

Optical fiber termination and splicing

Splicing of the optical fiber cabling shall be minimized through careful Contractor planning. **There shall be no mid-span splices allowed.** All required splices shall be planned to occur at tower structures or within facilities.

All optical fiber splicing shall be accomplished with fusion splices and each splice shall be fitted with a splice protection sheath. All splices and bare fiber shall be neatly installed in covered splice trays supporting no more than 12 splices each.

(1) Splice enclosures

(A) Suitable splice enclosures shall be provided to encase the optical cable fusion splices in protective, moisture and dust free environment. The splice enclosures shall be compiled with the followings:

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IN-LINE CLOSURE FOR OPTICAL FIBER CABLE

(In-line closure for core network)

1. GENERAL

1.1 This specification covers requirement of re-enterable fiber optic splice closure that shall be met to ensure the satisfactory operation of a fiber optic splice closure in outside plant environments.

1.2 This specification contains criteria for fiber optic splice closure which shall be installed in horizontal direction.

1.3 The scope of uses, the closure according to this specification shall be applied to use for covering the spliced fibers of optical fiber cable in core network (may called as "backbone") installing in manhole, direct buried and aerial optical fiber cable network

1.4 Full details of this following information shall be provided in bidding document by bidder. Failure in this item, the proposal shall be disqualified.

- Product specification issued by product manufacturer.
- The material and grade of material used as per Section 3.1 in this specification.

2. GENERAL REQUIREMENTS

2.1 The configuration of the fiber optic cable closure shall be in-line design and allowable for easy re-entry, splicing, assembly and installation as follow: straight joint and branch joint. Dome closure is not concerned in this specification.

2.2 The closure kit shall be easy for handling and installation. The closure shall allow easy fiber access during installation and maintenance.

2.3 The closure shall be able of accepting additional cables without removal of the sheath retention or strength member clamping hardware on previously terminated cables or disturbing existing splices.

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2.4 The closure shall be sealed with high quality grade rubber gasket or silicon gasket or equivalent. The cable sealing of closure shall be based on gel-tape or sealing tape technology or equivalent. The heat shrinkable seal system is not allowable.

2.5 The cable port seal shall be non heat shrink seal while the gap between the cable port seal of the closure and the cable shall be tightened by sealing system.

2.6 All small parts of fastener hardware used to assemble the closure body for opening/closing the closure such as nuts, bolts and other assembling hardware etc shall be captivated for preventing accidental loss (connect with housing) and for easy workability during installation and maintenance activities.

2.7 The closure shall be possible to terminate different cable types. The strength members of the cables shall be mechanically attached to the inner hardware of the closure.

2.8 The closure shall at least contain 6 (SIX) entrance port. Each cable ports required shall be capable to accommodate for ADSS cable diameter around 10 – 12 mm. ,DW cable diameter around 8-10 mm. and Figure 8 Armored Aerial Optical Fiber Cable 24 Cores diameter around 13-20 mm. Unused cable ports shall be closed with plugs. At least 1(one) set of the branch off kit accessories (minimum 2 sub cable ports) installing at cable port for distribution cable shall be separately provided.

2.9 The closure shall be capable of accommodating splice organizer which accept fusion splice method. The closure shall have provisions, for storing fiber splices in an orderly and identifiable manner, mountings for splice organizer assembly, and space for fiber access.

2.10 The closure organizer tray shall be 12 fibers per organizer tray and hinge-able parts (or hinging tray).

2.11 All fiber cable elements shall be routed in such a way that no transmission degradation is seen after accessing these cable elements. The minimum bend radius of the fibers after installation shall be 30 mm throughout the whole closure system.

2.12 Installation of the closure shall not require special tool or equipment, other than those normally carried by splicer or craftsman. The closure shall be designed for installation by using



the amount of tool types as less as possible. Tool-less installation and wrench tool of hex flat head bolt/nut are preferably, the insert lock head bolt/nut shall not be allowable.

2.12 The closure shall be provided two self-supporting aerial strand clamps which made from stainless steel. Its clamps shall be capable to accommodate for ADSS cable (no sharp edges, corners, burrs or other hazardous features that could result in damage to the cable)

2.13 The closure shall have no sharp edges, corners, burrs or other hazardous features that could result in damage to the fiber or injury to splicer or craftsman.

2.14 The closure kit shall at least consist of the following components:

- a) Closure cover 1 set
- b) Fiber splice organizer
- c) Clamping for mounting on cable strand 1 set
- d) Heat shrink splice protector (Sleeve size 60 mm) with stainless steel reinforced metal rod.
- e) Sealing gasket
- f) Sealing tape or gel tape or equivalent
- g) Buffer tube or transportation tube, if necessary, depending on each manufacturer product design.
- h) Cable clamps
- i) Alcohol tissue
- j) Shield continuity, bonding and external grounding components (Suitable for closure type)
- k) Dummy plugs for unused cable port
- l) Instruction at least one per closure kit preparing in Thai or English language including:
 - Installation and maintenance instruction
 - Description how to manage or arrange the fiber inside closure
 - Drawings or pictures of fully fiber installed inside closure and finish installed closure related to applications concerned.

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3. TECHNICAL REQUIREMENTS

3.1. Material Requirements

3.1.1. Housing or Covers shall be fabricated from black durable high density thermoplastic, which resists to solvents and stress cracking and be compatible with chemicals and other materials used in the various closure applications. This plastic also resists deterioration when exposed to the ultraviolet ray of the sun for long life. Dimension of housing shall be less than 400 x 200 x 130 mm. weight ≤ 2.50 kg.

3.1.2. All gaskets shall be fabricated from high quality grade rubber or equivalent and be compatible with chemicals and other materials to which they might be exposed in normal applications.

3.1.3. Splice tray and tray cover shall be made of polycarbonate or ABS in white or similar color. The black color is not acceptable.

3.1.4. Reinforced metal rod for protective sleeve shall be made of stainless steel.

3.1.5. All outside parts of metallic materials shall be made of stainless steel (304 series grade) such as bolts, nuts, and self stranding clamps.










IN-LINE CLOSURE FOR OPTICAL FIBER CABLE

(In-line closure for Distribute and Last mile network)

1. GENERAL

1.1 This specification covers requirement of re-enterable fiber optic splice closure that shall be met to ensure the satisfactory operation of a fiber optic splice closure in outside plant environments.

1.2 This specification contains criteria for fiber optic splice closure which shall be installed in horizontal direction.

1.3 The scope of uses, the closure according to this specification shall be applied to use for covering the spliced fibers of optical fiber cable in core network (may called as "Distribute or Last mile") installing in manhole, direct buried and aerial optical fiber cable network

1.4 Full details of this following information shall be provided in bidding document by bidder. Failure in this item, the proposal shall be disqualified.

- Product specification issued by product manufacturer.
- The material and grade of material used as per Section 3.1 in this specification.

2. GENERAL REQUIREMENTS

2.1 The configuration of the fiber optic cable closure shall be in-line design and allowable for easy re-entry, splicing, assembly and installation as follow: straight joint and branch joint. Dome closure is not concerned in this specification.

2.2 The closure kit shall be easy for handling and installation. The closure shall allow easy fiber access during installation and maintenance.

2.3 The closure shall be able of accepting additional cables without removal of the sheath retention or strength member clamping hardware on previously terminated cables or disturbing existing splices.



2.4 The closure shall be sealed with high quality grade rubber gasket or silicon gasket or equivalent. The cable sealing of closure shall be based on gel-tape or sealing tape technology or equivalent. The heat shrinkable seal system is not allowable.

2.5 The cable port seal shall be non heat shrink seal while the gap between the cable port seal of the closure and the cable shall be tightened by sealing system.

2.6 All small parts of fastener hardware used to assemble the closure body for opening/closing the closure such as nuts, bolts and other assembling hardware etc shall be captivated for preventing accidental loss (connect with housing) and for easy workability during installation and maintenance activities.

2.7 The closure shall be possible to terminate different cable types. The strength members of the cables shall be mechanically attached to the inner hardware of the closure.

2.8 The closure shall at least contain 4 (Four) entrance port. Each cable ports required shall be capable to accommodate for DW cable diameter around 8-10 mm. Unused cable ports shall be closed with plugs. At least 1(one) set of the branch off kit accessories (minimum 2 sub cable ports) installing at cable port for distribution cable shall be separately provided.

2.9 The closure shall be capable of accommodating splice organizer which accept fusion splice method. The closure shall have provisions, for storing fiber splices in an orderly and identifiable manner, mountings for splice organizer assembly, and space for fiber access.

2.10 The closure organizer tray shall be 12 fibers per organizer tray and hinge-able parts (or hinging tray).

2.11 All fiber cable elements shall be routed in such a way that no transmission degradation is seen after accessing these cable elements. The minimum bend radius of the fibers after installation shall be 30 mm throughout the whole closure system.

2.12 Installation of the closure shall not require special tool or equipment, other than those normally carried by splicer or craftsman. The closure shall be designed for installation by using the amount of tool types as less as possible. Tool-less installation and wrench tool of hex flat head bolt/nut are preferably, the insert lock head bolt/nut shall not be allowable.



2.12 The closure shall be provided two self supporting aerial strand clamps which made from stainless steel. Its clamps shall be capable to accommodate for DW cable (no sharp edges, corners, burrs or other hazardous features that could result in damage to the cable)

2.13 The closure shall have no sharp edges, corners, burrs or other hazardous features that could result in damage to the fiber or injury to splicer or craftsman.

2.14 The closure kit shall at least consist of the following components:

- a) Closure cover 1 set
- b) Fiber splice organizer
- c) Clamping for mounting on cable strand 1 set
- d) Heat shrink splice protector (Sleeve size 60 mm) with stainless steel reinforced metal rod.
- e) Sealing gasket
- f) Sealing tape or gel tape or equivalent
- g) Buffer tube or transportation tube, if necessary depending on each manufacturer product design.
- h) Cable clamps
- i) Alcohol tissue
- j) Shield continuity, bonding and external grounding components (Suitable for closure type)
- k) Dummy plugs for unused cable port
- l) Instruction at least one per closure kit preparing in Thai or English language including :
 - Installation and maintenance instruction
 - Description how to manage or arrange the fiber inside closure
 - Drawings or pictures of fully fiber installed inside closure and finish installed closure related to applications concerned.







3. TECHNICAL REQUIREMENTS

3.1. Material Requirements

3.1.1. Housing or Covers shall be fabricated from black durable high density thermoplastic, which resists to solvents and stress cracking and be compatible with chemicals and other materials used in the various closure applications. This plastic also resists deterioration when exposed to the ultraviolet ray of the sun for long life. Dimension of housing shall be less than 50x220x170 mm. weight 1.2 kg.

3.1.2. All gaskets shall be fabricated from high quality grade rubber or equivalent and be compatible with chemicals and other materials to which they might be exposed in normal applications.

3.1.3. Splice tray and tray cover shall be made of polycarbonate or ABS in white or similar color. The black color is not acceptable.

3.1.4. Reinforced metal rod for protective sleeve shall be made of stainless steel.

3.1.5. All outside parts of metallic materials shall be made of stainless steel (304 series grade) such as bolts, nuts, and self stranding clamps.

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WALL MOUNTED FIBER DISTRIBUTION FRAME

1. GENERAL

1.1. This specification covers the requirements of the fiber distribution frame intended to use for cross connection of fiber network

1.2. This FDF shall be designed under indoor environmental condition which used in building. The primary design consideration of the FDF shall protect the optical fiber from environmental and mechanical stresses.

1.3. The fiber patch cord and pigtail used for this FDF specification

1.4. Full details of this following information shall be provided in technical bidding proposal by bidder. Failure in this section the proposal shall be disqualified.

- Product specification and drawings or pictures of all product components
- The material used and grade (or composite material) in detail for all components of product proposed
- Pictures of fully loaded termination of FDF covering housing, patching and splicing area (showing the wiring of splicing tray and connectorized pigtails) and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF .

2. DESIGN AND FEATURE

The wall mounted FDF shall accommodate 12, 24 and 48 fibers and shall at least composed of followings :

- Wall mounted FDF housing
- Splicing area

Splice tray(s)

Bending control devices

- Patching area

Patch panel

2.1. Wall mounted FDF housing

2.1.1. FDF housing shall conform to or exceed IP20 protection level

2.1.2. FDF shall be separated into 2 compartments; a splicing area and a patching area.

2.1.3. FDF housing shall have 2 swing doors and shall be lockable by key which one door shall be used for covering splicing area and another door shall be L-shaped swing design using for covering patching area according to figure 1. Each swing door shall be attached to the housing with an internally positioned hinge.

2.1.4. Splicing area and patching area in the FDF housing shall be provided at least 2 entrance ports at each specified position which the entrance positions shall follow as figure 1. The entrance ports shall be sealed with a solid removable grommet.

2.1.5. The enclosed wall mount FDF shall be as follows:

Fiber capacities	Typical dimension	
	Minimum area (WxH) (mm ²)	Minimum depth (D) (mm)
12	82,350.0	85
24	136,968.0	85
48	136,986.0	140

Thickness (minimum): 1.5 mm

The bidder can propose any dimensions of width and height but its total area (WxH) shall not below than the minimum area (WxH) as specified in table 1.

2.1.6. FDF housing design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite with any types of FDF applications.

2.1.7. FDF housing shall be capable of being installed wall mounted. No access from the rear. For safety reason, FDF housing shall be provided the mounting hardware to secure and assure the FDF housing to be firmly installed with building wall or other available structures.

2.1.8. FDF housing shall permit easy access to cables, patch cords and pigtailed during installation, maintenance and upgrade without removal the other existing components

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and without disturbing the systems already in service.

2.1.9. Optical fiber cables and patch cords shall be organized, stored and mechanically protected in the housing. Provision shall be made for the adequate protection and bend control of cables, patch cords and pigtails throughout the housing (called positive fiber management). A minimum bend radius of 30 mm shall be respected to all bend controls.

2.1.10. All critical bend positions of whole length of patch cord wiring, there shall be bend control devices which have curve surface structure. Hoop or ring or equivalent is not allowable to use for patch cord as such critical bend position.

2.1.11. Protective color coating of the FDF housing shall use powder color coating method with minimum thickness of 50 μm . The other color coatings than powder color coating are not allowable.

2.1.12. Standard kit content of the FDF housing shall be as follows:

1) Pre-mounted fiber wiring management component for all length of cable, OFC loose tube, patch cord, pigtail such as bending control device, etc. The fiber wiring management components shall also be sufficiently installed in cable/OFC tube routing and patch cord routing area.

2) Installation Instructions (at least 1 set)

☐ Fully in details of installation Instruction.

☐ Drawings or pictures of fully loaded termination of wall mounted FDF proposed and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.

3) Identification strips or marking of manufacturer

4) Identification label/markings/card/card holder and record system to identify the cables, patch cords, pigtails, fibers, station route and caution sign etc.

5) Cable termination system for instance: cable attachment plate with cable clamp and strength member fixations

6) Flexible tubing, transportation (protection) tube etc.

7) Wall mounting kit.

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2.1.13. The bidder can propose the different design from as specified in figure 1 which can be proved that having better performance and easier operation.

2.2 Splicing Area

2.2.1. The splicing area as defined in this specification shall consist of splice tray holder and splice trays. The splicing components shall be designed to be mounted in FDF housing.

2.2.2. The appearance of product shall be precise, elaborate and none of deformation, sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.2.3. The splice tray shall provide mechanical protection and storage of pigtails, fibers, splices, connectors and other passive optical devices in FDF housing.

2.2.4. The splice tray shall be designed to allow the accommodation of the fibers with a minimum bend radius of 30 mm throughout the whole system after installation.

2.2.5. The splicing organizer tray shall be hinge-able parts (or hinging tray) and accommodate the single splices up to 12 fibers per organizer tray. The tray holder belt or equivalent shall be also provided.

2.2.6. The splicing components mounting design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite with any types of FDF applications.

2.2.7. The splice protection sleeve holder/slot of the splice tray shall be able to hold the spliced fibers securely and shall not be loose at either vertical or horizontal alignment of the splice tray.

2.2.8. The bidder can propose the different design from as specified above which having better performance and easier-operation and it shall then be acceptable with requiring to maintain the maximum capacity 12 fibers/tray and shall able to be mounted in FDF housing.

2.3 Patching Area

The patching area as defined in this specification shall be required as follows:

General Requirements

2.3.1. The appearance of product shall be precise, elaborate and none of deformation,

sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.3.2. The patch panel shall be designed to be securely mounted in FDF housing. Patch panel mounting kit shall be provided.

2.3.3. The patch panel shall be designed for easy operation to access the connector for patching or other maintenance activities.

2.3.4. Protective color coating of the patch panel shall use powder color coating method with minimum thickness of 80 μm . The other color coatings than powder color coating are not allowable.

2.3.5. The whole patch panel area should be in same background color.

Specific Requirements

2.3.6. In case of FC/UPC connector used,

1) Through adaptor shall be the standard D-shaped, ceramic alignment sleeve. It shall be allow terminating with the same standard connector type of the manufacturer.

2) The patch panel hole for through adaptor shall be the standard D shape. To be easily accessed for patching and maintenance.

3) The minimum hole spacing of through adaptor (measured from center to center) in horizontal and vertical interval shall be 25 mm and 19 mm respectively. The minimum spacing below bottom row shall be 24 mm when measured up to center of the lowest row hole of the through adaptor. The minimum spacing between the last column hole and the inner edge of the patch panel shall be 24 mm as shown in figure 2. The spacing shall be designed based on easy-access to all connectors.

4) The patch panel capacity shall be equipped with through adaptor required according to table 2 (Ordering Information) which accommodate 12 fibers (6 rows x 2 columns), 24 fibers (6 rows x 4 columns or 12 rows x 2 columns) or maximum 48 fibers (12 rows x 4 columns). Running fiber count pattern shall be as per figure 2.

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2.3.7. In case of SC/UPC connector used,

1) Through adaptor shall be the standard square shaped, ceramic alignment sleeve. It shall be allow terminating with the same standard connector type of the manufacturer.

2) The patch panel hole for through adaptor shall be the standard square shaped. To be easily accessed for patching and maintenance.

3) The minimum hole spacing of through adaptor (measured from center to center) in the vertical interval shall be 25 mm which the horizontal interval shall be depends on the manufacturer design. The minimum spacing below bottom row shall be 24 mm when measured up to center of the lowest row hole of the through adaptor. The minimum spacing between the last column hole and the inner edge of the patch panel shall be 24 mm as shown in figure 3. The spacing shall be designed based on easy-access to all connectors.

4) The patch panel capacity shall be equipped with through adaptor required according to table 2 (Ordering Information) which accommodate 12 fibers (6 rows x 2 columns), 24 fibers (6 rows x 4 columns or 12 rows x 2 columns) or maximum 48 fibers (12 rows x 4 columns). Running fiber count pattern shall be as per figure 3. The number of columns can be different from as specified but each row shall be in even number of through adaptor.

3. MATERIAL REQUIREMENTS

3.1. Housing

3.1.1. Material: made of metal material shall be steel or aluminum or equivalent.

3.1.2. Housing thickness shall not be less than 1.5 mm

3.2. Splicing and patch panel area

3.2.1. Tray: Polycarbonate, PBT or ABS

3.2.2. Through adapter : Ni (nickel) plated brass or stainless steel (300 series grade) or better corrosion resistance material for metal part, and ceramic alignment sleeve.

3.2.3. Patch panel: made of same FDF housing material.

3.3. All metal hardware and metal part shall be resistant to the corrosive influences

they may encounter in normal use.

4. PERFORMANCE REQUIREMENTS

4.1. Through Adaptor Endurance

Each side of through adaptor shall be terminated and re-terminated with standard connector. Each side of through adaptor shall withstand a minimum mating/demating of 500 times after test check the appearance (as specified below). The attenuation and return loss change per connector before and after test shall be less than 0.2 dB and 2 dB respectively when used the 1310, 1550 nm source wavelength.

The appearance: the sample shall be examined with naked eyes for damage and the sample shall not appear the deformation, flaws, defects or cracks that could impair functionality.

4.2. FDF housing door Endurance

Each side of the FDF housing door shall be opened to its extreme position. This door shall then be closed again into its extreme position. This sequence shall be repeated 500 cycle times.

5. PRODUCT MARKING AND IDENTIFICATION

5.1. All major component of wall mounted FDF shall be marked with manufacturer trademark or name.

5.2. Identification label/marketing/card/card holder and record system for fiber routing, fiber count number or other necessary sign or detail in whole wall mounted FDF area shall be provided.

6. ORDERING INFORMATION

Table 2

Product Type	Capacity(fibers)	Packing
Wall mounted FC/UPC 12F	12	1 set/box
Wall mounted FC/UPC 24F	24	1 set/box
Wall mounted FC/UPC 48F	48	1 set/box
Wall mounted SC/UPC 12F	12	1 set/box
Wall mounted SC/UPC 24F	24	1 set/box

Wall mounted SC/UPC 48F	48	1 set/box
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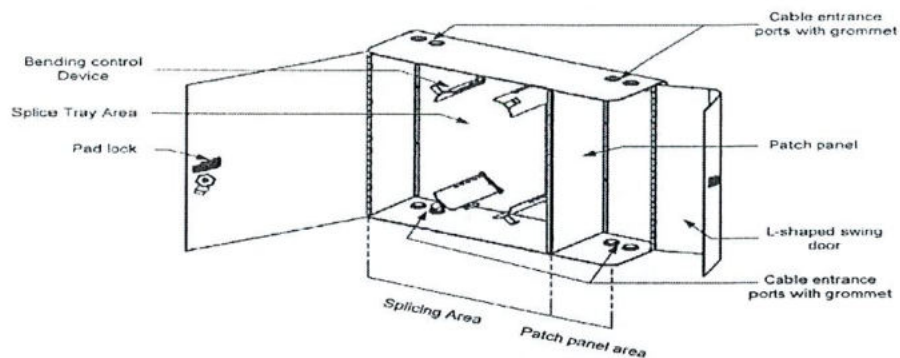


Figure 1 An example of a wall mounted FDF housing design

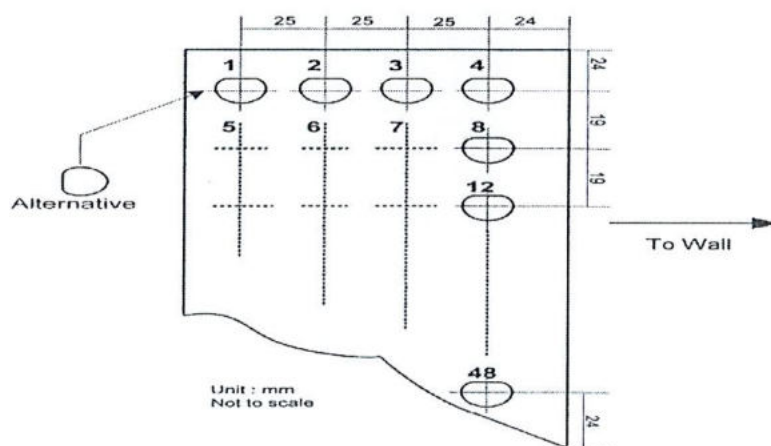


Figure 2 Typical FC patch panel of wall mounted FDF 48F (12 rows x 4 columns)
(minimum spacing required)

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FIBER DISTRIBUTION FRAME (FDF) FOR EXCHANGE (FDF for Exchange)

1. GENERAL

1.1. This specification covers the requirements of the fiber distribution frame (FDF) to be supplied intended to use for cross connection of fiber network in building.

1.2. This FDF shall be designed under indoor environmental condition which used in building. The primary design consideration of the FDF shall protect the optical fiber from environmental and mechanical stresses. The FDF required as this specification shall be in accordance with figure 1 to 3 or better design.

1.3. The fiber patch cord and pigtail used for this FDF specification shall be according to patch cord and pigtail specification.

1.4. Full details of this following information shall be provided in technical bidding proposal by bidder. Failure in this section the proposal shall be is qualified.

- Product specification and drawings (or pictures) of all product components issued by manufacturer.

- The material used and grade (or composite material) in detail for all components of product proposed.

- Pictures of fully loaded termination of FDF covering the rack, patching/splicing shelf (showing the wiring of splicing tray, connectorized pigtails, through adaptors and patch cords) and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.

2. Design and Feature

FDF required in this specification shall at least compose of followings:

- FDF Rack (herein after referred to as the "Rack") :
 - Enclosed Rack (Rack with cabinet), 19" rack size (482.6 mm)
 - Part of optical fiber cable (OFC) routing and OFC loose tube routing
 - Part of excess patch cord storage and patch cord routing



- Shelf Units (or may called sub-rack).
 - Patching/splicing shelf

The FDF proposed shall be designed in accordance with figure 1 (Dimension and allocation of FDF).

2.1. FDF Rack

2.1.1. The rack shall be the metal rack and shall be compliant with ETSI specification ETS 300 119-2 (Engineering requirement for rack and cabinet). The rack shall be enclosed in cabinet with swing double doors and meet the IP20 protection level according to IEC 60529. Its double doors shall be lockable, transparent and removable/re-assembling.

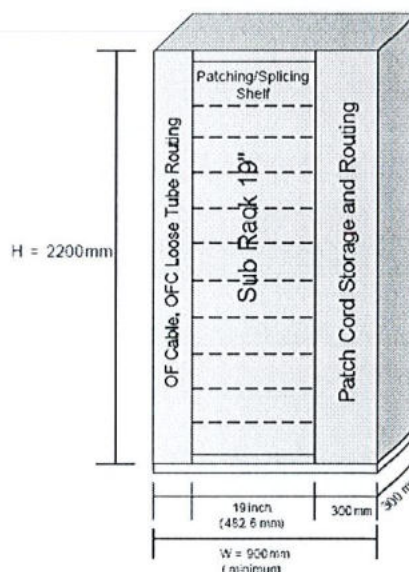


Figure 1 Dimension and allocation of FDF

2.1.2. The size of the enclosed rack shall be as follows:

- Height: 2,200 mm
- Width: 900 mm (minimum)
- Depth: 300 mm

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2.1.3. The rack design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite any kind of FDF application.

2.1.4. The rack shall be capable of being installed back to back, side to side or against the wall. No access from the rear or from either side. Since this is the floor type rack and 2.2 meters height for safety reason, the rack shall be provided the mounting hardware to secure and assure the FDF firmly installed with building floor or other available structures.

2.1.5. The rack shall have complete flexibility in patching from one side of the rack to the other, without the need to pre-calculate the individual cable lengths. Storage of excess length of patch cords shall be provided.

2.1.6. The rack shall permit easy access to cables, patch cords and pigtails during installation, maintenance and upgrade without removal the other existing shelf and without disturbing the systems already in service. The rack shall be only accessible from the FDF front side.

2.1.7. Optical fiber cables and patch cords shall be organized, stored and mechanically protected in the rack. Cables and patch cords shall be able to enter from the top or the bottom of the rack. Provision shall be made for the adequate protection and bend control of cables, patch cords and pigtails throughout the rack (called positive fiber management). A minimum bend radius of 30 mm shall be respected to all bend controls.

2.1.8. All critical bend positions of whole length of patch cord wiring, there shall be bend control devices which have curve surface structure. Hoop or ring or equivalent is not allowable to use for patch cord as such critical bend position.

2.1.9. Each individual units, its front panel controls and indicators shall be properly identified by simple symbols or labels in English or Thai.

2.1.10. The free location in rack or shelf units (for future extensions) shall be fitted with dust covers or dummy panels in order to prevent the shelf units from dust and improve the equipment appearance.

2.1.11. Protective color coating of the rack shall use powder color coating method with minimum thickness of 50 μm . The other color coatings than powder color coating are not allowable.

2.1.12. The rack (part of OF cable and OFC loose tube routing) shall be designed to allow the accommodation of the incoming/outgoing OFC up to 12 cables. The incoming/outgoing cable shall be handled by the break out unit to ensure the cable protection/management in between the rack unit to sub-rack unit. The incoming/outgoing cable shall be fitted into a cable attachment plate with cable clamp and then the cable loose tubes shall be distributed by cable break out unit device into the flexible tube before get into the shelf unit (splicing/patching shelf). All hardware concerned in this section shall be sufficiently provided to accommodate the in-out OFC as specified.

2.1.13. Standard kit content of the FDF rack shall be as follows:

- 1) Enclosed rack
- 2) Pre-mounted fiber wiring management component for all length of cable, OFC loose tube, patch cord, pigtail such as patch guide, patch drum, patch drum plate, cable hoop, bending control device etc. The fiber wiring management components shall also be sufficiently installed in cable/OFC tube routing and patch cord routing area.
- 3) Installation Instructions (at least 2 sets/FDF)
 - Fully in details of installation Instruction.
 - Drawings or pictures of fully loaded termination of FDF proposed and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.
- 4) Identification strips or marking of manufacturer
- 5) Identification label/markings/card/card holder and record system to identify the cables, patch cords, pigtails, fibers, station route and caution sign etc.
- 6) Cable termination system for instance: cable attachment plate with cable clamp, cable break out unit including cable gland and strength member fixations. The termination system component quantity shall also be sufficiently provided as specified.
- 7) Flexible tubing, transportation (protection) tube etc.

8) Earthing facility: connection of the metal parts to each other and a connection point to the building earthing, at least one (1) earthing point shall be provided in the rack, all metallic parts of the rack shall be electrically interconnected with this earthing point.

9) Cable shield ground facility

2.2. Shelf Units

The shelf units (may called sub-rack or patching/splicing shelf) as defined in this specification shall be required as follows:

General Requirements

2.2.1. The shelf units shall be of plug-in type and designed to be mounted in FDF rack (19") as specified in section 2.1.

2.2.2. The shelf unit requirement shall be the drawer (slide out) type or swing type. The splice magazine type or the connector module type is not allowable for this specification.

2.2.3. Manufacturing process and assembly of all shelf unit components shall use international industry standard. The appearance of product shall be precise, elaborate and none of deformation, sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.2.4. Protective color coating of the shelf unit housing shall use powder color coating method with minimum thickness of 50 μm . The other color coatings than powder color coating are not allowable.

2.2.5. The whole patch panel area and front cover at the front side of shelf should be in same background color.

2.2.6. The patching/splicing shelf shall be designed to put in the same shelf unit together, herein after called "patching/splicing shelf".

2.2.7. The patching/splicing shelf shall provide mechanical protection and storage of pigtails, fibers, splices, connectors and other passive optical devices in FDF rack.

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2.2.8. Through adaptor shall be ceramic alignment sleeve. It shall allow to terminate with the same standard connector type of the other manufacturer.

2.2.9. The shelf shall be designed to allow the accommodation of the fibers with a minimum bend radius of 30 mm throughout the whole system after installation.

2.2.10. Each patching/splicing shelf unit shall be fully covered with front cover (identification plate) when the shelf is in the extreme close position. Its front cover shall be hinge-able cover and inside of cover there shall be the label to note the fiber, routing details related to each fiber adaptor position on patching panel.

2.2.11. The splicing organizer tray shall be hinge-able parts (or hinging tray) and accommodate the single fusion splices up to 12 fibers per organizer tray and support the heat shrink splice protector (Sleeve size 60 mm). The tray holder belt shall be also provided.

2.2.12. The spacing on the pigtail side between the through adaptor and the splicing tray or fiber management devices, the spacing between those shall be kept the enough space to conveniently access all through adaptors, connectors and pigtails.

2.2.13. In case of FC/UPC connector used,

1) Each patching/splicing shelf capacity shall be equipped with through adaptor up to maximum 48 fibers (4 rows x 12 columns) and running fiber count as per figure 3

2) The patching panel shall be designed to be easy-removable to change the through adaptor from FC/UPC to be SC/UPC or LC without changing the major part of the shelf unit.

3) The patching panel hole for through adaptor shall be the standard D-shape. To be easily accessed for patching and maintenance, the minimum hole spacing of through adaptor (measured from center to center) in horizontal and vertical interval shall be 25 mm and 19 mm respectively. The minimum spacing below bottom row shall be 24 mm when measured up to center of lowest row hole of through adaptor hole as shown in figure 3.

2.2.14. In case of SC/UPC connector used

1) Each patching/splicing shelf capacity shall be equipped with through adaptor up to maximum 72 fibers (6 rows x 12 columns or other better allocations) and running fiber count as per figure 4.

2) The patching panel shall be designed for easy operation to access the connector for patching or other maintenance activities. The minimum spacing between through adaptors shall be in accordance with figure 4, except for the vertical spacing shall depend on manufacturer design based on easy-access to all connectors.

Specific Requirements

2.2.16. Design concept of patching access shall be only the front patching which is classified to be the shelf units as follows:

- 1) Drawer (slide out) type (as shown in figure 2)
- 2) Pivot or swing type (as shown in figure 3)

The bidder shall not propose combination of those two design concepts in one FDF. If not otherwise specified in TOR (Term of Reference), each bidder shall be able to propose both design concepts and bidding evaluation committee will considerate the design concept proposed to make decision what design concept should be selected.

2.2.17. In case of shelf unit with drawer (slide out) type proposal

- 1) The shelf unit design in general shall be referred to figure 2 for guideline.
- 2) The patching/splicing shelf unit shall consist of chassis with drawer and accommodate the mounting bracket for splicing trays, pigtail bend control devices, patching panel and identification front plate etc.
- 3) The patching/splicing shelf functionality shall be easy for operation. The drawer tray shall be securely locked by itself with the chassis while the drawer is opened by sliding out to its extreme position in order to prevent the shelf dropping down and also when the drawer tray is closed by sliding into its extreme position the drawer tray shall be securely locked by itself with the chassis.

2.2.18. In case of shelf unit with pivot or swing type proposal

- 1) The shelf unit design in general shall be referred to figure 2 for guideline.
- 2) The patching/splicing shelf unit shall at least consist of chassis with swing mechanism system, splicing trays, pigtail bend control devices, patching panel and identification front plate etc.
- 3) The patching/splicing shelf functionality shall be easy for operation. The drawer tray shall be securely locked by itself while the drawer is opened by swing out (swing to right side of operator) to its extreme position (90 degree) in order to prevent the shelf moving and also when the drawer tray is closed by sliding into its extreme position the drawer tray shall be securely locked by itself.
- 4) The patching/splicing shelf shall be designed to support the full load of its application without obstruction to swing-out and swing the patching/splicing shelf. The swing mechanism system shall be installed to strengthen the supporting of shelf-weight and its loads through the product service life.

2.2.19. The bidder can propose the different patching/splicing shelf design from as specified above which having better performance and easy operation than requirements in this specification and it shall then be acceptable requiring to maintain the maximum capacity of 48 fibers/shelf and 72 fibers/shelf within 3U (maximum) height shelf for FC and SC connector respectively.

3. Material Requirements

3.1. Rack

3.1.1. Material: made of metal material shall be steel or aluminum or equivalent. Non-metal material shall be allowable.

3.2. Shelf Units

3.2.1. Patching/Splicing shelf

1) Drawer: metal material chassis shall be steel, aluminum or equivalent and non-metal material shall be allowable.

2) Tray: Polycarbonate, PBT or ABS

3) Through adaptor: Ni (nickel) plated brass or stainless steel (300series grade)

or better corrosion resistance material for metal part, and ceramic alignment sleeve.

3.2.2. Dummy panel (if any)

1) Drawer: metal material shall be steel, aluminum or equivalent and non-metal material shall be allowable.

3.3. All metal hardware and metal part shall be resistant to the corrosive influences they may encounter in normal use.

4. Product Marking and Identification

4.1. All major component of FDF shall be marked with manufacturer trademark or name.

4.2. Identification label/markings/card/card holder and record system for fiber routing, fiber count number or other necessary sign or detail in whole FDF area shall be provided.

5. Ordering Information

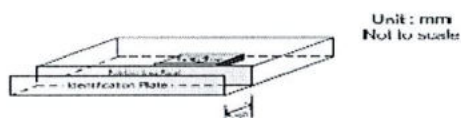


Figure 2 typical patching/splicing shelf unit

* Note: This figure 2 intend to explain the spacing between a patching panel and an identification plate and guide the general design of patching/splicing shelf.

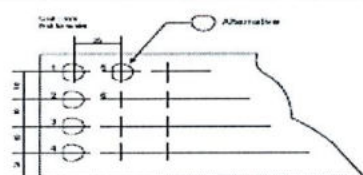


Figure 3 Typical FC patch panel of shelf unit (minimum spacing required)

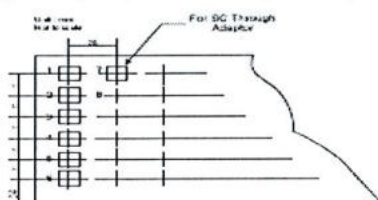


Figure 4 Typical SC patch panel of shelf unit (minimum spacing required)

SINGLE MODE FIBER PATCH CORD AND PIGTAIL

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(FC/UPC, SC/UPC, LC/UPC)**1. GENERAL**

1.1. This specification covers the requirements of the standard patch cord and pigtail to be supplied

1.2. The patch cord shall be used for optical fiber jump ring between FDF (Fiber Distribution Frame) on patching panel and equipment. The pigtail application shall be used to splice at non-connector end with incoming cable and another end of pigtail coupling with connector shall be terminated to patching panel of FDF.

1.3. This patch cord and pigtail shall be designed under indoor environmental condition which used in building. The primary design consideration of the cable shall protect the optical fiber from environmental and mechanical stresses. The patch cord and pigtail required as this specification shall be in accordance with Figure 1 to 17.

1.4. Abbreviation;

FC/UPC: Fiber Connector / Ultra polished Physical Contact.

SC/UPC: Subscription channel Connector / Ultra polished Physical Contact.

LC/UPC: Lucent / ultra polished Physical Contact.

1.5. Full details of this following information shall be provided in technical bidding proposal by bidder, Failure in this Section (1.4) the proposal shall be disqualified.

- Product specification issued by manufacturer including specification of fiber cord, pigtail, connector kit etc.

- The material used and grade (or composite material) in detail for all components of product proposed.

2. Specific Requirements

The patch cord and pigtail shall compose of fiber cord (cable) and connector kit assemblies as shown in Figure 1 to Figure 17.

2.1. Fiber Cord requirements



2.1.1. Fiber Characteristics

All fiber characteristics of the fiber cord shall be, at least, in accordance with the ITU-T Recommendation G.652.D, Single Mode Optical Fiber Cable and shall be as follows.

Cladding Diameter: $125\ \mu\text{m} \pm 1\ \mu\text{m}$

Core-Clad Concentricity Error: $\leq 0.5\ \mu\text{m}$

Cladding Non-Circularity: $\leq 1.0\%$

Mode Field Diameter @ 1310 nm: $9.2\ \mu\text{m} \pm 0.4\ \mu\text{m}$

Cable Cut-Off Wavelength (λ_{cc}): $\leq 1260\ \text{nm}$

Attenuation Coefficient:

$\leq 0.35\ \text{dB/km @} 1310\ \text{nm}$

$\leq 0.35\ \text{dB/km @} 1383\ \text{nm}$

$\leq 0.21\ \text{dB/km @} 1550\ \text{nm}$

$\leq 0.23\ \text{dB/km @} 1625\ \text{nm}$

Maximum Attenuation with -

macrobending 2 turns 30 mm radius: $\leq 0.10\ \text{dB @} 1550\ \text{nm}$

2.1.2. Fiber Cord Physicals

Structure & Materials:

Outer jacket and boot: Polymer or polyethylene (PE) filled with FR (Flame Retardant, UL94-V0), or LS (Low smoke) and ZH (Zero Halogen or Halogen Free), fiber cord jacket overall diameter of FC, SC and LC shall be 2.4 mm, 2.0 mm and 2.0 mm respectively, boot shall be designed to be applicable for cord strain relief.

Jacket color: Yellow.

Boot color: Yellow for FC /UPC, Blue for SC/UPC and Grey for LC/UPC

Strain relief: Aramid yarns (fully completely cover around the tight buffer, no adhesion to jacket or buffer tube), as Figure 1.

Tight buffer tube: Jelly free, tight buffer tube $\varnothing 900\ \mu\text{m}$ (0.9 mm), non-bucking, made from TPE (Thermo plastic elastomer) or PBT (Polybutylen

terephthalate) or PA (Polyamide) or equivalent, filled with FR (Flame Retardant, UL94-V0), in Yellow color.

2.2. Connector Kit Assembly Requirements

Connector kit assembly shall be at least composed of followings:

FC/UPC: connector body (housing), strain relief crimp, connector key, ferrule and dust cap (cover).

SC/UPC, LC/UPC: connector body (housing), connector subassembly, strain relief crimp, ferrule and dust cap (cover).

Note: In case of duplex connector (SC, LC), the connector body (housing) shall be duplex clip connector.

2.2.1. Materials

1) Metallic materials

All metallic parts of connector kit assembly shall be resistant to the corrosive influences they may encounter in normal use. If stainless steel used, it shall be made of 300 series stainless steel or better corrosion resistance material. The metallic part of galvanized steel or other steel materials that have corrosion resistance property lower than 300 series stainless steel are not allowable.

2) Plastic materials

All plastic parts of connector kit assembly (except dust cap) shall be made of flame retardant material.

2.2.2. Specific materials

1) FC/UPC

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Connector body: Ni (nickel) plated brass or stainless steel (300 series grade) or better corrosion resistance material.

Ferrule: Zirconia Ceramic.

2) SC/UPC,LC/UPC

Connector body: PBT material with Flame Retardant or equivalent plastic material.

Ferrule: Zirconia Ceramic.

3 Marking

3.1 The patch cord shall be marked on the connector or the boot or the fiber cord (jacket) with manufacturer's name or trademark.

3.2 The patch cord jacket shall be provided length marking at intervals of approximately 1 meter along the whole patch cord length. The accuracy of the measurement of length marking shall be held within the limits of $\pm 1\%$.

3.3 The patch cord jacket identification marking. Each length marking interval, the identification marking shall be permanently identified as the followings:

- Customer name
- Manufacturer name or trade mark
- Date month and year (C.E) of fiber cord manufacture or finished product manufacture
- Type of fiber and jacket, O.D. such as SMOF ... PE-FR-LS-ZH, O.D. etc.

3.4 For traceability purpose, necessary information shall be placed on the patch cord for instance: - the trace label etc.

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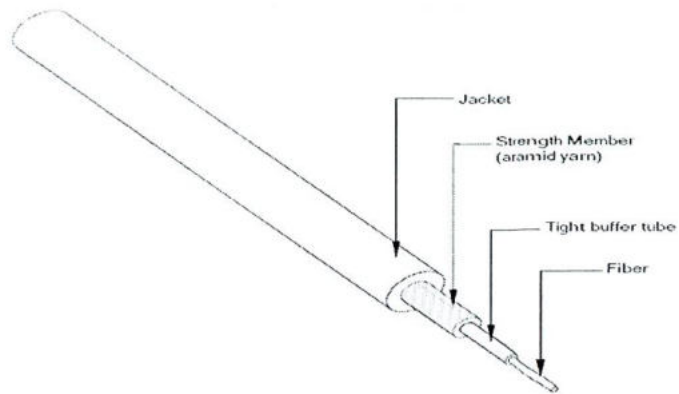


Figure 1 Cable Structure of Single Mode Fiber Patch Cord

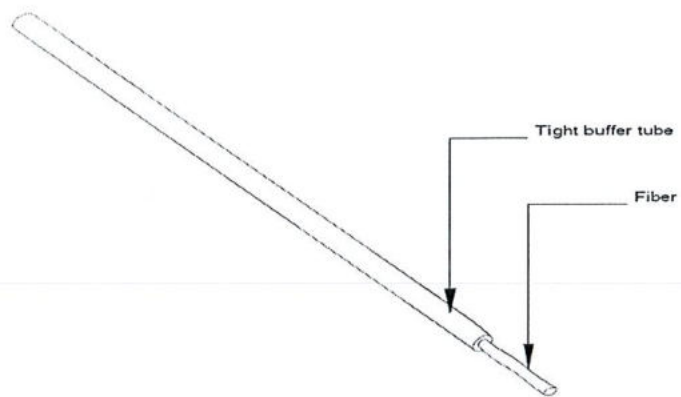


Figure 2 Cable Structure of Single Mode Fiber Pigtail

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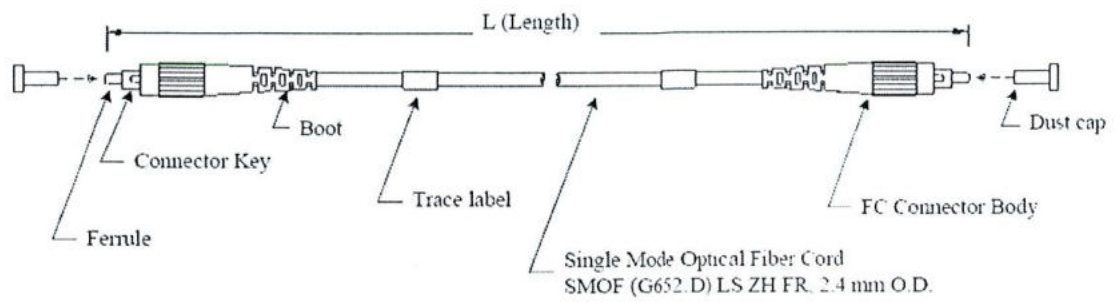


Figure 3 FC to FC Single Mode Fiber Patch Cord

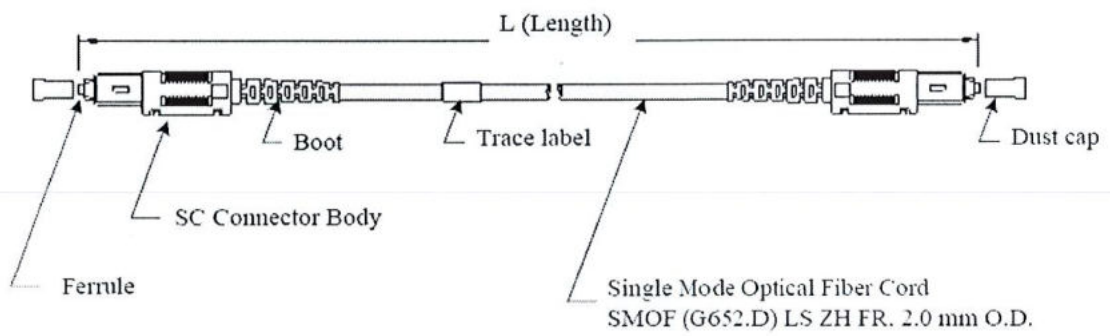


Figure 4 SC to SC Single Mode Fiber Patch Cord

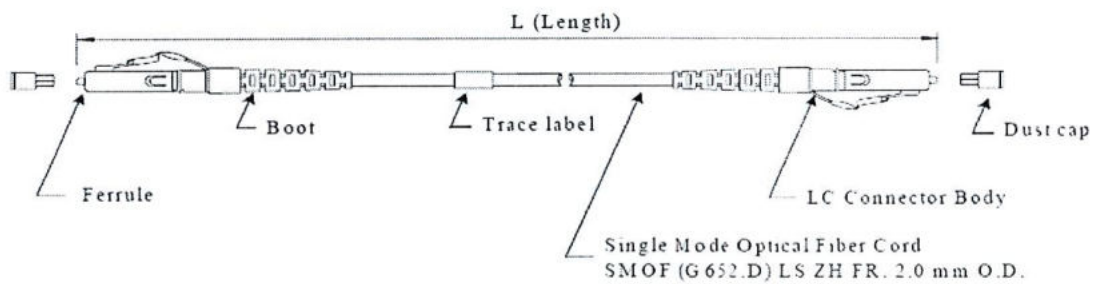


Figure 5 LC to LC Single Mode Fiber Patch Cord

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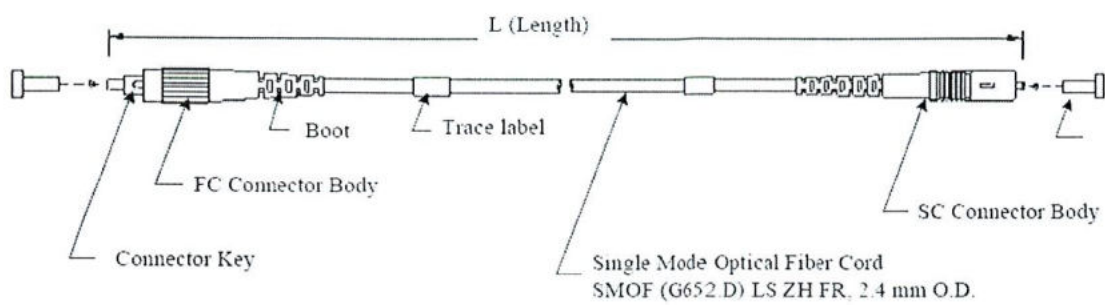


Figure 6 FC to SC Single Mode Fiber Patch Cord

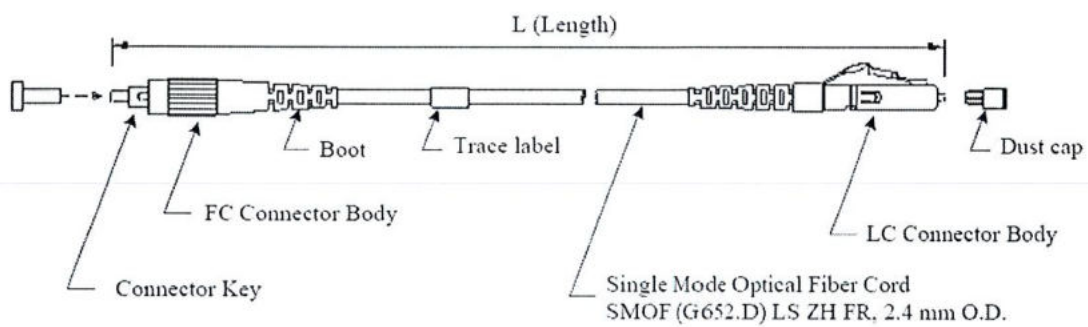


Figure 7 FC to LC Single Mode Fiber Patch Cord

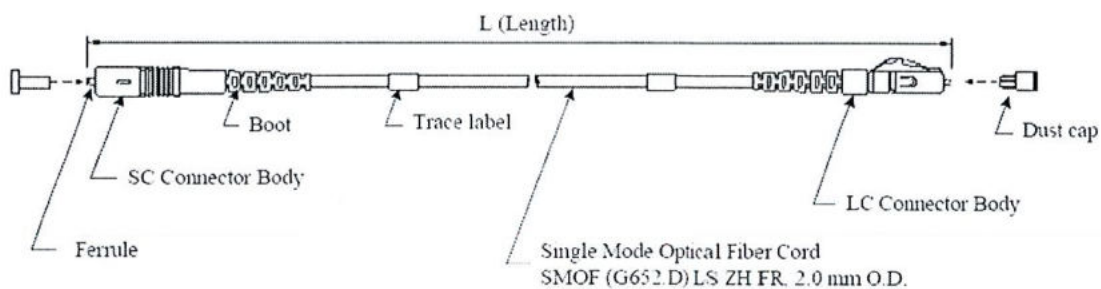


Figure 8 SC to LC Single Mode Fiber Patch Cord

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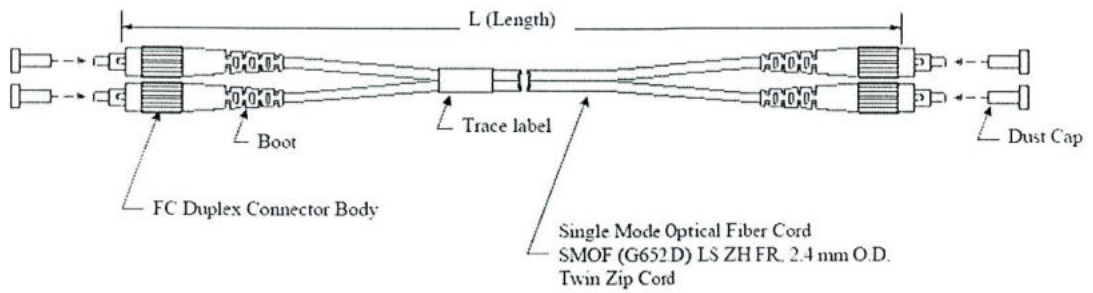


Figure 9 FC to FC Single Mode Fiber Patch Cord Duplex

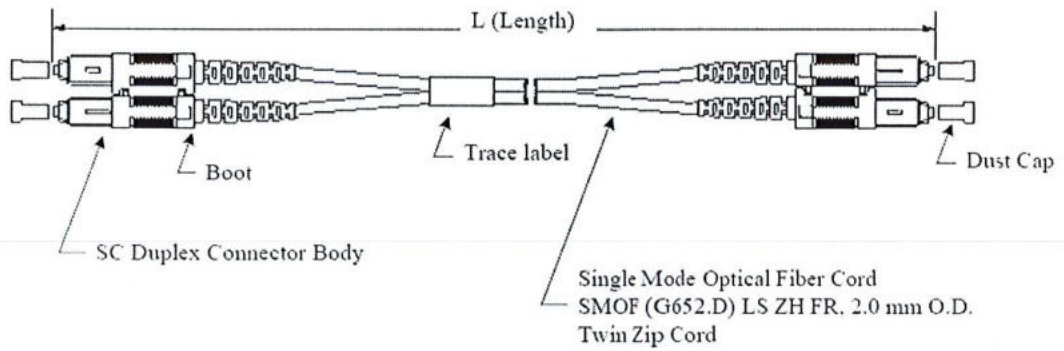


Figure 10 SC to SC Single Mode Fiber Patch Cord Duplex

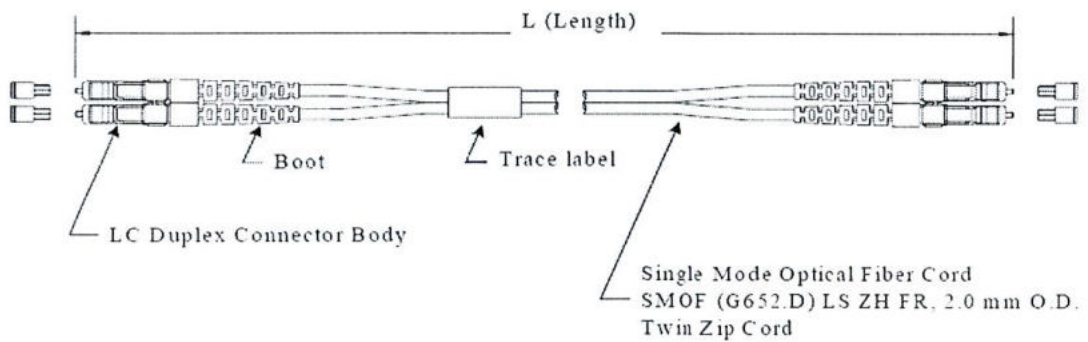


Figure 11 LC to LC Single Mode Fiber Patch Cord Duplex

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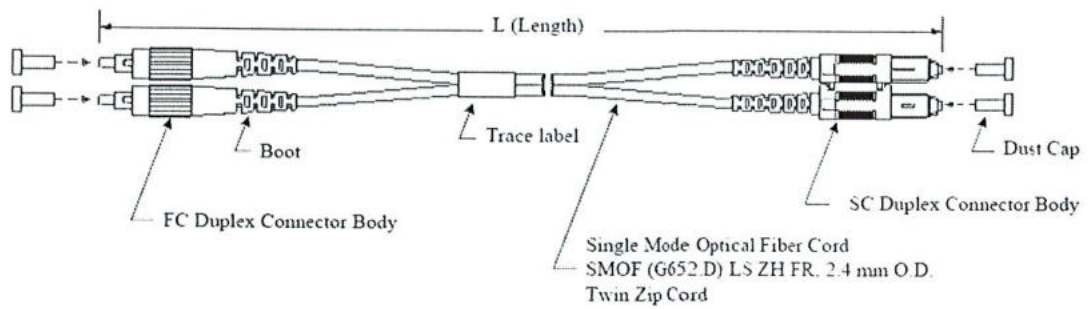


Figure 12 FC to SC Single Mode Fiber Patch Cord Duplex

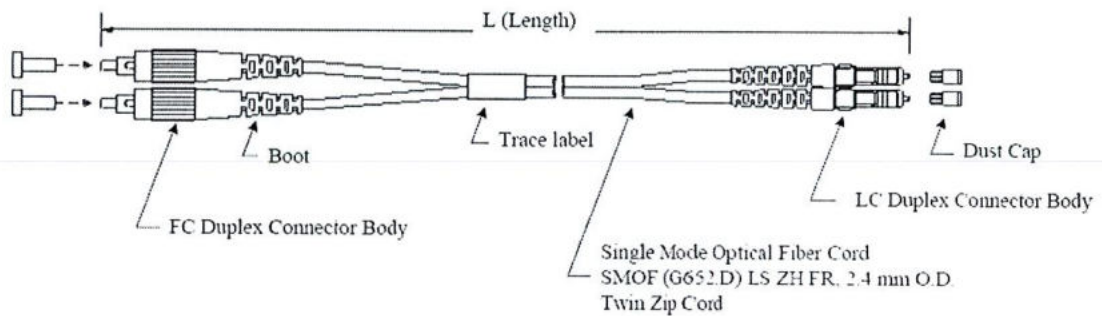


Figure 13 FC to LC Single Mode Fiber Patch Cord Duplex

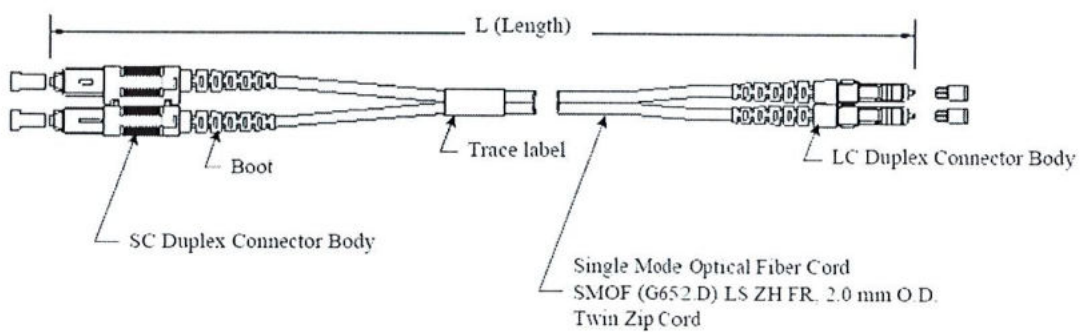


Figure 14 SC to LC Single Mode Fiber Patch Cord Duplex

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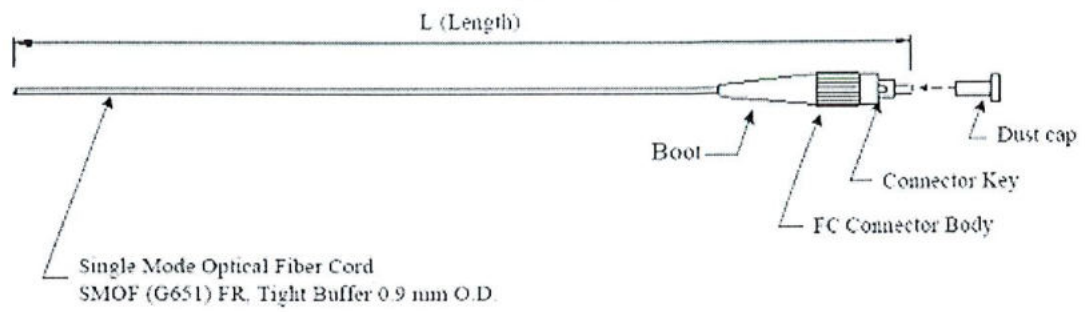


Figure 15 FC Single Mode Fiber Pigtail

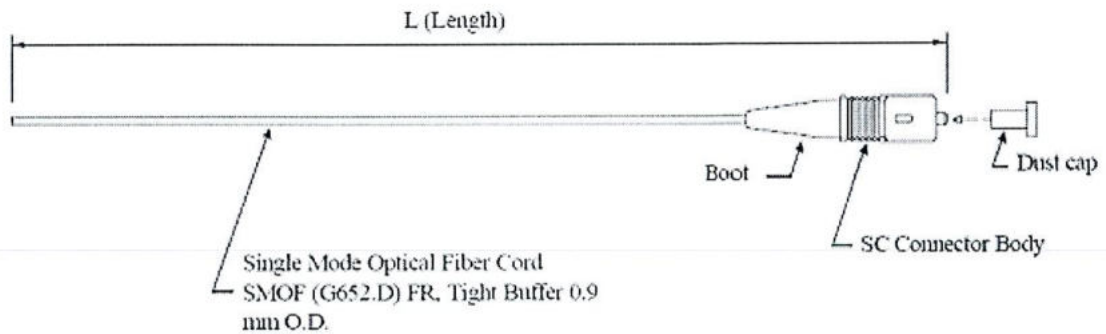


Figure 16 SC Single Mode Fiber Pigtail

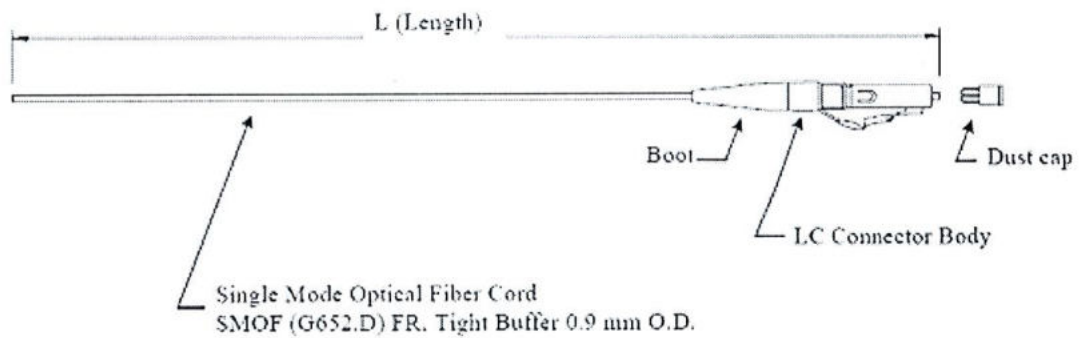


Figure 17 LC Single Mode Fiber Pigtail

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เอกสารแนบ 4 ข้อกำหนดการบำรุงรักษาส่วนสนับสนุนการบริหารจัดการบำรุงรักษาโครงข่าย

ข้อกำหนดการบำรุงรักษาส่วนสนับสนุนการบริหารจัดการบำรุงรักษาโครงข่าย

ผู้รับจ้างต้องบำรุงรักษาระบบส่วนสนับสนุนการบริหารจัดการบำรุงรักษาโครงข่ายของ สป.อว สำหรับการบริหาร Help Desk ของ Network Operating Center-NOC ให้สามารถใช้งานได้ มีรายละเอียดดังนี้

1. ผู้รับจ้างจะต้องบำรุงรักษาระบบเฝ้ามองและแสดงสถานะเครือข่าย (Network Monitoring System) ของ สป.อว ใช้งานอยู่เดิม ที่มีคุณสมบัติดังนี้
 - 1.1 สามารถตรวจสอบและแสดงสถานภาพของอุปกรณ์ ในโครงข่ายได้อย่างน้อย 3,900 อุปกรณ์
 - 1.2 สามารถตรวจสอบและแสดงสถานภาพการเชื่อมต่อระหว่าง Router/Switch ในโครงข่ายได้
 - 1.3 เป็น web-based technology ที่ผู้ใช้งานสามารถเรียกดูผ่าน web browser
 - 1.4 สามารถกำหนดสิทธิ (Privilege) ให้กับผู้ใช้งานเป็นรายคนได้
 - 1.5 รายงานต่าง ๆ ต้องสามารถ export เป็นแฟ้มข้อมูลแบบ pdf และ MS Excel
 - 1.6 สามารถแสดงสถานภาพของอุปกรณ์ Router/Switch โครงข่าย (Network Topology) โดยแสดงสถานะอุปกรณ์ได้บนหน้าจอแบบ Visio
 - 1.7 สามารถตรวจสอบและแสดงสถานภาพของอุปกรณ์ DWDM ซึ่งเชื่อมต่อการทำงานร่วมกับระบบ U2000 และแสดงสถานะอุปกรณ์ได้บน อย่างน้อยดังนี้
 - 1.7.1 สถานะ up/down ของอุปกรณ์และการเชื่อมต่อระหว่างอุปกรณ์
 - 1.7.2 สามารถแสดงระดับค่าสูญเสีย Receive Power ได้
 - 1.8 สามารถจัดทำรายงานประจำวันประจำเดือนแบบอัตโนมัติและแจ้งผู้ใช้งานทาง e-mail โดยแนบไฟล์รายงานมาด้วย
 - 1.9 สามารถแสดงผลภาพรวมสถานะของอุปกรณ์เครือข่ายในระดับประเทศ ระดับจังหวัด อำเภอและตำบลได้
 - 1.10 สามารถแสดงรายละเอียดที่เป็นส่วนของ Status, Event, Inventory Map และ Top N ในรูปของ Dashboard ได้
 - 1.11 สามารถใช้งานระบบเฝ้ามองและแสดงสถานะเครือข่าย (Network Monitoring System on Mobile) บนอุปกรณ์พกพาเคลื่อนที่ได้
 - 1.12 สามารถทำรายงานการใช้งาน Bandwidth ต่ำสุด - สูงสุด ของสถานศึกษา ในแบบรายวันและรายเดือนได้ จำนวนอย่างน้อย 1,300 interface
 - 1.13 สามารถทำ Data Analytics เช่น Predictive Performance Analytics ได้
 - 1.14 สามารถวิเคราะห์และออกรายงานพฤติกรรมการใช้งานเครือข่าย (Net Flow) ของ Interface ได้อย่างน้อย 100G port, 10G port และ 1G port
 - 1.15 สามารถแสดงและแจ้งเตือนกรณีที่มีลูกข่าย Down ต่อเนื่องเป็นเวลานานเกินกว่าที่กำหนด และมี Filter+ Textbox ให้ใส่ข้อความ Remark เพื่อ Acknowledge ได้

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เอกสารแนบ 4 ข้อกำหนดการบำรุงรักษาส่วนสนับสนุนการบริหารจัดการบำรุงรักษาโครงข่าย

- 1.16 ระบบสามารถเปิด Application Programming Interface (API) ให้ระบบอื่นของสำนักงานฯ เรียกดูข้อมูลได้
2. ระบบบริหารจัดการและเก็บข้อมูลการซ่อมบำรุง (Trouble Ticket Online) มีคุณสมบัติรองรับการใช้งานขั้นต่ำ ดังนี้
 - 2.1 ระบบสามารถรับข้อมูลการแจ้งเตือนจากระบบเฝ้ามองและแสดงถึงสถานะเครือข่าย (Network Monitoring System) ได้
 - 2.2 สามารถรับการแจ้งซ่อมบำรุงจากการป้อนข้อมูลลงโปรแกรมจากระบบอัตโนมัติและจากเจ้าหน้าที่ได้
 - 2.3 สามารถตรวจสอบสถานะและป้อนข้อมูลประกอบการแจ้งซ่อมบำรุงได้
 - 2.4 สามารถบันทึกและจัดเก็บข้อมูลการเปิดการแจ้งซ่อมได้และแจ้งข้อมูลการแจ้งซ่อมให้กับผู้ปฏิบัติงานทาง e-mail ได้
 - 2.5 สามารถบันทึกและคำนวณเวลาที่ใช้จริงตามข้อตกลงระดับการให้บริการ (Service Level Agreement/SLA) ได้
 - 2.6 รายงานต่าง ๆ ต้องสามารถ export เป็นแฟ้มข้อมูลแบบ pdf และ MS Excel
 - 2.7 สามารถบันทึกข้อมูลการซ่อมบำรุงผ่านอุปกรณ์พกพาเคลื่อนที่ (Service Desk on Mobile) ได้ รวมถึงจัดหาสิทธิการใช้งานให้สามารถใช้งานได้อย่างน้อย 100 อุปกรณ์ พร้อมๆกัน
 - 2.8 สามารถค้นหาเหตุขัดข้อง (Incident) โดยแยกตามพื้นที่เกิดเหตุเสียได้
 - 2.9 สามารถตรวจสอบการแจ้งเหตุขัดข้อง (Incident) ซ้ำกันบนระบบได้
 - 2.10 สามารถแสดงผลแบบ BI โดยแสดงผลในสถานะปัจจุบันและแยกเป็นรายโซนได้
 - 2.11 สามารถออกรายงานแบบราย Incident โดยให้สามารถมีรูปที่อยู่ในข้อมูลการซ่อมบำรุงแสดงมาด้วย
 - 2.12 มีหน้า Portal เพื่อรองรับผู้ใช้งาน (user) สำหรับเข้ามาลงทะเบียนขอบัญชีผู้ใช้งานได้ด้วยตนเอง (User self-registration)
 - 2.13 ระบบสามารถส่ง Notification ผ่านทาง Line Application เข้าทาง Line Group ได้เป็นอย่างดี เพื่อแจ้งให้ทราบว่า มี New Case/Ticket, Overdue SLA, Escalate Case/Ticket
 - 2.14 ระบบที่ผู้รับจ้างเสนอต้องเปิด Application Programming Interface (API) ให้ระบบอื่นของสำนักงานฯ เรียกดูข้อมูลได้

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การบำรุงรักษาสวนสนับสนุนการบริหาร Help Desk สำหรับใช้งานร่วมกับระบบบริหารจัดการเครือข่าย
ของสำนักงานควบคุมและบริหารโครงข่าย (Network Operating Center)

ผู้รับจ้างต้องบำรุงรักษาระบบสวนสนับสนุนการบริหารจัดการบำรุงรักษาโครงข่ายของ สป.อว ใช้งานอยู่
เดิม ที่มีคุณสมบัติดังนี้

1. ระบบโทรศัพท์แบบ IP Telephony รองรับการใช้งานดังนี้
 - 1.1 สายนอกแบบ ISDN ไม่น้อยกว่า 30 วงจร และวงจรสายใน แบบ H.323 ไม่น้อยกว่า 20 วงจร
 - 1.2 เครื่องโทรศัพท์ IP Phone สำหรับเจ้าหน้าที่ และหัวหน้างานรวมทั้งสิ้นจำนวน 30 ชุด
 - 1.3 เครื่องโทรศัพท์ IP Phone สำหรับเจ้าหน้าที่ทั่วไป (Back Office) จำนวน 50 ชุด พร้อม Adapter สำหรับ IP Phone จำนวน 50 ชุด
 - 1.4 อุปกรณ์ L2 Network Switch จำนวน 1 ชุด
2. ส่วน Multimedia Contact Center ประกอบด้วยระบบต่างๆดังต่อไปนี้
 - 2.1 สามารถกระจายสายแบบอัตโนมัติ (Automatic Call Distribution - ACD)
 - 2.2 สามารถรองรับการใช้งานเชื่อมต่อ Facebook Inbox
 - 2.3 ต้องมีเครื่องมือที่ใช้ในการออกแบบ Call Flow (Design Tool) แบบ GUI (Graphic User Interface)
 - 2.4 ส่วนบริการข้อมูลอัตโนมัติ (Interactive Voice Response-IVR)
 - 2.5 มีระบบ Outbound Campaign
 - 2.6 รองรับการโทรออกแบบ Progressive และ Preview
 - 2.7 สามารถ Import ข้อมูลลูกค้าที่ต้องการโทรออกเพื่อสร้างเป็น Campaign ได้ในรูปแบบ Text file, CSV file หรือผ่าน ODBC ได้
 - 2.8 สามารถกำหนด Campaign ได้หลากหลายเงื่อนไข เช่น กำหนดวันเวลาเริ่มต้น หรือสิ้นสุด กำหนดให้ Repeat Call ได้ กำหนดให้มีการ Recall โดยกลับมาที่พนักงานรับสายคนเดิม หรือกลุ่มเดิมได้
 - 2.9 สามารถตั้งค่าความสำคัญ (Priority) ในการโทรออกได้ โดยดูจาก Prefix ของเลขหมาย โทรศัพท์ หรือจาก Campaign ได้
 - 2.10 สามารถบันทึกผลการโทรออกได้หลากหลาย และสามารถเลือกข้อมูลเดิมมาดำเนินการต่อได้ เช่น เลือกผลที่โทรไม่ติดมาโทรซ้ำ เป็นต้น
 - 2.11 มีเครื่องมือในการบริหารจัดการ Campaign แบบ GUI ซึ่งสามารถจัดการ Campaign ได้แบบ Real Time
3. ส่วนบันทึกเสียง (Voice Recorder)
4. ระบบสามารถแสดงผล Dashboard ในรูปแบบ Web-based โดยสามารถเรียกดูหรือแสดงผลได้บนจอมอนิเตอร์ และจัดหา Supervisor License ให้เพียงพอต่อการใช้งาน