for in the Contract, shall be supplied or executed by the Contractor.

4.9 The Contractor shall provide details concerning the racks for devices that he intends to use and which will be subject to AM's approval.

5. SPARE PARTS AND MAINTENANCE

5.1 Spare Parts

5.1.1 The Contractor shall be responsible for the supply of spare parts in accordance with the requirements specified in the General Specifications document and in this article

5.1.2 Sufficient spare parts shall be provided by the Contractor to insure the availability of each telecommunications and low voltage system and the safe and reliable operation of the Metro, in general. As a general rule, the Contractor shall be responsible to supply a sufficient quantity of spare parts as required to maintain the high availability standards for the supplied system.

5.1.3 The Contractor shall use the RAMS study to develop the requirements for spare parts that shall be available to support the proposed operation and maintenance plan to be developed in relation to the supplied communication sub-systems.

5.1.4 The Contractor shall prepare a comprehensive report on the requirement for spare parts, which shall be submitted to AM for approval and finalization of the spare parts required per system.

5.1.5 The Contractor shall be responsible for the supply of all required spares during the 3-year warranty period, following the commissioning of the Project. Upon expiry of the warranty period, the Contractor shall replenish the stock spares to match the quantity specified in the approved list of spare parts.

5.1.6 The Contractor shall be responsible for the execution of the preventive maintenance and the provision of all related spare parts and consumables for a period of 1 year uppn commissioning of the Project, while he shall have available 1 electrical engineer for low voltage for reasons of technical support, if required during that specific time period.

5.1.7 The Contractor shall guarantee that all suppliers/manufacturers of the equipment to be used in the Project shall provide the required spare parts for a period of fifteen (15) years following the expiry of the warranty period for the entire Project.

5.1.8 The following spare parts for all telecommunication and low voltage sub-systems should be available, as a minimum, both upon commissioning of the Project and upon expiry of the warranty period, a milestone marking that the Contractor has no other obligations as regards the supply of spare parts.

SYSTEM - EQUIPMENT	QUANTITY OF SPARE PARTS
Closed Television Circuit - CCTV	
Varifocal Lenses	2
Digital Video Recorder	1
CCTV Screens 21.5"	2
Video Decoder	1
Audio Surveillance microphone	2
Outdoor Fixed Camera	2
PTZ Camera	2
Outdoor fixed Camera housing	2
Passenger Information System - PIS	

Screens - Passenger Information Display	2
Acess Control System/Intrusion Detection System - ACC/IDS	
Proximity card reader with integrated keyboard	5
Central access controller, connection up to 2 card readers in 2 ports in bus, in a box with power supply 3,5A	1
Central access controller, connection up to 2 card readers in 2 ports in bus, in a box with power supply 3,5A and battery, with TCP/IP	1
Electromagnet 600lbs, supervised with integrated magnetic contact with base for outward opening door	5
Single contact exit button	5
Emergency exit button	2
Switchboard, Grade 3, 16 zones, expandable to 520, with power supply, encoder, Ethernet grade, 4xRS485 data buses and battery 12VDC 7Ah Grade 3	1
RIO expansion module with 8 inputs and 4 outputs, power supply 2.75Amps, in box and battery 12VDC 7Ah Grade 3	1
Magnetic contact, white Grade 3	5
Outdoor magnetic contact, Grade 3	2
Magnetic contact to control the trays of shafts	2
Motion detector of 1 passive infrared & 1 microwave channel, coverage 16x22μ, with MaskAlert, tamper protection, Grade 3	2
Motion detector 2 passive infrared & 2 microwave channels, outdoor, IP65, pet immune, Grade 3	1
Self-supplied siren with flash & battery, 118dB, Grade 3	1
Keyboard for handling & indications with LCD screen, Grade 3	1
ICCS	
Workstation (for ICCS Clients, NMS, DMT, CCTV Workstations)	1
Screen (for ICCS Clients, NMS, DMT, CCTV Workstations)	1
Radio Communication - TETRA	
Radio Base Station BS-Node	2
Mobiles - VS3000	1
Portable Radios - PUMA T3	2
Portable Radios - PUMA T3 Plus	2
RF Indoor antenna	2
RF Outdoor antenna	2
Leaky Cable 1-1/4" Eupen RMC 114-T "A series"	500 m

Directional Coupler CN20	1
Splitter K 63 20 22 1 &K 63 20 23 1	1
Power Splitter	1
Distribution Unit	1
Public Announcement - PA	
Network Controller	1
Power Amplifier 4x125W	1
Call Station Remote	2
Call Station basic keyboard	2
Supervision Control Board	2
Horn Loudspeaker	2
Ceiling Loudspeaker	5
Sound Projector	1
AVC Microphone	3
Digital Transmision System - DTS	
Layer 3 Network Switch	1
Layer 2 Network Switch	2

5.1.9 Moreover, as regards equipment not included in the aforementioned list including I/O boards and individual components/ units/ cards (including motherboards), the Contractor shall provide 2% of their replaceable modules.

5.2 Maintenance

5.2.1 To maintain the system reliability requirements, the Contractor shall develop a preventive maintenance plan for each telecommunication and low voltage sub-system that shall be tailored to the needs of the Project. The objective of the proposed maintenance plan shall be to maintain the maximum availability of installed systems.

5.2.2 The maintenance plan for each system (independently or for all systems) shall be submitted to AM for approval.

6. TRAINING

6.1 General

6.1.1 The Contractor shall develop a detailed plan for providing comprehensive training to the operations and maintenance personnel of the Department or the Operation Company. The proposed training plan shall be developed in accordance with the requirements specified in the General Specifications.

6.1.2 All training course shall be given in Greek or in English. Training manuals shall be in English and Greek language. Complete training documentation shall be submitted AM for approval.

6.1.3 Two types of training courses are foreseen as regards:

- System Operation
- System Maintenance

6.1.4 Training courses shall take place at Pylea Depot and on site of the Project of the extension in communication with the Project Owner and the Operations Company/Agency, while if required, special courses also take place at the facilities of the equipment supplier companies abroad.

6.1.5 The Contractor shall submit for approval to AM the syllabus and the training schedule at least 3 months prior to the commencement of the relevant courses.

6.1.6 Upon completion of the training, the Contractor shall provide the appropriate certificates to the trainees to certify their training.

6.2 System's Operation Courses

The objective of the training shall be to update and enable the operation personnel of the Operations Company/Agency in the use/operation of the supplied communication and low voltage equipment, including the surveillance and control arrangements in the SMR, the OCC and the ECR.

6.3 System's Maintenance Courses

The maintenance training courses shall have the objective of giving to the maintenance personnel the full comprehension -in technical and operational terms- of its main hardware and software components, aiming at acquiring the capability to manage failures, maintain and repair the system under normal and emergency conditions, as well as to manage effectively the required spare parts. The maintenance training course for each system shall be supplemented by on-the-job training which shall be supplied by the Contractor during the maintenance period.

7. PROJECT DESIGN PHASES AND DELIVERABLES

7.1 Design Phases

Upon Contract signing, the Contractor shall commence the preparation of the General Final Design (GFD). Preparation of the Detailed Final Design (DFD) shall follow the GFD phase, while the "As Built" Design preparation phase shall follow construction.

7.2 General Final Design (GFD)

7.2.1 The following drawings shall be submitted during the GFD phase:

- System architecture – layout of each system and single-line diagrams
- Installation drawings showing the equipment to be installed in the tunnels and the cables, at scale 1:500
- Cable routing drawings in the stations, along with a list of cables at scale 1:100
- Layout drawings for technical rooms in the stations, shafts and the SMR at each station, ar scale 1:50, details 1:10

7.2.2 The following designs and reports shall be submitted during the GFD phase:

- Description and main characteristics of each Telecommunications – Low Voltage systems included in the Contract, covering their sub-systems
- Ensuring electro-magnetic compatibility
- Determination of all Safety and RAMS related requirements
- Report on the interfaces points between the telecommunications and low voltage equipment and other, Civil Works and architectural finishes.
- Power supply related requirements.

7.3 Detailed Final Design (DFD)

7.3.1 The following drawings shall be submitted during the DFD phase:

- Detailed schematic – circuit diagrams of each system at each station, shaft and the entire extension
- Detailed drawings of the equipment – installation layout and details
- Detailed cable routing drawings
- Equipment connection detailed drawings

7.3.2 The following designs and reports shall be submitted during the DFD phase:

- Calculations and simulations, where required
- Detailed description, configuration, performances, equipment dimensioning, selection of equipment and customisation of each Telecommunications – Low Voltage systems of the Contract
- Selection of cabling and switching material
- Material Submittal Sheets (MSS) of the manufacturer for each item of the hardware and software equipment
- Methodologies concerning the installation
- Lists of cables
- RAMS designs

- Typical Factory Test Procedures (FAT) and on site of the Project (SAT, SIT, SPT)
- Factory and worksite tests plan.

7.3.3 Other back-up documents to be delivered prior to commissioning:

- Operation and User Manuals
  For each system and equipment, this document shall include a full description of the operations under execution, the equipment configuration, its geometric characteristics, its technical characteristics, the start-up requirements, the possibilities and selections related to the operation and the screens that are available to the user in the central control system, information that is stored and the procedures for the re-configuration of the system to the extent that is allowed by the manufacturer
- Maintenance Manuals
  For each system or equipment, this document shal include instructions about the preventive maintenance of the equipment, the periodic change of its items, if and when required, the identification and settlement of failures, as well as the spare parts required to be available.
- Drawings and As Built Documentation, incorporating the field changes made during the installation of equipment and networks, in the approved Detailed Final Designs