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1. Scope

- 1.1 This Specification lays down the technical specification, functional features and performance characteristics of basic equipment items, quality of installation, materials used and standard of workmanship which are required for the provision of a digital Private Automatic Branch Exchange System (PABX or the System).
- 1.2 This specification should be read in conjunction with the “General Requirements for Electronic Contracts, ESG01” and the Particular Specification. Unless otherwise stated in the Particular Specification, the requirements and conditions stipulated in this Specification shall apply to all contracts/orders for the supply and installation of PABX systems issued by the Electrical & Mechanical Services Department.

2. Description of System

2.1 A PABX system typically consists of:-

- a. Digital switching system;
- b. Telephone instrument with plug;
- c. On-site control terminal(s);
- d. Cables and connectors interconnecting the PABX cabinets, PABX main equipment to Main Distribution Frame (MDF) and all other ancillary equipment offered;
- e. Internal Cable Distribution System (ICDS);
- f. Battery and charger system;
- g. Other sub-systems such as Voice Messaging System (VMS), Unified Messaging System (UMS) and so on;
- h. Equipment cabinet and all related accessories.

2.2 Detailed tailoring of individual system is given in the Particular Specification. Where specialized techniques and equipment components are required for a particular system, these should also be referred in the Particular Specification.

3. Related Documents and Reference

3.1 References to User/Design/Installation/Testing Specification

The following references are stipulated to guide the contractor on design, installation and other requirements:-

- a. General Specification for the Electrical Installation in Government Buildings of the Hong Kong Special Administrative Region issued by the Architectural Services Department;
- b. Code of Practice for the Electricity (Wiring) Regulations published by Electrical and Mechanical Services Department;
- c. IEC 61082 - Preparation of documents used in Electrotechnology;

- d. IEC 60050 - International Electrotechnical Vocabulary;
- e. IEC 60065 - Audio, video and similar electronic apparatus - Safety requirements;
- f. IEC 60068 - Environmental testing;
- g. IEC 60364 - Electrical Installations of Buildings;
- h. IEC 60896-22 – Stationery Lead-acid Batteries, Part 22: Valve Regulated Types - Requirements
- i. IEC 61643-21 - Low voltage surge protective devices - Part 21: Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods
- j. IEC 61643-22 - Low-voltage surge protective devices - Part 22: Surge protective devices connected to telecommunications and signalling networks - Selection and application principles
- k. ISO/IEC 11801 - Information Technology – Generic Cabling for Customer Premises;
- l. Telecommunications Ordinance (Chapter 106) – Laws of Hong Kong;
- m. Telecommunications (Control of Interference) Regulations (Chapter 106B);
- n. Relevant Codes of Practice or Guidelines by the Office of the Communications Authority;
- o. Relevant Customer Technical Guides or equivalent of Network Operators;
- p. All relevant Ordinances and Laws of Hong Kong.

3.2 Other National and International Standards

Equipment complying with other National or International Standards such as IEC, ISO, ANSI and etc. may also be accepted provided they meet all requirements of the Specification.

4. Definition

4.1 Terminology and Glossary of Terms

- a. “Government” means the Government of the Hong Kong Special Administrative Region.
- b. “Network Operator” means licensee of “Fixed Telecommunications Network Services Licence”, or “Fixed Carrier Licence”, or “Unified Carrier Licence”.

4.2 Abbreviations

- a. “ANSI” means American National Standard Institute.
- b. “BS” means British Standards.
- c. “CND” means Calling Number Display.

- d. “DDI” means Direct Dialling In.
- e. “DFS” means Distribution Frame System.
- f. “DTMF” means Dual-tone Multi-frequency.
- g. “EIA” means Electronic Industries Alliance.
- h. “EMSD” means Electrical and Mechanical Services Department.
- i. “HKCA XXXX” means the specifications prescribed by the Communications Authority (CA) are named as HKCA specifications
- j. “ICDS” means Internal Cable Distribution System.
- k. “IDA-P” means Integrated Digital Access-P
- l. “IEC” means International Electrotechnical Commission.
- m. “IET” means Institution of Engineering and Technology
- n. “ISO” means International Organization for Standardization.
- o. “ITU” means International Telecommunication Union.
- p. “MDF” means Main Distribution Frame.
- q. “OFCA” means Office of the Communications Authority
- r. “PABX” means Private Automatic Branch Exchange.
- s. “PSTN” means Public Switched Telephone Network.
- t. “rms” means “root mean square”.
- u. “UMS” means Unified Messaging System.
- v. “VMS” means Voice Messaging System.

5. System Requirements

5.1 General Requirements

- 5.1.1. The PABX shall have a serviceable life of at least 10 years. Tenderers shall quote the equipment service lifetime with supporting information from the equipment manufacturer.
- 5.1.2. The PABX shall not generate any radio spurious which exceed the limits as specified in the Telecommunications (Control of Interference) Regulations (Chapter 106B).
- 5.1.3. The PABX shall be a digital electronic system supporting TDM-based voice traffic or a hybrid system which supports both TDM-based and IP-based voice traffic with all internal signalling in digital technique and full redundancy structure for all main components in the system. The voice reception via the PABX shall be of good quality.

- 5.1.4. The PABX shall be able to support simultaneous voice and data communications on 2-wire or 4-wire cables.
- 5.1.5. The PABX shall be capable of carrying out routine background diagnostics automatically on a 24-hour basis or on demand by user to identify any faulty component in the PABX and give different levels of alarms and indications to the user for maintenance and repair.
- 5.1.6. The PABX shall be equipped with remote alarm panel for the PABX at location, within the buildings complex, to be specified by the user in order to display the system alarm and status.
- 5.1.7. The PABX shall be capable of initiating respective alarms in the event of failures of trunk line, AC mains, battery and network line as the minimum requirement.
- 5.1.8. When an alarm is triggered, an audio alert (sound level adjustable with range 50dB to 90dB) shall be generated by the remote alarm panel. The audible alert can be manually muted while visual indication shall be maintained during the presence of the alarm.
- 5.1.9. All the alarms initiated from the PABX, in addition to being monitored by the system administration console, shall be configured as dry contacts or other standard interface for IoT connectivity for remote monitoring

5.2 System Capacity Requirements

- 5.2.1. The PABX shall be able to meet the initial capacity and capable of expanding to meet the ultimate capacity specified in the Particular Specification.

5.3 Traffic Handling Capability

- 5.3.1. The switching sub-system of the PABX shall perform at least at a grade of service of 1% under the following average busy-hour traffic condition. The PABX shall meet the performance requirements when it is brought into service initially as well as when the PABX is expanded to the ultimate capacity. Documents or descriptive literature shall be provided to show the traffic handling capacity of the proposed PABX:-
 - a. Extension to extension both-way traffic of 0.06 erlang per extension;
 - b. Incoming exchange line traffic of 0.055 erlang per extension;
 - c. Outgoing exchange line traffic of 0.055 erlang per extension;
 - d. Voice traffic for operator console of 0.6 erlang;
 - e. Data traffic for computer connection of 1 erlang per connection; and
 - f. Data traffic for data terminal of 1 erlang per terminal.

5.4 Call Handling Capacity

- 5.4.1. The PABX shall have sufficient processing power, time slots, DTMF sender and receiver circuits, signalling control circuits and etc.in order to provide the required standard of services, Busy Hour Call Attempts (BHCA) or Busy Hour Call Completions (BHCC) when the PABX is equipped at the initial capacity as well as

up to the ultimate capacity.

- 5.4.2. The dial tone delay probability shall not be greater than 0.015 with delay time more than three seconds.
- 5.4.3. The number of calls that are incorrectly handled or mis-processed by the PABX shall not be more than 1 in 1000.
- 5.4.4. All extension lines shall be available at all times for internal calls, even when traffic loading is huge.

5.5 Number Handling Capacity

- 5.5.1. The PABX shall be able to receive 2 digits, 3 digits or 4 digits from the PSTN and route the call to the relevant extension automatically.
- 5.5.2. The PABX shall be able to insert, delete or translate some of the digits sent from the PSTN when required.
- 5.5.3. The Contractor shall liaise with Network Operator on the extension numbering plan and trunk group arrangement for both incoming and outgoing traffic during system implementation.
- 5.5.4. In general, the following numbering arrangement shall be used:-
 - a. "0" for access to operator console; and
 - b. "9" for access to PSTN.
- 5.5.5. The offered PABX shall support multiple trunk group operation.
- 5.5.6. The PABX shall be capable of transmitting not less than 15 digits to the PSTN via the connected exchange lines and trunks for call routing purposes.

5.6 Reliability and Availability Requirements

- 5.6.1. All critical components of the PABX shall be of design so as to improve the reliability of the whole PABX. These shall include, but not limited to, central processing unit (CPU), memory, mass storage device, changeover unit for CPUs, memory arbitrator and power supply circuits. For centralized control PABX, the dual CPU shall operate either in a hot standby or fully synchronized mode. The changeover of the CPUs shall produce no interruption or interference to the calls already established. Manual and automatic changeovers of the CPUs shall be allowed.
- 5.6.2. The Mean Time Between Failures (MTBF) which causes a total loss of service of the PABX shall exceed 10 years.
- 5.6.3. The monthly failure rate of extension circuits of the PABX shall be less than 0.4 failure per 100 extensions.
- 5.6.4. The monthly failure rate of trunk circuits of the PABX shall be less than 0.45 failure per 100 trunk circuits.
- 5.6.5. The availability of the PABX for traffic measurement, administrative operations and background diagnostic shall exceed 99.5%.

5.6.6. The Mean Time To Repair (MTTR) of the extension circuit fault, trunk circuit fault and other minor faults shall be less than 3 hours, which excludes the travelling time of the maintenance personnel.

5.6.7. The PABX System shall automatically switch on and reload of all necessary data to resume normal operation immediately after restoration of the power supply.

5.7 Interfacing Requirements

5.7.1. Interface to PSTN

5.7.1.1. The PABX shall be able to support concurrently the following interfaces connecting to the PSTN, Internet Protocol (IP) Network or remote PABX without additional software: -

5.7.1.1.1. Loop start trunk with DTMF signaling;

5.7.1.1.2. Direct T1 access with ISDN-D channel signalling (Integrated Digital access with Primary Rate Access, IDA-P);

5.7.1.1.3. E&M signalling; and

5.7.1.1.4. H.323 – Internet Protocol, SIP and/or other interfaces as appropriate

DDI facility shall be provided for the above items. All the above signalling shall conform to the relevant HKCA specifications.

5.7.1.2. The PABX shall be able to communicate via PSTN, Internet Protocol (IP) Network or directly with other telecommunications systems, such as voice messaging systems, interactive voice response systems and allow all offered telephones to communicate (including voice and DTMF signalling) freely with those telecommunications systems.

5.7.1.3. The corresponding certificates issued under Hong Kong Telecommunications Equipment Evaluation and Certification (HKTEC) Scheme shall be submitted for tender evaluation if available.

5.7.2. Interface to Voice Recording System

5.7.2.1. The PABX shall be able to support voice recording interface for connection of any extension line circuits to analogue and digital voice recording system.

5.8 Voice over Internet Protocol (VoIP) Capacity

5.8.1. The proposed PABX system shall VoIP ready and support VoIP technology by adding VoIP module/equipment to the System without replacing the whole system.

6. Equipment Functional Requirements and Performance Characteristics

6.1 PABX System Features

The PABX shall provide the following system features:-

6.1.1. Direct Dialling In (DDI)

All incoming calls shall be capable of being routed directly to any extension number

without operator assistance.

6.1.2. Direct Outward Dialling

All extension users can access the outgoing exchange line automatically by dialling the exchange line access code of “9” or any assigned number.

6.1.3. Access Restrictions

The PABX shall be programmable to restrict certain functions for different extensions. The following restriction functions are required:-

- 6.1.3.1. Class of Service - The PABX shall be able to define a number of classes of service. Each extension will then be assigned to one of the classes. Each class will define certain features and trunk group access capability to be used by the extensions.
- 6.1.3.2. Code Restriction - The PABX shall be able to restrict some extensions to access a particular trunk group by code restriction.
- 6.1.3.3. Service and Feature Restriction - The PABX shall be able to restrict or allow different stations to activate and use the services and features available by using the class of service.

6.1.4. Power Failure Transfer

The PABX shall be able to provide a power failure transfer unit to re-direct an analog trunk to an analog phone (bypassing the PABX) to make and receive telephone calls in case of a PABX failure.

6.1.5. Hunting

When the called extension is busy, the PABX shall be able to route the call to other extensions according to a pre-defined path.

6.1.6. External Extension

The PABX shall be able to support the connection of external extensions that are far away from it. The PABX shall support external extensions with loop resistance up to at least 1,200 ohms.

6.1.7. Discriminating Dial Tone

The PABX shall be able to provide different kinds of dial tone for internal and external dialing.

6.1.8. Discriminating Ringing Tone

The PABX is able to provide different kinds of ringing tone for internal and external calling.

6.1.9. Music On Hold

The PABX shall be able to provide background music automatically when an extension is being put on hold. The music shall be removed automatically after the release of the on-hold process. Such musical source shall be patent-free and shall

not incur any recurrent cost of intellectual property rights on Government or the related organization.

6.1.10. Call Detail Record (CDR)

The PABX shall be able to log down a CDR including the phone numbers of both the calling and receiving parties, the start time, and call duration. The information can be retrieved and printed out whenever required (applicable to the system with storage device or printing device enabled). The following information shall be logged:-

- (i) Extension number of calling party for outgoing call;
- (ii) Extension number of called party for incoming call;
- (iii) Date and time of the call;
- (iv) Duration of the call;
- (v) Telephone number of external called party for outgoing call; and
- (vi) Telephone number of external calling party for incoming call.

The selection criteria for the types of telephone calls to be logged shall be programmable and accessible via the on-site and/or remote control terminal.

6.1.11. Night Service

The PABX shall be able to route all the incoming calls to a pre-selected station when the operator console is unattended.

6.1.12. Parallel Extension

- 6.1.12.1. The PABX shall be able to handle at least 2 parallel extensions per analog line circuit. The maximum number of parallel extensions supported by an analog line circuit and the features that cannot be offered on parallel extensions shall be clearly stated.
- 6.1.12.2. Users may connect an analogue telephone provided by a third party to an extension in parallel with a standard telephone for convenient use. The third party telephone will comply with the specification HKCA2011 (Network Connection Specification for Connection of Customer Premises Equipment (CPE) to Direct Exchange Lines (DEL) of the PSTN in Hong Kong) or equivalent
- 6.1.12.3. The Contractor shall provide, free of charge technical advice to the user on whether the third party telephone to be used is suitable to be connected to the extension line circuits of the System.

6.1.13. Calling Number Display (CND)

- 6.1.13.1. When the PABX is equipped with ISDN Primary Rate interfaces and a telephone call is routed through one of the interfaces:-
 - (i) For incoming calls,

- (a) A PABX extension, when equipped with a display telephone, shall be capable of displaying the caller's calling line identification (CLI) when the proposed System is connected via suitable IDA-P trunks; and
 - (b) The PABX shall differentiate “out-of-area” and “private” calls in accordance with the Classification of CND information provided by the Network Operator.
- (ii) For outgoing calls,
- (a) A called party who connects with the PSTN and is equipped with a suitable device is capable of displaying the calling PABX extension number if the number is provided by the PSTN; and
 - (b) The per call blocking and per call unblocking shall be provided. When the per call blocking function is enabled, the outgoing call shall be classified as “private” and this classification information shall be sent to the PSTN. When the per call unblocking function is enabled, the telephone number of the calling extension shall be sent to the PSTN.

6.1.14. Extension Features

The PABX shall provide the following basic extension features to the users:-

6.1.14.1. Call Forward - Busy

- (i) When the called extension is busy, incoming calls shall be automatically routed to another pre-selected extension.

6.1.14.2. Call Forward- No Answer

- (i) When the called extension does not answer after a prescribed time or number of rings, the incoming call shall be automatically routed to another pre-selected extension.
- (ii) The user shall be able to activate and deactivate the feature.

6.1.14.3. Call Forward- All Calls

- (i) Incoming calls to an extension shall be automatically forwarded to another pre-selected extension.
- (ii) The user shall be able to activate and deactivate the feature.

6.1.14.4. Hunting

- (i) When the called extension is busy, incoming calls shall be routed to an idle extension in a pre-arranged group.

6.1.14.5. Call Pickup

- (i) The PABX shall be able to assign several extensions to form a pickup

group.

- (ii) Intra Group- When a call arrives, a user in the same pickup group is able to pick up this incoming call.
- (iii) Inter Group - A user is allowed to answer an incoming call to an extension belonging to another pickup group.

6.1.14.6. Automatic Call Back

- (i) The PABX shall allow a user on encountering a busy extension to be alerted when the extension becomes free.
- (ii) The PABX shall allow a user on encountering a busy trunk access code to be alerted when the trunk route becomes free.

6.1.14.7. Executive Busy Override

- (i) The PABX shall allow an authorized user to enter an established connection after a warning tone.

6.1.14.8. Abbreviated Dialing

- (i) The PABX shall be able to store at least 10 telephone numbers for each extension. The telephone number will be accessible and dialed by a short code and programmable by individual user.

6.1.14.9. Call Transfer

- (i) An extension user shall be able to hold the existing call and originate another call to a third party. The extension user may consult privately or transfer the original call to the third party.
- (ii) An extension user shall be able to transfer a call received to a third party, including an external telephone number.

6.1.14.10. Conference Call

An extension user shall be able to hold the existing call and originate another call to a third party. The third party may be inside or outside the PABX. After the consultation call has been established, the originating extension may connect all three parties for a 3-party conference. Tenderers shall state:-

- (i) the maximum number of external parties allowable in a conference call; and
- (ii) the maximum number of internal parties allowable in a conference call.

6.1.14.11. Last Number Redial

The last number dialed from an extension shall be stored in the PABX memory or extension memory automatically. The stored number can be redialled using a key or by entering an access code from the same extension.

6.1.14.12. Hold

An extension user can hold an established call and originate or receive a second call. On the conclusion of the second call, the extension user shall be able to go back to the call on hold by a simple operation.

6.1.14.13. Executive and Secretary

- (i) Any two extensions can be assigned to form the Executive and Secretary relation. Such relationship shall be definable by the system administrator.
- (ii) For two extensions with the Executive and Secretary relation, all calls incoming to the Executive extension can alert and be answered by the Secretary extension. The Secretary extension user can, if necessary, perform private conversation with the Executive extension user while holding the call or even transfer the call to the Executive extension user if required.
- (iii) Telephones of Executive/Secretary extension shall be provided with the following function key(s):-
 - (A) for Secretary extension user to access Executive extension user and to perform private conversation, and vice versa; and
 - (B) for Secretary extension user to transfer the call which is originally destined for the Executive extension to the Executive extension user.
- (iv) Telephones of Executive/Secretary extension shall be provided with the following visual indication(s):-
 - (A) to show the line status of the corresponding Secretary/Executive extension;
 - (B) to alert the Executive/Secretary extension user when he or she is being called by the corresponding Executive/Secretary extension user, and vice versa;
 - (C) to alert the Executive extension user when a call is transferred by the corresponding Secretary extension user; and
 - (D) to show the activation/deactivation status of the Executive and Secretary feature.
- (v) Executive/Secretary extension users will be able to activate and deactivate this Executive and Secretary feature via either of the extensions by:-
 - (A) pressing a designated key; or
 - (B) keying in a security code.
- (vi) The PABX to support combination of:-
 - (A) multiple Executive extensions and single Secretary extension; and
 - (B) multiple Executive extensions and multiple Secretary extensions.

6.1.14.14. Terminating only

All kinds of call origination shall be restricted.

6.1.14.15. Originating only

All kinds of call termination shall be restricted.

6.1.14.16. Intercom only

All incoming and outgoing calls from/to PSTN shall be restricted.

6.1.14.17. Call Waiting

- (i) The System shall alert an extension user with a call waiting tone that there is another call waiting to be answered while the user is engaged in an established call. The call waiting function shall be available to both external and internal calls.
- (ii) The external callers shall hear normal ringing tone and be unaware that the called extension user is busy.

6.1.14.18. Do-Not-Disturb

The extension user, on activation of the feature, can drive all telephone calls to a voice message for asking the caller to call later.

6.1.14.19. Remote Activation of Call Forwarding

The user can remotely change the forwarding registration to another extension. Facilities should be provided so that this feature will only be available to authorized users.

6.1.14.20. Special Call Forwarding Features

- (i) The System shall support call forwarding to an extension number within the System or to an external telephone number.
- (ii) In conjunction with the Call Forward features specified in this Specification, the PABX will allow several telephone numbers to be programmed for an extension as the destination of call forwarding.
- (iii) When an incoming call is being forwarded, the PABX will monitor whether the call is answered by the destination number. If the destination number is busy or does not answer in a pre-defined time or number of rings, the PABX will forward the call to another destination number, according to the sequence of the destination numbers programmed in Clause (ii) above.

6.1.14.21. Priority Access

Priority access of the PSTN could be provided to a group of designated extensions with the arrangement by the Network Operator and/or fixed Carrier licensees in case of heavy traffic situation or under emergency. The total number of extensions is subject to the requirements of the Government.

6.1.15. Operator Console Features

The operator console shall have the following features:-

- 6.1.15.1. Answer Calls - The operator console shall be able to answer all internal and external calls with user-friendly designed buttons.
- 6.1.15.2. Operator Busy Override - The operator console shall be allowed to override a call with a warning tone when required.
- 6.1.15.3. Call Waiting Display - An indicator shall be provided to show the incoming calls on waiting.
- 6.1.15.4. Handset and Headset Operation - The operator console shall be provided with a handset and headset for operation.
- 6.1.15.5. Incoming Call Indication - When there is an incoming call, the operator console shall have an indicator and shall generate a signal to alert the operator.
- 6.1.15.6. Night Service - The operator console shall have a switch to activate the night service directly.
- 6.1.15.7. Alarm Field - The operator console is able to display the different alarm signals generated by the PABX.

6.2 System Software

- 6.2.1. The software offered shall be able to handle all features and facilities required as well as all the hardware including all the subsystems, equipment and any components which form part of the System, up to the ultimate capacity without any degradation of system performance.
- 6.2.2. The requirements described in this part shall apply to all software provided for the System as well as its associated or ancillary components such as PABX, VMS, UMS, telephone sets and so on. All software supplied with the System shall be provided in original packages with valid licences.
- 6.2.3. The Contractor shall submit a full set of software feature and software manuals to the user.
- 6.2.4. If the offered software is subsequently found to be experiencing bugs which are unacceptable to the user department, the Contractor shall upgrade the System with corrected/new version of software at a date and time to be specified by the user department and at no additional cost to the Government. The corrected/new version of software shall be proven and shall support all features and functionalities available in the installed System.
- 6.2.5. The software shall be reliable and robust (fault-tolerant) such that the System will maintain reliable operation even in the presence of hardware faults and software errors.
- 6.2.6. Installation DVD/CD(s) or other acceptable media, such as USB devices, of all the software supplied including the operating system, system software, application programs and configuration files shall be provided by the Contractor, together with the user licences. Source code of all custom programs shall also be provided.
- 6.2.7. The Contractor shall constantly perform system backup of the installed software,

configuration files, system data and application data of the System. One copy of the system backup files, stored in DVD/CD(s) or other acceptable media, shall be provided to the Government within one month after site acceptance test and one month before the expiry of the 12-month Defects Liability Period.

6.3 Power Supply, Charger and Batteries

- 6.3.1. The PABX main equipment shall be powered by 48V DC power supply which shall consist of a float charger system and backup batteries.
- 6.3.2. The DC power supply system shall be able to switch to the backup batteries automatically when the AC mains fails. When the AC mains is recovered, the system shall be able to switch back automatically to normal condition.
- 6.3.3. The power consumption of the equipment shall not exceed 5 watts for each equipped extension or trunk circuit when the PABX is fully equipped.
- 6.3.4. The charger system for the PABX shall consist of two identical units and each shall be controlled by its own circuitry. Both units shall equally share the load current and the battery charging current. If one unit fails, the other unit shall automatically supply the full load current and the charging current. Alarm indicators will show which charger has tripped or mains failure.
- 6.3.5. The use of “N+1” redundancy charging system is also acceptable. Tenderers shall state the detailed arrangement.
- 6.3.6. The chargers offered shall have a serviceable life of 10 years. Tenderers shall quote the lifetime with supporting information from the manufacturers.
- 6.3.7. The charger output must be constantly available and consistent in quality.
- 6.3.8. Adequate charging protection, smoothing filters and elimination of radio frequency interference circuitry of suitable rating must be built-in to protect the charger against damage from input fluctuations, spikes and transient voltages. The ripple voltage shall be limited to 2mV psophometrically weighted to 800 Hz, with or without a battery connected.
- 6.3.9. If the battery has been fully discharged after a prolonged period of mains failure, the initial charging current upon restoration of mains would be proportionately high in the first instance. Consequently, adequate current limiting control at output circuit is required to safeguard the charger from such high current demand.
- 6.3.10. If the batteries offered are not tolerant to be fully discharged after a prolonged period of mains failure, protection circuit shall be provided to avoid permanent damage to the batteries.
- 6.3.11. The charger offered shall be automatically self-reset after AC mains failure.
- 6.3.12. Remote alarm indicator or alert signal, both visual and audible, with mute switch shall be provided at the suitable position as determined by the users to show power failure to the charger and any charger has tripped though the system is working on standby batteries.
- 6.3.13. The charger offered shall be able to supply additional power if required to the equipment for the digital trunk interfaces, such as IDA-P, from Network Operator and the System up to the ultimate capacity.

- 6.3.14. More than one modules of 48V battery units shall be provided and shall be arranged in such a way that failure of any one module shall not affect the performance of the battery system.
- 6.3.15. The batteries shall be durable, maintenance-free and sealed type conforming to IEC 60896-22. The batteries offered shall have a normal life span of 10 years.
- 6.3.16. The capacity of the batteries shall be sufficient to maintain continuous normal operation of the System and the equipment for the digital trunk interfaces (if required) from the Network Operator for 6 hours (unless otherwise specified) under peak load condition when the System is fully equipped to the ultimate capacity during mains supply failure.
- 6.3.17. The battery-stand shall be of rigid construction designed to provide ease of access to the battery cells for inspection and replacement. It shall be either corrosion-resistant or protected against corrosion by painting, plating or any other suitable surface treatment.
- 6.3.18. The batteries shall be equipped with safety vent caps to prevent internal cell explosions caused by internal pressure developed during the battery discharge or recharge.

6.4 Internal Cable Distribution System

6.4.1. General Requirements

6.4.1.1 The Internal Cable Distribution System (ICDS) is the backbone cable network which is the communication media between the end-users and the PABX. The ICDS shall include the following accessories:-

- (i) Distribution Frame System (DFS) to be installed in the PABX room with:-
 - (a) Equipment side distribution frame which connects to the voice and data circuits of the PABX;
 - (b) Subscriber side distribution frame which connects to the distribution boxes of each floor via the block-wiring cables;
 - (c) Exchange line distribution frame which terminates and connects the incoming and outgoing exchange lines from and to Network Operator;
 - (d) Jumper cables which interconnect the various distribution frames (including the screening cables connecting the network terminating unit (NTU) and the intermediate distribution frame (IDF) of the digital trunks from Network Operator to PABX); and
 - (e) Metal type cable trays, trunkings and surface conduits which carry the telephone cables within the PABX room, as and when required;
- (ii) Block-wiring cables which connect the subscriber side distribution frame to the distribution boxes;

- (iii) Distribution boxes which are used to interconnect the block-wiring and pre-wiring cables;
- (iv) Pre-wiring cables which connects the distribution boxes to the end-user point;
- (v) Modular type telephone plugs and sockets;
- (vi) Lightning protectors for exchange lines and where necessary, extension lines; and
- (vii) All related accessories.

6.4.1.2 Cabling and wiring shall be carefully designed and installed such that the trunks shall be connected to different port cards in the PABX, and if possible, to different shelves or cabinets.

6.4.2. Requirements of Distribution Frame

- 6.4.2.1. The distribution frame shall be of modular design and can be built up to any size by adding new connection blocks.
- 6.4.2.2. The distribution frame shall be made of high quality material.
- 6.4.2.3. All the connection blocks shall be of breaking type so that testing equipment can be inserted to isolate the connection and test the lines.
- 6.4.2.4. All the connection blocks shall be able to accept a lightning protector by direct plug-in.
- 6.4.2.5. All the distribution frames and all connection blocks shall be clearly labelled and a layout plan shall be available for reference.
- 6.4.2.6. Different distribution frames shall be arranged in the most appropriate positions so as to minimize the length of jumper wires required. The Contractor shall prepare a layout plan of distribution frames and submit to the Engineer for approval.
- 6.4.2.7. Since 4-wire circuits are used for the extensions, all the distribution frames shall have sufficient connection blocks for 4-wire cables.
- 6.4.2.8. High speed insulation displacement termination method shall be employed.
- 6.4.2.9. The Contractor shall run and bond a copper earth wire of no less than 14 square mm cross sectional area from the frame to the ground connection point without a break by an isolation joint.

6.4.3. Telephone Cables for Block-wiring and Pre-wiring

- 6.4.3.1. The Contractor shall lay the in-house block-wiring cables with 4-wire connections. The block-wiring cables shall provide connections between:-
 - (i) The subscriber side distribution frame and distribution boxes; and
 - (ii) The two distribution frames.

All cables shall be laid and mounted in an orderly and tidy manner.

- 6.4.3.2. The Contractor shall lay and install 4-wire type pre-wiring with sockets. All the pre-wiring cables shall be interconnected to the block-wiring cables in the distribution boxes.
- 6.4.3.3. Multi-core twisted pair cables shall be used for the block-wiring.
- 6.4.3.4. Two twisted pairs cable with PVC external cover shall be used for pre-wiring.
- 6.4.3.5. The cables used for block-wiring and pre-wiring shall be of gauge 24AWG or better. The diameter of the copper conductor shall be 0.50 mm minimum. The loop resistance of the cable shall be less than 400 ohms per km.
- 6.4.3.6. The newly installed in-house cables shall have a lifetime of at least 10 years under normal wear and tear.

6.4.4. Distribution Box

- 6.4.4.1. Distribution boxes shall be installed in all the junction points for the connection between the block-wiring and the pre-wiring.
- 6.4.4.2. The distribution boxes used shall be made of corrosion resistive type material and have covers with lock. Distribution boxes and their covers shall provide adequate mechanical protection for the items installed.
- 6.4.4.3. The boxes shall have 4-wire type termination for each extension circuit. Flexible connection blocks with breaking type shall be used for the connection of the block-wiring and pre-wiring.
- 6.4.4.4. The boxes shall have sufficient connection points for the block-wiring side and the pre-wiring side. Sufficient spare area within the box shall be reserved for 30% future expansion.

6.4.5. Terminal Equipment Plug and Socket

- 6.4.5.1. Telephone sets and other terminal equipment shall be connected to the PABX via plug-and-socket connection.
- 6.4.5.2. Telephone sockets shall be used for terminating the PABX extension circuits and accepting the plug-ended line cords of the terminal equipment. Normally, single outlet type socket shall be provided.
- 6.4.5.3. The plug and socket offered shall be easy to use, highly reliable and durable.
- 6.4.5.4. The telephone plugs to be offered shall be complied with the following requirements:-
 - (i) Minimum plating on all contacts of plugs to be 2.5 micron of gold over 3 micron of nickel, over base metal; and
 - (ii) Ductility of the nickel undercoat plating shall be well controlled such that there should be no cracking on the plating surfaces which could cause exposure of the substrate with sequential corrosion problems under adverse environmental conditions.

6.4.5.5. The telephone sockets to be offered shall be 6-way. Both 4-wayplug and 6 way plug shall mate satisfactorily with the socket. In addition, the socket shall be:-

- (i) Designed for surface-mounting;
- (ii) Miniature and in harmony with office environment;
- (iii) Equipped with spring-loaded shutter and a moulded lead-in so that the plug can be used to raise the shutter, thereby enabling single-handed operation; and
- (iv) Equipped with a bell capacitor where necessary.

6.5 Telephone Instrument

6.5.1. General Requirements

- 6.5.1.1. All telephone sets offered shall meet local safety and electrical protection requirements for connection via the offered PABX to the PSTN.
- 6.5.1.2. The telephone shall be equipped with keypads for push-button keying. The push-button keypad layout of digit numbering and arrangement shall be as indicated in ITU-T Recommendation E.161.
- 6.5.1.3. The signalling between the telephone and the PABX shall either be of DTMF or digital type.
- 6.5.1.4. The telephone shall be line powered by the PABX at 48V DC. If separate power supply is required for the attendant console, the power adapter shall be included as part of the telephone.

6.5.2. Mechanical Requirements

- 6.5.2.1. The telephones offered shall be of aesthetically pleasing appearance employing good physical and technical design features and has a modern appearance.
- 6.5.2.2. Desk-top and wall-mounted telephones are required to meet the following particular requirements:-
 - (i) For desk-top telephone, there shall be sufficient friction between the feet of the telephone and the horizontal surface on which the telephone is normally placed to prevent movement of the telephone either during dialing or when the handset cord is extended to a length of at least 1 meter at 45 degrees from the horizontal plane and perpendicular to the front; and
 - (ii) For wall-mounted telephone, the handset shall be retained in the telephone set when subject to a series of shocks as those detailed in EIA RS316B or equivalent.
- 6.5.2.3. The handset and the handset cord shall be detachable to facilitate easy replacement of parts by users.
- 6.5.2.4. The handset cord shall be of the helical close coiled type with retracting

properties and able to extend over 1 meter.

- 6.5.2.5. The telephone instrument parts shall be of unit type construction e.g. the bell, dial, being independent units which can be changed without interference to other units.
- 6.5.2.6. Removal of the telephone case for access to components and wiring shall be effected by a simple operation.
- 6.5.2.7. The plungers and operating mechanism shall be designed for low friction, positive operation and to minimize the entry of dust.
- 6.5.2.8. The handset shall be designed for comfort and maximum transmission efficiency and shall be made of the same material as the housing.
- 6.5.2.9. The telephone mould parts shall be made of high impact Acrylonitrile Butadiene Styrene (ABS) or other similarly high quality plastic material.
- 6.5.2.10. The mould parts shall comply with the followings:-
 - (i) A high standard of finish;
 - (ii) Scratch resistant;
 - (iii) Resistant to hand perspiration or common cosmetic products;
 - (iv) A high degree of fastness to light;
 - (v) All thread holes in metal inserts shall be free from moulding material;
 - (vi) A high standard of colours which match various areas of office environment;
 - (vii) Sufficiently robust to meet the safety requirements when subject to impact of a severity likely to be encountered in normal use. The telephone shall meet IEC or equivalent standard on impact test;
 - (viii) Drop Test:-

The test will be carried out as follows:-

- (a) Telephone Set

Random drops from a height of 75 cm onto concrete covered with 3 mm asphalt tile.

- (b) Handset

Random drops from a height of 150 cm onto concrete covered with 3 mm asphalt tile.

6.5.3. Safety Requirements

- 6.5.3.1. The telephone shall not have mechanical parts such as sharp edges or cavities which could be harmful to the telephone user or could trap fingers.

6.5.3.2. The design of the telephone shall be such that while connected to the line terminals and in the on hook and off hook states, it shall suffer no damage or functional impairment while the various voltage supplies mentioned below are connected to the terminals provided for connection to the line. At least one calling device shall be included in the circuit.

- (i) A 56V DC supply of either polarity having a source resistance in the range of 360 ohms to 1550 ohms connected continuously;
- (ii) An AC supply of 75V rms at a frequency of 25 Hz having source impedance of approximately 600 ohms, connected for period of 10 seconds;
- (iii) A line which has induced longitudinal voltages of up to 12V rms at 50 Hz continuously and up to 750V rms at 50 Hz for up to 100 ms superimposed on the supplies of (i) and (ii) above;
- (iv) A pulse derived from a four microfarad capacitor charged to 4kV and applied to a series combination of 4 ohms and 40 ohms non-reactive resistors with the telephone under test connected across the 40 ohms resistor. This test shall be carried out for each polarity of charge and shall be made between the A and B wires, and from each wire to earth of the telephone;
- (v) The insulation resistance between points designated to be electrically isolated shall not be less than 5 Megaohms measured with 250V DC applied for not less than 5 seconds.

6.5.4. Susceptibility

The telephone shall have no degradation of overall performance due to the emission of spurious audio signals by the telephone when it acts as a calling device or a receiver, either in on-hook or off-hook state.

6.5.5. Line Cord and Terminal Block Requirements

6.5.5.1. The line cord of the telephone set shall be terminated on a plug for connection to the PABX via a telephone socket.

6.5.5.2. The length of the line cord shall be long enough to extend the extension equipment at a suitable location.

6.5.6. Reliability

The telephone shall have a normal operating life of at least 10 years.

6.6 On-site Control Terminals

6.6.1. The control terminals shall be able to perform maintenance, management and administrative services such as system configuration, traffic report, status report and etc. User-friendly and easy to use software languages shall be employed for the access and control of the System. High level man-machine language (MML) shall be employed for the access and control of the system wherever applicable.

6.6.2. The control terminals shall be installed with the maintenance software to facilitate routine preventive maintenance of the System. They shall also be equipped with

software tools to perform traffic measurements for the PABX.

- 6.6.3. The system administrator and maintenance staff shall be able to use the control terminals to carry out administrative and maintenance works of the System. They shall be able to configure the system, to assign features to extensions, to monitor the performance and healthiness of the System.
- 6.6.4. The control terminals shall be preloaded with the latest version of the operating system, word processing, presentation, data base, report generating and communication software.
- 6.6.5. The control terminals shall have security system to prevent unauthorized access to the System. The System shall be accessed only by authorized users with password protection.

6.7 Remote Access Features

- 6.7.1. Remote access features for the System for all kind of usages shall be disabled as default. The usages include but not be limited to remote access for system setting/ system configuration/ remote maintenance or access for setting call forward function/ making outgoing call/ IDD call/ accessing voicemail box/ performing other system functions via modem, Direct Inward System Access (DISA), maintenance port or by other means.
- 6.7.2. Notwithstanding the sub-clause of this clause, subject to the approval by the system administrator, the Contractor may enable particular remote access features according to user's requirements and operational needs.
- 6.7.3. Security measures shall be implemented for the enabled remote access features to prevent unauthorized access. The security measures shall include but not be limited to password setting, setting the maximum number of password entry attempts, configuring the limit on the number of system access.
- 6.7.4. The Contractor shall list out all the enabled remote access features and inform the system administrator for the corresponding system setting and the security measures implemented.

6.8 Security Management/Protection

- 6.8.1. The System shall be designed with security measures taken into account for protection of the System and its information entities against unauthorized access or hacking and network tapping attacks by external parties who may gain access to the facilities or network connections. The common security measures shall include, but not be limited to, the following:-
 - (i) All equipment rack and cabinet with main unit, workstation, switch, storage device, printing device and patch cable held inside shall come with a physical lock.
 - (ii) The main unit, workstation and storage device of the System shall be protected by password. The Contractor is required to regularly change the password, keep record of such change and notice the system administrator.
 - (iii) The Contractor shall design and provide the System with two-level

passwords, one for system monitoring, and one for system administration.

- (iv) The Contractor shall properly record all the system configuration and its subsequent updates and operations. Audit trail function for the system configuration and operation is desirable.
- (v) The Contractor shall not expose system information (e.g. system diagram, cable routing, etc.) in a location where external parties may gain access to.
- (vi) The Contractor shall not disclose system information to unauthorized parties.

7. Installation Requirements

7.1 Earthing

- 7.1.1 All consoles, operator panels, equipment chassis, camera housing, monitor housing that are constructed from metal shall be suitably earthed against electric shock.
- 7.1.2 If the system design or equipment configuration requires the signal circuit common (applicable to communication, radio frequency or control circuitry) to be earthed to minimize interference and/or electromagnetic to pick-up, these shall be earthed at a single point to avoid hum loops.
- 7.1.3 Earthing arrangements shall be in accordance with IET wiring regulations.

7.2 Lightning Protection

- 7.2.1. Lightning protectors are required for all exchange lines and extension lines where necessary. The protector offered shall be well fitted and pluggable into the connection blocks of the distribution frames directly.
- 7.2.2. The offered lightning protector shall be of a 3-electrode gas discharge tube type.
- 7.2.3. The lightning protector shall comply with ITU-T Recommendation K.12, IEC 61643-21, IEC 61643-22 or equivalent.
- 7.2.4. The lightning protector shall be fail-safe to short circuit.

7.3 Equipment Fixing

- 7.3.1. All equipment except portable equipment shall be firmly held in place. Fastenings and supports shall be adequate to support their load with a safety factor of at least 3.
- 7.3.2. All switches, connectors, jacks, receptacles shall be clearly, logically and permanently marked during installation. All wires and cables shall be identified at every termination and connection point with permanent type markers.

7.4 Cabling and Connections

- 7.4.1. All cables shall be run in conduits separated from power and signal cables. If surface wiring of cables has to be performed, they shall maintain a distance of at least 100 mm from power conductors.
- 7.4.2. Connection of cables between equipment and a wall-mounted adapter box; or between the equipment rack or console and the cable conduit or trunking shall be protected by flexi-conduit to BS731.
- 7.4.3. Internal wiring within console or equipment racks shall be neatly run and held fixed in cable ducts by non-rusting cleats or cable ties.
- 7.4.4. Cable connections to an equipment or console or control panel shall, as far as possible, be provided with plug-socket configuration. Where direct entry of a cable through a metallic cover or panel of an equipment rack is unavoidable, the hole through the metallic cover or panel shall be protected by rubber grommets to avoid cuts.
- 7.4.5. The Contractor shall supply and install cable covers/protectors to protect the telephone cables and cords on floor and on walls for the surface wiring installation.
- 7.4.6. Clear labelling shall be provided for the cables distribution frames, distribution boxes and related accessories. All telephone cables terminated on the circuit cards of the PABX shall be clearly labelled.
- 7.4.7. The Contractor should ensure that there is no mechanical strain on the battery terminals by the connection bars so as to avoid any damage to the batteries at a later date.
- 7.4.8. All cables shall be run within conduits and trunking specially provided for the purpose by others. If there are short lengths without these provisions, the contractor is required to provide the supplementary conduits, trunking, rackways and adapter boxes to complete the installation.
- 7.4.9. Jointing of cables shall be avoided. Where a joint is considered acceptable by the Engineer all cables shall be joined by properly designed connectors or inside joint boxes.
- 7.4.10. The installation and handling of the cables shall be undertaken at all times by adequate staff trained and supplied with all the necessary equipment and tools. The arrangement of the cables and all method of laying shall be approved by the Engineer and shall be in an orderly manner, free from unnecessary bends and crossing which will permit the removal of any cable without undue disturbance to adjacent cables.
- 7.4.11. Signal cables, when installed on the surface, shall have a separation of at least 100 mm from light or power conductors not in conduit or cable, or be permanently separated from conductors of the other system by a continuous and firmly fixed non-conductor in addition to the installation on the wires.

7.5 Surface Wiring

- 7.5.1. All cables shall be run in a vertical or horizontal direction. Only cables required to feed a point on a ceiling may be fixed to the ceiling.
- 7.5.2. When cables pass through walls or columns, a piece of PVC sleeve of adequate size

shall be inserted into the wall or column, and the cables shall be drawn therein. Holes so created around the sleeve shall be fitted up with cement and touched up with paint. Colour of paint shall match to the walls or columns.

- 7.5.3. Rubber grommets or insulated bushes shall be used to protect the cables when passing through metal covers of distribution board, boxes or any other metal work.
- 7.5.4. Unless otherwise authorized by the Engineer, cables shall be secured flat to the surface of walls and ceiling by means of buckle clips or cable saddles.
- 7.5.5. Buckle clips shall be of heavy gauge, heavily tinned brass with counter-sunk fixing holes, and shall be fixed by means of non-corrosive pins or screws of 10 mm minimum length secured to plaster, concrete etc. the plug shall be made from teak dwelling of parallel length. Every fixing hole in buckle up will be deemed to require a pin or screw. The heads of the screws or pins shall be level with the surface of the clips that no damage to the sheath of the cables can occur.
- 7.5.6. Spacing of the clips shall not exceed 150 mm in horizontal direction and 225 mm in vertical direction.
- 7.5.7. A clip shall be provided not less than 75 mm and not more than 100 mm from any bend or termination and cables shall be set so that they lie flat against the surface.

7.6 Surface Conduit

- 7.6.1. Surface conduits shall be fixed by galvanized heavy spacing saddles, and shall run only in a perpendicular or horizontal direction. On straight run 20 mm and 25 mm conduits shall be supported by not less than one saddle every 1 meter in addition to support provided by any structure, box or fittings.
- 7.6.2. For 32 mm and larger conduit, saddle may be placed not more than 1.2 meters apart. Angle bends shall in all cases be supported by two saddles as near thereto as possible. Heavy spacing galvanized saddles shall be fixed with brass screws in wall plugs, or other approved methods.
- 7.6.3. Conduit bends shall have a radius of four times the outer diameter of the conduit.
- 7.6.4. A saddle shall be provided not less than 150 mm and not more than 200 mm from any bend or termination.
- 7.6.5. Steel conduit systems shall be mechanically and electrically continuous throughout, and efficiently earthed.
- 7.6.6. Chassis for conduit in wall shall be perpendicular or horizontal.
- 7.6.7. Joints in runs of steel conduits shall be made by means of a coupler into which the ends of both conduits are to be inserted and tightened up.
- 7.6.8. An adequate number of suitably sized hot-dipped galvanized cast iron draw-in boxes shall be provided in conduit runs to enable cables to be drawn in easily and without damage. Draw-in boxes shall be fitted after every two bends, or after a maximum straight run of 15 meters.

8. Environmental Conditions

8.1 PABX

- 8.1.1. The PABX and its ancillary equipment shall be able to operate with normal performance continuously in ambient temperature from 10 °C to 29 °C and relative humidity from 20% to 60% non-condensing.
- 8.1.2. The System shall not generate unpleasant noise during operation.
- 8.1.3. The System shall occupy less than 60% of the PABX room space so that sufficient area is left for maintenance work and air circulation. Tenderers are required to submit a proposed layout for the offered equipment and the structural arrangement of the Internal Cable Distribution System inside the PABX room as well as the related equipment installed by the Network Operator.
- 8.1.4. Outdoor equipment shall be protected by a housing designed to a standard equivalent to at least IP-54.

8.2 Telephone Instrument

- 8.2.1. The telephone sets and components shall be tropicalized and shall use suitable materials and/or metal finishes to prevent the formation of rust and corrosive attaches caused by high temperature and humidity conditions. All materials chosen shall be unpalatable to insects.
- 8.2.2. The telephone and its associated accessories shall be able to operate with normal performance continuously in ambient temperature from 5 °C to 40 °C and relative humidity from 10% to 90% non-condensing.
- 8.2.3. The telephone shall be insect proof. All large holes shall be covered by suitable gauze to prevent the ingress of insects. No particle with a cross-sectional area exceeding 1 mm square shall be able to filter to interior of the telephone.
- 8.2.4. The telephone set will meet all requirements embodied in this Specification and in accordance with Part 2 of IEC 60068 or other equivalent standard.

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