



Kursus Rekabentuk Sistem ICT & Telefon (Asas)

Kursus Asas Rekabentuk ICT & Telefon



- ☐ Kursus ini dilaksanakan bagi memberi **pengetahuan asas rekabentuk** berkaitan sistem ICT dan Telefon



- ☐ Peserta kursus **memahami asas rekabentuk** Infrastruktur ICT dan Telefon dalam melaksanakan projek;
- ☐ Meningkatkan **kompetensi** peserta (Band 2) dalam menjalankan tugas-tugas mengikut Akta, Piawaian dan Garis Panduan yang berkaitan.



Kandungan Kursus

- Pengenalan
- Perancangan Projek
- Proses-proses Rekabentuk
- Latih Amal

CONTENT





Pengenalan



Definisi Infrastructure ICT & Telefon

Infrastruktur rangkaian *Information & Communication Technology* (ICT) dan Telefon yang terdiri daripada pendawaian, perkakasan dan perisian yang berkaitan.



Tujuan Pemasangan

Memenuhi keperluan pengguna di dalam premis untuk **berkomunikasi**, **akses kepada Internet** dan **capaian kepada aplikasi-aplikasi di dalam talian** yang berkaitan dengan pantas berkualiti dan selamat.

Aplikasi : email 1govuc, HRMIS, laman sesawang agensi kerajaan dll)





Perancangan Projek



Keperluan Rekabentuk

- Keperluan Pelanggan & Objektif
- Kajian Tapak
- Terminologi
- Standard & Garis Panduan
- Konsep Rekabentuk
- Penyediaan Anggaran Awalan
- Keperluan Ruang ICT & Telefon



Keperluan Pelanggan & Objektif

Objektif keperluan rangkaian

- Maktab – pengajaran & pembelajaran
- Hospital – proses automasi perkhidmatan pesakit

Penentuan keperluan kritikal

- Maktab – Bahan bacaan online
- Hospital – Keputusan ujian darah online

Anggaran bilangan pengguna

Jenis pengguna rangkaian

- Maktab – pelajar
- Hospital – doktor & pekerja
- Gunasama – jabatan-jabatan kerajaan



Lawatan Tapak Bersama ISP/Telekom

- a. Pegawai dari ISP/TELEKOM yang perlu hadir
 - i. Pegawai Sales Tempatan
 - ii. Wakil Pegawai Access Network Development (TM sahaja)
- b. Tujuan lawatan
 - i. Mendapatkan kelulusan kebenaran merancang
 - ii. Mengenalpasti status infrastruktur sedia ada ditapak @ infrastruktur baru
 - iii. Mengenalpasti jenis infrastruktur (jenis talian & rangkaian) ; PRI, HSBB etc
 - iv. Mengenalpasti laluan kabel sedia ada (bawah tanah @ overhead)
 - v. Mengenalpasti manhole ISP yang terdekat serta laluan yang sesuai
 - vi. Mengenalpasti pegawai ISP yang bertanggungjawab kepada kelulusan infrastruktur
- c. Dokumen yang perlu disediakan:
 - i. Lukisan cadangan laluan manhole & ducting bersama surat Permohonan Kelulusan Pelan Cadangan sebanyak 4 salinan

**** Contoh surat maklumbalas TM**

Nota: Keperluan dokumen tambahan seperti lukisan terperinci tidak boleh dikemukakan kepada pihak ISP kerana belum melalui proses perolehan

Lawatan Tapak Projek Bersama Pihak Pelanggan

- a. Pegawai Yang perlu hadir
 - i. Pegawai Pembangunan kementerian / jabatan berkaitan
 - ii. Pegawai Bahagian Teknologi Maklumat Pelanggan & pegawai senggara
 - iii. Wakil pengguna
 - iv. Wakil JKR Elektrik Negeri
- b. Tujuan:
 - i. Projek baru
 - a. Mendapatkan keseluruhan perancangan skop ICT daripada pihak pelanggan
 - b. Mengenalpasti keadaan tapak (bentuk muka bumi)
 - c. Mengenalpasti keperluan pelanggan
 - ii. Naiktaraf & blok tambahan
 - a. Mendapatkan keseluruhan perancangan skop ICT daripada pihak pelanggan
 - b. Mengenalpasti infrastruktur & lain-lain sistem sedia ada di dalam kawasan premis pelanggan yang berkaitan dengan skop projek
 - c. Mengkaji & Mengenalpasti status @ keadaan semasa infrastruktur & sistem sedia ada
 - d. Membincangkan tindakan susulan perlu di ambil (mengganti /mengalih
/ melupus/ menaiktaraf)

Latih Amal – Sila kemaskini maklumat berikut:

1. Nama Kumpulan
2. Ahli kumpulan
3. Projek
4. Objektif rangkaian
5. Keperluan Arkitek
6. Elektrik
7. Mekanikal





Bersambung.....



Terminologi

- ☐ Horizontal Cable
- ☐ Vertical Cable
- ☐ Backbone Cable
- ☐ Telecommunication Closet Room (TCR)



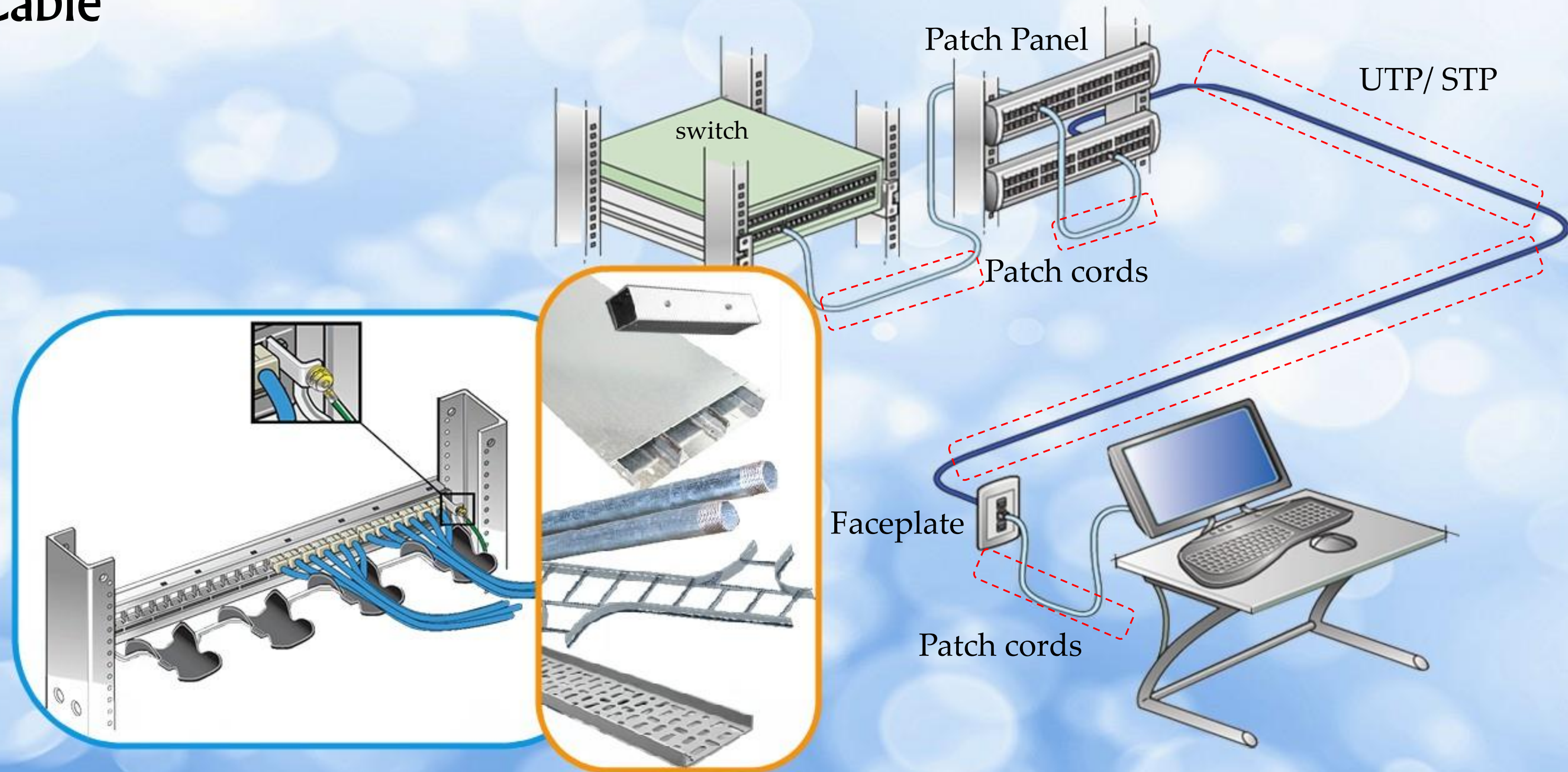
Terminologi

❑ Horizontal Cable

Cabling from the switch to the faceplate / data point (work area)

Consist of :

- ✓ Patch cords
- ✓ Patch Panel
- ✓ Twisted Pair (UTP/STP) cable
- ✓ RJ45 modular jack
- ✓ Faceplate



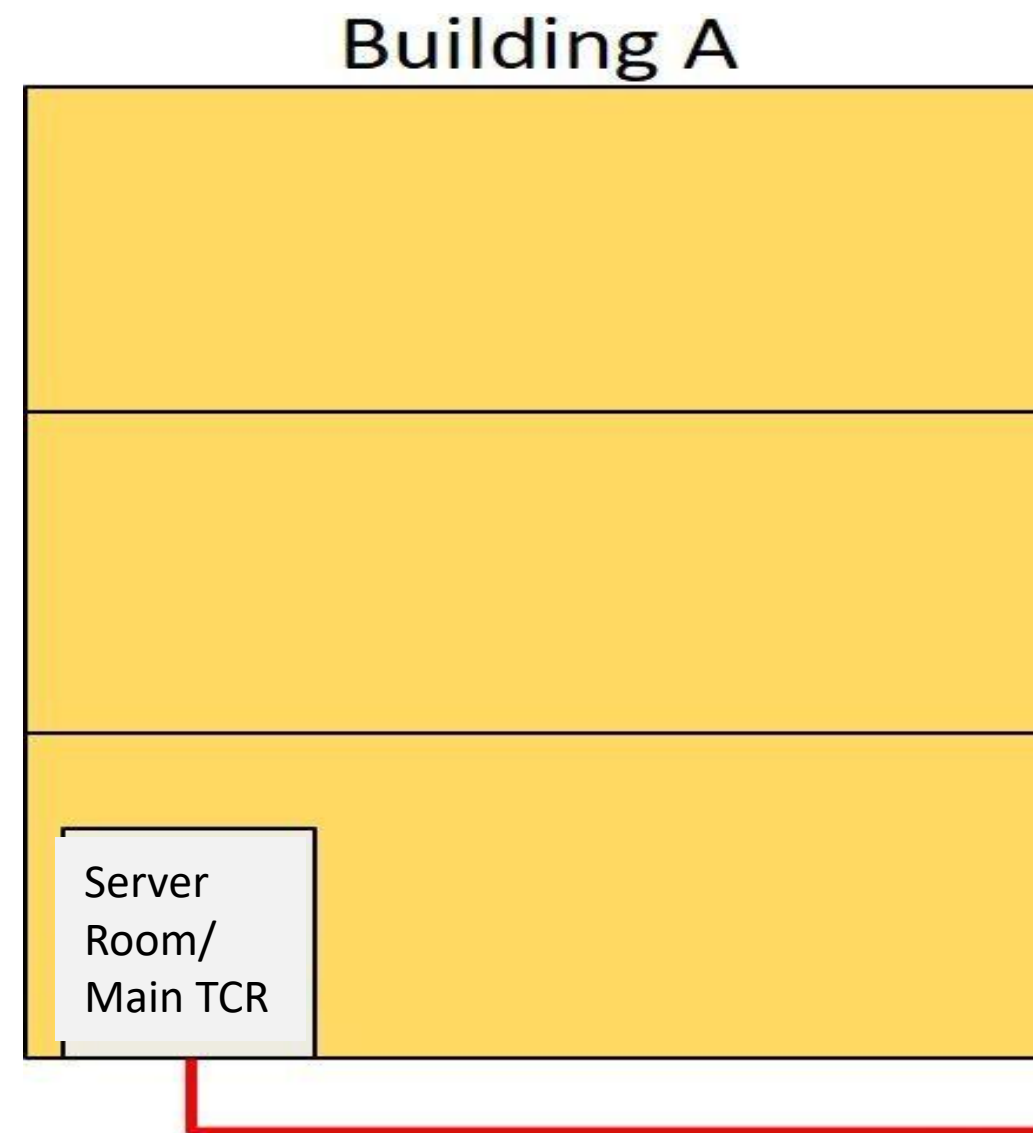
Terminologi

❑ Backbone Cable

Cabling between **switch (core/distribution)** to another in the different building.

Consist of :

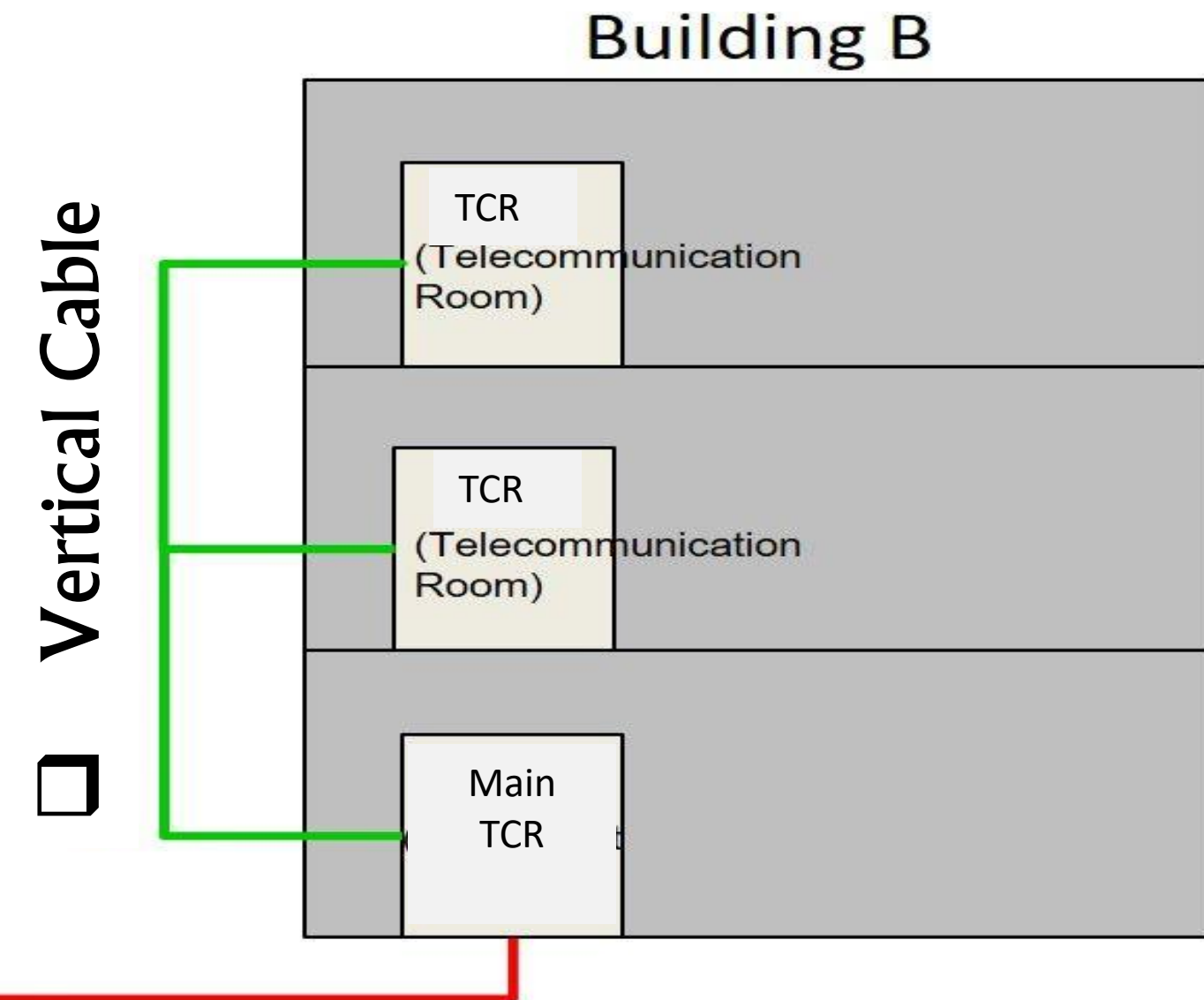
- ✓ Patch cords
- ✓ Fiber optic cable (SM/MM)
- ✓ Splicing Cassette
- ✓ Patch Panel
- ✓ SC/LC connector



❑ Backbone Cable

❑ Vertical Cable

Cabling between **one switch** to another in the same building which can be in different or in the same floors.



Terminologi

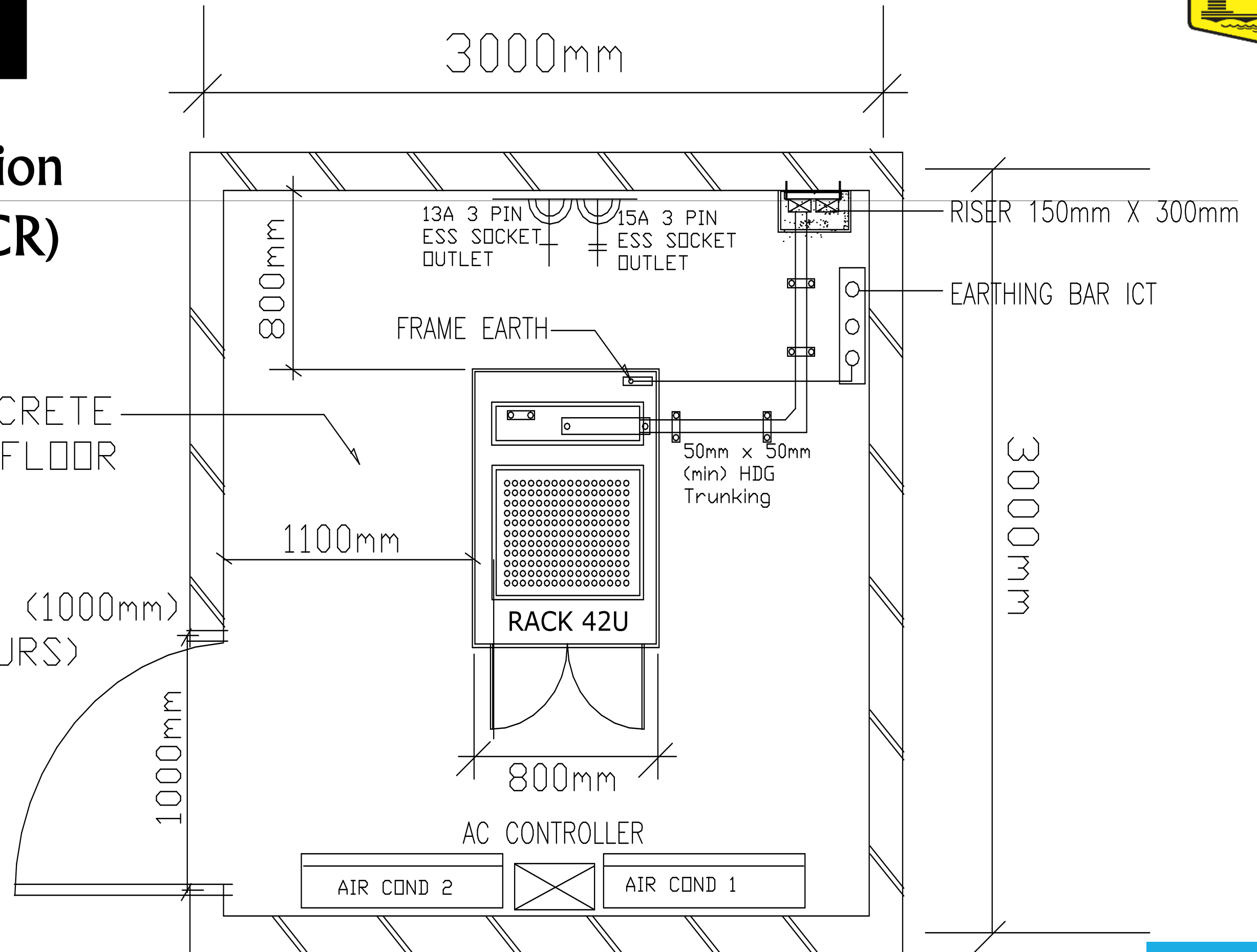
UNIT PERUNDING ICT, CAWANGAN KEJURUTERAAN ELEKTRIK



❑ Telecommunication Closet Room (TCR)

RAISED 50mm CONCRETE
WITH ANTI DUST FLOOR

SINGLE LEAF DOOR (1000mm)
FIRE RATED (2 HOURS)
OPEN OUTWARD



Standard & Garis Panduan



Standard	TIA-942	EN50173-5	ISO 24764
Copper	Category 6A	Class E _A	Class E _A
Fiber	OM3/OM4 OS1/OS2	OM3/OM4 OS1/OS2	OM3/OM4 OS1/OS2
Connector	LC (1-2 fibers) MPO(>2 fibers)	LC (1-2 fibers) MPO(>2 fibers)	LC (1-2 fibers) MPO(>2 fibers)

Standard & Garis Panduan

		ISO/IEC	CENELEC	TIA
General/generic	Design	None	EN50173-1	TIA-568.0
Office	Design	ISO/IEC 11801	EN50173-2	TIA-568.1
Industrial	Design	ISO/IEC 24702	EN50173-3	TIA-1005
Homes	Design	ISO/IEC 15018	EN50173-4	TIA-570
Data centers	Design	ISO/IEC 24764	EN50173-5	TIA-942
Building services	Design	TR 24704	EN50173-6	TIA-862
Specification	Installation	ISO/IEC 14763-2	EN50174-1	TIA-569
Indoor	Installation	ISO/IEC 14763-2	EN50174-2	TIA-569
Outdoor	Installation	ISO/IEC 14763-2	EN50174-3	TIA-758
Administration	Installation	ISO/IEC 14763-1	None	TIA-606
Bonding	Installation	In progress	EN50310	TIA-607

Standard & Garis Panduan

❑ ANSI/TIA 568-B.X



- ✓ Category 6 Transmission Performance
- ✓ Balanced Twisted Pair Cabling Components
- ✓ Optical Fiber Cabling

❑ ISO/IEC 11801



- ✓ Generic cabling for customer premises
- ✓ Multi-vendor cabling



Standard & Garis Panduan

□ Garispanduan JKR



- ✓ General Practices For ICT System Installation
- ✓ Technical Requirement for Server Room and TCR
- ✓ Structured Cabling System
- ✓ LS 16

□ SKMM



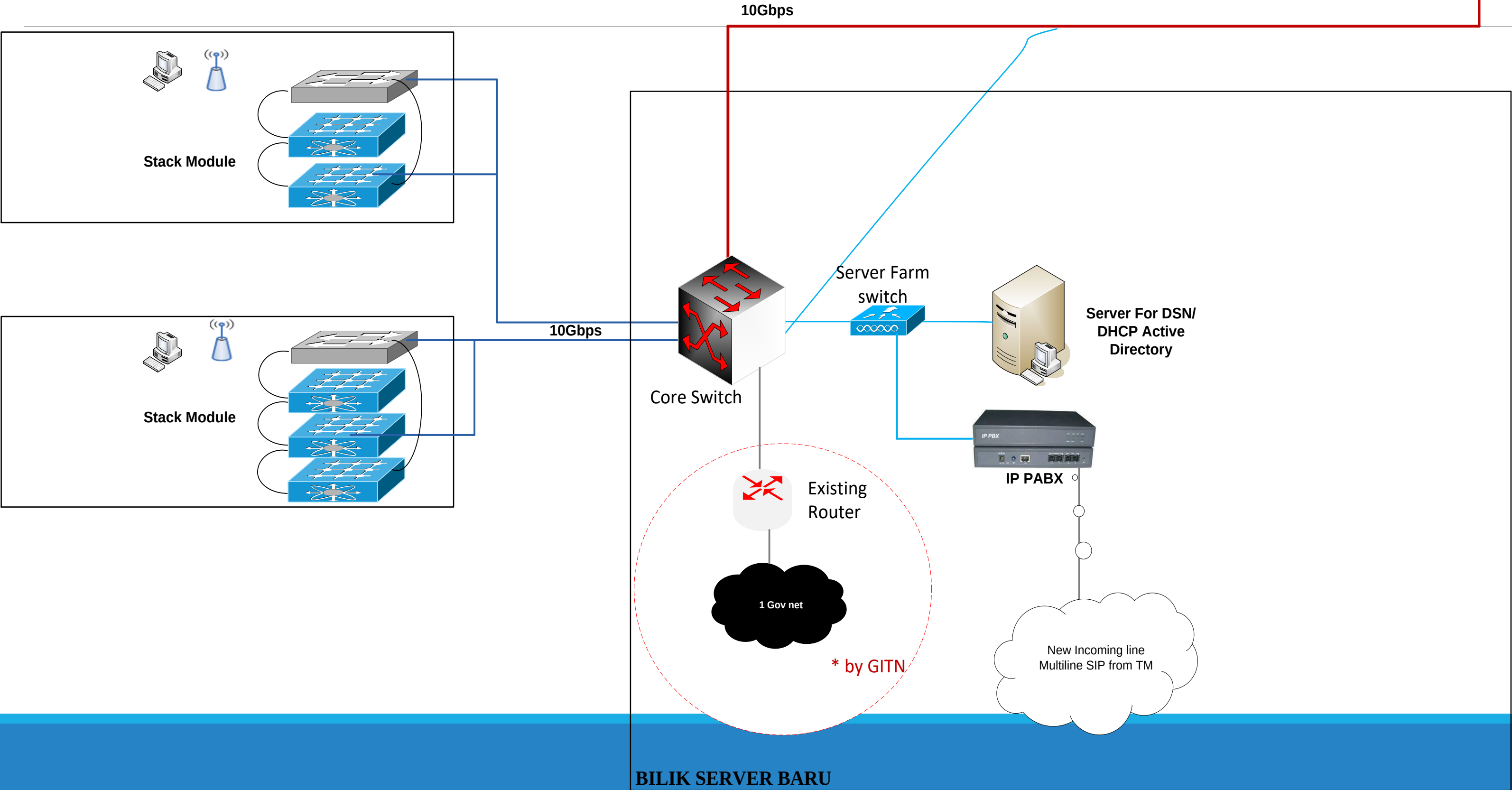
- ✓ Basic Civil Works For Communication Infrastructure - SKMM/G/01/09
- ✓ Guideline on Telephone Service Over IP - MCMC/G/02/05
- ✓ Wireless Local Area Network (WLAN)

Konsep Rekabentuk

- a. Jenis infrastruktur secara kampus atau *stand alone*
- b. Menyediakan *lukisan network topology*
- c. Mengkaji konsep *network architecture* yang bersesuaian
- d. Mengkaji, merancang dan menentukan peralatan ICT yang bersesuaian
- e. Menentukan kedudukan keperluan ruang ICT



Contoh Konsep Rekabentuk



Penyediaan Anggaran awalan

Rules of 👍 : RM5,000.00 per bilangan pengguna (bagi bangunan pejabat)
tidak termasuk kos bagi keperluan fasiliti di Bilik Server @ Pusat Data

ATAU

Rules of 👍 untuk Kos ICT : $0.25 \times [\text{kos keseluruhan (LV/MV/ELV/ICT)}]$
: $0.25 \times [0.25 \times \text{kos bangunan}] \approx \text{Kos ICT}$

ATAU

Link Excel Sheet: Penyediaan Anggaran awalan terperinci ([PDA](#))

Rujukan Anggaran Jabatan: <http://ratol.jkr.gov.my/search>

Latih Amal:

Penyediaan Konsep Rekabentuk dan Anggaran awalan :

- Berdasarkan Contoh Lukisan Tender Arkitek yang diberikan, sila sediakan Lukisan *Network Topology* dan Anggaran awalan menggunakan formula yang dinyatakan..





Bersambung.....



Keperluan Ruang ICT & Telefon

- TCR - Telecommunication Closet Room
- MTCR - Main Telecommunication Closet Room
- SDF - Subscriber Distribution Frame Room
- PABX - Private Branch Exchange Room
- SR - Server Room
- DC - Data Centre
- TR - Telephone Riser
- OR - Operator Room

Objektif Kerja Luaran

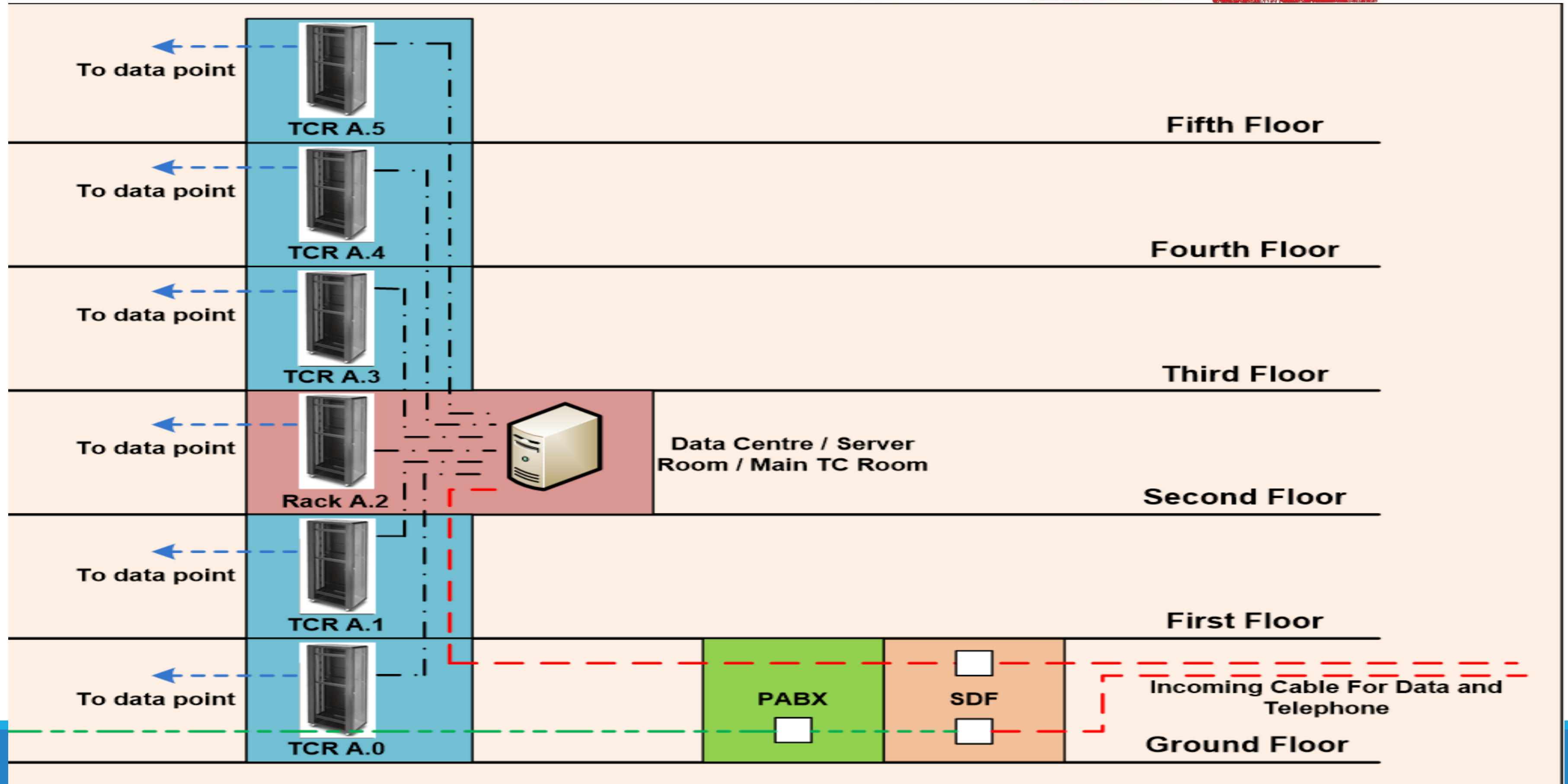
- Menyediakan laluan masuk kabel dari Man-hole terdekat pihak TELCO ke Bilik SDF.
- Menyediakan laluan kabel antara bangunan.
- Memudahkan kerja pemasangan dan penggantian kabel antara bangunan
- Memudahkan kerja selenggaraan kabel.

❑ Spaces and Room requirement

★ **VERY** ★
★ **IMPORTANT** ★

★ **VERY** ★
★ **IMPORTANT** ★

★ **VERY** ★
★ **IMPORTANT** ★



Latih Amal:

Penyediaan lukisan cadangan pelan pembangunan infrastruktur ICT

- Berdasarkan Lukisan *Site Plan* yang diberikan, sila sediakan Lukisan cadangan pelan pembangunan infrastruktur ICT.





Bersambung.....



Proses-proses Rekabentuk

Sistem ICT



Penentuan Network Point

- Min. 1 No. di setiap ruang kerja/meja pegawai
- Tambahan 1 No. di setiap 8 Nos. ruang kerja – untuk network printer
- 2 Nos di Bilik Mesyuarat
- 2 Nos di Bilik Seminar
- 1 No di setiap meja komputer di makmal komputer
- 4 Nos untuk makmal sains



Penentuan Wireless Access Point (AP)

- Ruang terbuka (1 bagi setiap 15-20m radius)
- Perpustakaan
- Ruang pejabat
- Asrama
- Galeri
- Cafeteria
- Dewan
- Bilik Mesyuarat
- Bilik Seminar
- Nota: Penentuan lokasi AP boleh dibuat melalui simulasi *heat map*
;Cth:Ekahau.Pro Tools



Pemilihan Kabel

Horizontal Cabling

- UTP Cat 6 < 100 meter
- UTP Cat 6A < 100 meter

Vertical Cabling

- 50um Indoor Multimode Fibre < 500 meter
- 9um Indoor Singlemode Fibre > 500 meter

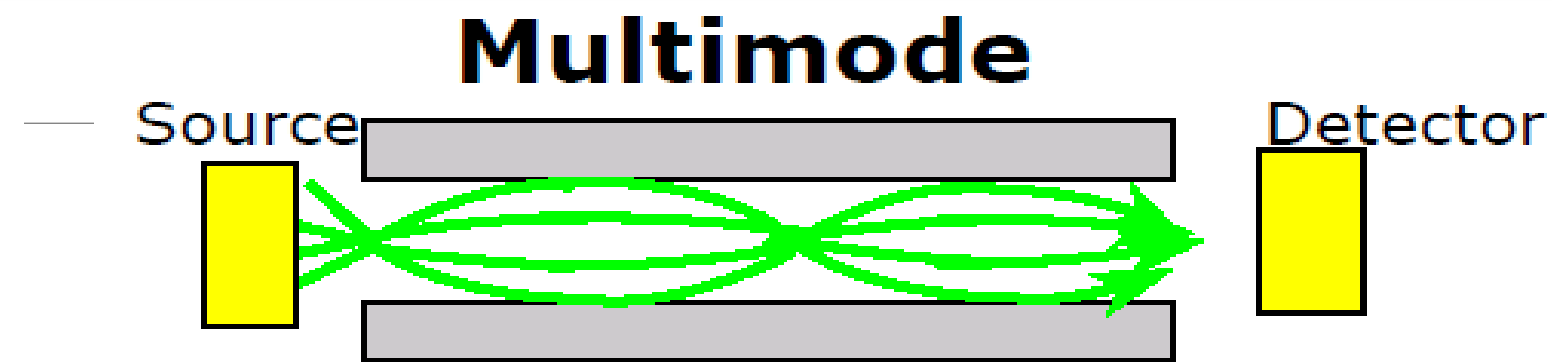
Backbone Cabling (1Gbps)

- 50um Outdoor Multimode Fibre < 500 meter
- 9um Outdoor Singlemode Fibre > 500 meter

Backbone Cabling (10Gbps)

- 9um Outdoor Singlemode Fibre > 500 meter

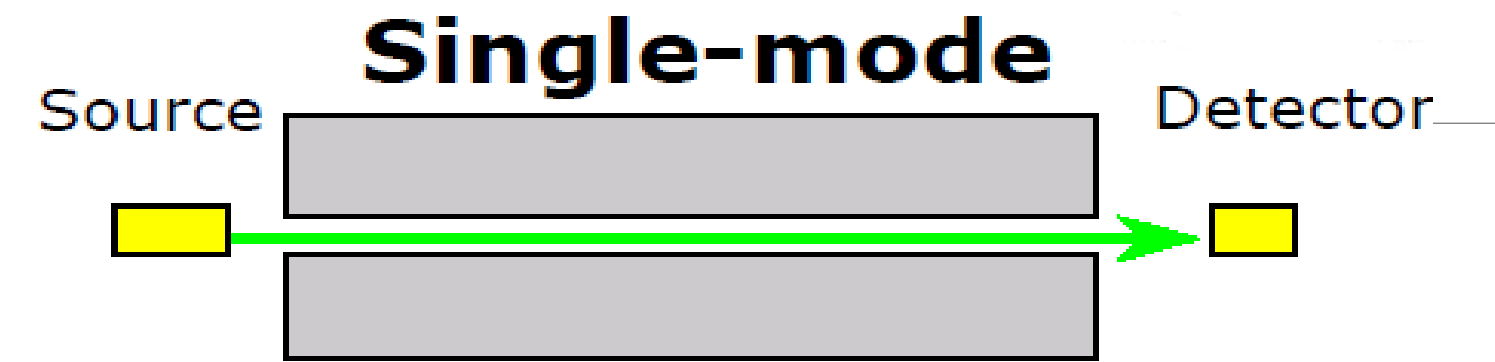
SM vs MM Systems Comparisons



- + Low cost sources
 - + 850 nm and 1310 nm LEDs
 - + 850 nm lasers at 1 & 10G
 - + Low precision packaging
- + Low cost connectors
- + Lower installation cost
- Higher fiber cost
- + **Lower system cost**
- Higher loss, lower bandwidth
- Distance up to 2 km

Best for:

- **Premises, Data Center, CO**



- High cost sources
 - 1310+ nm lasers 1 and 10G
 - 1000 Gb/s+ w/ DWDM
 - High precision packaging
- Higher cost connectors
- Higher installation cost
- + Lower fiber cost
- **Higher system cost**
- + Lower loss, higher bandwidth
- + Distance to 60 km+

Best for:

- **WAN, MAN, Access, Campus**

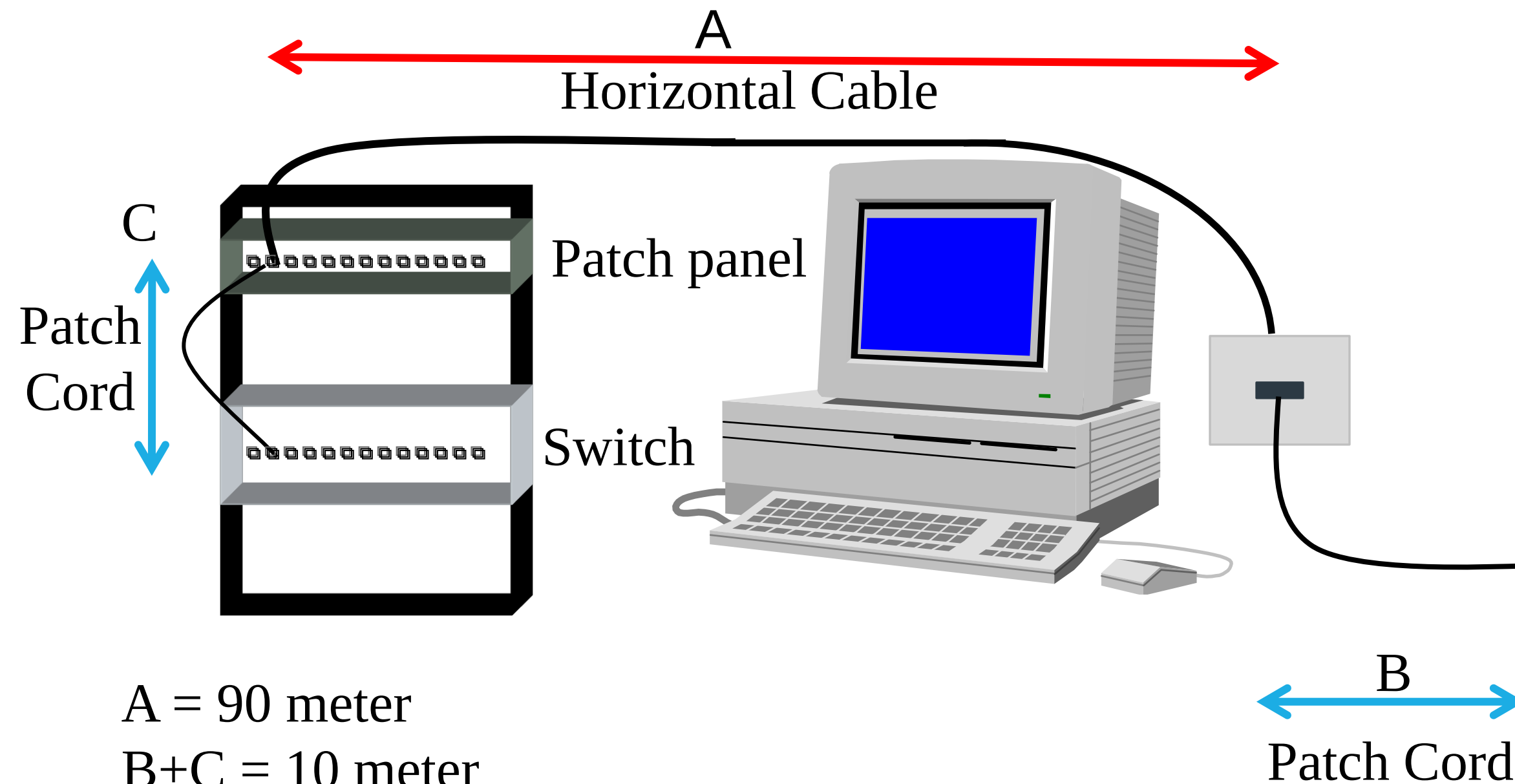
Signal Range untuk Single Mode Fiber

Type	Application	Distance	Wavelength
Gigabit	1000BASE-LX	5 km	1310 nm
10 Gigabit	10GBASE-LX4	10 km	1310 nm
	10GBASE-E	40 km	1550 nm
40 Gigabit	40GBASE-LR4	10 km	1310 nm
	40GBASE-FR	2 km	1310 nm
100 Gigabit	100GBASE-LR4	10 km	1310 nm

Jarak Maksima Kabel Multimode

Cable Type	Bandwith*Length Product (MHZ*km or GHz*m)	10 Gb Ethernet Distance 10GBASE-SR	40 Gb/100 Gb Ethernet Distance 40GBASE-SR4 and 100GBASE-SR10
OM1 Fiber	160-200	33 m / 100 ft	N/A
OM2 Fiber	400-500	82 m / 260 ft	N/A
OM3 Fiber	2000	300 m / 1000 ft	100 m / 330 ft
OM4 Fiber	4700	400 m / 1300 ft	150 m / 500 ft

Horizontal Cabling



$A = 90$ meter

$B + C = 10$ meter

$A + B + C = 100$ meter



Contoh Schedule Of Accommodation (SOA)

Bil	Kod Ruang	Ruang	Bil. Bilik	Kapasiti Pengguna	ICT												
					Data Dan Telephone Point			Data Point			Wireless Point	Telephone Type				FWS	Saiz rack
					300 (H)	900 (H)	Floor	300 (H)	900 (H)	Floor	Wireless	Standard	Executive	Fax	Direct Line		
1		KAUNTER TIKET	1	1		1			1								
2		GERAI 1	1	1												1	
3		GERAI 2	1	1												1	
4		GERAI 3	1	1												1	
5		RUANG MENUNGGU	1	20							2						
		TERMINAL BAS & TEKSI	5	24	0	1	0	0	1	0	2			0		3	

JUMLAH DATA DAN TELEPHONE POINT	1
JUMLAH DATA POINT	1
JUMLAH WIRELESS POINT	2
JUMLAH FWS	3



Latih Amal:

Penyediaan SOA:

- Berdasarkan Contoh Lukisan Tender Arkitek yang diberikan, sila sediakan SOA sepertimana contoh yang dipaparkan.



Equipment Rack

Kenapa 19”?

- Saiz-saiz peralatan adalah 19” (lebar)

Saiz Rack

- Wall mounted
 - 9U
 - 11U
 - 15U
- Floor Standing
 - 15U
 - 21U
 - 27U
 - 33U
 - 37U
 - 42U



Equipment Rack

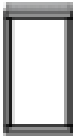
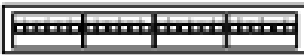
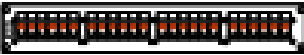
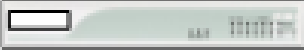
Peralatan-peralatan di dalam rack

- Fibre Termination Unit
- UTP Patch Panel
- Cable Management Unit (Cable Manager)
- Switch
- UPS
- Router





Komponen dalam Equipment Rack

LEGEND	
	Equipment Rack
	Fiber Termination Unit
	24 Port UTP CAT 6 Patch Panel
	Cable Management
	Router (By Others)
	Unified Threat Management
	Server

	Core Switch
	48 Ports Access/Edge Switch
	24 Ports Access/Edge Switch
	8 Ports Access/Edge Switch
	LCD Rack Console with KVM Switch
	UPS (Uninterruptible Power Supply)



Contoh pengiraan saiz Rack

Aras 1 mempunyai 96 bil. network points

Apakah saiz TC diperlukan?

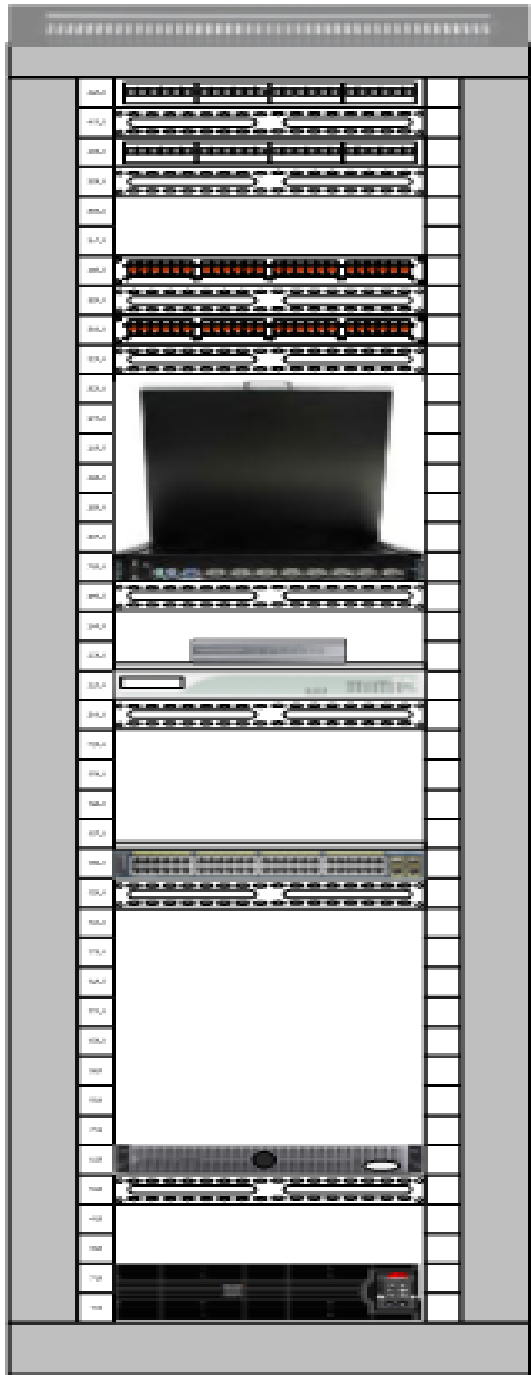
- 96 network points
- Jumlah switch yang diperlukan = $96 \div 24 = 4$
- 4 unit 24 port switch = 4U
- 4 unit 24 port patch panel = 4U
- 4 x 2 unit cable management = 8U
- 1 unit Fibre Termination Unit = 2U
- 1 unit UPS = 3U
- **JUMLAH** = **21U**
- 20-30% Future expansion = 6 U
- **SAIZ RACK** = **27 U => sekiranya kiraan saiz rack melebihi 15U, saiz rack yang akan digunapakai ialah 42U**



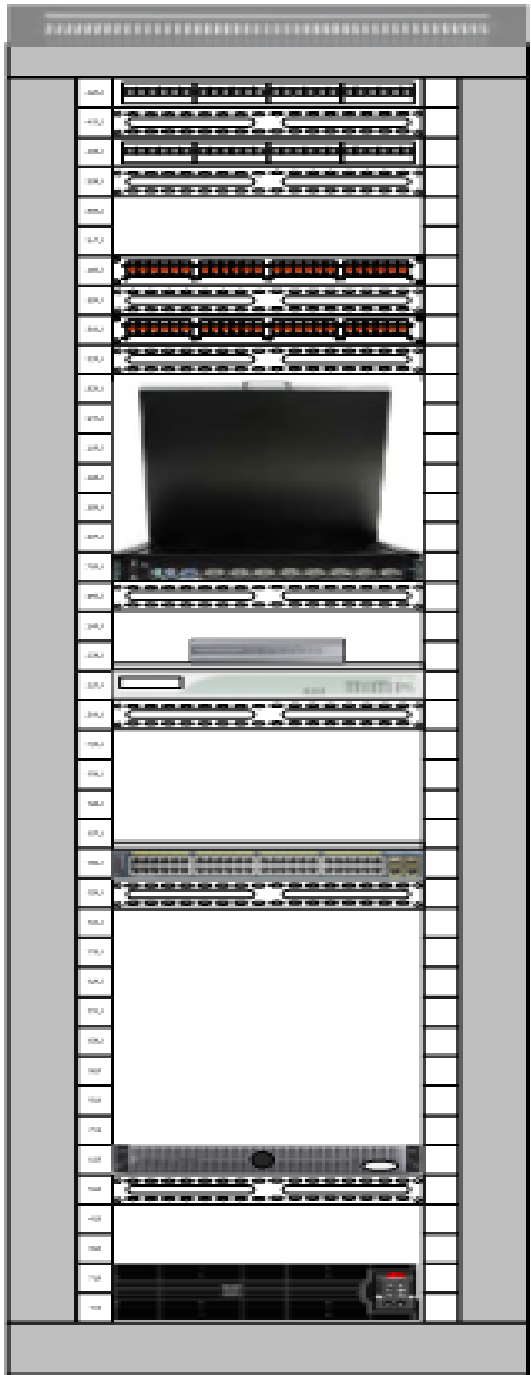


Rack Population Diagram

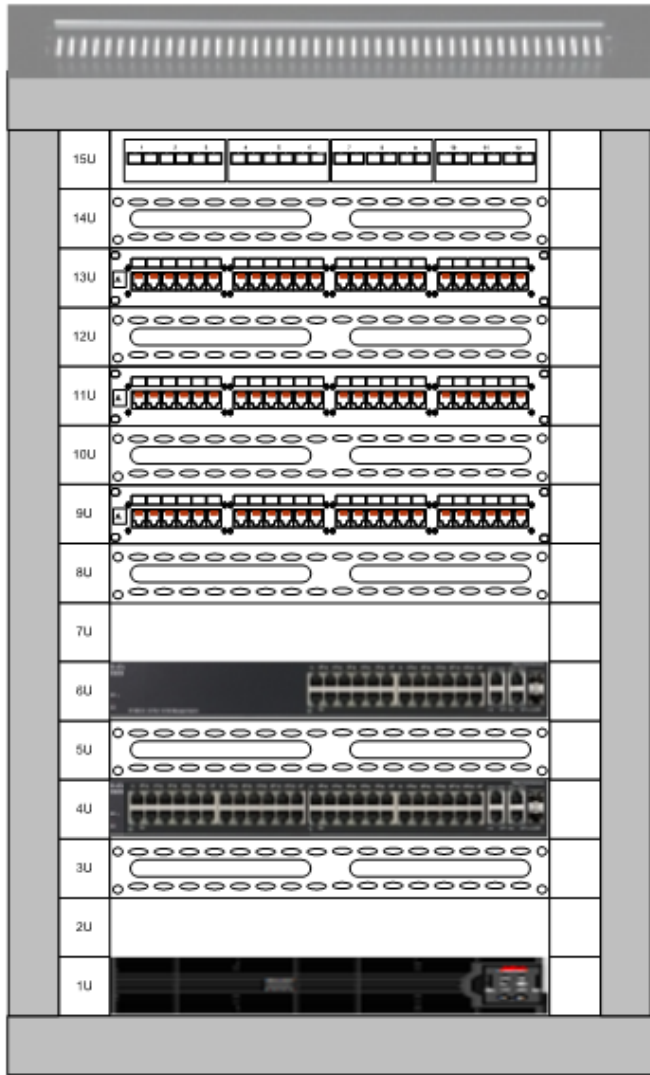
Server Rack



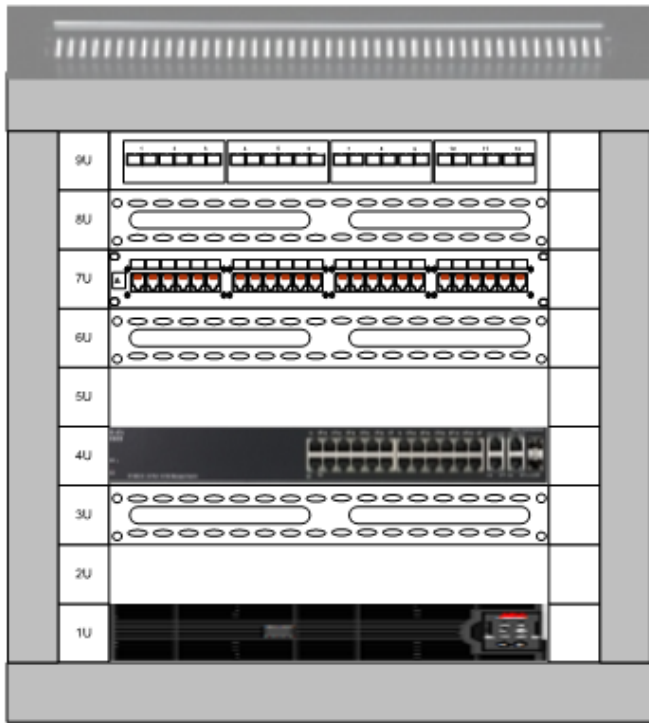
Server Rack



Network Rack

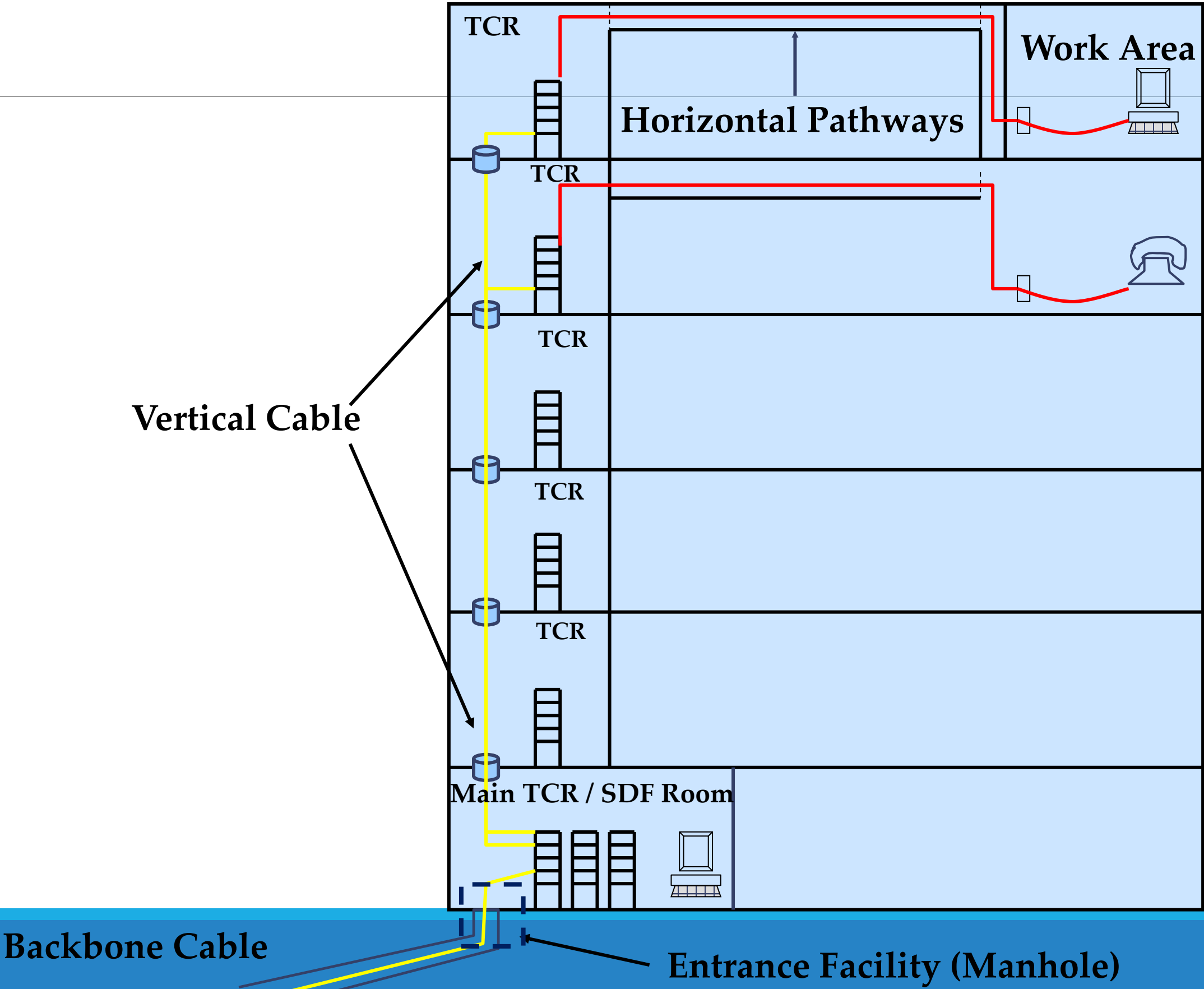


Network Rack



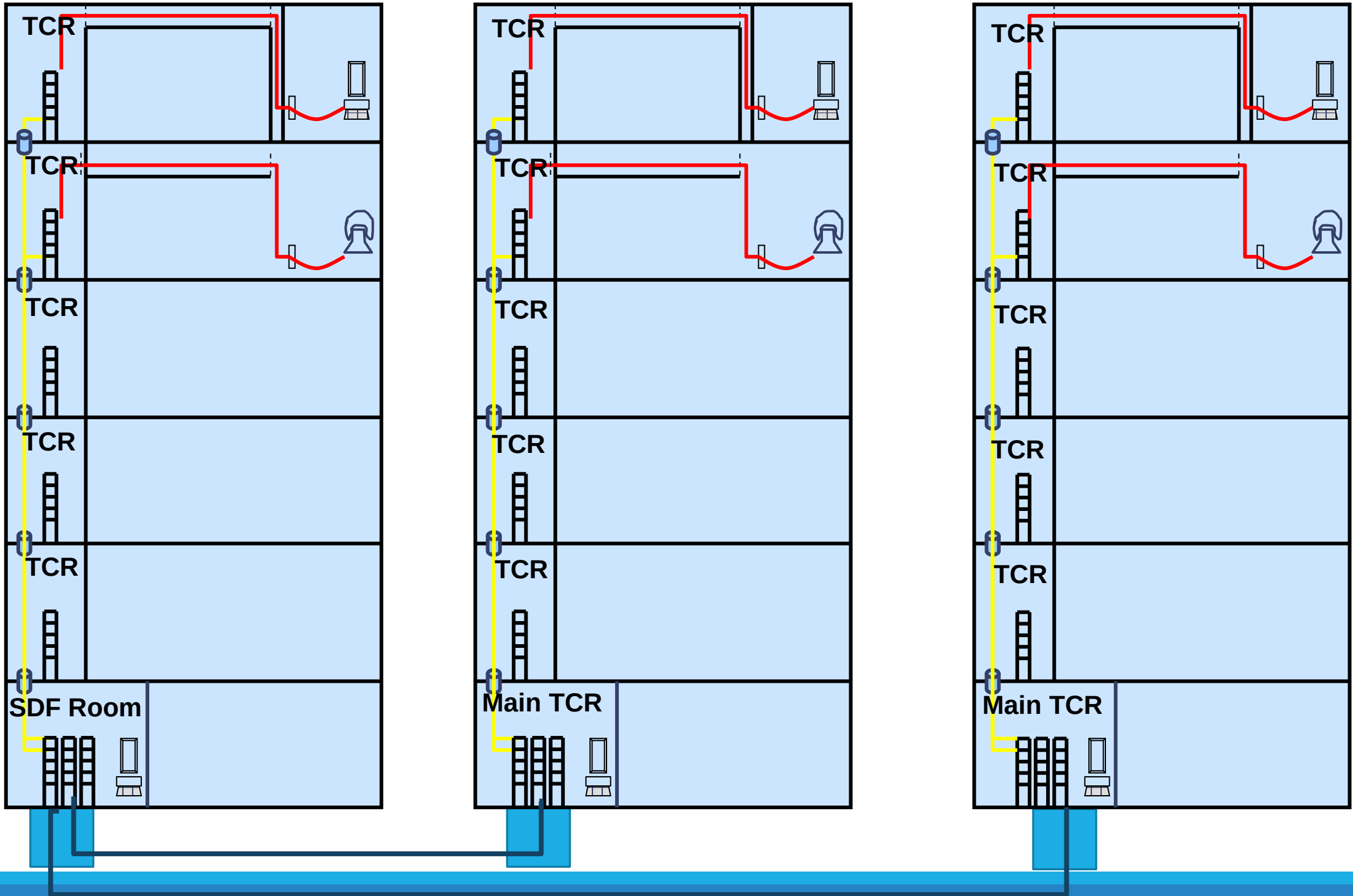


Vertical Cable



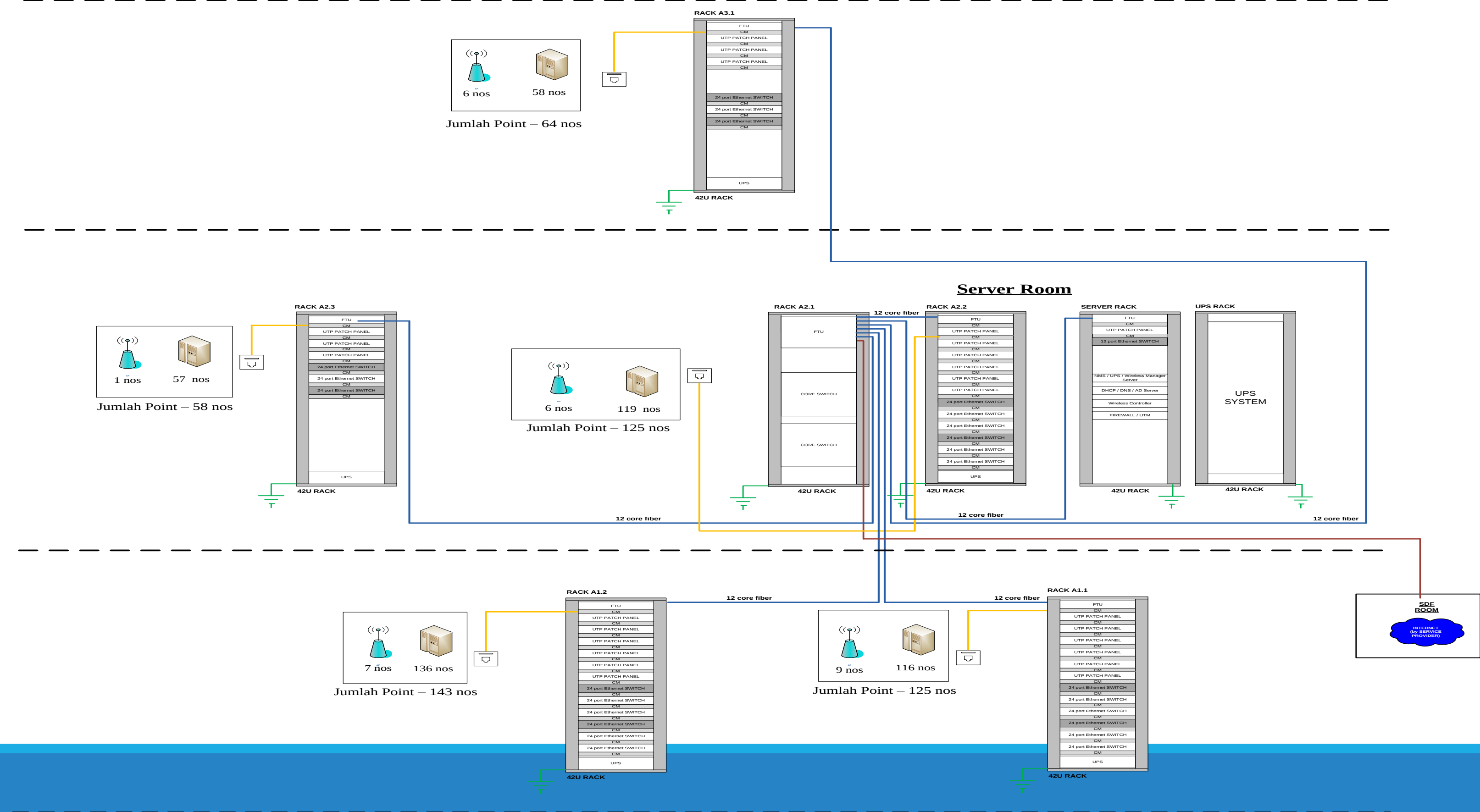


Backbone Cable





Contoh Network Schematic



Latih Amal:

Penyediaan *Network Schematic*:

- Berdasarkan Contoh Lukisan Tender Arkitek yang diberikan, dan maklumat yang telah dikenalpasti, sila sediakan *Network Schematic* sepertimana contoh yang dipaparkan.



Kod-Kod Label Peralatan

Kod Blok

- A, B, C,.....Z, AA, AB..

Kod Aras

- Gnd/Bawah = 1, Tingkat 1 = 2

Kod TC

- A1.1 [KOD BLOK & ARAS.NO TC]

Kod Point

- A1.1.D1 [KOD TC.D POINT]





Bersambung.....



Proses-proses Rekabentuk

Sistem Telefon

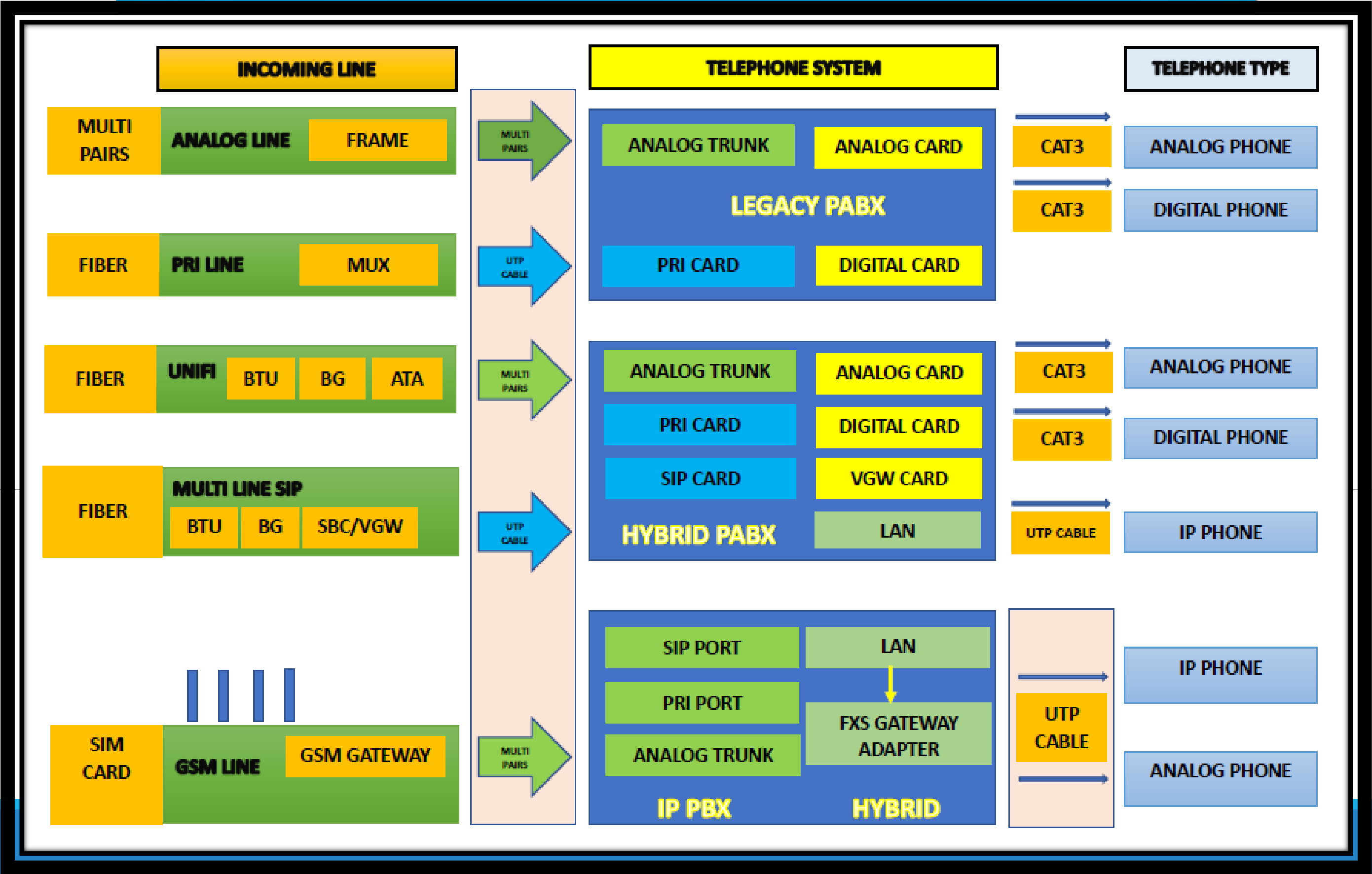


TELEPHONE SYSTEM

- ✓ **CONVENTIONAL SYSTEM**
- ✓ **CONVENTIONAL HYBRID SYSTEM**
- ✓ **IP PBX SYSTEM**
- ✓ **HYBRID SYSTEM**



MATRIX TELEPHONE SYSTEM



SISTEM TELEFON

CONVENTIONAL SYSTEM

- ❖ Keperluan ruang: SDF Room, Riser Tel dan PABX Room
- ❖ Jenis Telefon: Analog Phone dan digital Phone
- ❖ *Telephone point* menggunakan pendawaian *2 pairs 0.63mm copper cable* dengan RJ11
- ❖ *Indoor* menggunakan *multipairs copper 0.63mm cable*
- ❖ *Outdoor* menggunakan *copper multipairs copper 0.63 cable*
- ❖ *Distribution Frame* dan *Distribution Point*
- ❖ Perlu memasang lightning arrestor pada DF/DP untuk setiap out going dan incoming line

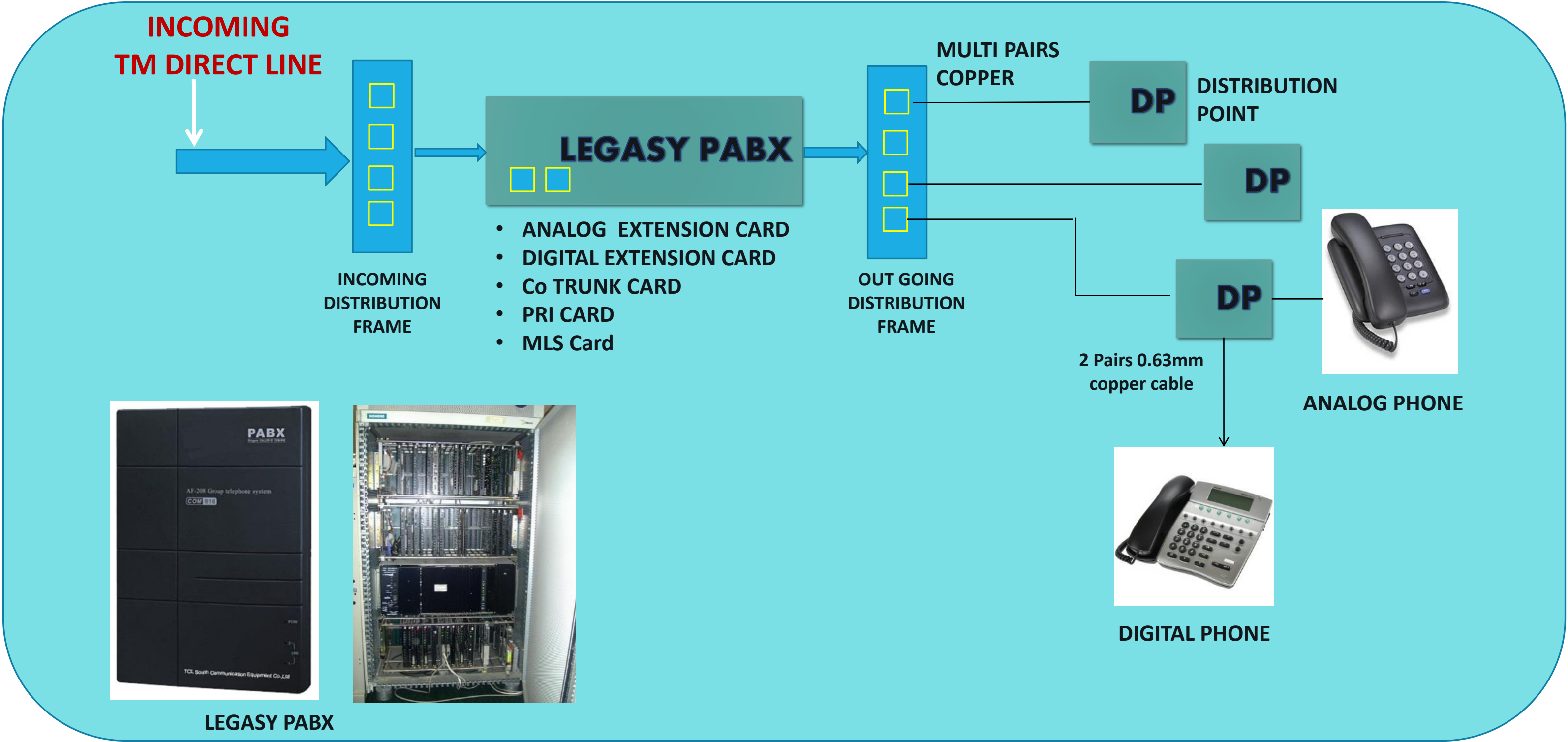
SISTEM TELEFON

REKABENTUK CONVENTIONAL PABX

- ❖ Menentukan bilangan extension yang diperlukan mengikut SOA
- ❖ Menentukan bilangan direct line diperlukan
- ❖ Menentukan bil jenis Analog Phone dan Digital Phone
- ❖ Menentukan Jenis dan bilangan Card diperlukan- Digital Card, Analog Card
- ❖ Menentukan bil multipairs indoor dan outdoor cable
- ❖ Menentukan saiz Frame, MDP, DP serta kedudukan
- ❖ Menentukan jenis incoming line TM: Analog line, PRI Line, dan Multiline SIP.
- ❖ Menentukan jenis line Card: CO trunk, PRI Card, Multi Line Card.

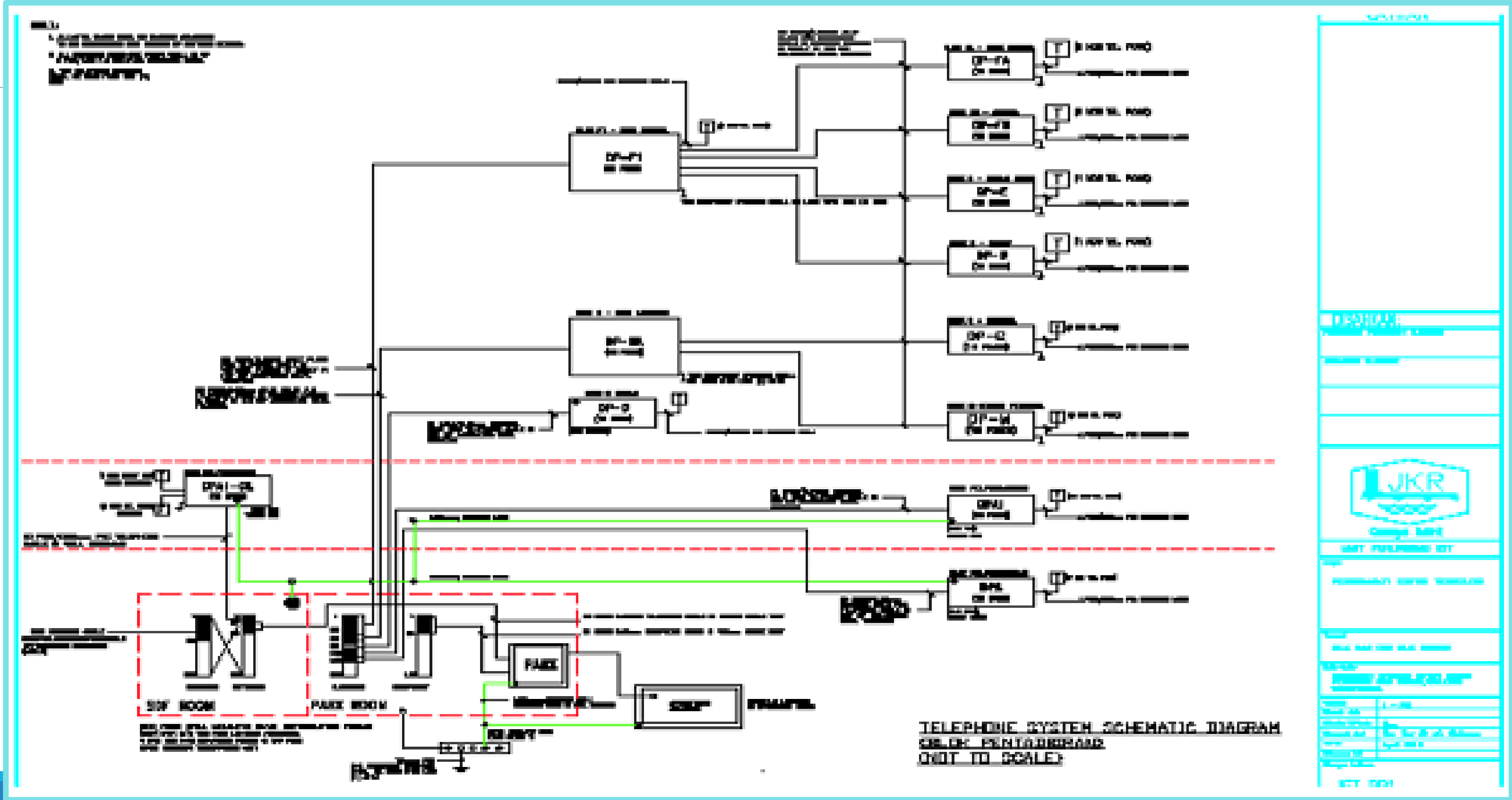


CONVENTIONAL TELEPHONE SYSTEM





SCHEMATIC DIAGRAM TEL SYSTEM CONVENTIONAL



SISTEM TELEFON

CONVENTIONAL HYBRID PABX

- ❖ Menggabungkan dua sistem telefon konvensional dan IP Telefon system.
- ❖ Sesuai untuk projek yang mahu mengekalkan dan menggunakan semula telefon analog dan digital sediaada disamping menaiktaraf telefon baharu kepada IP Phone.
- ❖ Sistem ini tidak lagi sesuai untuk teknologi masa kini.

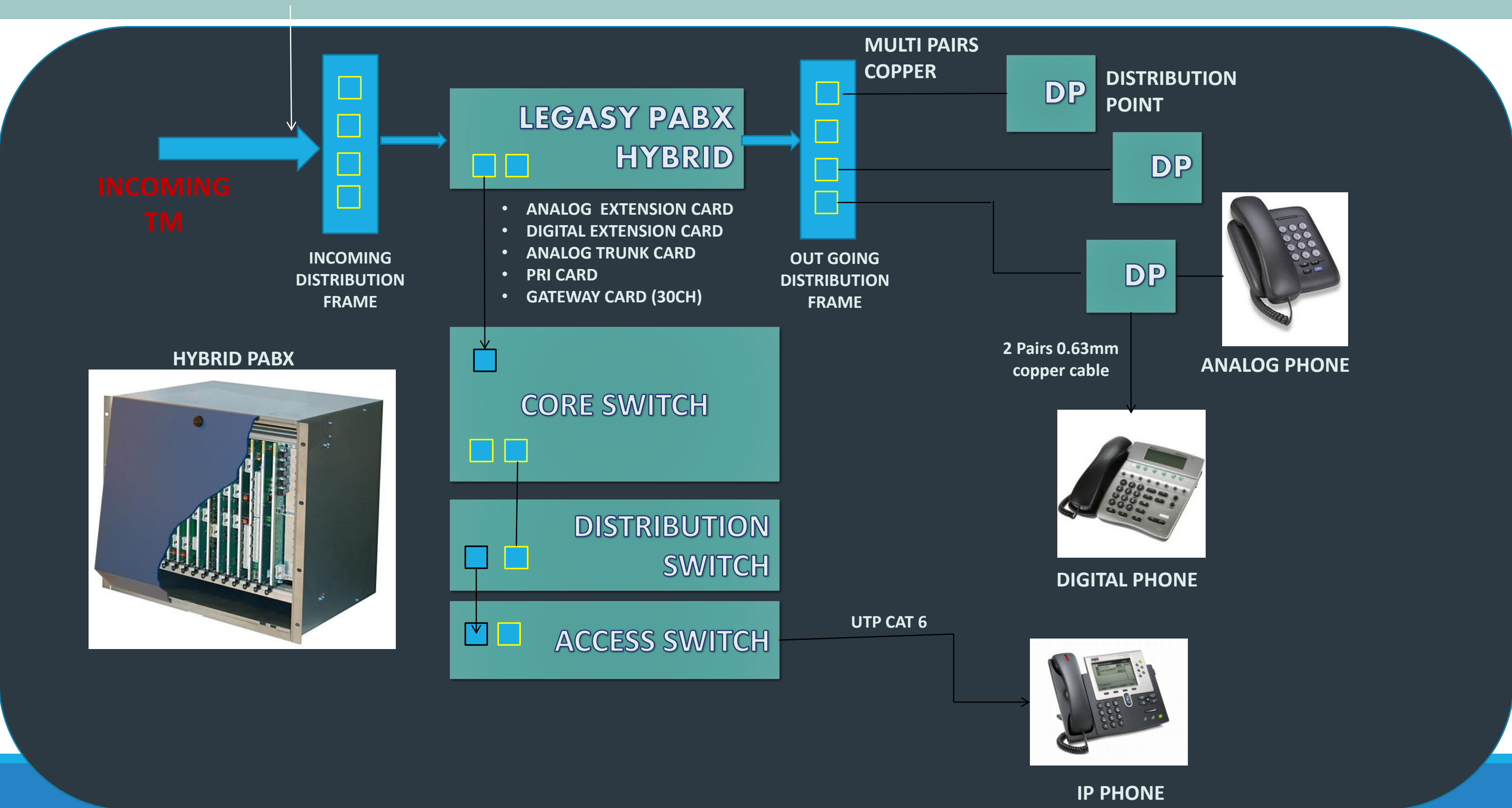
SISTEM TELEFON

REKABENTUK CONVENTIONAL HYBRID PABX

- ❖ Memastikan PABX sediaada mempunyai fungsi IP
- ❖ Menentukan bil extension dan jenis IP Phone yang diperlukan mengikut SOA.
- ❖ Memastikan point data untuk IP Phone mencukupi atau perlu penambahan
- ❖ Menambah bilangan channel Gateway Card yang sesuai dengan bilangan extension IP Phone.
- ❖ Membuat konfigurasi IP PABX dan IP Phone.



CONVENTIONAL PABX HYBRID TELEPHONE SYSTEM





PABX HYBRID DIAGRAM

PABX HYBRID

MULTILINE
SIP

FIBER
CABLE

BROADBAND
TERMINATION UNIT

BTU



UTP
CAT6

SBC/VOICE GATEWAY

SIP TRUNK Card

PABX HYBRID

Analog Card / digital / IP card

RJ 11

VERTICAL FRAME



CORE SWITCH

DISTRIBUTION
SWITCH

ACCESS SWITCH

UTP
CAT6

ANALOG & DIGITAL PHONE





Bersambung.....



SISTEM TELEFON

REKABENTUK IP PBX

- ❖ Menentukan bilangan *IP Telephone* mengikut SOA pelanggan
- ❖ Menentukan samada *Network Point* berkongsi dengan *IP Phone* atau berasingan
- ❖ Memastikan *Access Switch* jenis POE
- ❖ Membuat konfigurasi VLAN untuk *IP Phone*
- ❖ Menentukan jenis talian masuk TM: *CO trunk line*, *PRI Line* dan *Multiline SIP*.
- ❖ Menentukan spesifikasi IP PBX yang sesuai dengan bilangan extension berserta lesen
- ❖ Menentukan keperluan *Session Border Control*

INCOMING LINE TELEPHONE

SESSION INITIATION PROTOCOL

- ❖ *SIP Trunking is a virtual connection to the PSTN that can handle both voice and data transmissions. SIP trunks require little or no hardware investment for deployment.*
- ❖ *SIP Trunking uses a packet switched model for making voice connections between people*
- ❖ *SIP Trunking is typically Best Effort*

TM Multiline SIP Package Offering:-

CHANNEL	4	8	12	16	20	24	28	32	64	128
DIRECT IN DAIL	30	60	90	120	150	180	210	240	480	960
SEWA BULANAN	180	280	400	500	600	680	700	750	1230	2300

INCOMING LINE TELEPHONE

SIP USING IP METRO-E

- ❖ Untuk sekala besar TM menyediakan package yang lebih stabil iaitu yang ada SLA dan SLG dari 99.00% hingga 99.90%.
- ❖ SIP Trunking yang menggunakan IP Metro-E line kos perlu membayar sewaan bulanan berasingan Metro-E line dan bilangan SIP Channel
- ❖ Sesuai untuk jabatan yang kritikal.

TM Multiline SIP IPME:

CHANNEL	32	64	128	256	512
DIRECT IN DIAL	240	480	980	1800	3400
99.0%	750	1280	2300	4600	9200
99.5%	900	1800	3600	7200	14400
99.9%	1000	2000	4000	8000	16000

INCOMING LINE TELEPHONE

PRIMARY RATE INTERFACE

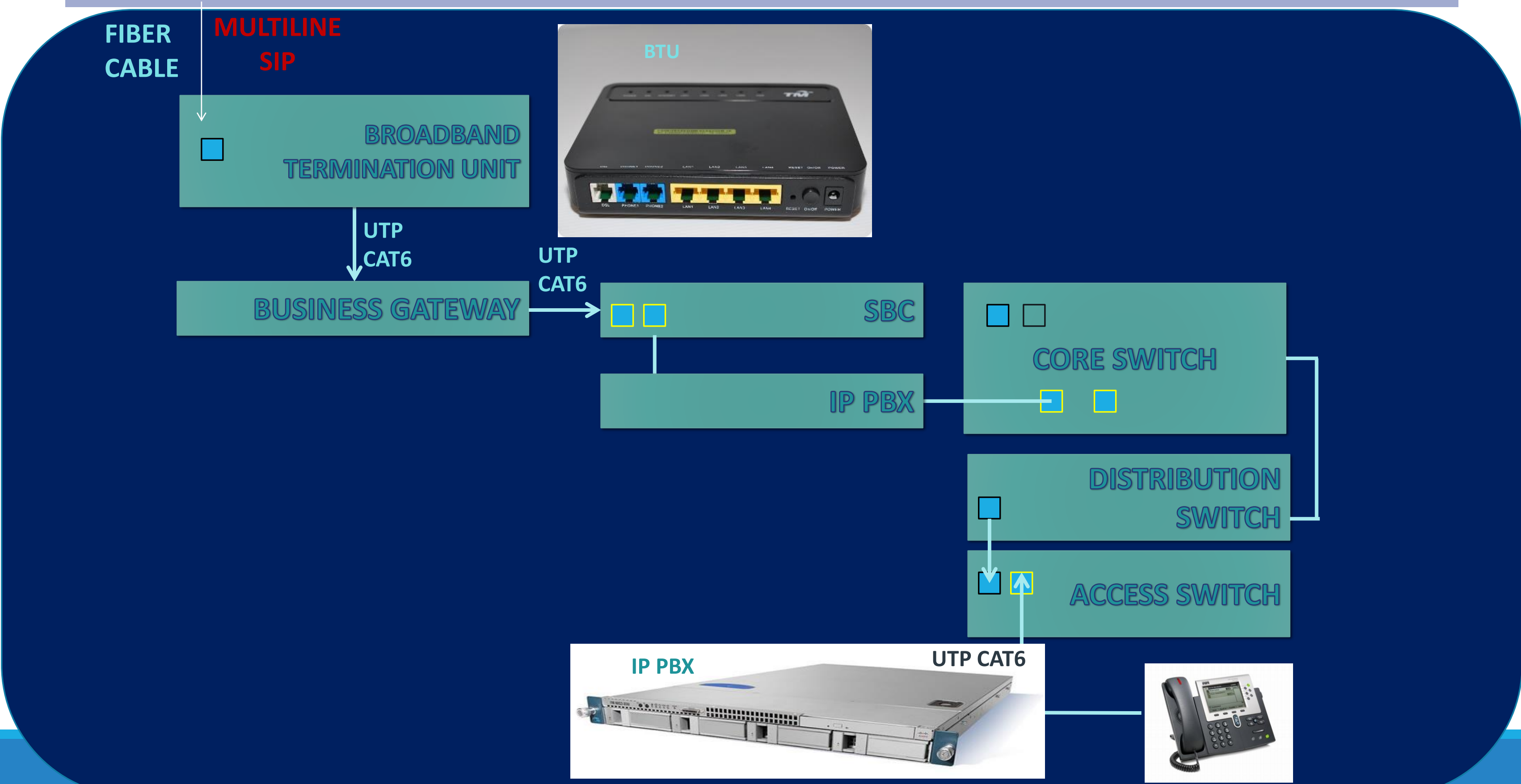
- ❖ *PRI is a systems are physical connections over a dedicated line which can only handle voice transmission and require complex setup, maintenance and up-front investment in hardware.*
- ❖ *PRI uses a circuit switched model for making voice connections between people*
- ❖ *PRI has a guaranteed Quality of Service (QoS)*

PRI Package Offering:-

CHANNEL	➤ 32
DIRECT IN DAIL	➤ 200 – 300
SEWA BULANAN	➤ RM 980.00



IP PBX SYSTEM DIAGRAM





IP PBX SYSTEM DIAGRAM

Primary Rate
Interface
(PRI) LINE

MINI MuX



BALON

COAXIAL
CABLE

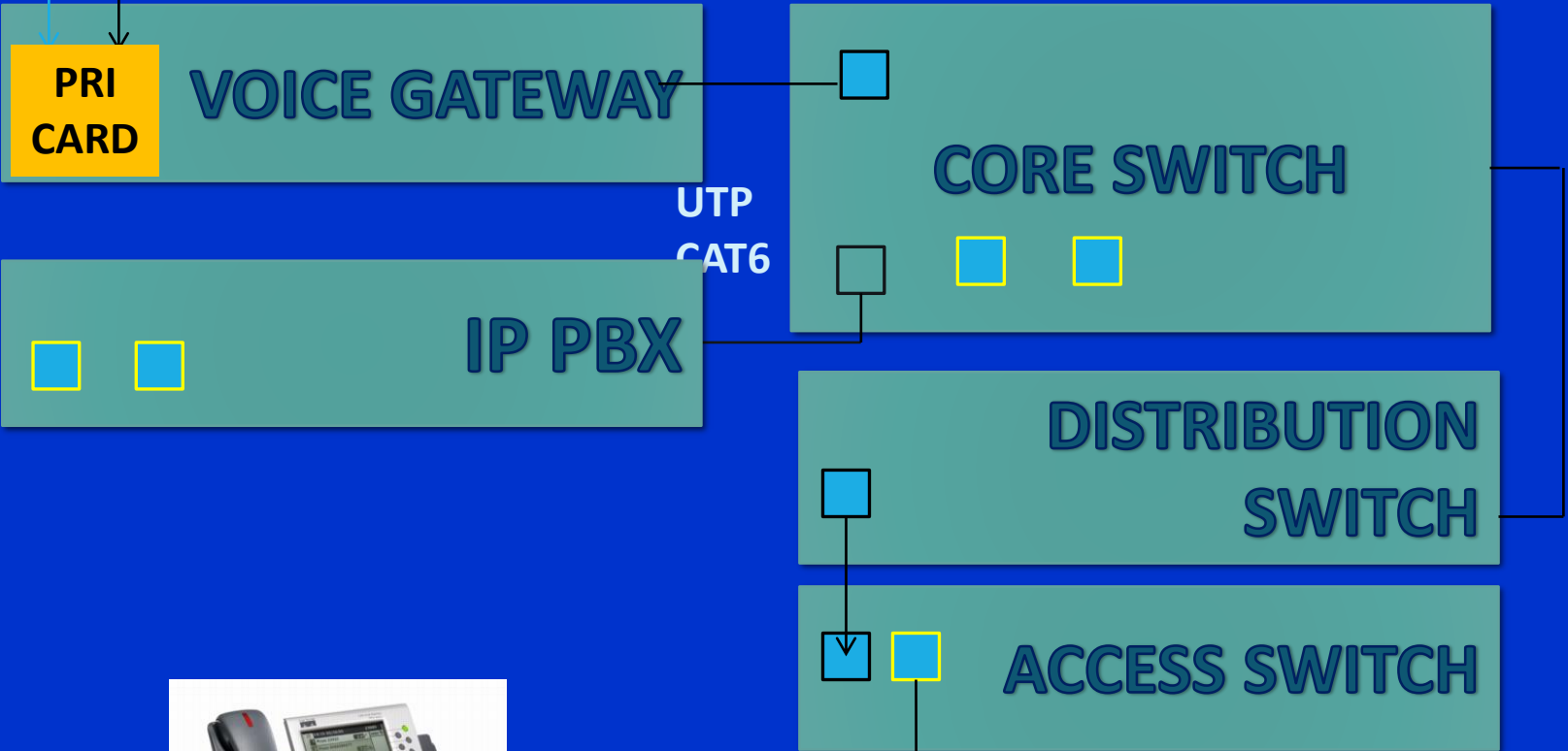
UTP
CAT6



Cisco Integrated Services
Router (ISR) 4321

- 32 Channel 200 Direct inward Dialing (DID)

Cisco BE6000M Business Edition 6000
Series Unified Computing System
Server



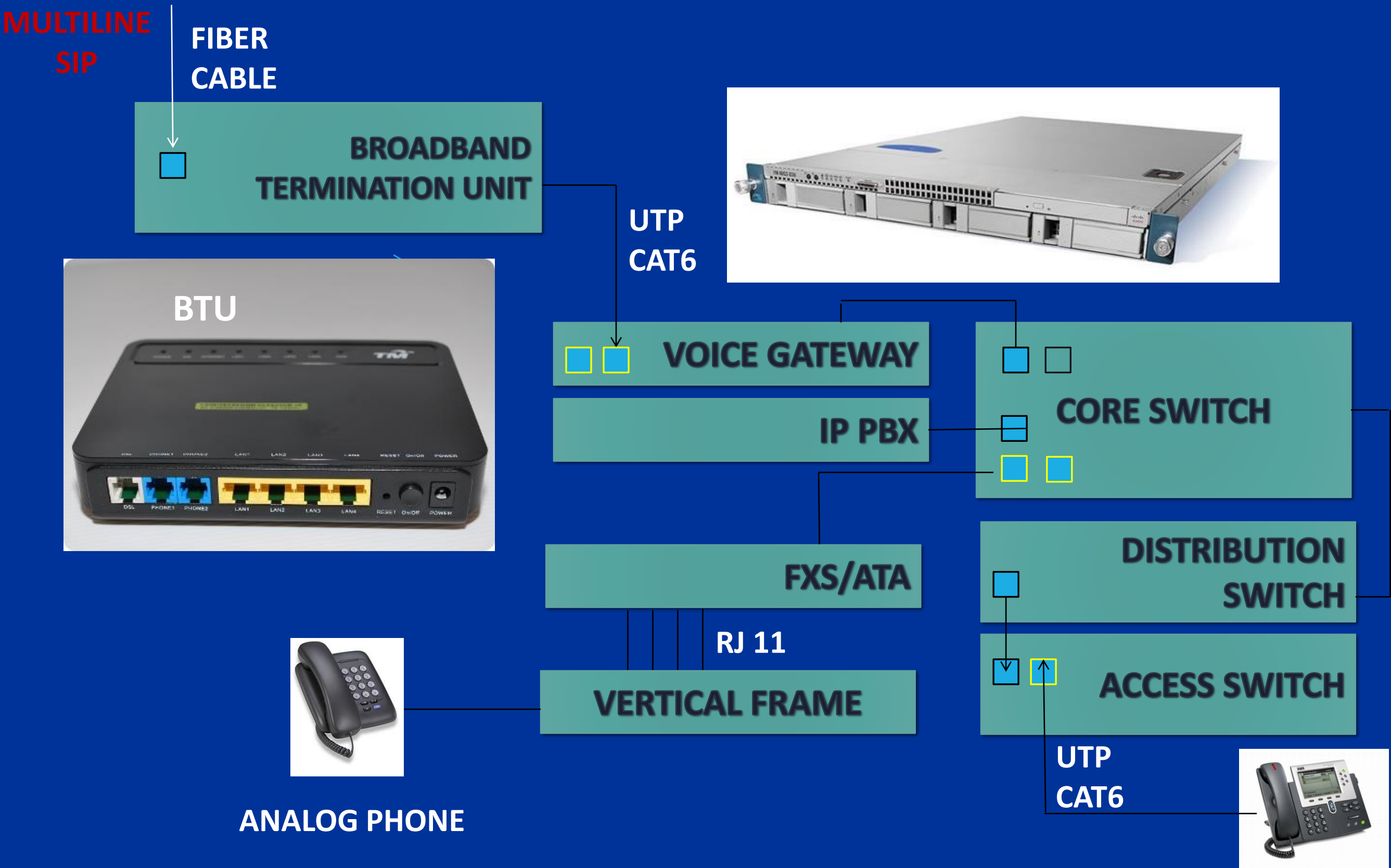
SISTEM TELEFON

IP PBX HYBRID SYSTEM

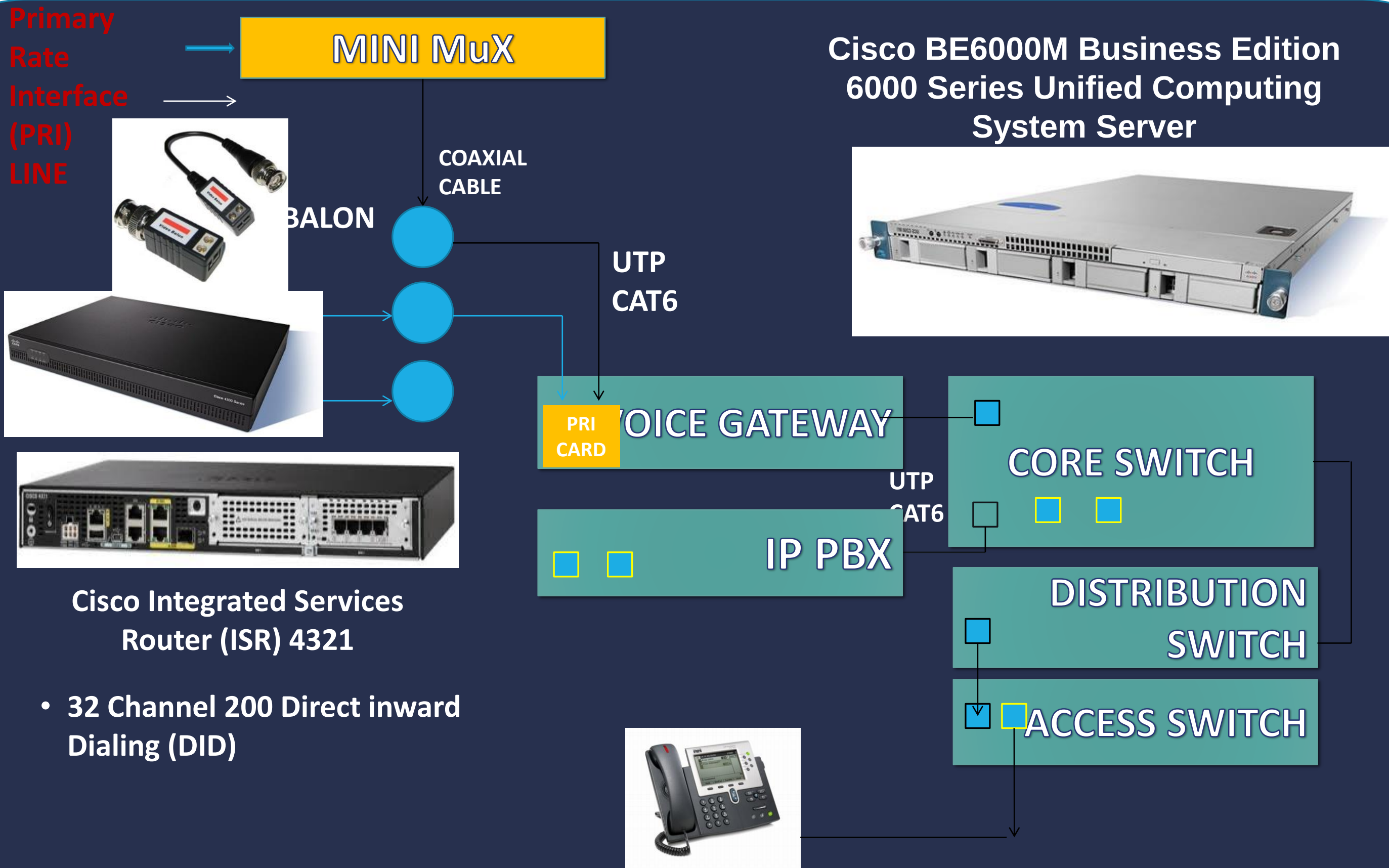
- ❖ Mengubahsuai IP PBX system kepada Hybrid dengan menambah FXS.
- ❖ Sesuai untuk projek IP Phone System yang mahu mengekalkan dan menggunakan semula telefon analog sediaada.
- ❖ Menggantikan PABX Sistem lama yang tidak boleh diselenggara dengan menggunakan pendawaian telefon sedia ada.



IP PBX HYBRID DIAGRAM



PRI INCOMING DIAGRAM





Bersambung.....





UNIFY BACKUP LINE

HSBB LINE

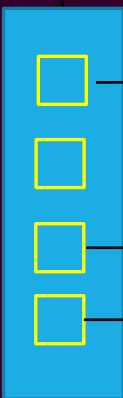
FIBER
CABLE



RJ11

CAT3
CABLE

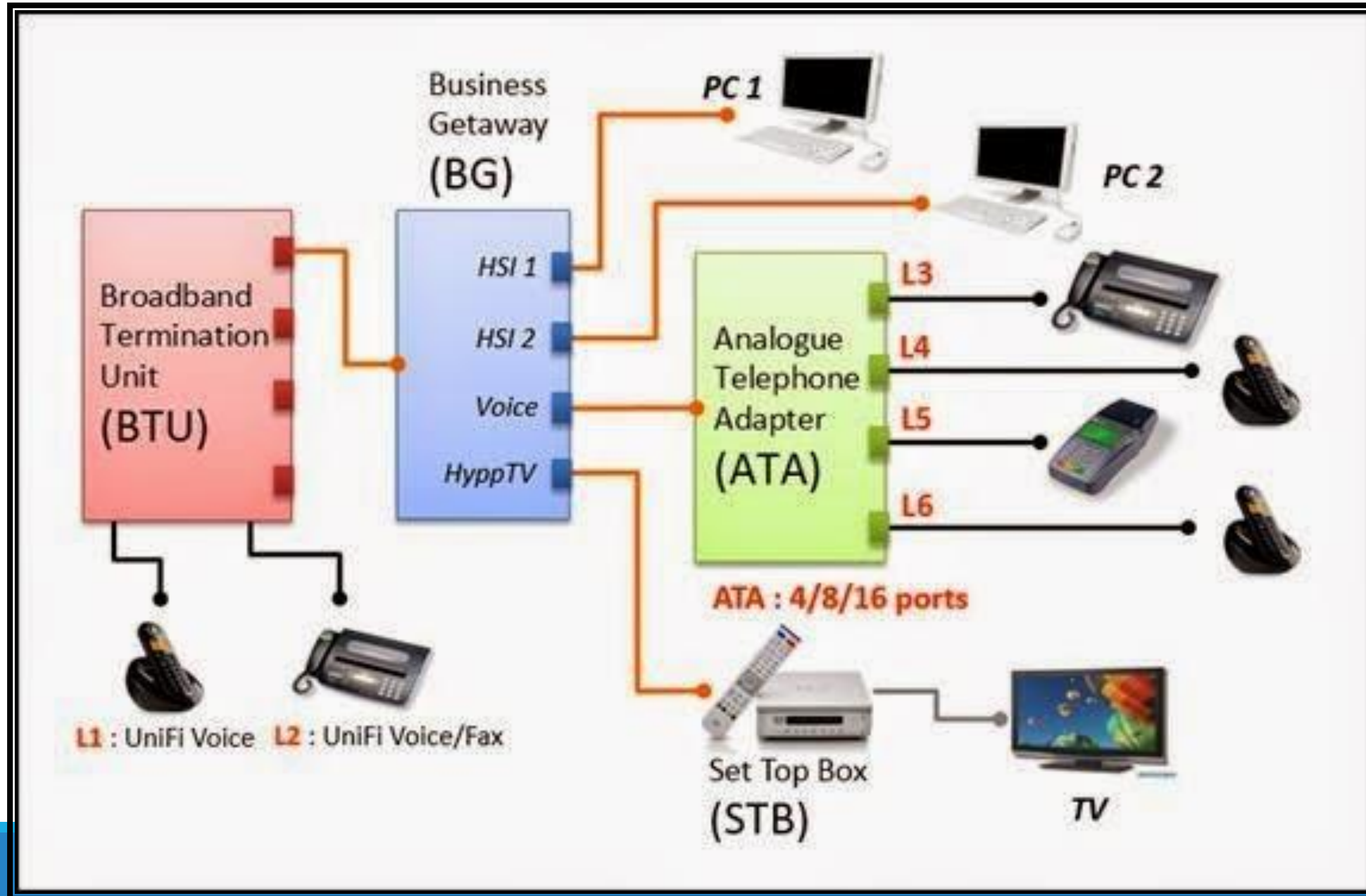
DIST.
FRAME



MULTIPAIRS
COPPER
CABLE



IP UNIFY LINE DIAGRAM



- ❑ IP- SESSION INITIATION PROTOCOL
 - ❑ SBC - SESSION BORDER CONTROLLER
 - ❑ POTS – PLAIN OLD TELEPHONE SERVICE
 - ❑ FXO - FOREIGN EXCHANGE OFFICE
 - ❑ FXS - FOREIGN EXCHANGE SUBSCRIBER
 - ❑ ATA – ANALOG TELEPHONE ADAPTER
 - ❑ SLT – SINGLE LINE TELEPHONE
 - ❑ TDM - TIME-DIVISION MULTIPLEXING
 - ❑ PSTN-PUBLIC SWITCH TELEPHONE NETWORK
 - ❑ ISDN - INTEGRATED SERVICES DIGITAL NETWORK
-

NetBorder
SBC



POTS



MEDIA GATEWAY





Latih Amal – Sila kemaskini dokumen berikut:

1. SOA
2. Kod Blok, Bilik Server & TCR
3. Panjang kabel dan jenis kabel yang digunakan
4. Penentuan Saiz Rack
5. Rack Population Diagram
6. Skematik atau lukisan
 - a. Luaran
 - b. Dalaman bagi sistem ICT dan system telefon





Pembinaan

Sistem ICT & Telefon



Rujukan Amalan Terbaik

1. Sila rujuk dokumen Do's and Don't ICT :



http://jpedia.jkr.gov.my/images/7/7d/DO_%26_DONT2_%2808_JULAI_2020%29.pdf



Pengujian & Pentaulliahan

Sistem ICT & Telefon



Jenis Pengujian & Pentauliahan

Structured Cabling System Test

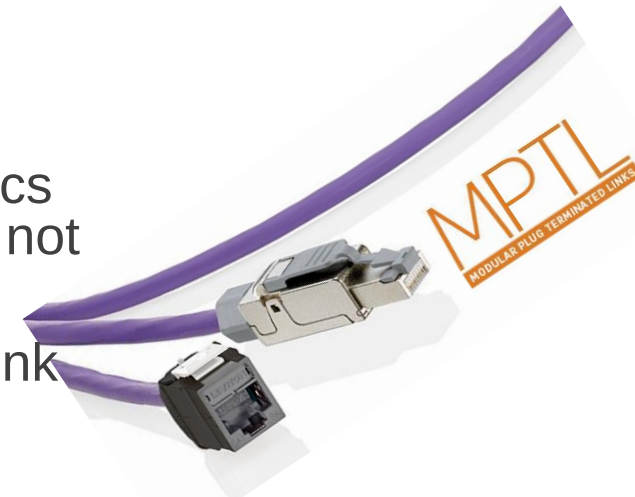
❖ using a valid version of cable tester or analyzer (i.e. Fluke Field Tester or Softing or Viavi or similar) with the latest updated firmware and software.

➤ Twisted Pair Copper Cable

- **Channel link test** which includes the continuity, presence of electrical parameters and performance characteristics such as return loss, insertion loss (attenuation), pair to pair near end crosstalk (NEXT). Any **marginal pass** shall not be accepted.
- The Modular Plug Terminated Link (MPTL) test shall be conducted with TIA Cat 6A MPTL test limit, Permanent Link Adapter and Patch Cord Adapter for Category 6A testing on the Far End or Remote Test Equipment

➤ Fiber Optic Cable

- Tier 1 test (Optical Loss Test Set) shall include the bi-directional end to end test with 1 jumper reference methods, total link loss attenuation, channel length and polarity of fiber channel.
- The cable shall be tested at both wavelengths 850 nm and 1300 nm for multimode and 1310 nm and 1550 nm for singlemode.
- The insertion loss for each mated optical fiber connection shall not exceed 0.3dB for multimode and 0.5dB for singlemode.





Jenis Pengujian & Pentauliahan

Network Equipment Test

- **Visual inspection** to ensure the network equipment shall be properly mounted/installed according to the manual, free from dust, physically in good condition without any scratch or crack.
- **Configuration test** to check the administrator able to login into the equipment web browser, IP addresses as per network topology designed, signal strength of the Wi-Fi system, security configuration as per client's policy, the equipment appear in NMS and indicates error-free status.
- **Functionality test** to ensure the equipment/system meets the functional requirement.
- **User Acceptance Test** with the present of S.O's Representative and Client's Representative.





Latih Amal – Sila kemaskini dokumen berikut:

1. SOA
2. Kod Blok, Bilik Server & TCR
3. Panjang kabel dan jenis kabel yang digunakan
4. Penentuan Saiz Rack
5. Rack Population Diagram
6. Skematik atau lukisan
 - a. Luaran
 - b. Dalaman bagi sistem ICT dan system telefon





**SEKIAN
TERIMA KASIH**

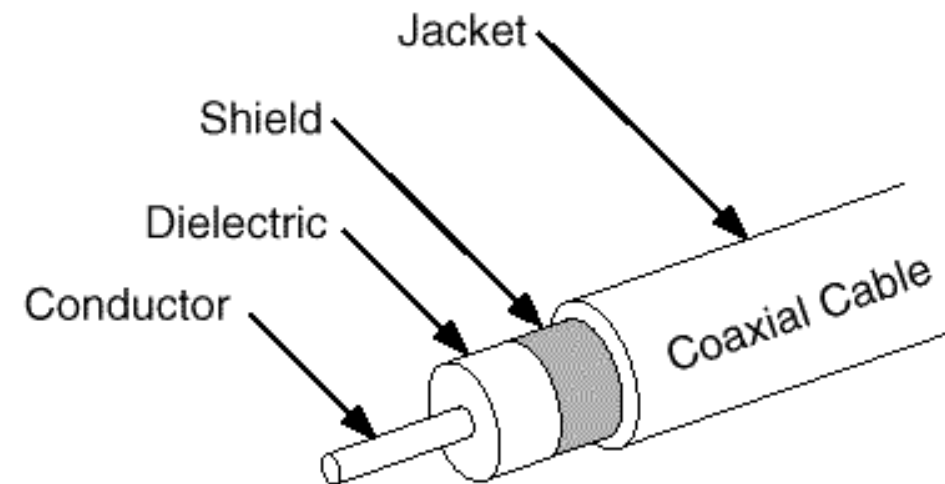


NOTA TAMBAHAN

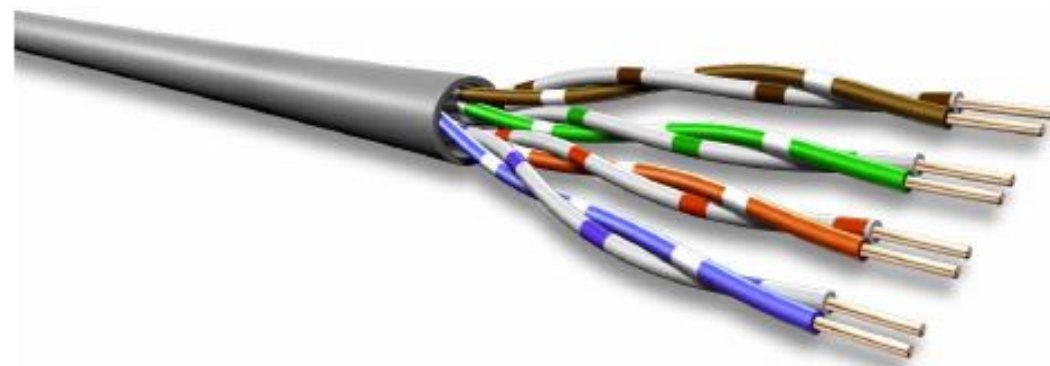


TWISTED PAIR CABLING SYSTEMS

Copper Cables



Coaxial Cable

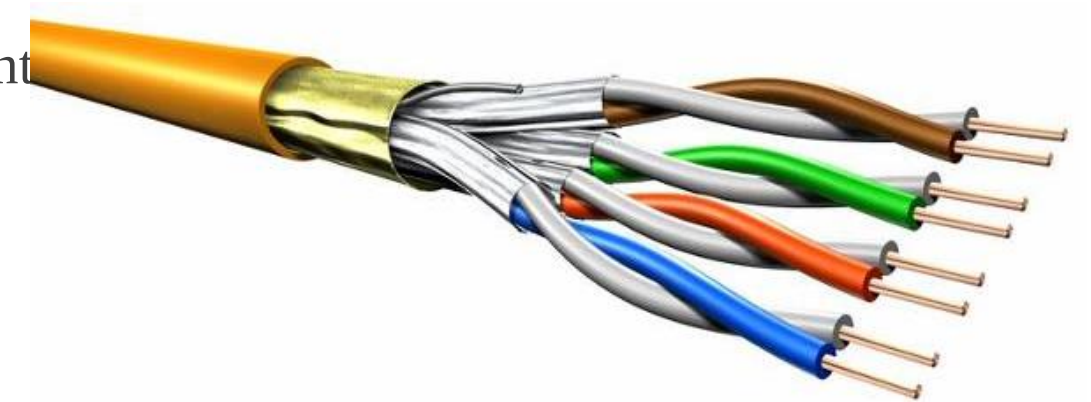
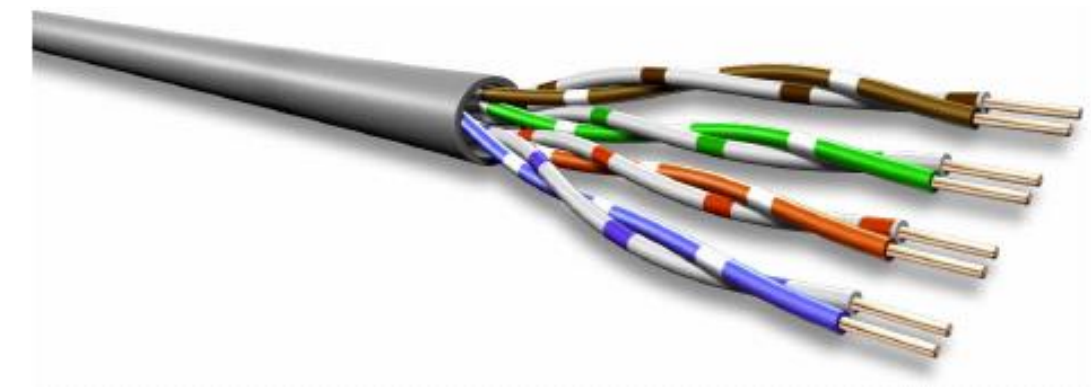


Twisted Pair Cable

- Coaxial cabling has a single copper conductor and a plastic layer provides insulation between the center conductor and a braided metal sheath.
 - Coaxial cables are network specific cables and are not specified in the standard for generic cabling system applications.
-
- Twisted Pair cables consist of pairs of conductors with matching pairs “twist wrapped” around each other.
 - ISO call this cable Balanced cable, while TIA call this cable Twisted Pair.

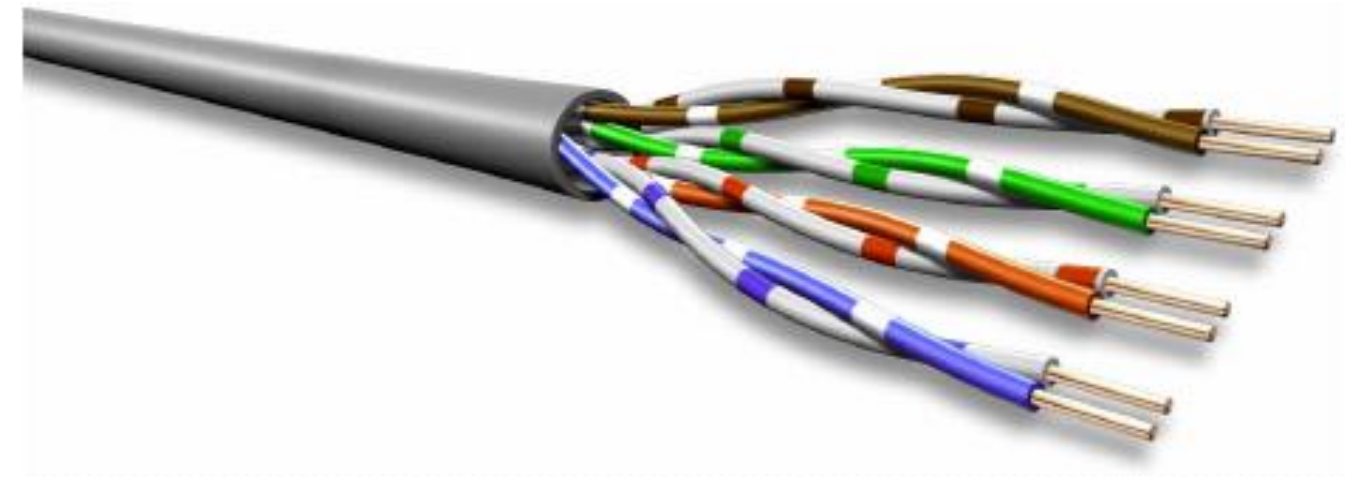
Twisted Pair Wires

- Consists of two insulated copper wires arranged in a regular spiral pattern to minimize the electromagnetic interference between adjacent pairs
- Often used at customer facilities and also over distances to carry voice as well as data communications
- Low frequency transmission medium
- Two varieties
 - STP (shielded twisted pair)
 - the pair is wrapped with metallic foil or braid to insulate the pair from electromagnetic interference
 - UTP (unshielded twisted pair)
 - each wire is insulated with plastic wrap, but the pair is encased in an outer covering

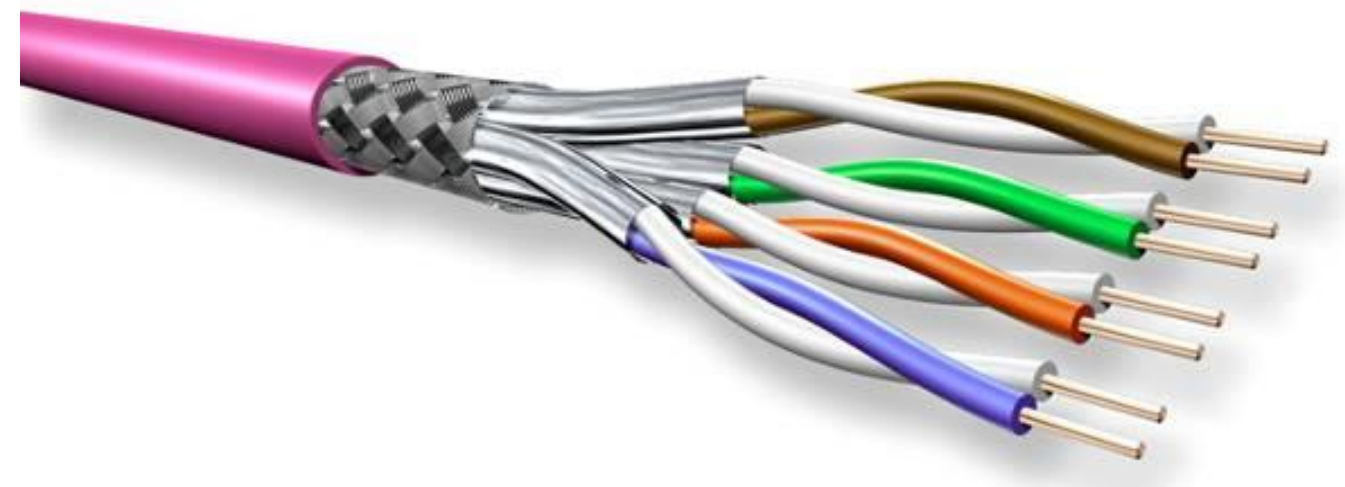


Twisted Pair Cabling

- Has been around for a long time
- Created for voice transmissions
- Most widely used media for networking
 - Lighter
 - More flexible
 - Easier to install
 - Cheaper
 - Greater speeds
- Two types:
 - Unshielded twisted pair (UTP)
 - Screened twisted pair (ScTP)



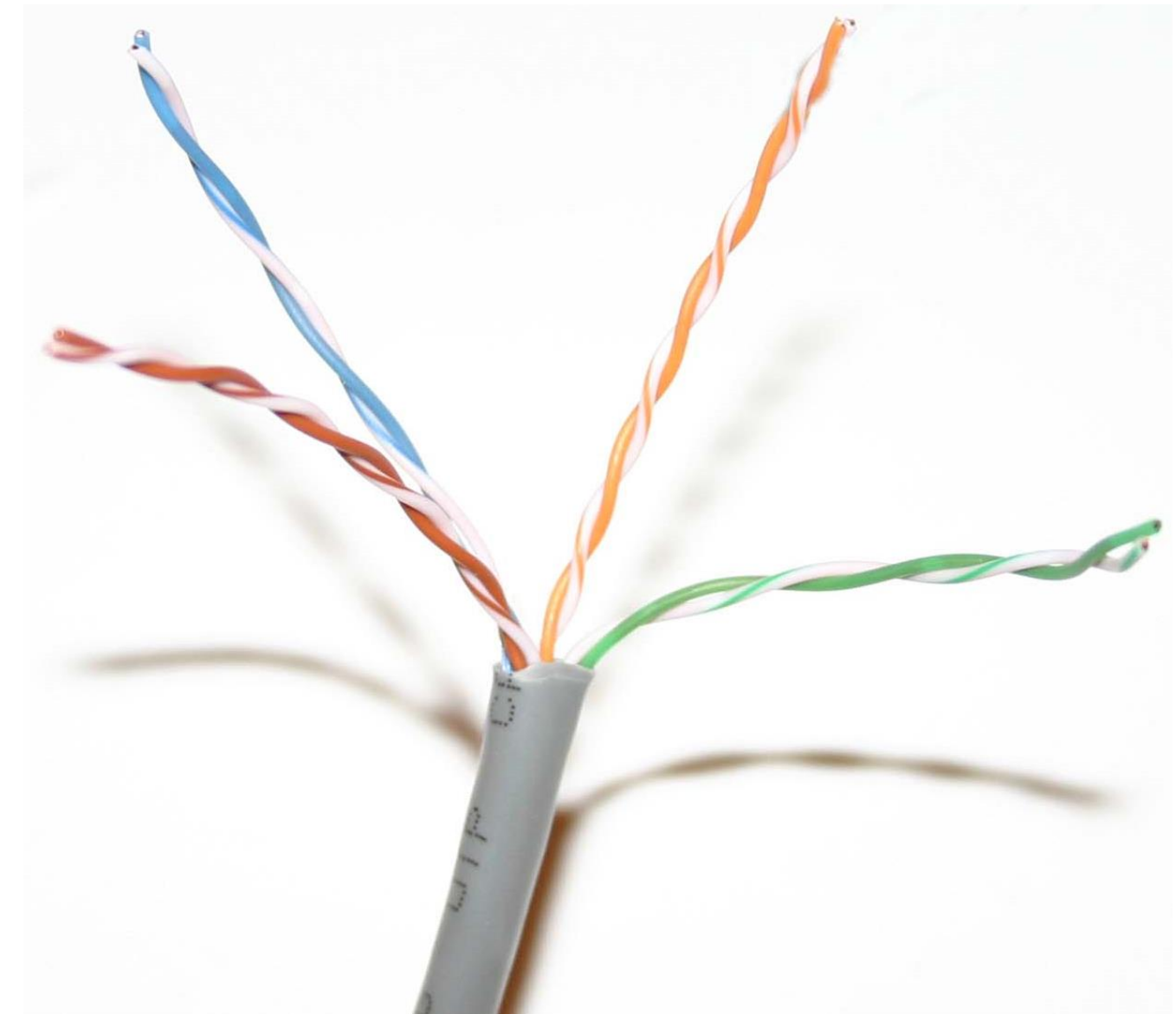
Unshielded twisted Pair



Screened Twisted Pair

Twisted-Pair Cable

- One difference between the different categories of UTP is the tightness of the twisting of the copper pairs.
- The tighter the twisting, the higher the supported transmission rate and the greater the cost per foot.
- The quality of UTP may vary from telephone-grade wire to extremely high-speed cable.
- The cable has four pairs of wires inside the jacket.
- Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices.
- Buy the best cable you can afford.



Unshielded Twisted Pair Types

■ Benefits of UTP

- Inexpensive and readily available
- Flexible and light weight
- Easy to work with and install

■ Disadvantages of UTP

- May be susceptible to radio noise and electrical frequency interference (RFI, EFI).
- Attenuation problem
 - For analog, repeaters needed every 5-6km
 - For digital, repeaters needed every 2-3km
- Relatively low bandwidth (3000Hz)



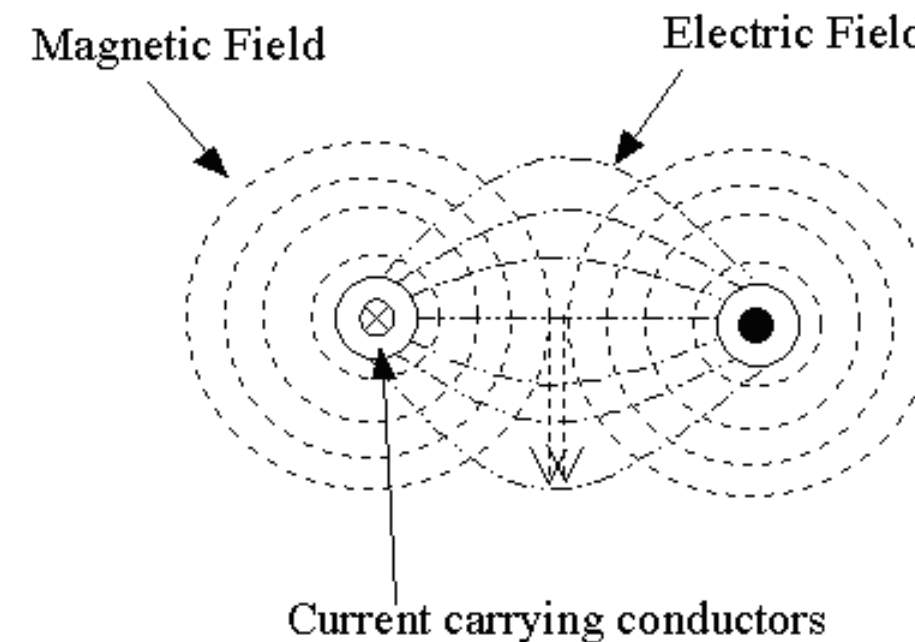
Twisted Pair Cable Applications

Network Platform	Cable Category Min Requirement	T-568-A Wiring (Pair Used)	T-568-B Wiring (Pair Used)	Pin Used
Analog Voice	Cat 3	1	1	4,5
ISDN		1 & 3	1 & 2	3,6 & 4,5
10 Base-T		3 & 2	2 & 3	1,2 & 3,6
Token Ring	Cat 5	1 & 2	1 & 2	4,5 & 3,6
TP-PMD (CDDI)		3 & 4	3 & 4	1,2 & 7,8
ATM				
100Base-TX		3 & 2	2 & 3	1,2 & 3,6
100Base-T4		1 to 4	1 to 4	1,2 & 3,6 & 4,5 & 7,8
100VG-AnyLAN	Cat 3			
1000Base-T	Cat 5e			
10GBase-T	Cat 6a			

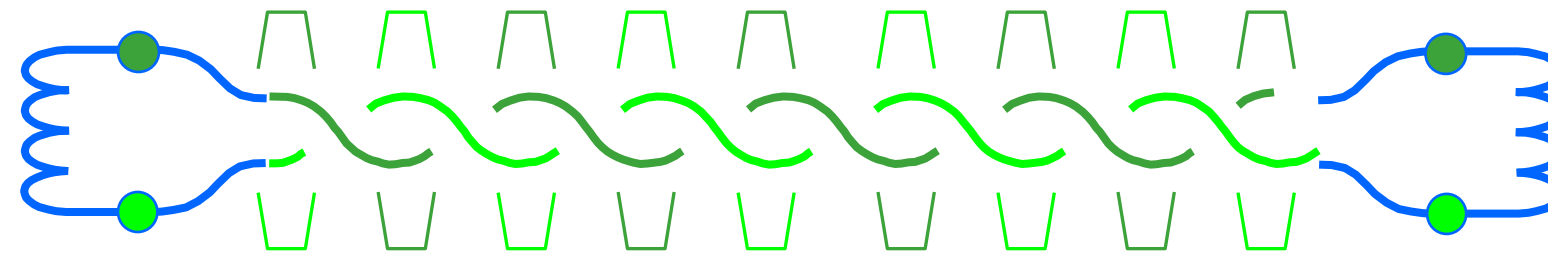
Where Pair 1 = Blue color, Pair 2 = Orange color, Pair 3 = Green color and Pair 4 = Brown color

Signal Transmission

- The main reason for twisting pair of conductors is to minimize crosstalk and noise by decreasing capacitance unbalance and mutual inductance coupling between pairs through electromagnetic field cancellation.
- Each pair is twisted because this allows opposing fields in the wire pair to cancel each other.
- The tighter the twist, the more effective the cancellation and the higher the data rate supported by the cable.



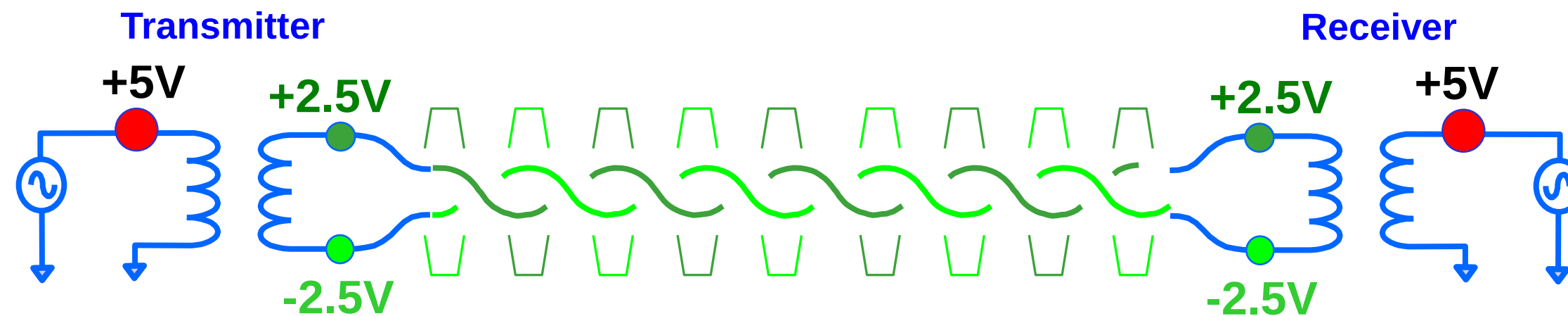
Signal Transmission



- Balanced circuit uses 2 wires (Tip & Ring) to carry the signal.
- Currents flowing through the wires in each pair are equal, but flow in opposite directions. These currents produce electromagnetic fields that could transmit electrical noise to nearby wires.
- However, the fields surrounding the two wires have opposite polarities. Twisting the wires together reduce inductive coupling between pairs.
- Inductive coupling is caused by the expanding and contracting magnetic fields caused by a signal through the wire.
- The twists create coupling between the two wires in the pair such that opposing electromagnetic fields are canceled.

Balanced Mode Transmission Over Twisted Pair

The signal is fed into the wire pair (Tip and Ring) using differential mode transmission scheme



The two conductors of a pair carry the opposite transmitted signal:

- The difference of the signals carries all the data

$$+2.5V_1 - (-2.5V_2) = +5.0V_{\text{Diff}}$$

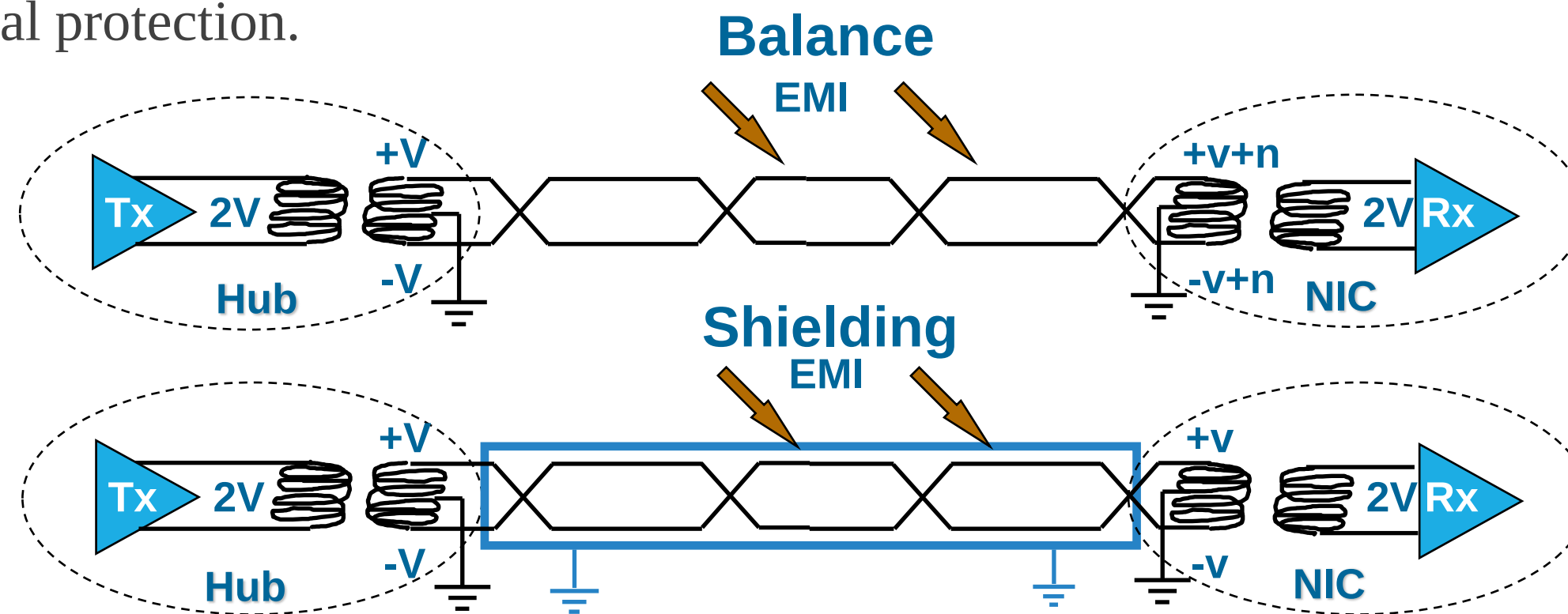
- The sum of the signals is ideally zero resulting in no net emissions

$$+2.5V_1 + (-2.5V_2) = 0V_{\text{Emission}}$$

Screened Twisted Pair Cables

Shielding Benefits

- Reduce the level of radiated signal from the cable.
- Minimize the effect of external electromagnetic interference (EMI) on the wire pairs.
- Provide electrical hazard protection when properly grounded.
- Provide physical protection.



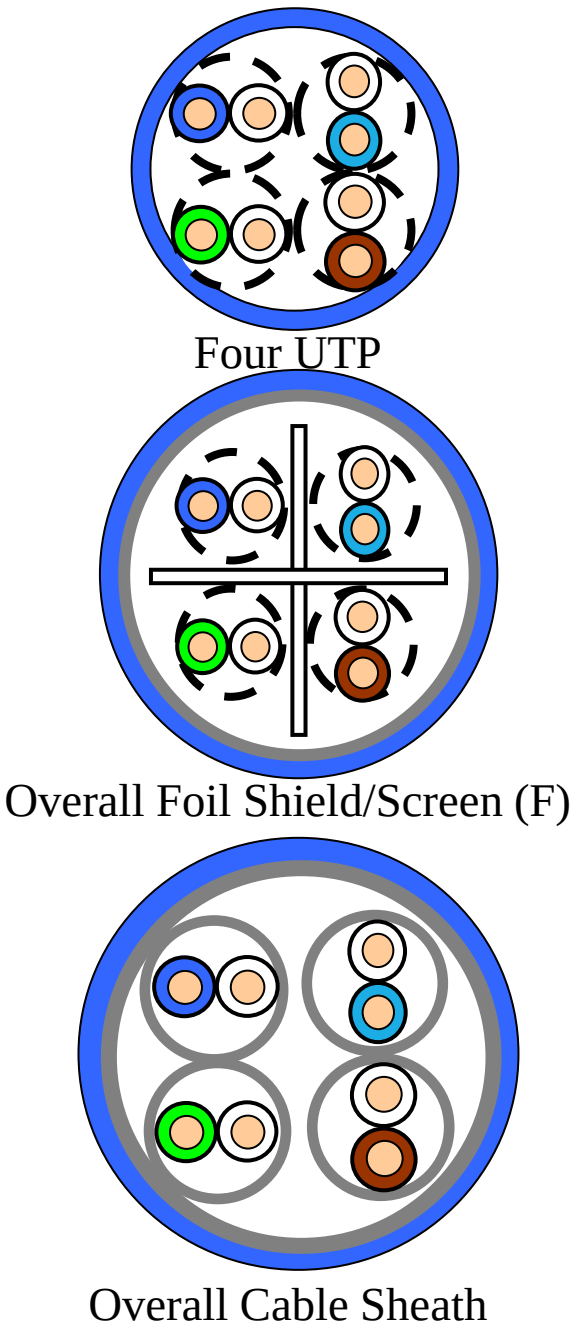


What is Shielded Cable?

Cable constructions and designations

Current Designations	New Designations	Description
UTP	U/UTP	Unshielded twisted-pair
FTP	F/UTP	Foil over UTP
S-FTP	SF/UTP	Screen and foil over UTP
S-STP	S/FTP	Screen over foil shielded pairs

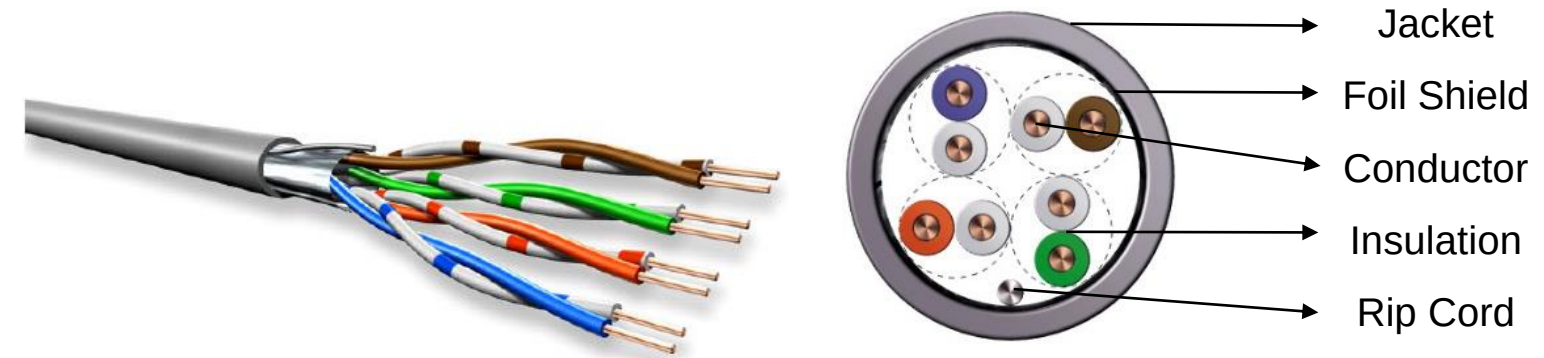
U – Unshielded, F – Foil Shield, S – Braided Shield
First letter designation indicates type of outer shield
Second letter designation indicates type of shield on each pair



Screened Twisted Pair (ScTP) Cables

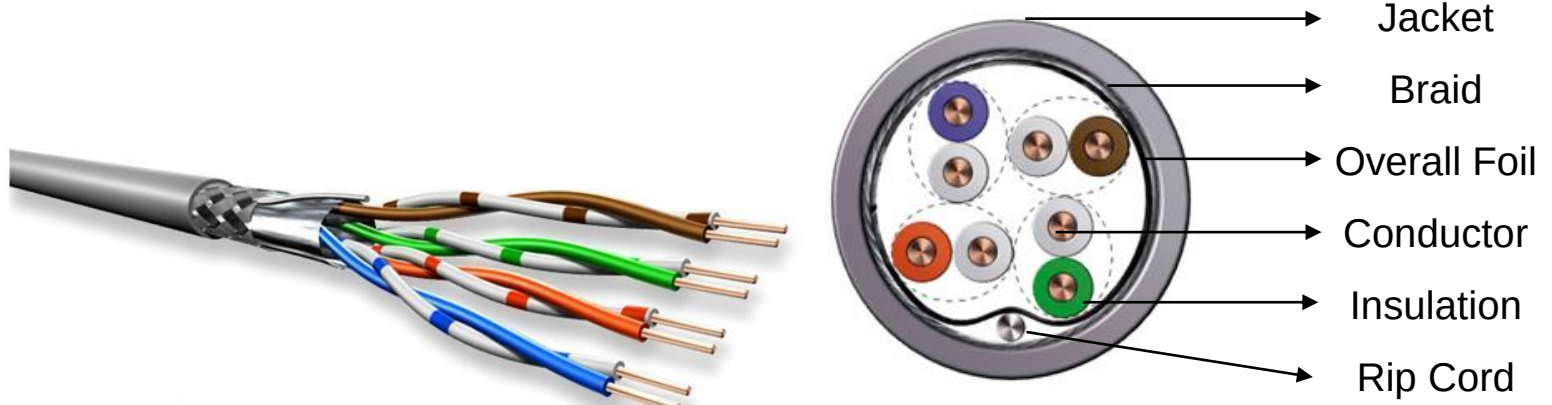
Foiled Twisted Pair (F/UTP)

- Category 5e, 4 pr
- Category 6, 4 pr
- Category 6a, 4pr



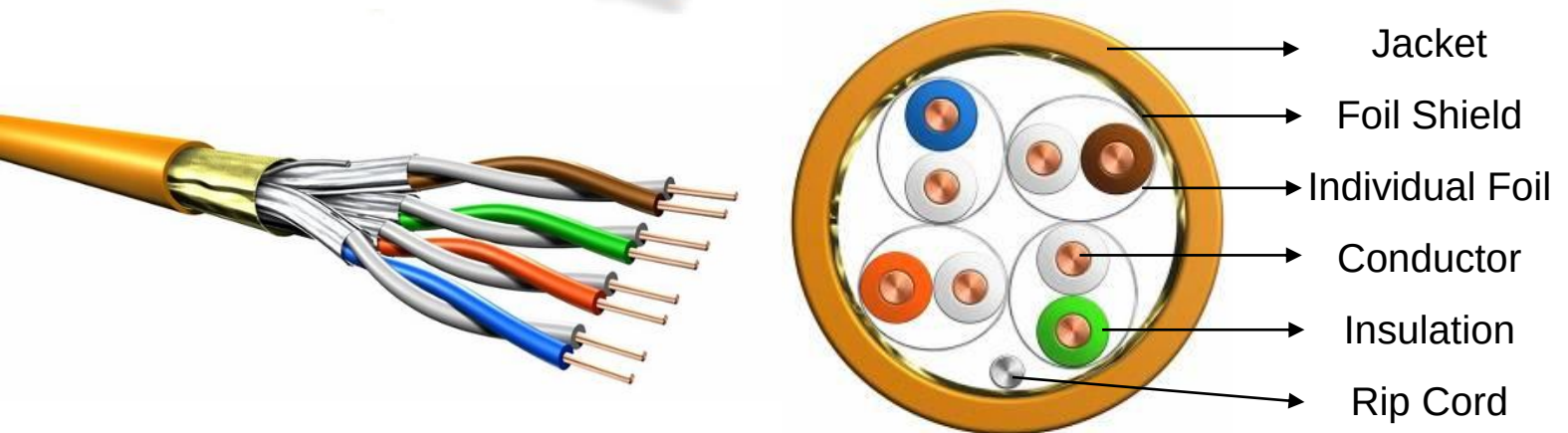
Screened, Foiled Twisted Pair (SF/UTP)

- ScFTP (Old)
- Category 5e, 4 pr



Pair in Metal Foil (F/FTP)

- PiMF
- Category 6, 4 pr
- Category 7, 4 pr
- Category 7a, 4 pr

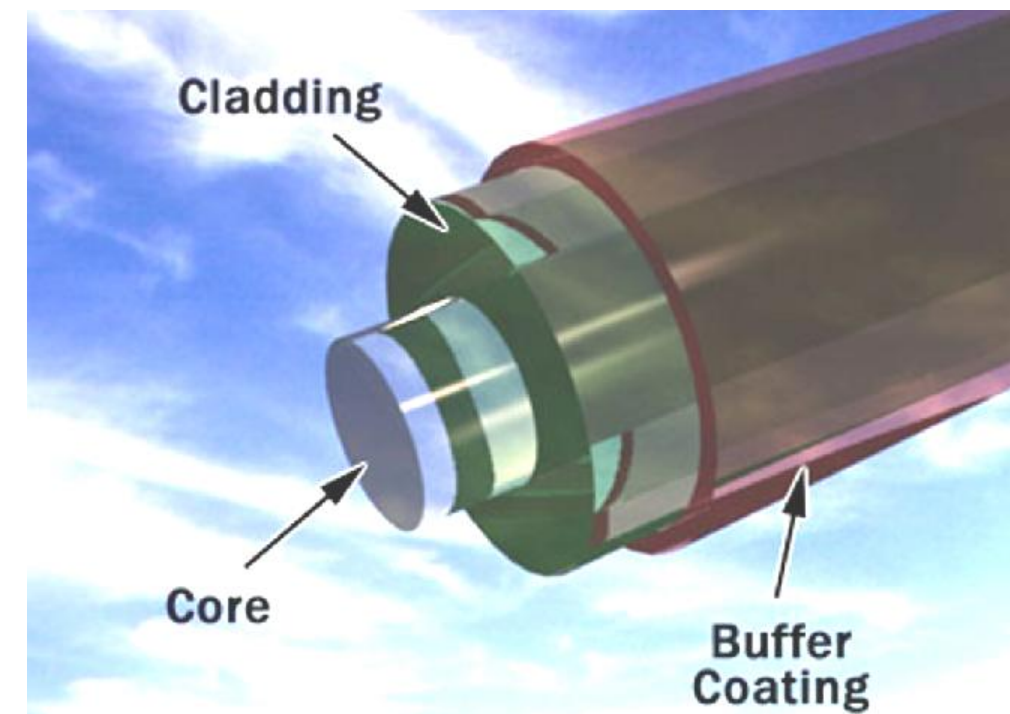
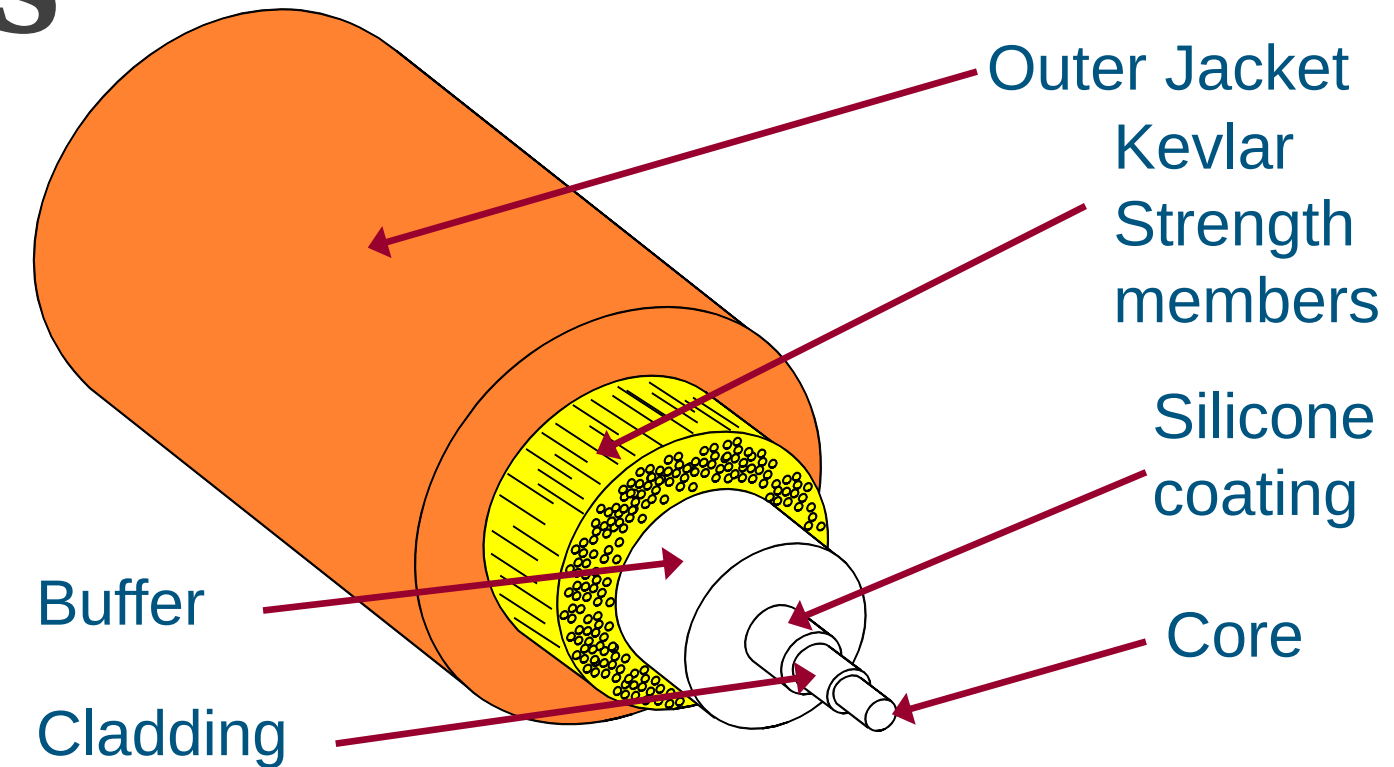




OPTICAL FIBRE CABLING SYSTEMS

Optical Fiber Benefits

- High Bandwidth
- Low Signal Attenuation
- Increase Transmission Distance
- Easy and Dependable Installation
- Compact and lightweight materials
- EMI/RFI Immunity
- No Crosstalk Problems
- Enhanced Security
- Future proof



Elements of Optical Fiber

■ CORE

- Carries the light signal (pure silica glass and doped with germanium)

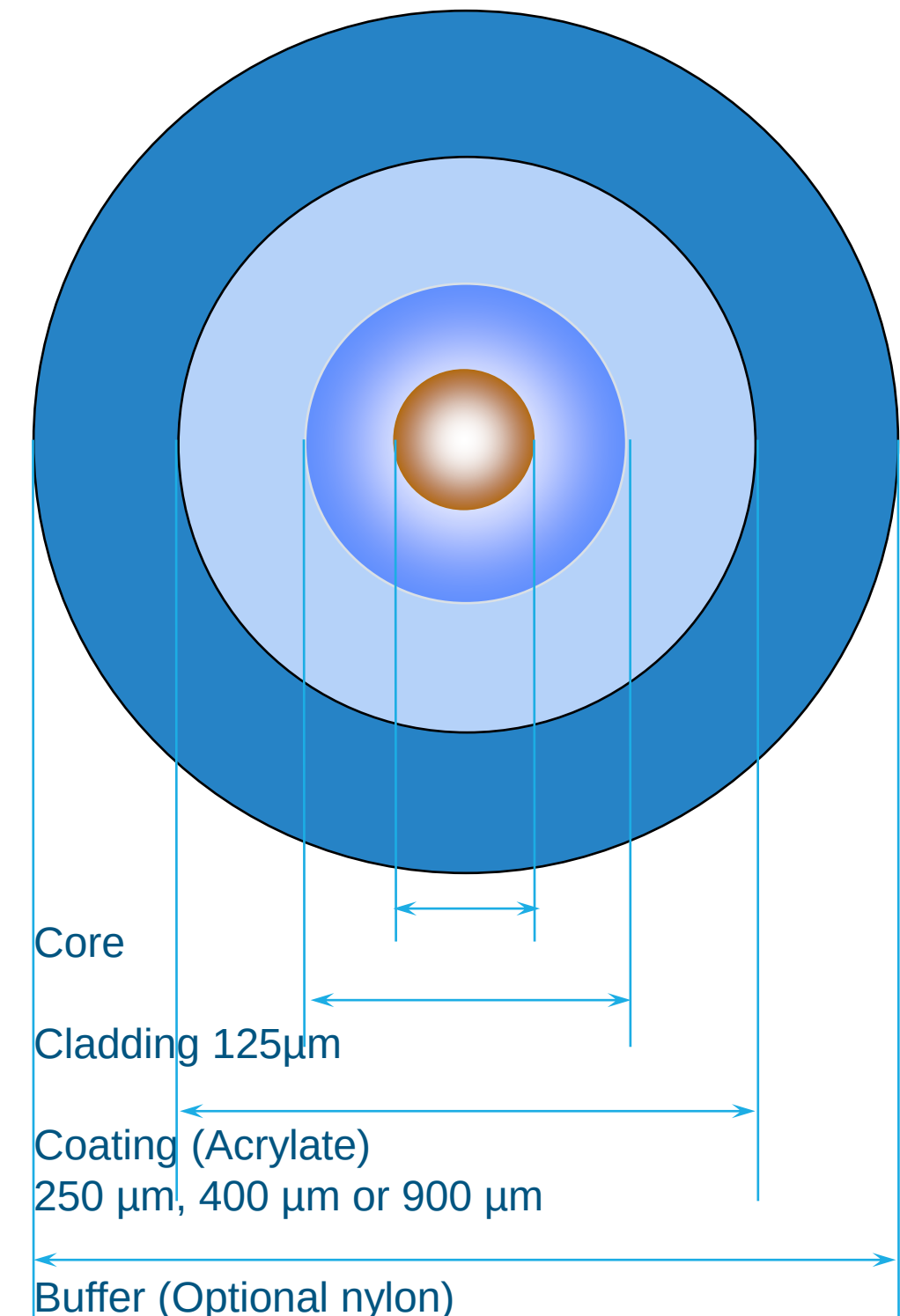
■ CLADDING

- Keeps light signal within core (Pure Silica Glass)

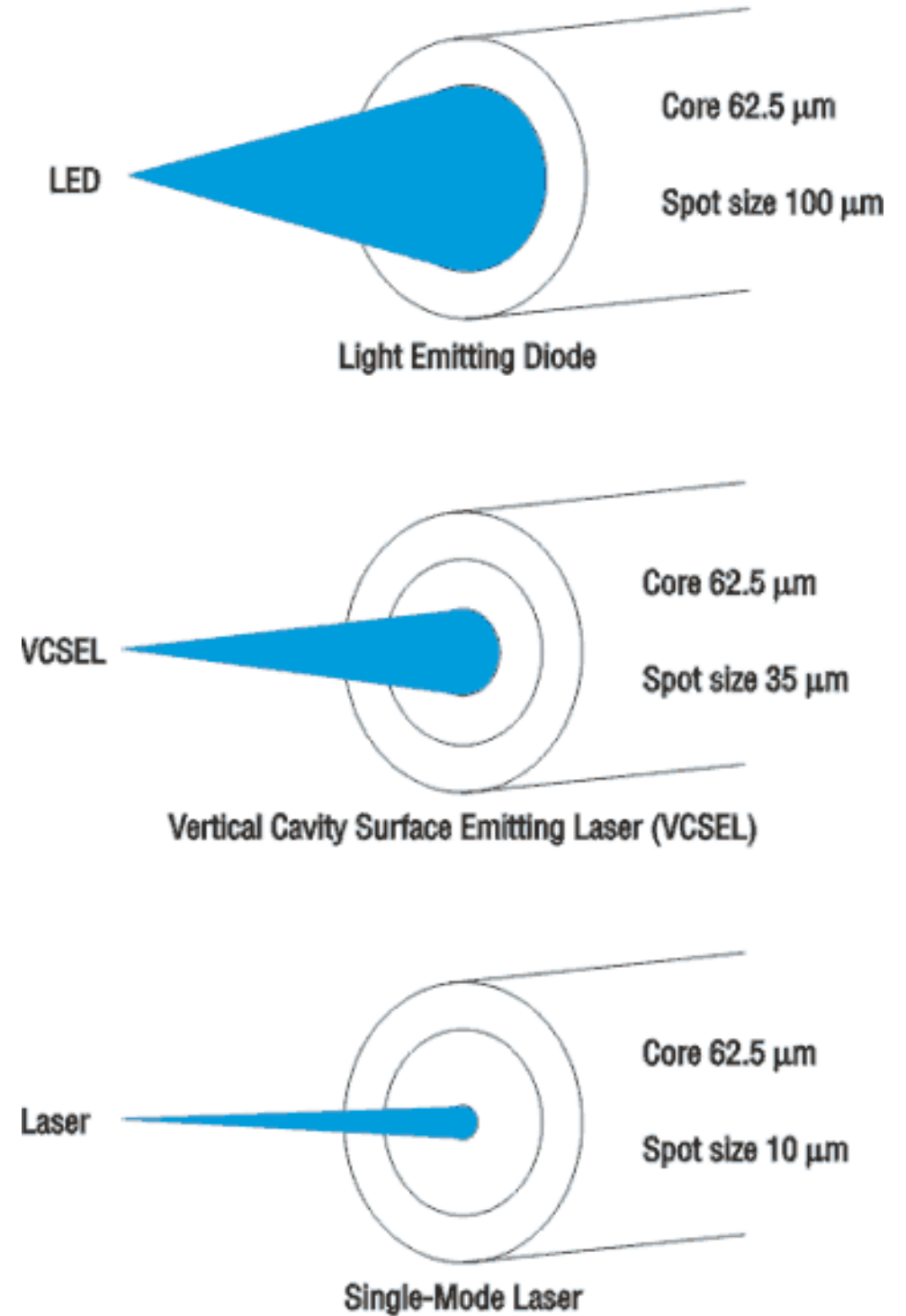
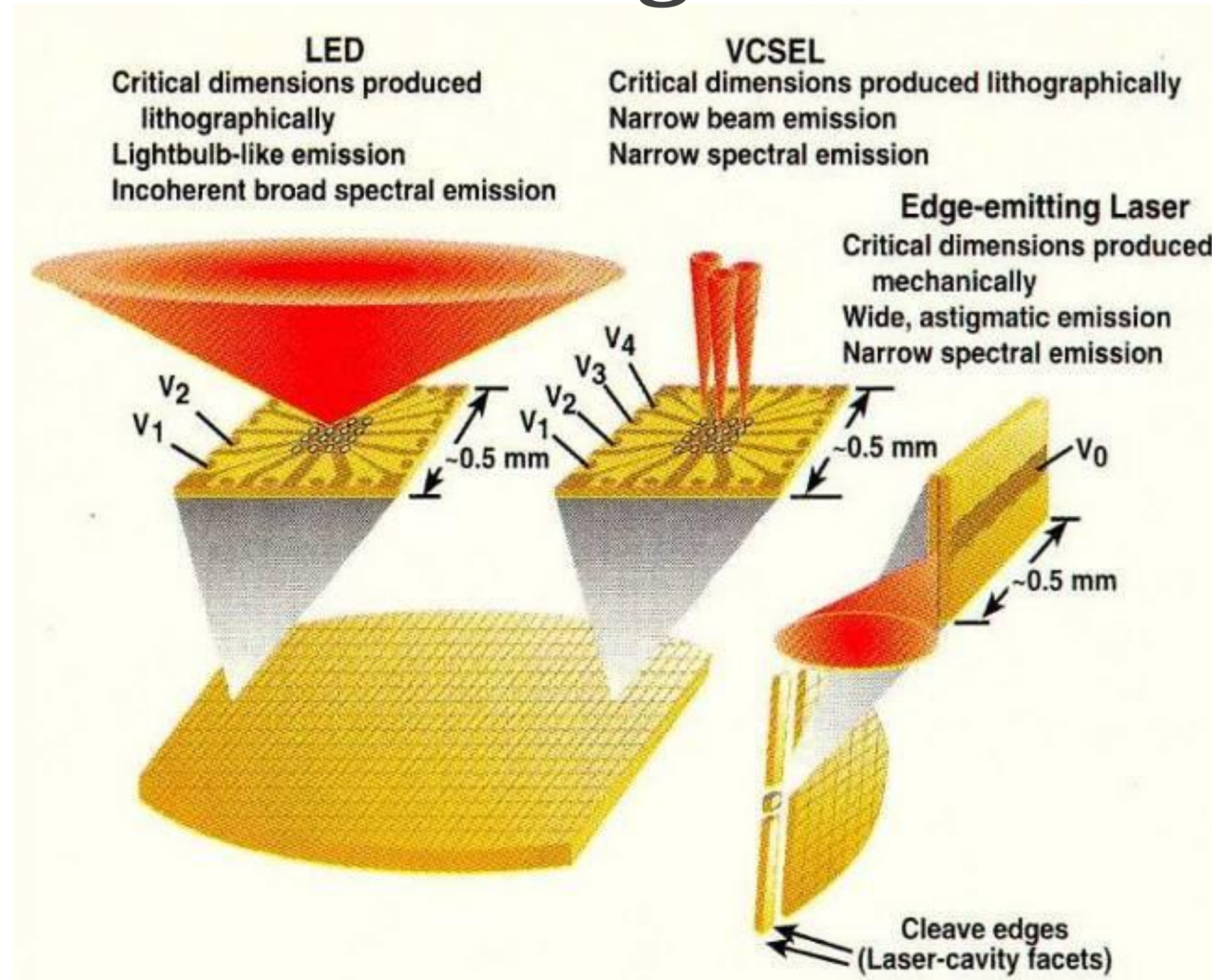
■ COATING

- Protects Optical Fiber From Abrasion and External Pressures (UV Cured Acrylate/Acrololyte)
- OFN : General use, less than 50'
- OFNR : Riser rated, Can be used in vertical passages.
- OFNP : Plenum rated, Can be installed in air plenums without conduit.
- LSZH : Low Smoke, Zero halogen, No specific flame requirements

1 micron (m) = 1 micrometer/ 10^{-6} meters



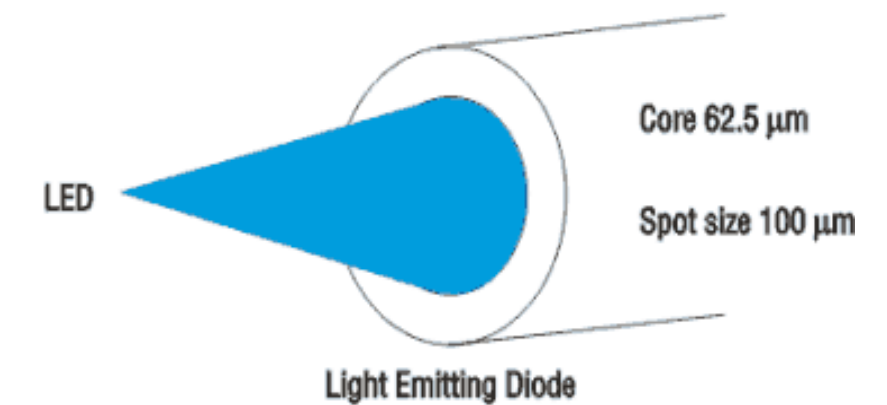
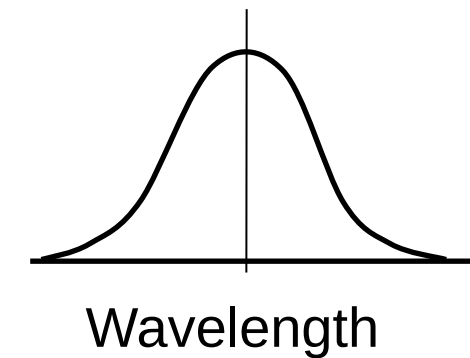
Transmitter Light Sources



Transmitter Light Sources

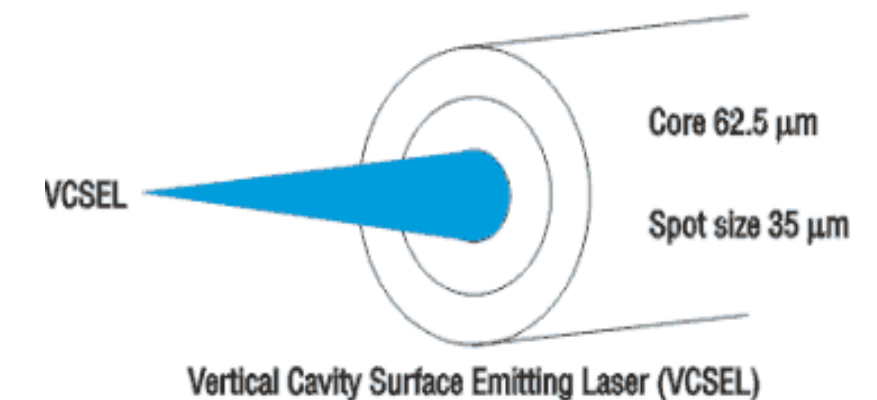
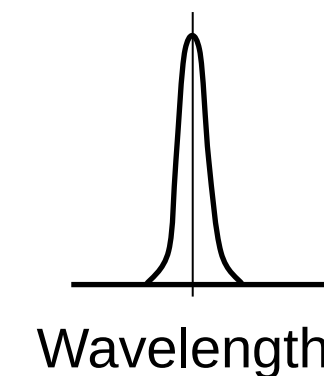
Light Emitting Diodes (LED)

- Used for multimode: 850 nm or 1300 nm
- Wide beam width fills multimode fibers
- Wider spectrum (typically 50 nm)
- Inexpensive



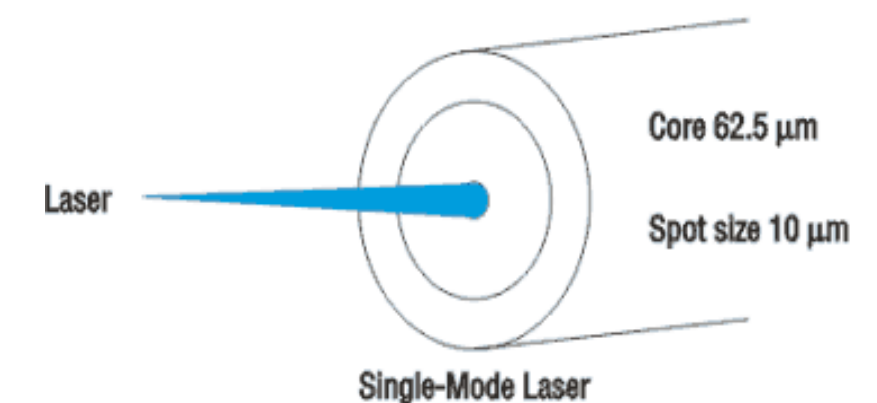
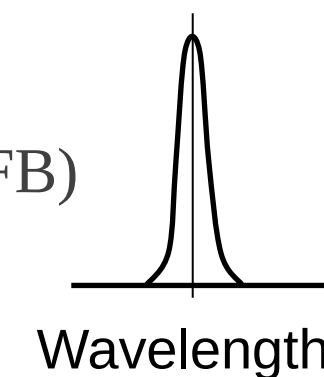
VCSELs

- Vertical Cavity Surface Emitting Laser
- Used for multimode at 850 nm
- Quite narrow spectrum
- Narrow beam width (does not fill multimode fibers)
- Much less expensive than FP or DFB lasers
- Applications: Gigabit Ethernet



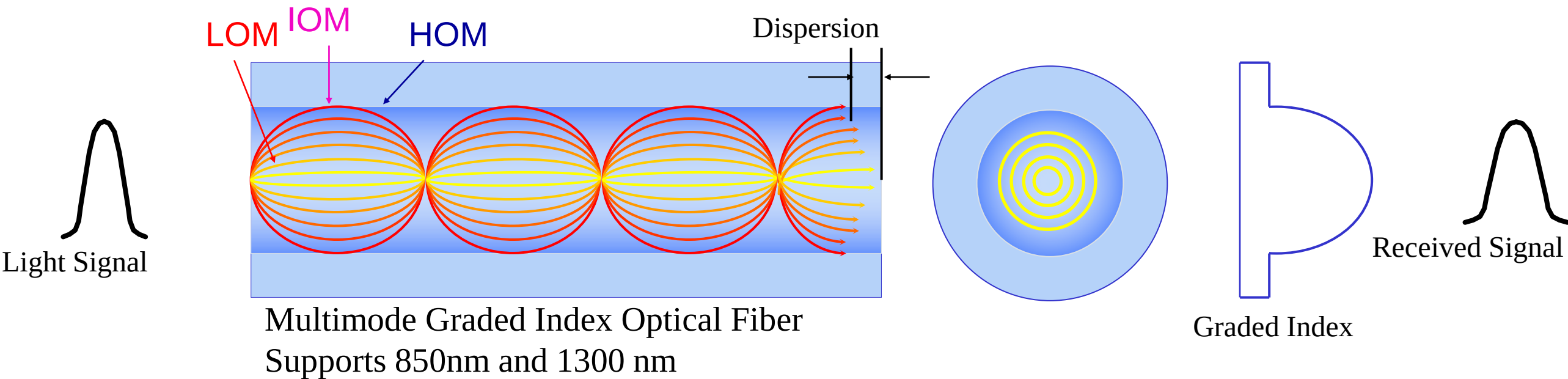
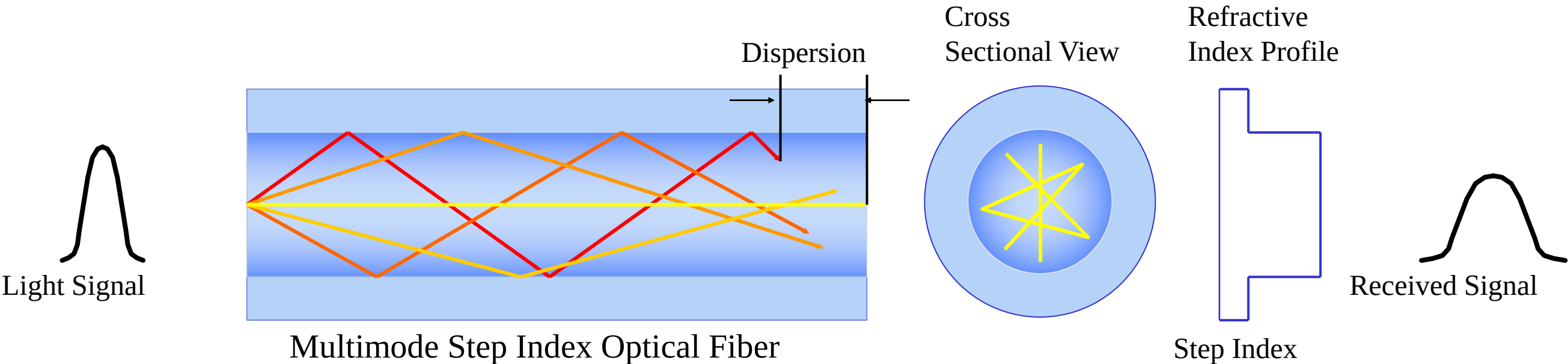
Lasers

- Used for singlemode: 1310 nm or 1550 nm
- Two Common Types: Fabry-Perot (FP) and Distributed Feedback (DFB)
- Narrow spectrum (can be less than 1 nm)
- Narrow beam width (does not fill multimode fibers)
- Highest power and fastest switching
- Most expensive (especially DFB)





Types of Multimode Optical Fiber

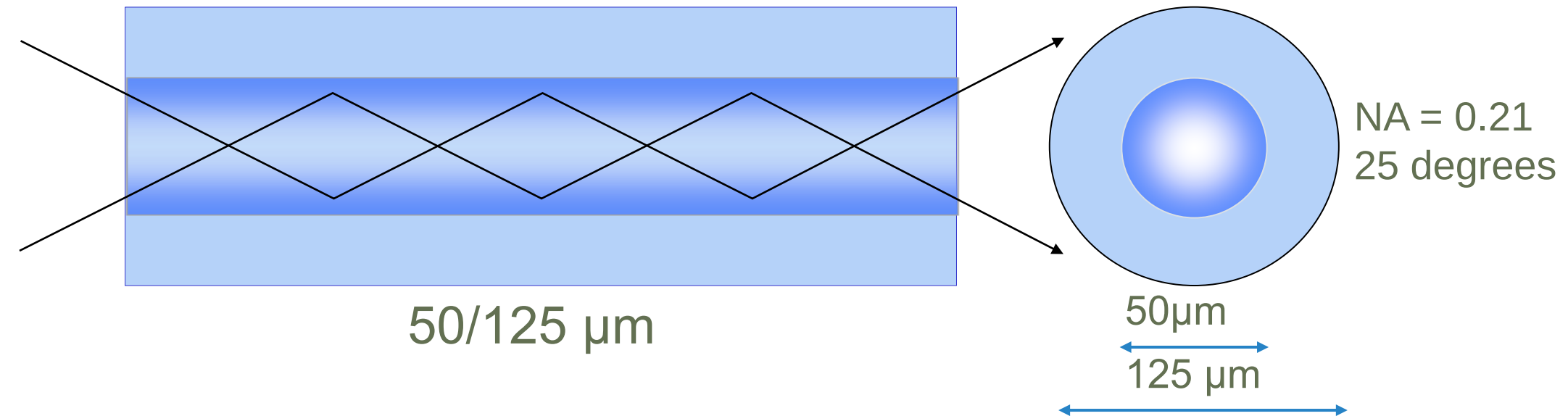


Multimode Graded Index Optical Fiber

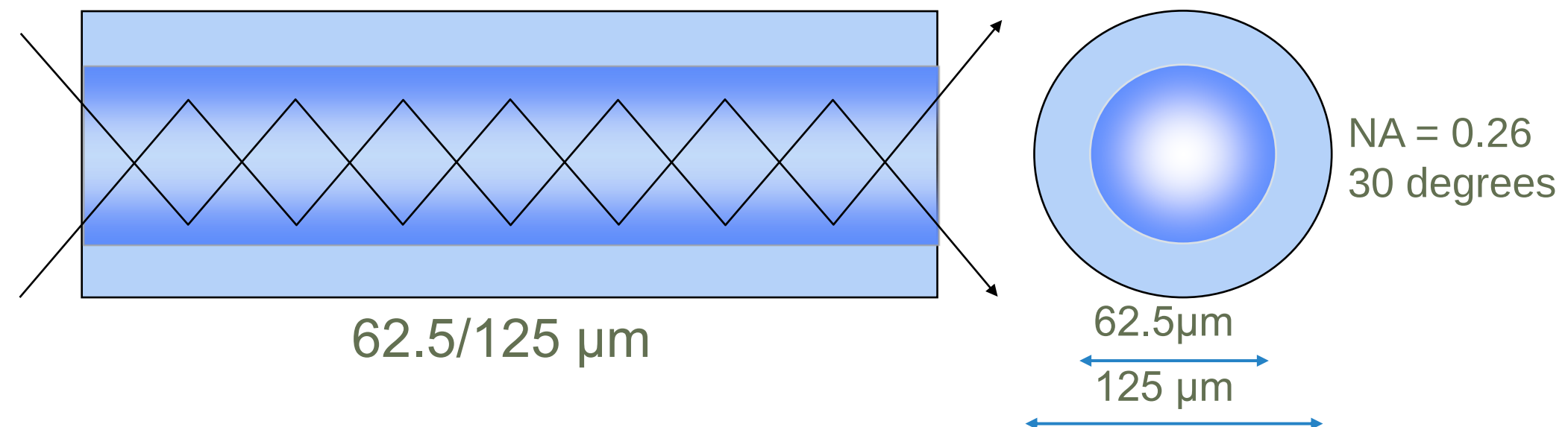
- A larger core size means more modes, or paths of light in the core
- More modes means more modal dispersion, as the light energy takes more paths
- More modal dispersion means more pulse spreading, since the light energy in different modes arrives at different times
- More pulse spreading means less bandwidth because pulses that overlap cannot be distinguished from one another
- Smaller core size means fewer modes and less modal dispersion

Multimode Graded Index Optical Fiber

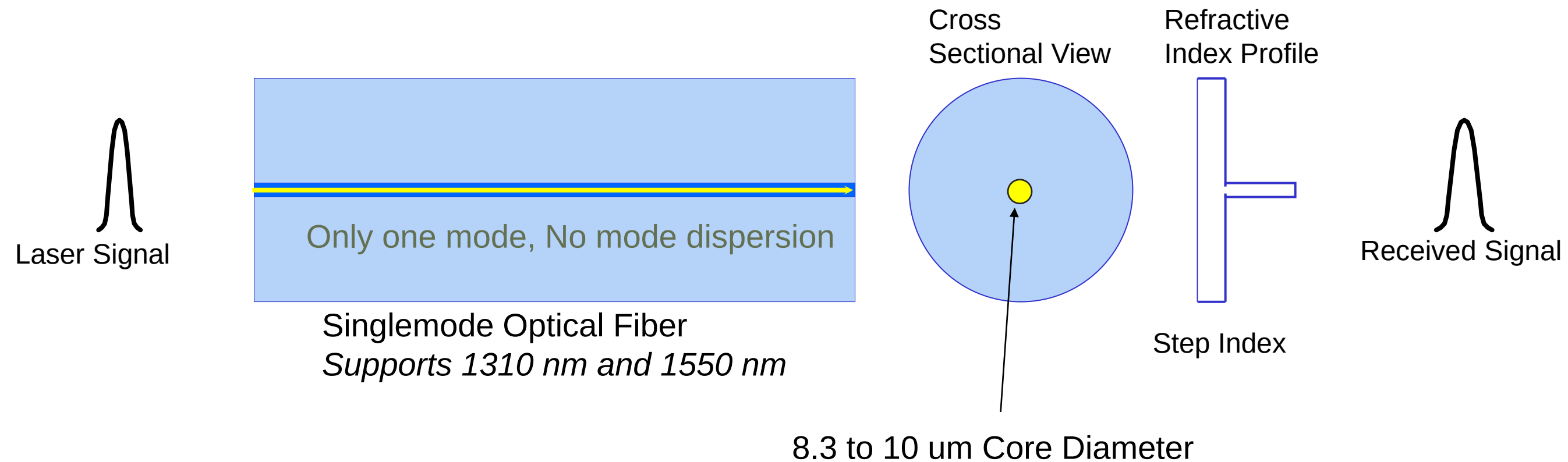
Small Aperture



Large Aperture



Singlemode Optical Fiber





Fiber Selection Table

Description	ISO/IEC Spec.	Bandwidth (MHz.km)		Max. Link length (m)			
		850 nm	1300 nm	850 nm 1000Base-SX Serial VCSEL	1,300 nm 1000Base-LX Serial Laser	850 nm 10GBase-SR/SW Serial VCSEL	1,300 nm 10GBase-LX4 CWDM Laser
62.5/125µm MM	OM1	200	600	300m*	550m*	33m*	360m*
62.5/125µm MM	OM1 Plus	250	800	400m*	1000m*	65m*	450m*
50/125µm MM	OM2	500	500	600m*	600m*	82m*	300m*
50/125µm MM Laser Grade	OM2 Plus	600	1200	750m*	2000m*	100m*	1000m*
50/125µm MM XG (10 Giga)	OM3	1500	500	1000m	600m	300m	300m
50/125µm MM XG (10 Giga)	OM4	3500	500	1040m	600m	550m	300m
9/125µm SM	OS1	Not Specified		-	5000m	-	10000m



Key IEEE Standards and Media for 10 Gigabit Ethernet

- IEEE Ethernet protocol standard 802.3 for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
- IEEE standard 802.3ae for 10 Gigabit Ethernet over Optical Fiber (single-mode and multi-mode).
- IEEE standard 802.3aq for 10 Gigabit Ethernet over installed multimode Optical Fiber up to 220 meters.



Multimode Fiber Selection Table

Standard	Data Rate (Mbps)	Cable Type	IEEE Standard Distance
10Base-FL	10	850nm Multimode OM1, OM2, OM3	2km
100Base-FX	100	1300nm Multimode OM1, OM2, OM3	2km
100Base-BX10	100	1310nm/1550nm Singlemode OS1	10km
1000Base-LX10	1,000	1310nm Multimode/Singlemode	10km
1000Base-BX10	1,000	over single-strand fiber: 1490 nm downstream 1310 nm upstream	10km
1000Base-LH	1,000	1310nm Singlemode OS1	10-70km (6.2-43.4miles)
1000Base-ZX	1,000	1550nm Singlemode OS1	~ 70km
1000Base-EX	1,000	1550nm Singlemode OS1	70-100km (43.4-62miles)
10GBase-LRM	10,000	1300nm Multimode OM1*, OM2*, OM3, OM4	220m
10GBase-LR	10,000	1310nm Singlemode OS1	10-25km
10GBase-ER	10,000	1550nm Singlemode OS1	40km
40GBase-SR-4	40,000	850nm parallel VCSEL Array, OM3	100m
40GBase-SR-4	40,000	850nm parallel VCSEL Array, OM4	150m with 1.0dB connector loss
100GBase-SR10	100,000	850nm parallel VCSEL Array, OM3	100m
100GBase-SR10	100,000	850nm parallel VCSEL Array, OM4	150m with 1.0dB connector loss

* Mode Conditioning Patchcords required

- LRM - Long Range(Reach) Multimode
- LR/ER - Long Range(Reach)/Extended Range; Single Mode

Proposed Physical Medium Dependent (PMD) by IEEE802.3ba Task Force

PMD nomenclature	Media type	Wavelength Window	Minimum reach objective
40GBase-LR4	Singlemode fiber (G.652/021)	1310nm	10km
40GBase-SR4	Multimode fiber OM3	850nm	100m
40GBase-CR4	Copper Cable		7m
40GBase-	Backplane		1m
100GBase-ER4	Singlemode fiber (G.652/021)	1310nm	40km
100GBase-LR4	Singlemode fiber (G.652/021)	1310nm	10km
100GBase-SR10	Multimode fiber OM3	850nm	100m
100GBase-CR10	Copper Cable		7m

LR/ER - Long Range/Extended Range; Single Mode