

MCMC MTSFB TC G010:2017

TECHNICAL CODE

RADIOCOMMUNICATIONS NETWORK FACILITIES - SMART POLE

Developed by



Registered by



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Development of technical codes

The Communications and Multimedia Act 1998 ('the Act') provides for Technical Standards Forum designated under section 184 of the Act or the Malaysian Communications and Multimedia Commission ('the Commission') to prepare a technical code. The technical code prepared pursuant to section 185 of the Act shall consist of, at least, the requirement for network interoperability and the promotion of safety of network facilities.

Section 96 of the Act also provides for the Commission to determine a technical code in accordance with section 55 of the Act if the technical code is not developed under an applicable provision of the Act and it is unlikely to be developed by the Technical Standards Forum within a reasonable time.

In exercise of the power conferred by section 184 of the Act, the Commission has designated the Malaysian Technical Standards Forum Bhd ('MTSFB') as a Technical Standards Forum which is obligated, among others, to prepare the technical code under section 185 of the Act.

A technical code prepared in accordance with section 185 shall not be effective until it is registered by the Commission pursuant to section 95 of the Act.

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Contents

	Page
Committee representation.....	ii
Foreword	iii
0. Introduction.....	1
1. Scope	1
2. Normative references	2
3. Abbreviations.....	3
4. General requirement	4
4.1 Mandatory and optional requirements of smart pole	4
5. Site design for smart poles - Concept of smart pole	9
5.1 Smart pole design requirements	9
5.2 Loading configurations - Ancillary loadings.....	12
5.3 Design criteria and codes.....	12
5.4 General requirements	135
6. Installation	16
6.1 Basic procedures	16
6.2 Power supply.....	17
7. Maintenance	18
7.1 Site access	18
7.2 Maintenance activities.....	19
 Annexes	
A IoT platform features and requirements	21
B Sample checklist for routine maintenance of smart pole.....	25

MCMC MTSFB TC G010:2017

Committee representation

Radiocommunications Network Facility (External) Working Group (RNF (Ex) WG) under the Malaysian Technical Standards Forum Bhd (MTSFB) which developed this Technical Code consists of representatives from the following organisations:

Digi Telecommunications Sdn Bhd
edotco Malaysia Sdn Bhd
Huawei Technologies (Malaysia) Sdn Bhd
International Islamic University Malaysia
Malaysian Access Forum Berhad
Maxis Communications Berhad
MEASAT Broadcast Network Systems Sdn Bhd
REDtone Marketing Sdn Bhd
Sacofa Sdn Bhd
Sapura Research Sdn Bhd
Shan Poornam Metals Sdn Bhd
Sharp-Roxy Sales & Service Company (M) Sdn Bhd
Telekom Malaysia Berhad
TIME dotCom Berhad
U Mobile Sdn Bhd
webe digital sdn bhd
YTL Communications Sdn Bhd
Zettabits Technologies (M) Sdn Bhd

Foreword

This technical code for Radiocommunications Network Facilities - Smart Pole ('this Technical Code') was developed pursuant to section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd ('MTSFB') via its Radiocommunications Network Facility (External) Working Group (RNF (Ex) WG).

This Technical Code serves as the supplement document to Part 3 (Radiocommunications Network Infrastructure (External)) in order to establish general requirements on the implementation of radiocommunications network on smart pole.

This Technical Code shall continue to be valid and effective until reviewed or cancelled.

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RADIOCOMMUNICATIONS NETWORK FACILITIES - SMART POLE

0. Introduction

The radiocommunications network forms an important and very large part of the service providers' network infrastructure. There are various design methods, each being adopted by individual service providers. The intention of this Technical Code is to gather common best practices from the industry and compiled into a comprehensive set of requirements.

This Technical Code provides the general requirements and the operations and maintenance (O&M) of smart pole for base station sites. The design requirements for construction, structural, mechanical, and electrical aspects of the smart pole are elaborated. Emphasis is also given to the aesthetic and safety aspects of the implementation of the smart pole with consideration to the public and community. Many sample drawings and pictures are included to enhance visualisation of the various types of infrastructures.

Smart pole can be installed at road-side and public places. The smart pole is categorised as "network facility" under the Communications and Multimedia Act, 1998. Therefore, the structure shall be owned and managed by individuals or companies with a valid Network Facilities Provider (NFP) license granted by the Malaysian Communications and Multimedia Commission (MCMC).

The development of mobile technologies and Internet of Things (IoT) will require a greater number of telecommunication transmitter sites to support the required quality of mobile and IoT services in the future. These transmitter sites will have to be closer apart from each other as compared to existing installations.

To support the deployment of transmitter sites for mobile communications and IoT applications, the smart pole concept is introduced where the physical structure of the pole can be use not only for installation of transmitter sites, but it can also support other functionalities such as surveillance, environmental sensors, digital information broadcasting, and emergency services. The use of smart poles as structures for the installation of transmitter sites represents an option for telecommunication facility providers, local councils, property developers and other relevant bodies to adopt for a greater installation density of transmitters in applicable geographic areas.

1. Scope

A smart pole refers to a network facility that is primarily used as radiocommunications structure with other ancillary services that include street lighting and data collection sensor. Other functions of the smart pole may include digital signage, Closed Circuit Television (CCTV), electric vehicle charging station, and push to talk emergency system, among others. The data collection sensors support IoT based applications.

This Technical Code:

- a) describes the general requirements and engineering practices necessary for the safe and proper implementation of smart pole;
- b) provides the standards for the installation of new smart pole; and
- c) outlines the design concepts and methodologies used in construction of smart pole which include structural, mechanical, and electrical works.

This Technical Code does not specify any requirements to modify and upgrade existing lamp pole to a smart pole.

MCMC MTSFB TC G010:2017

2. Normative references

The following normative references are indispensable for the application of this Technical Code. For dated references, only the edition cited applies. For undated references, the latest edition of the normative references (including any amendments) applies.

MTSFB 001:2009, *Technical Standards and Infrastructure Requirements: Radiocommunications Network Infrastructure (External) (Part 3)*

Commission determination on the mandatory standard on access (Determination No.3 of 2016)

AS 3995, *Design of steel lattice towers and masts*

BS 499-1, *Welding terms and symbols*

BS 2901, *Filler rods and wires for gas shielded arc welding*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts*

BS 4190, *ISO metric black hexagon bolts, screws and nuts.*

BS 4320, *Specification for metal washers for general engineering purposes. Metric series*

BS 4360, *Specification for weldable structural steels*

BS 4592-2, *Industrial type flooring and stair treads. Expanded metal gratings. Specification*

BS 5135, *Specification for metal arc welding of carbon and carbon manganese steels*

BS 5493, *Code of practice for protective coating of iron and steel structure against corrosion*

BS 5950, *Structural Use of Steelwork in Building, appropriately adopted by using an acceptable material factor in accordance with BS 8100: Parts 1, 2 and 3.*

BS 6399 (All parts), *Loading for buildings*

BS 8110 (All parts), *Structural use of concrete*

BS 8100-1, *Lattice towers and masts. Code of practice for loading. Code of practice for loading.*

BS 8100-2, *Lattice towers and masts. Guide to the background and use of Part 1 'Code of practice for loading'*

BS EN ISO 1461, *Hot-dip galvanized coatings on iron and steel articles*

Communications and Multimedia Act, 1998

Garis panduan Pembinaan Struktur Pemancar Telekomunikasi di Negeri Selangor Darul Ehsan, 2012 (4.3 Struktur Sistem Pemancar Dwifungsi)

Guidelines for Public Safety and Health at Construction Sites, 2007

NIOSH (National Institute for Occupational Safety and Health Safety) AKKP (Arahan Keselamatan dan Kesihatan) 1994 & 1996 requirements (Act 514)

Prosedur dan Garispanduan Pembinaan Menara dan Struktur Pemancar Telekomunikasi Negeri Pulau Pinang, 2015

ASCE Manual 72:1990, *Design of steel transmission pole structures*

TIA/EIA-222-G, *Structural standard for antenna supporting structures and antennas*

3. Abbreviations

API	Application Program Interface
CAS	Common Antenna Sharing
CCTV	Closed Circuit Television
DMZ	Demilitarised Zone
DOSH	Department of Safety and Health
EIA	Electronic Industries Association
exmet	expanded metal
IDS	Intrusion Detection System
IoT	Internet of Things
IP	Internetwork Protocol
JPEG	Joint Photographic Expert Group
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MICC	Mineral-Insulated Copper-clad Cable
MPLS	Multiprotocol Label Switching
NFP	Network Facility Provider
ODF	Optical Distribution Frame
PVC	Permanent Virtual Circuit
RF	Radio Frequency
ROW	Right of Way
TIA	Telecommunications Industry Association
Tx	Transmitter
UTP	Unshielded Twisted Pair
VPN	Virtual Private Network
WiFi	Wireless Fidelity

4. General requirement

Smart pole is designed to support its primary function as a radiocommunications network facility for cellular services and other services such as CCTV, WiFi, data collection sensor, advertising panel, street lighting and electric vehicle charger.

The general requirements for smart pole as shown in Figure 1 are as follows:

- a) electricity supply;
- b) fiber technology for backhaul;
- c) cellular access connectivity with minimum Third Generation (3G);
- d) energy efficient lighting;
- e) interactive devices such as smart lighting, environmental sensors or other smart devices.

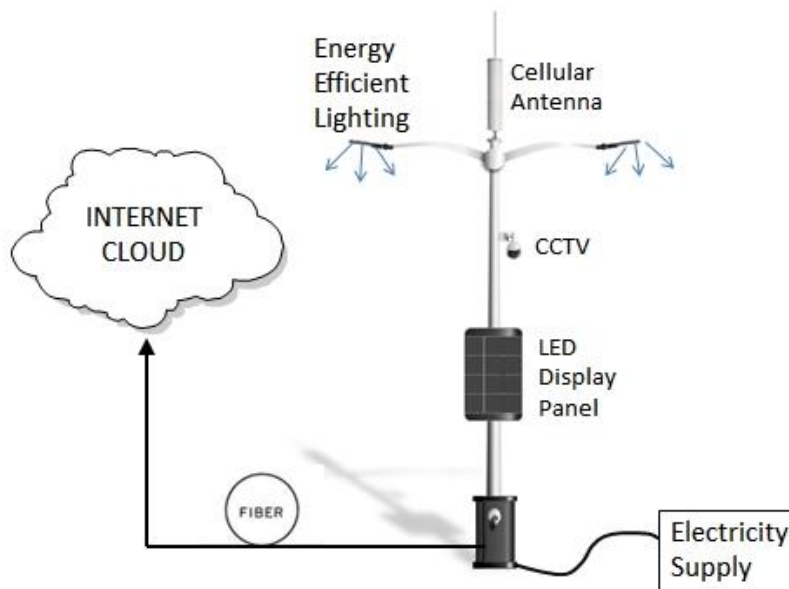


Figure 1. General requirement for smart pole

4.1 Mandatory and optional requirements of smart pole

The requirements for smart pole can be divided into two categories as summarised in Table 1.

Table 1. Summary of smart pole requirements

Requirements	Features
Mandatory	a) electricity supply; b) fiber technology for backhaul; c) cellular access connectivity (minimum 3G); d) energy efficient lighting; and e) interactivity
Optional	a) environmental monitoring; b) green energy; c) digital information broadcasting; d) WiFi connectivity; e) surveillance; and f) emergency services.

4.1.1 Electricity supply

A stable commercial power supply to power all devices on the smart pole is required as further defined in 6.2.

4.1.2 Fibre technology for backhaul

It is mandatory for the smart pole to have fibre backhaul connectivity features installed even if the fibre backhaul facilities are not available during its initial installation. The fibre connectivity ready features such as Optical Distribution Frame (ODF) and ducts must be in-place as part of the mandatory feature of the smart pole.

4.1.3 Cellular access connectivity (minimum 3G)

The provision of transmitters for mobile cellular coverage is a mandatory requirement for a smart pole installation. The transmitter installation should allow for sharing of antenna by more than one mobile operator with optional capabilities to further share the backhaul facilities, base station electronics and power supplies.

In the event of any Radio Frequency (RF) interference occur when common antenna system is used for smart pole, operator-to-operator coordination is required. Appropriate mitigation parameters might be needed to be deployed among the respective system (subject to analysis) so that the respective bands can co locate among each other without RF interference.

4.1.4 Energy efficient lighting

The lighting shall be energy efficient by using LED technology with light controller that is able to provide automatic control of the luminance.

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4.1.5 Interactivity

There shall be a minimum of one interactive application that provides the ability for the devices on smart pole to interact with the surrounding and the responses are controlled by a remote network. This may be in the form of a remote control of light luminance or automatic alarm report of the lighting performance. The interactive applications may also be implemented by other features listed under optional requirements in Table 1.

Depending on the scale of implementation, IoT platform may be used to support various interactive applications and services. Annex A provides description of IoT platform features and requirements.

4.1.6 Environmental monitoring

Due to its strategic location, smart pole infrastructure can be used for environmental monitoring. Example of sensors that may be mounted on the smart pole are:

- a) air quality sensor;
- b) noise sensor;
- c) temperature sensor; and/or
- d) humidity sensor.

4.1.7 Emergency response

The smart pole can be integrated with items for emergency response such as:

- a) siren;
- b) loudspeaker/PA system;
- c) SOS panic button/push-to-talk system; and/or
- d) flood sensor.

4.1.8 Public safety and surveillance

CCTV and other sensor devices can be implemented on smart pole to support:

- a) public security monitoring;
- b) crowd density monitoring;
- c) traffic monitoring; and
- d) public asset monitoring (e.g. manhole cover).

4.1.9 Green energy

Solar panel can be installed onto the smart pole and the smart pole can serve as a charging station for electric vehicles or bicycles.

4.1.10 WiFi Connectivity

Access points can be mounted on smart poles to provide WiFi connectivity.

4.1.11 Digital information broadcast

LED panels can be mounted on smart poles to allow for broadcast of information to the public. Information broadcasted can be used to support:

- a) advertising;
- b) news update; and
- c) breaking news update.

Figure 2 illustrates various applications and services that may be installed on a smart pole.

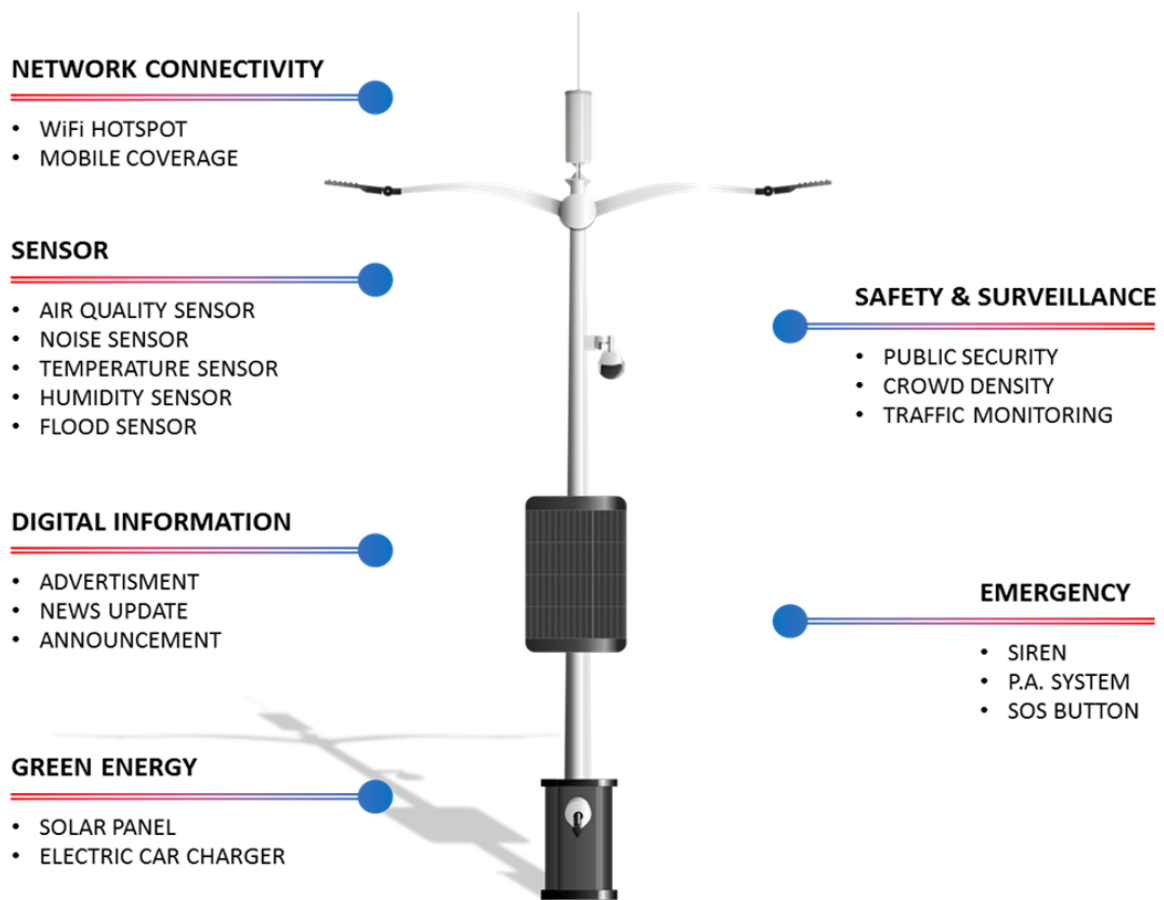


Figure 2. Various applications and services on smart pole

Figure 3 illustrates a possible implementation of smart pole that incorporates cellular service, LED lighting and other interactive applications.

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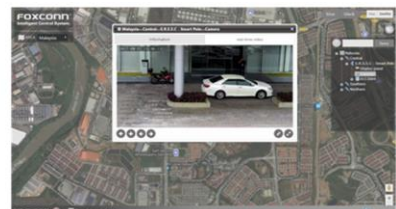
a) Smart pole



MULTI-TIER LOGIN ACCESS



GOOGLE MAP INTERFACE



LIVE MONITORING SYSTEM



SMART DEVICE MANAGEMENT



GROUP STREET LIGHT CONTROL



CUSTOMISABLE DATALOG EXTRACTION

b) Applications

Figure 3. Smart pole deployment example

5. Site design for smart poles - Concept of smart pole

This section details the generic design requirements for the deployment of smart pole designed to provide street level coverage or "gap filler" for capacity and/or coverage for blind spot that is not able to be addressed by conventional macro sites such as tower, monopole, lamp pole or rooftop sites.

The smart pole shall co-exist with existing macro sites and it's not meant to replace the macro sites.

Continuous demands towards better experience the cellular communications have brought the smart pole into the market with its main objectives to resolve capacity and blind spot issues.

With the above objectives in mind, smart poles are expected to be built in area where typical structure for macro sites are hard to build, such as by the roadside and public spaces in urban areas. The smart pole should blend into its environment with additional smart features as follows:

- a) promote Common Antenna Sharing (CAS) and fibre transmission bandwidth sharing among telcos; and/or
- b) promote additional features such as surveillance, public WiFi, environmental sensors or LED/LCD display.

5.1 Smart pole design requirements

5.1.1 Design codes

All designs, materials and workmanship shall, wherever relevant, comply with and be tested to the requirement of the latest editions of the standards listed below together with all the current amendments unless otherwise stated.

- a) BS 499-1;
- b) BS EN ISO 1461;
- c) BS 2901;
- d) BS 3692;
- e) BS 4360;
- f) BS 5135;
- g) BS 5950;
- h) BS EN 1993-3-1;
- i) BS 4592-2;
- j) BS 5493;
- k) ASCE Manual 72;
- l) TIA/EIA-222-G; and
- m) AS 3995.

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5.1.2 Basic design wind speeds

The smart pole shall be designed, for the purpose of assessing its structural strength to a basic design wind speed of 33.33 m/s (120 km/h), 3 second gust speed or 22.22 m/s mean hourly wind speed for all sites. This corresponds to a return period of 1 in 50 years. For the purpose of compliance check for maximum deflection (sway) and twist of the smart pole, 1 in 20 years return period wind speed of 30 m/s (3 second gust) or 20 m/s mean hourly wind speed shall be used.

5.1.3 Design loads

The structures shall be designed so that no failure or permanent distortion shall occur on any part of the structures during simultaneous application of the loads in their specified loading configuration as shown in Table 2.

The height of the pole shall be within 8 m to 15 m. The maximum height of smart pole may differ from one area to another. Therefore, all installer/operator shall consult on this matter with local council of the area prior to any installation. For any installation of poles of more than 15 m in height, please refer to the MTSFB 001:2009 and it is beyond the scope of this document.

Table 2. Specified loading configuration

Loading type	Distance from top of the pole	
	Level 1 (0.8 m)	Level 2 (3.5 m)
0.6 m microwave (temporary transmission before fibre readiness)	1 nos	-
2.10 H x 0.5 W x 0.21 D flat antenna	-	3 nos
Wifi antenna 0.3H x 0.3W x 0.21D flat/omni antenna	-	3 nos

The RF feeder cable/Tx cable arrangements as in Table 3 shall also be used.

Table 3. Cable arrangements

Type	Quantity	Dimension (inch)	Weight (kg/m)
RF feeder	maximum 18	7/8	1.1
Tx cable	2	1/4	0.5
UTP cable	2	0.04	0.01

These antenna elements and all related cables shall be arranged in such a manner that the resulting bending moment and shear forces are the greatest, and that the deflection under the relevant design wind speed shall be maximum irrespective of the direction of antenna and/or the direction of incident wind and shall not be limited to any pattern or direction of antenna arrangement.

Appropriate shielding of antenna may be used if justifiable by established means. The dynamic characteristic of the smart pole structure shall be assessed using established methods, and any instance of instability and vortex shedding shall be explicitly dealt with in the analysis of the pole structure. In this regard, the disposition of platform elements and antenna outstand shall be taken into account when deriving the natural frequency of the smart pole.

5.1.4 Galvanising

The galvanising coating shall be at least 610 g of zinc per square meter of surface and shall not be less than 0.086 mm (86 microns) thick and shall be able to withstand the test set out in BS EN ISO 1461.

5.1.5 Bolts and nuts

All connection bolts, nuts and spring washers that are to be used for member connections shall conform to BS 3692. All nut and bolt heads shall be of hexagonal shape.

Bolt holes shall not be more than 1.5 mm larger in diameter than the corresponding bolt diameter and free from burrs. The tolerance for location of centres of bolt holes shall be ± 2 mm.

All connection bolts and anchor bolts shall be galvanised including the threaded portion. All nuts shall be galvanised with the exception of the threads, which shall be oiled.

When in position, each connection bolt shall project through its nut for at least a full turn but not exceeding 10 mm.

Each connection bolt shall be supplied as a set, complete with one nut, one spring washer and one flat washer.

Nuts shall be finger tight on the bolt and will be rejected if they are, in the opinion of the telco, considered to have excessively tight or loose fit.

The minimum distance from the centre of the bolt holes to a rolled edge shall be 1.25 x bolt diameter. The minimum distance between holes for multi-bolted joints shall be 3 x bolt diameter. The minimum distance from the centre of the bolt holes to a sheared edge shall be 1.5 x bolt diameter.

5.1.6 Erection marking

All members shall be marked with distinguishing numbers and alphabets corresponding to the erection drawings or bill of materials. The erection marks shall be done before galvanising and shall be clearly legible afterwards.

The erection marks shall be at least 12 mm high, clearly legible and shall be stamped at easily locatable positions.

5.1.7 Materials

All designs shall be such that no trouble shall arise in service from vibration or excessive deflection due to the use of a very light section.

Rolled steel sections, flats, plates, bolts, nuts and bars shall, unless otherwise approved be of steel in accordance to BS 4360 or its latest equivalent British Standards Grade 43A and/or Grade 50C and shall be manufactured and rolled in approved mills.

Steel shall be cleaned and free from blisters, rust and scale or other defects before hot dipping process. Minimum thickness of structural members (angle sections) shall be 5 mm. The ultimate design stresses in tensile members shall not exceed the elastic limit strength of the material, whereas the ultimate stresses in the compression members shall not exceed a figure calculated from an approved formula.

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5.1.8 Deflection limit

The maximum twist and sway (deflection) at any specified elevation of the fully loaded smart pole (inclusive of all the designed antennae, accessories and radio feeders) shall not exceed 1 degree at a 1:20 year return period wind speed of 30 m/s 3 second gust or 20 m/s mean hourly wind speed. The gustiness of wind loading shall be included in the deflection assessment. A wind speed partial safety of 1.0 may be used.

5.1.9 Fabrication tolerances

The length of a member shall not deviate from its specified length by more than ± 3 mm. Straightness of a member shall not exceed 3 mm for all non-hollow sections and 2.5 mm for all other sections.

5.2 Loading configurations - Ancillary loadings

The smart pole shall be designed to carry parabolic microwave dishes, flat panel antenna, WiFi Access Point (AP)/antenna, and RF and Tx cables of various combinations. For the purpose of design, the following parameters shall be used as shown in Table 4.

Table 4. Design parameters

Loading type	Weight (kg)	Wind resistance area (m ²)
0.6 m microwave (temporary transmission before fibre readiness)	15	0.28
2.10 H x 0.5 W x 0.21 D flat antenna	33	1.05
Wifi antenna 0.3 H x 0.3 W x 0.21 D flat/omni	3	0.05

5.3 Design criteria and codes

The summary of requirements can be referred as in Table 5.

Table 5. Design criteria and codes

No.	Items	Description
1.	Type of structure	Mild steel polygonal smart pole minimum 20 sided
2.	Height of structure	Within 8 m to 15 m
3.	Design wind speed	a) 33.33 m/s (120 km/h) 3 second gust wind speed or 22.22 m/s mean hourly wind speed. b) 30 m/s 3 second gust or 20 m/s mean hourly wind speed for the purpose of deflection compliance check.

Table 5. Design criteria and codes (continued)

No.	Items	Description								
4.	Partial safety factors in design	Appropriate factors correspond to the quality and importance of the smart pole shall be obtained from BS 8100. A minimum material factor of 1.10 (corresponds to Class A quality) and a minimum wind speed factor of 1.20 (corresponds to site near to main trunk road and railway or any other major public utilities such as reservoir, power transmission lines, residential housing etc) shall be adopted. The definition of near shall mean the radial coverage of the height of the pole plus a buffer of 10 m.								
5.	Terrain category	In the derivation of wind loadings, a terrain category of 3 in accordance with BS 8100 or within town area in accordance with BS 6399: Part 2 shall be used for general design submission. In any particular application of the smart pole structure, the relevant terrain characteristic of the particular site shall be used and fresh calculations shall be submitted.								
6.	Wind loading code	Wind loads may be derived using BS 6399: Part 2 or BS 8100: Part 1. BS 6399: Part 2 may be used if detailed derivation in accordance with Annex C of the Code, that factor K_b , building type factor, and the resulting dynamic augmentation factor, C_r , falls within the Code applicability limit of 0.25. Otherwise, BS 8100 shall be used. CP3: Chapter V: Part 2 shall not be used as it had been superseded by BS 6399: Part 2.								
7.	Analysis and derivation of design forces	Equivalent static method of analysis may be used. Appropriate wind gust factors and force coefficients for antenna, branches and poles and ancillaries shall be taken into account in deriving the design wind loading. For cases whereby the natural frequency of the smart pole (calculated using established software, with due consideration of weight and disposition of platform and antenna away from the pole structure centre-line) being less than 2 Hz, dynamic analysis using spectral analysis or time history analysis shall be carried out to assess the pole response to wind excitation. In this regard, all mode shapes below 2 Hz shall be assessed. The more critical resulting forces derived from equivalent static method and dynamic method shall be use for detailed design.								
8.	The following force coefficient shall be used in the absence of more accurate information	<table border="1" data-bbox="596 1525 1358 1675"> <thead> <tr> <th data-bbox="596 1525 1123 1581">Diameter of parabolic antenna</th> <th data-bbox="1123 1525 1358 1581">Force coefficient</th> </tr> </thead> <tbody> <tr> <td data-bbox="596 1581 1123 1615">0.6 m</td> <td data-bbox="1123 1581 1358 1615">1.40</td> </tr> <tr> <td data-bbox="596 1615 1123 1648">2.10 H x 0.5 W x 0.21 D flat antenna</td> <td data-bbox="1123 1615 1358 1648">2.0</td> </tr> <tr> <td data-bbox="596 1648 1123 1675">0.3 H x 0.3 W x 0.21 D flat/omni antenna</td> <td data-bbox="1123 1648 1358 1675">1.0</td> </tr> </tbody> </table> <p data-bbox="564 1711 1382 1767">The wind resistance across the thickness of antenna due to diagonal wind incident direction shall be accounted for.</p>	Diameter of parabolic antenna	Force coefficient	0.6 m	1.40	2.10 H x 0.5 W x 0.21 D flat antenna	2.0	0.3 H x 0.3 W x 0.21 D flat/omni antenna	1.0
Diameter of parabolic antenna	Force coefficient									
0.6 m	1.40									
2.10 H x 0.5 W x 0.21 D flat antenna	2.0									
0.3 H x 0.3 W x 0.21 D flat/omni antenna	1.0									

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Table 5. Design criteria and codes (continued)

No.	Items	Description
9.	Analysis and design of pole foundation	<p>Footing foundation shall be used when the subsoil conditions within a depth of twice the maximum base dimension is capable to provide a safe bearing capacity of 100 kN/m². Otherwise piled foundation shall be used. There shall be no soil tension being developed at the base of the footing.</p> <p>The minimum factor of safety for overturning under un-factored design wind speed of 33.33 m/s 3 second wind gust or 22.22 m/s mean hourly wind speed shall be at least 2 without wind gust effect and 1.5 when wind gust is included. A safety factor 1.05 shall be used if factored wind speed is used with full wind gust effects applied.</p> <p>The rotational characteristic of footing onto the pole shall be taken into account when assessing the deflection limit of the pole. A sub grade reaction of 12 000 kN/m³ may be used for this purpose.</p> <p>In no case shall tension be allowed in any piles when a piled foundation is used.</p>
10.	Load configuration	<p>1 nos. 0.6 m diameters parabolic dish (temporary transmission before fibre readiness) and 3 nos. of flat panel.</p> <p>These shall be positioned such that maximum wind resistance is achieved.</p>
11.	Cable configuration	<p>12 nos. of 7/8" RF feeder cable stacked in 1 row and 2 nos. of 1/4" Tx cable. All cables are to be placed inside the smart pole. Cable guides are to be installed inside the smart pole.</p>
12.	Design codes	<p>a) Smart pole structure - BS 5950 (see also 3.1). b) Tower foundation - BS 8110.</p>
13.	Material codes	<p>a) Steel works - BS 4360. b) Galvanising - BS EN ISO 1461. c) Bolts and nuts - BS 4190, BS 3692 and BS 4320. d) Welding - BS 5135.</p>
14.	Material strengths	<p>All structural steel used are to be as follows:</p> <p>a) grade 43 with a yield strength, $f_y = 275 \text{ N/mm}^2$; b) grade 50 with a yield strength, $f_y = 355 \text{ N/mm}^2$; and c) welded sections: maximum ultimate weld strength of 215 N/mm² may be used.</p> <p>Grade 55 with a yield strength, $f_y = 450 \text{ N/mm}^2$ shall not be used when pole sections were being make up of welded pieces unless fatigue analysis in accordance with BS 8100 is carried out.</p> <p>All structural bolts used are to be of grade 8.8 with the following properties:</p> <p>a) yield strength $f_y = 627 \text{ N/mm}^2$; and b) shear strength $P_s = 375 \text{ N/mm}^2$.</p>

Table 5. Design criteria and codes (concluded)

No.	Items	Description
15.	Physical characteristics	Maximum tilt of the top of the structure is not to exceed 0.5° from centre under a design wind speed of 30 m/s 3 second gust wind speed or 20 m/s mean hourly wind speed, which corresponds to 1:20 years return period. Wind gust effects shall be included in the analysis for deflection compliance.
16.	Diameter of base flange	Maximum 600 mm.

5.4 General requirements

5.4.1 Site compound

Site compound of smart pole incorporates attributes required for fast and affordable deployment while at same time blending the pole or equipment cabinets into its surrounding environment. In general, no fencing is required for smart pole and its equipment cabinets, similarly typical roadside cabinets.

5.4.2 Fibre transmission

Fibre transmission should be key feature in smart pole to ensure better internet or data services for consumer. Microwave transmission can only be use as temporary transmission medium while waiting for fibre readiness.

5.4.3 Earthing and lightning protection

Earth continuity conductors and earth leads shall be of high-conductivity copper, continuous throughout their whole lengths and without joints, except by means of approved mechanical clamps. Where connections are made at switchgear and such items of electrical equipment, the conductors shall terminate in soldered or compression-type sockets.

In the case of Mineral-Insulated Copper-clad Cable (MICC)/Permanent Virtual Circuit (PVC) cables, the copper outer sheaths of the cables may be utilised as earth continuity conductors, provided that at the termination of each cable-run the copper sheaths (or sheaths in the case of single-core, multiple runs of MICC/PVC cables) shall be effectively bonded to earth.

Every circuit of a switchboard, distribution board, control board, tap-off unit and splitter switch-fuse unit shall be provided with its own earth-continuity conductor.

In hazardous locations, additional earth continuity conductor networks with their own earth electrode systems shall be provided for bonding metalwork to earth. Such networks, when required, shall be indicated on relevant layout drawings.

The impedance measured at any of the earth chambers connected as part of the earth grid shall not exceed 5 Ω.

For earth electrode system, electrodes shall comprise 16 mm diameter, 1.6 m long, extensible-type, copper-steel-cored rods ("Copper weld" or approved equivalent make), driven into the ground at interval of at least twice the driven length of any two electrodes. Electrodes shall be driven into ground by means of a "KANGO" or similar type electric or pneumatic hammer. Every connection clamp shall be provided with regulation-type concrete inspection chamber and cover.

MCMC MTSFB TC G010:2017

The minimum number of electrodes installed for each earthing point shall be 3 and the minimum length of each electrode shall be 1.6 m. The numbers of earthing points indicated in the drawings are indicative only and shall in no way imply that the earthing points are sufficient to obtain the value of 1 Ω .

The contractor shall increase the driven length or number of earth electrodes and if necessary, non-soluble earth enhancing compound be considered to obtain the required earth resistance, subject to the approval of service providers. In exceptionally bad areas, the contractor shall propose the use of extra copper earth grids and earth enhancing compound to achieve the desired earth resistance value

A lightning protection air termination or lightning rod shall be fitted to the top of each smart pole. As long as the structure is located nearby/surrounding buildings which have its own/sufficient lightning protection system, it might not be necessary/compulsory for the said structure to install its own lightning protection system.

6. Installation

6.1 Basic procedures

Prior to the installation of smart pole operator/installer shall:

- a) identify location; and
- b) obtain relevant permission from respective local council including but not limited to a formal written approval permit.

Safety measures shall be taken into serious consideration at the construction site during installation to prevent accidents, both to the workers and general public.

Proper coordination is critically essential prior to any installation. The relevant consent and interest of all parties including but not limited to the local council, service providers, consultants, contractors and land owner shall be considered.

The installer/operators shall observe and adhere to existing guidelines and laws set by the federal, state and local authorities. The following is the list of laws and existing guidelines that shall be referred to:

- a) Part X, Chapter 1 of CMA 98 (Installation of Network Facilities, Access to Network Facilities, etc):
 - i) s.215 (installation of network facilities);
 - ii) s.216 (minimal damage);
 - iii) s.217 (network facilities provider to restore land);
 - iv) s.218 (management of activity);
 - v) s.221 (notice to owner of land);
 - vi) s.223 (notice to road authority, public utility, etc.); and
 - vii) s.224 (road, etc., to remain open for passage).
- b) Department of Safety and Health (DOSH's) Regulations, Codes of Practice & Guidelines (e.g. Guidelines for Public Safety and Health at Construction Sites, 2007).

MCMC MTSFB TC G010:2017

- c) NIOSH (National Institute for Occupational Safety and Health Safety) AKKP (Arahan Keselamatan dan Kesihatan) 1994 & 1996 requirements (Act 514)

The following are examples of state guidelines and procedures which shall be referred to prior to installation of smart pole:

- a) Garispanduan Pembinaan Struktur Pemancar Telekomunikasi di Negeri Selangor Darul Ehsan 2012 (4.3 Struktur Sistem Pemancar Dwifungsi); and
- b) Prosedur dan Garis Panduan Pembinaan Menara dan Struktur Pemancar Telekomunikasi Negeri Pulau Pinang 2015.

6.2 Power supply

The electricity of the smart pole shall only be supplied by:

- a) Tenaga Nasional Berhad (TNB) for peninsular Malaysia;
- b) Sabah Electricity Sdn Bhd (SESB) for Sabah;
- c) Sarawak Electricity Supply Company Berhad (SESCO) for Sarawak; or
- d) other electrical power distribution licensees.

Other power supply mode such as generator set shall only be considered on case by case basis and subject to approval by relevant authorities.

MCMC MTSFB TC G010:2017

7. Maintenance

Maintenance of the sites shall remain the responsibility of the operator i.e. the NFP licence holder. Regular site inspection is required to ensure the smart pole is structurally sound. This is preventive maintenance where any deterioration can be highlighted ahead of time and corrective work be done to prevent further degradation to the structure. Failure to observe a regular maintenance schedule can create a potentially hazardous working and operating conditions.

Regular check of the structural integrity of all add-on assemblies is recommended to be carried out by trained personnel from the facilities operator.

7.1 Site access

It is important to ensure that there is 24 hours access availability to the station. However, for highly sensitive area for example 'Sasaran Penting Kerajaan', prior approval shall be obtained for site access. Site access should be made available:

- a) during office hours; and
- b) as and when required at the event of emergency.

Any arrangement on the site access should be commercially agreed by both parties as spelled out in the Commission Determination on the Mandatory Standard on Access (Determination No.3 of 2016).

The service provider's employees, contractor, vendor and/or agent are responsible to ensure that access members do not violate any service provider's policies, do not perform illegal activities, and do not use the access to property for outside business interests. The service provider's employee(s), contractor, vendor and/or agent bear responsibility for the consequences should the access be misused.

For any other access permission request that the service provider's employees, contractors, vendors and/or agents may deem would lead to the violation of access given, the service provider's employees, contractors, vendors and/or agents shall directly refer to the relevant authorised department or personnel(s) of the service provider for further verification.

Site access shall be strictly controlled. Control will be enforced via the following identification or authentication verification and log record:

- a) the service provider's employee identification data and/or pass card;
- b) authorisation letter; and
- c) authorised work permit.

Any personnel(s) that have access to the property shall fill in the visitor's log book as per detailing requirement.

Service provider's employee shall not provide their access identification data and/or pass card, access key and/or access password to anyone, not even service provider's members.

Any personnel(s) that have accessed to the property shall strictly follow the code of conduct as may be outlined while on the property premises.

7.2 Maintenance activities

This section seeks to establish procedures and guidelines for the inspection and maintenance of smart pole. It also identifies the deficiencies, the defective items and recommends solutions to keep the structure in good condition and optimum performance.

Structure owner to adhere to maintenance obligations stipulated in paragraph 5.12 of Commission Determination on the Mandatory Standard on Access (Determination No. 3 of 2016).

7.2.1 Inspection

The interval between site inspections should not be greater than 1 year and should be maintained in accordance with the findings from the inspection.

7.2.2 Inspection procedures

Workers shall adhere to the basic safety requirements set by DOSH while doing maintenance works at site e.g. wearing proper safety gears.

The visual inspection works begin when the field operations approach to the sites. Visually inspect and report on the findings shall follow the items below but not limited to:

- a) visually inspect the compound from a distance;
- b) visually inspect the paint condition of the structure;
- c) external environmental condition (i.e. slope erosion, soil settlement or movement, adjacent development, drainage system, etc.);
- d) site surroundings are clear of debris;
- e) ground rod present at top of the smart pole;
- f) visually inspect whether structure is plumb (straight); and
- g) visually inspect whether structure is free of twists.

Physical inspection of the structure and its ancillaries, i.e. structure members, bolt and nut, paint, climbing and cable ladder and gantry, platform, antennas, electrical components, waveguide, guys, and all associated structure hardware shall be evidenced with colour photographs of each structure being taken and incorporated into each report.

Antennas should be repainted, if required, with specially formulated RF transparent paint. The use of sky-lifts or elevated platforms/devices is recommended for accessing the antenna and devices installed on the smart pole. Other unsafe methods for accessing the devices is strictly discouraged.

It is crucial to check and report the structure condition in relation to external environmental condition (i.e. slope erosion, soil settlement or movement, adjacent development, drainage system, etc.) duly supported with photographic evidence, at least from 4 critical angle.

Photographic documentation of any deficiencies detected in the inspection shall be highlighted together with clear descriptions, which will trigger repairs, modifications or replacement. Hardcopy and Joint Photographic Experts Group (JPEG) images are required. Photographs should be labelled with site identification details and date, and position and nature of problem should be stated clearly.

MCMC MTSFB TC G010:2017

The inspection findings shall include comments of the condition as:

- a) satisfactory (in accordance with standards and no maintenance works required);
- b) not satisfactory (not to standard and maintenance works required);
- c) critical (immediate response, public health and life-threatening situation); and
- d) not applicable (not relevant to this site).

The inspector will complete and safe keep a hard copy and an electronic version of the following documents:

- a) inspection checklist for routine maintenance (as Annex B); and
- b) photographic records.

Annex A (informative)

IoT platform features and requirements

The components below can be supported in this single platform.

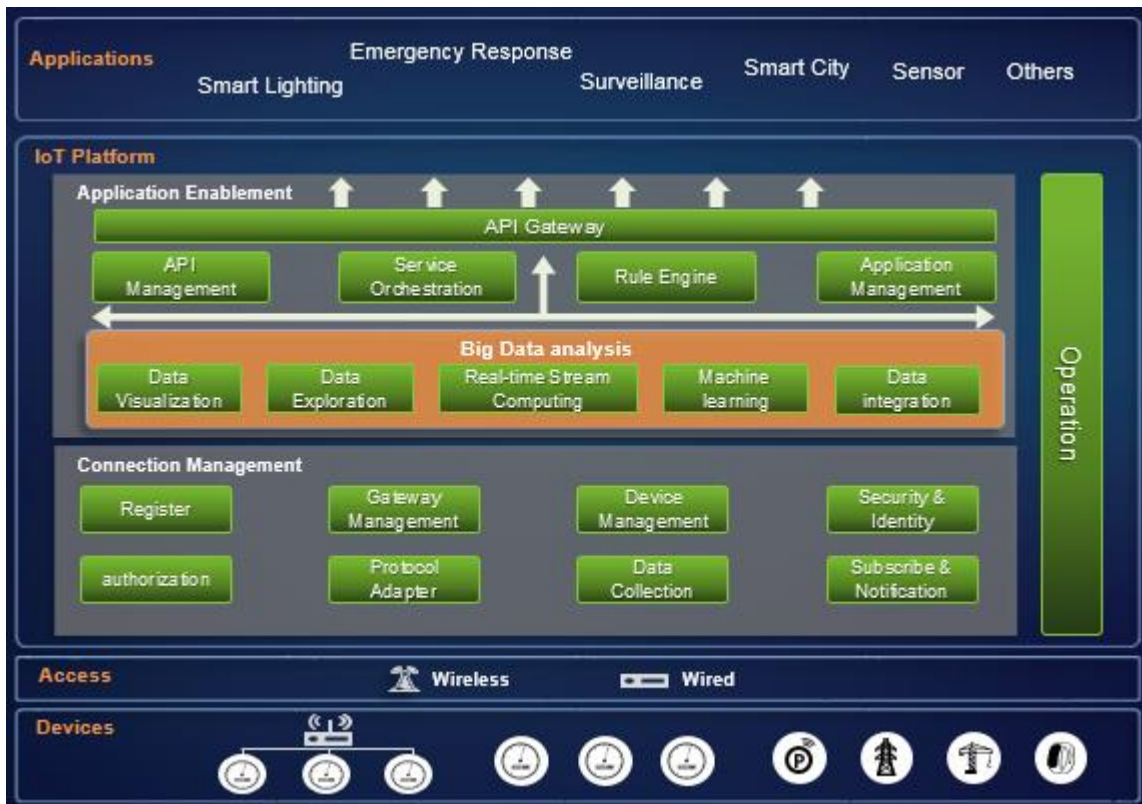


Figure A.1. IoT platform architecture

A1. Application enablement

IoT platform should supports to provide the Application Program Interface (APIs) to the 3rd party application system. By the integration with application system, IoT platform can support the system linkage with them via APIs and provides the capabilities such as to query device status, to control device, to receive the alarm notification, to setup the linkage strategy, the query the operation and alarm log, etc. To achieve and management integration with application layer, components below should be included in IoT platform architecture, i.e.:

- a) API management;
- b) API gateway;
- c) service orchestration;
- d) rule engine; and
- e) application management.

MCMC MTSFB TC G010:2017

A2. Big data analysis

It is anticipated that via IoT massive data will need to be processed. In addition, those data can be used to support various scenario such as predictive maintenance, artificial intelligence, real time stream analytic, location based service, etc. Therefore, it is a requirement for IoT platform to be designed such that data are acquired, process and able to support subsequent requirement. To support big data analysis, the required components are:

- a) data visualisation;
- b) data exploration;
- c) real time stream computing;
- d) machine learning; and
- e) data integration.

A3. Connection management

The connection management modules provide a uniform resource control framework to mask differences between devices, to provide standardised operation interfaces. By using such uniform policy definitions, the modules realise centralised policy implementation to control network capability. The modules synchronise user information with the platform for the convenient of service policy control and implementation. The basic components for connection management are:

- a) register;
- b) gateway management;
- c) device management;
- d) security and identity;
- e) authorisation;
- f) protocol adapter;
- g) data collection; and
- h) subscribe and notification.

A4. Interoperability and extensibility

IoT platform meets the requirements of openness to better support 3rd terminal devices and external system which can maximise the protection of the unit investment cost and project feasibility. The interconnection protocols with different entities are shown in figure below.

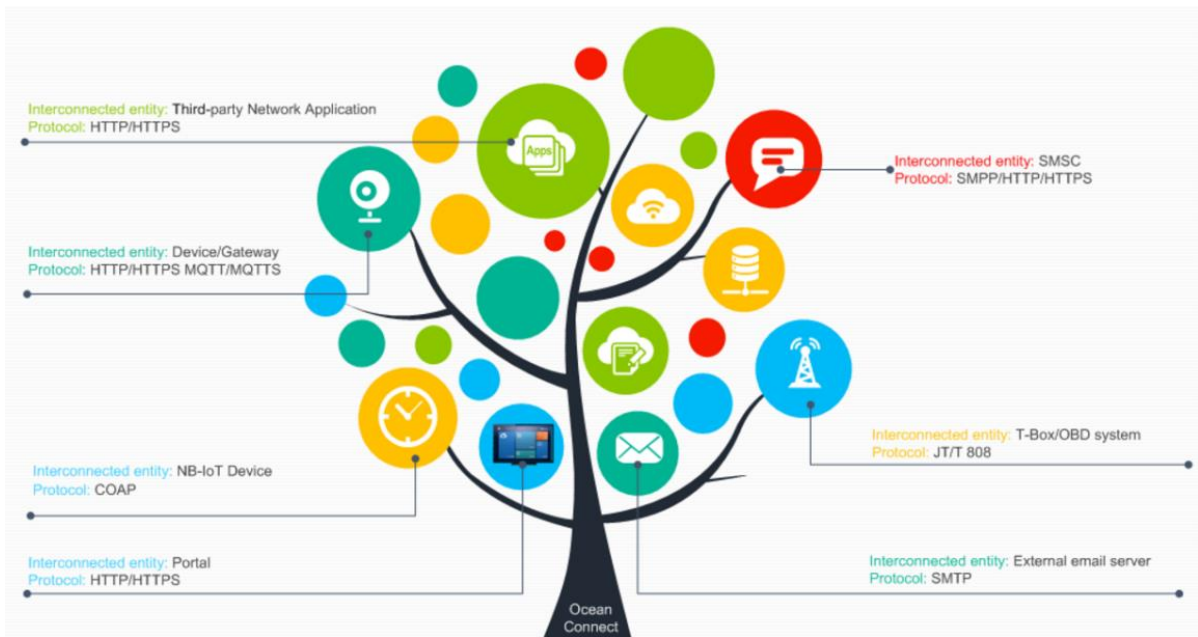


Figure A.2. Interconnected entity

A5. Security

In addition, multi-level of security need to be consider to ensure the IoT platform is secured. Key consideration aspects are as in A5.1 until A5.4.

A5.1 Information security

This is implemented via authentication → access control → Internetwork Protocol (IP) address access control → security audit → auto-spoofing, integrity protection and data confidentiality.

A5.2 Network security

Network security is ensured by securing the bearer network security and platform. Configuring security settings on routers in the bearer network can prevent certain attacks.

A5.3 Platform security

The security of the platform is the key to the security of the entire system. The platform security can be guaranteed in any of the following ways:

- Configure two network cards. Deploy one interface in the Multiprotocol Label Switching (MPLS) Virtual Private Network (VPN). Deploy another interface in the Internet.
- For the devices in the same administrative domain, deploy them in the same VPN. This is to ensure that video streams and signalling streams are securely forwarded and users in other administrative domains cannot access this VPN.
- Use a firewall and configure related access control policies to ensure data security. Deploy access gateways in the demilitarised zone (DMZ) of the firewall. Disable unused ports. Perform access control on the IP addresses.
- Enhance the firewall by controlling the network traffic, turning on the switch for defending against common attacks, and configuring alarms. The firewall supports the following security policies.

MCMC MTSFB TC G010:2017

A5.4 Operation security

Important devices, such as the authentication server, run on a two-node cluster with redundancy. When the active device fails, the standby device can take over the services. Network communication security is enhanced by using the firewall, Intrusion Detection System (IDS), anti-virus applications, and vulnerability scanner. In addition, important data, such as configuration, user information, logs, and alarm records, must be periodically or manually dumped. Critical data needs to be backed up in another location.

Annex B
(informative)

Sample checklist for routine maintenance of smart pole

General Information					
Site Name				Site ID	
Date				Time / Duration	
CME Part					
Activity	Findings (/)				Remarks
	1	2	3	4	
Earthing measurement at inspection pit					
Inspection pit 1					
Inspection pit 2					
Inspection pit 3					
Inspection pit 4 (Structure Leg)					
Earthing connection status.					
Earthing continuity status to all chambers.					
Earthing Resistance reading					
AC Power Status (3Phase - R, Y, B) or (1 phase - R-N, Y-N, B-N)					
Visual Check					
Compound Cleanliness					
Compound Condition					
Perimeter Fence					
Drainage System					
Plinth Condition					
Vegetation Condition					
Access Road					
Structure Leg					
Condition of structure member					

MCMC MTSFB TC G010:2017

Anti-climb cage to prevent theft					
Fall Arrest/Body Harness					
Compound Lighting					
Inspection pit cover					

Defects / Remarks to be rectified	
Checked By	Verified By
Name	Name
Date	Date
Contact	Contact
Company Name & Chop	Company Name & Chop
<p><i>Legend (Findings)</i> 1 - Satisfactory 2 - Not Satisfactory 3 - Critical 4 - Not Applicable</p>	

Acknowledgements

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