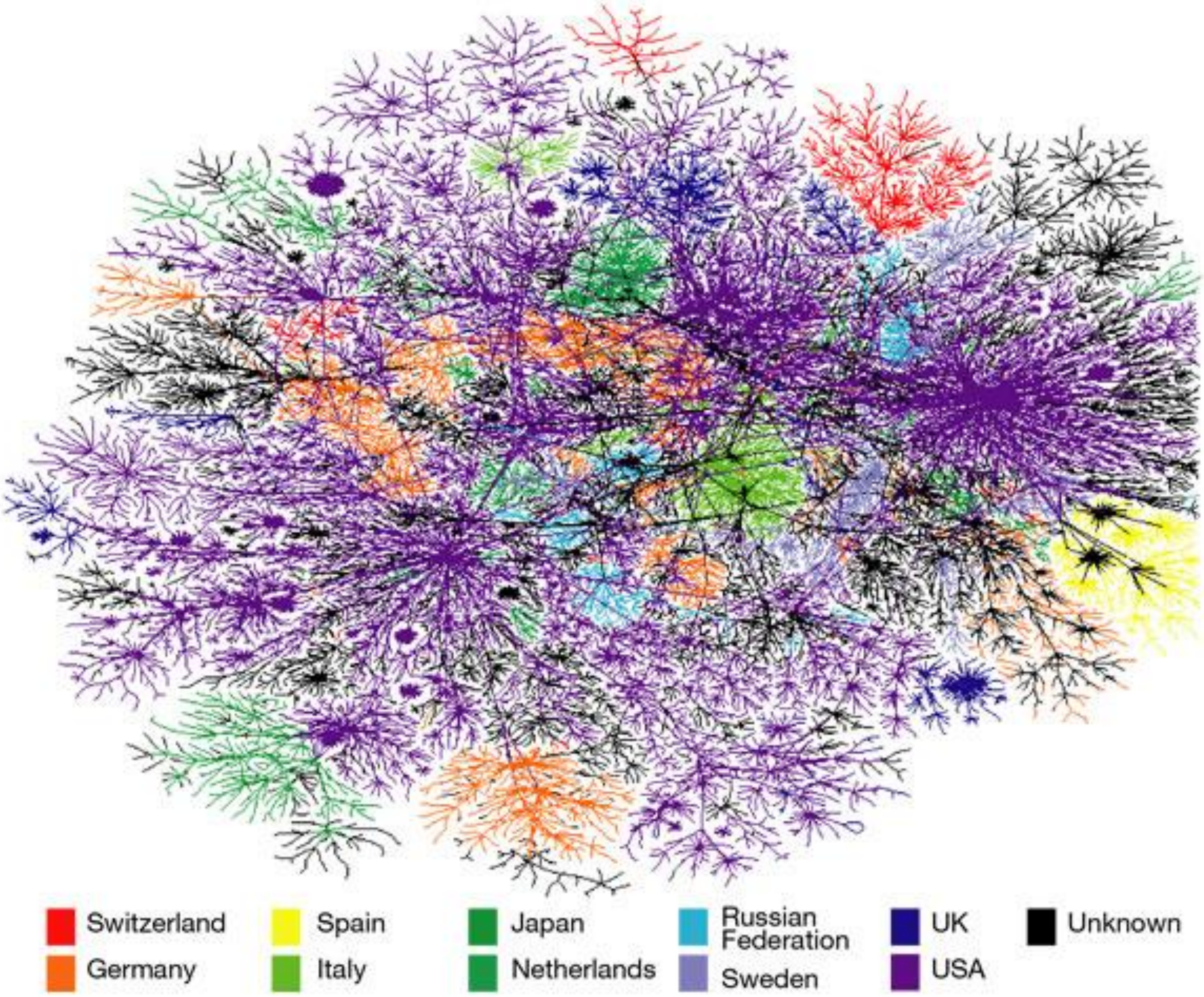
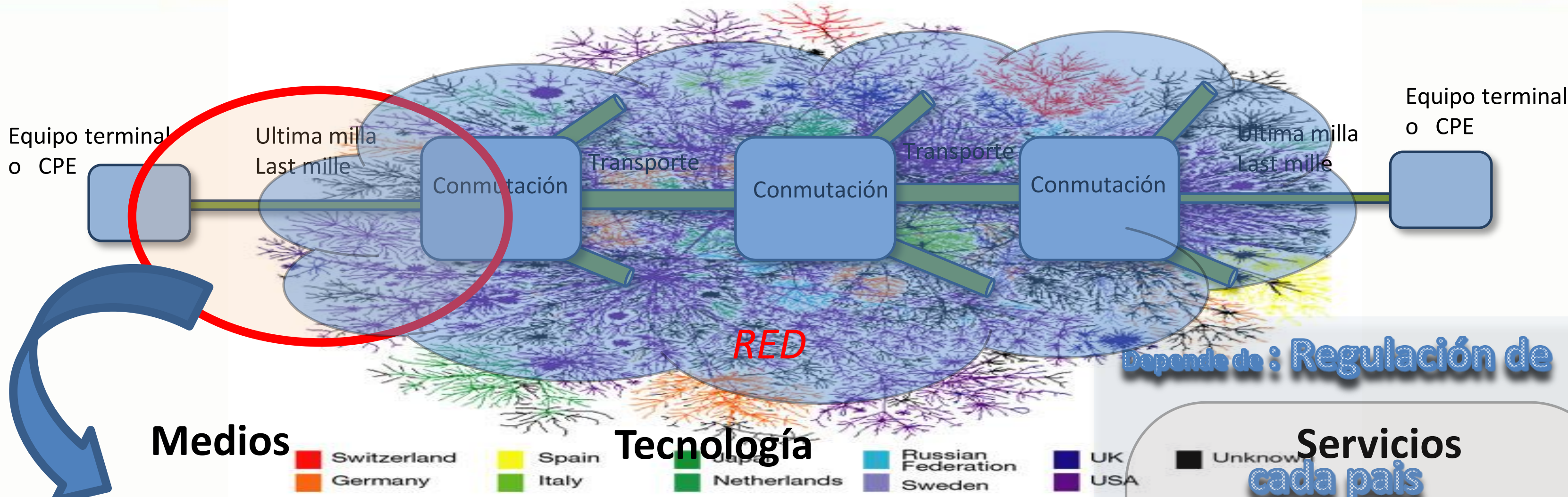
Un esquema de internet



Servicio y tecnología en redes de acceso o ultima Milla



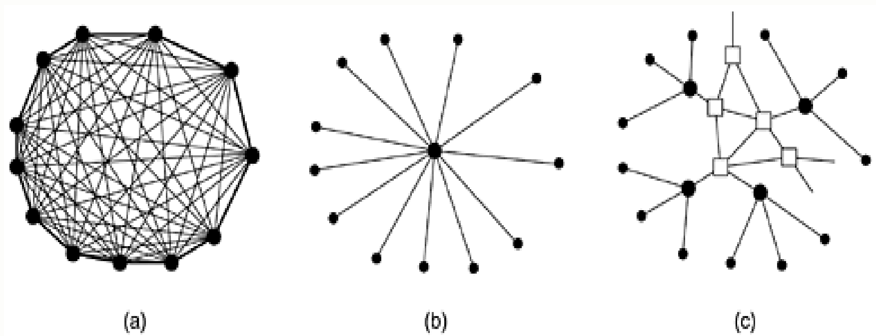
Depende de : Regulación de cada país

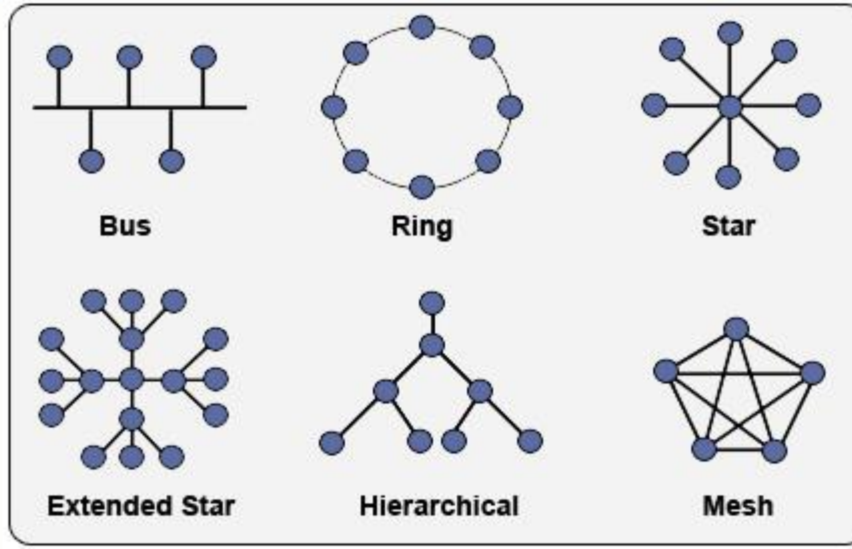
Medios	Tecnología	Servicios
Cobre	(x**DSL**: ADSL, VDSL, SHDSL, etc);	PSTN ; Internet *triple play*?
Coaxial	CATV , HFC (DOCSIS).	TV ; Internet, Telefonía
Fibra	PON (Passive optical network, red óptica pasiva) XPON (BPON , GPON , EPON ..)	TV ; Internet, Telefonía
Wireless	WIFI , WIMAX, CELULAR – 3 G, LTE	Internet, voz? Internet, Telefonía

2.4.3 .- Transmisión

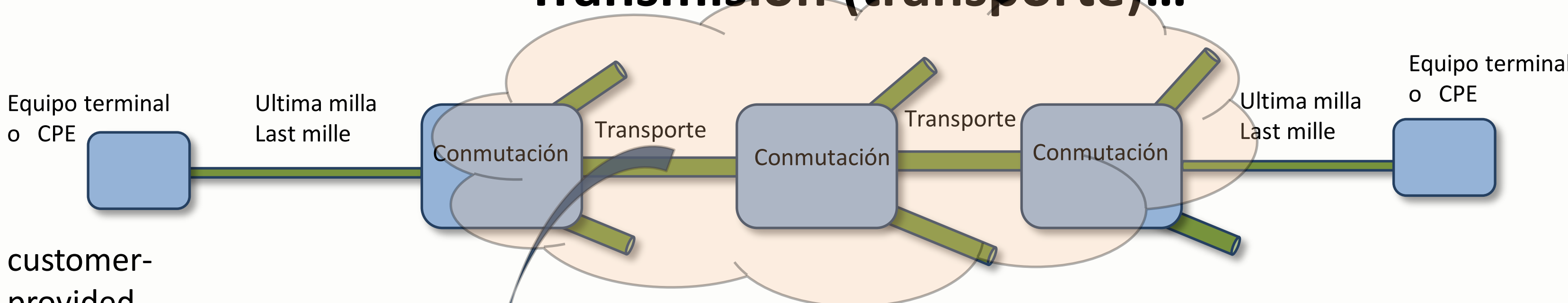
Estructura de las Telecomunicaciones

Topología de redes (en la literatura) ……





Transmisión (transporte)…



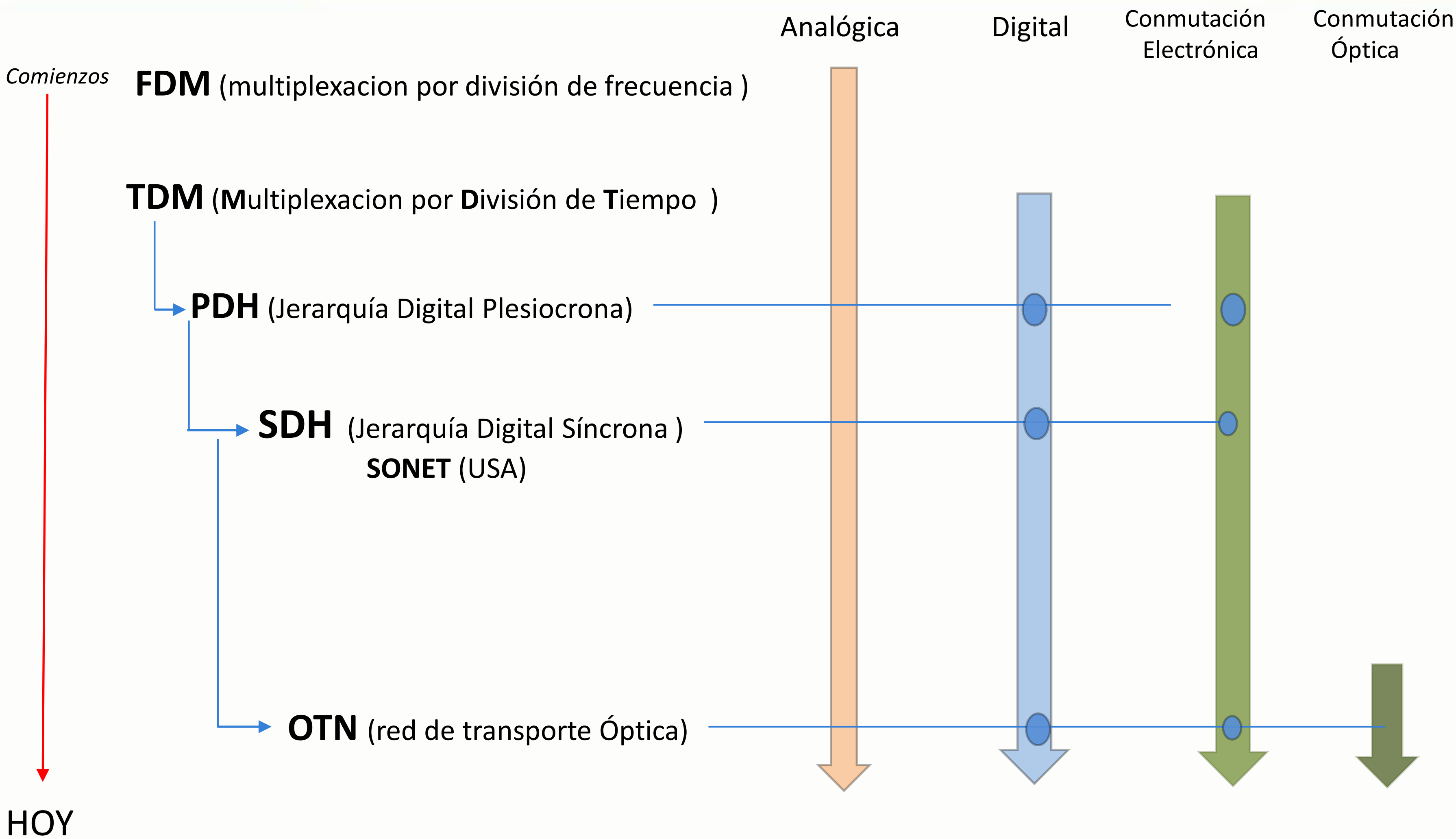
customer-provided *equipment* (CPE)

?

ANALOGICA → FDM

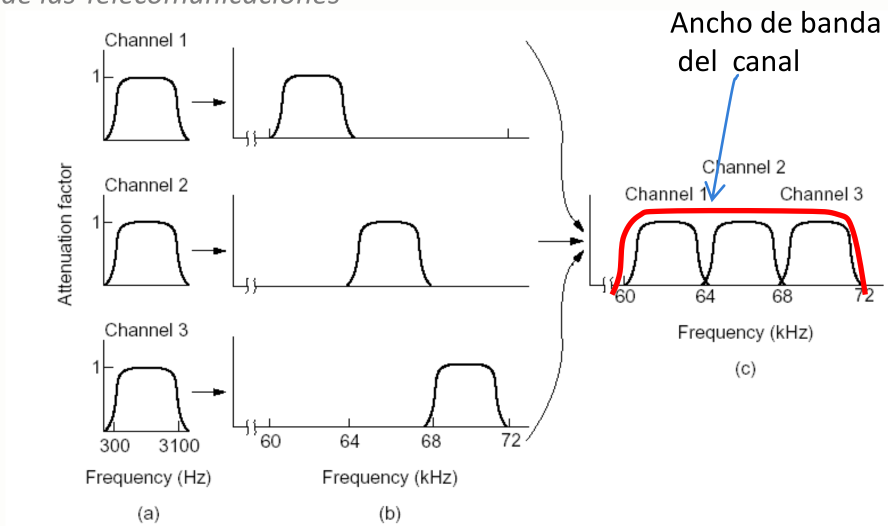
DIGITAL → TDM

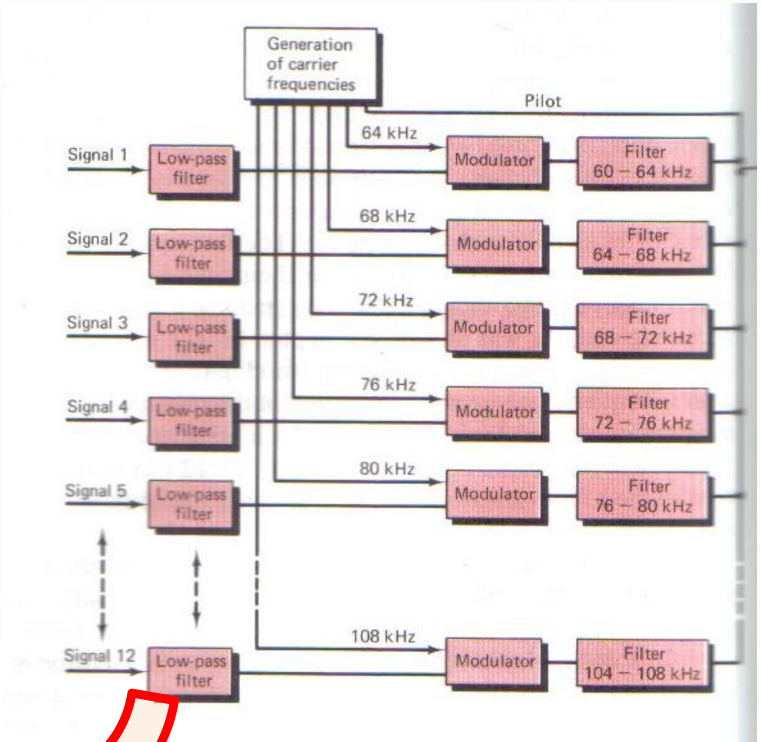
Evolución


Analógica
Digital
Conmutación Electrónica
Conmutación Óptica
Comienzos
FDM (multiplexacion por división de frecuencia)
TDM (Multiplexacion por División de Tiempo)
PDH (Jerarquía Digital Plesiocrona)
SDH (Jerarquía Digital Síncrona)
SONET (USA)
OTN (red de transporte Óptica)
HOY

MULTIPLEXACION POR DIVISION DE FRECUENCIA, *FDM.*

Estructura de las Telecomunicaciones





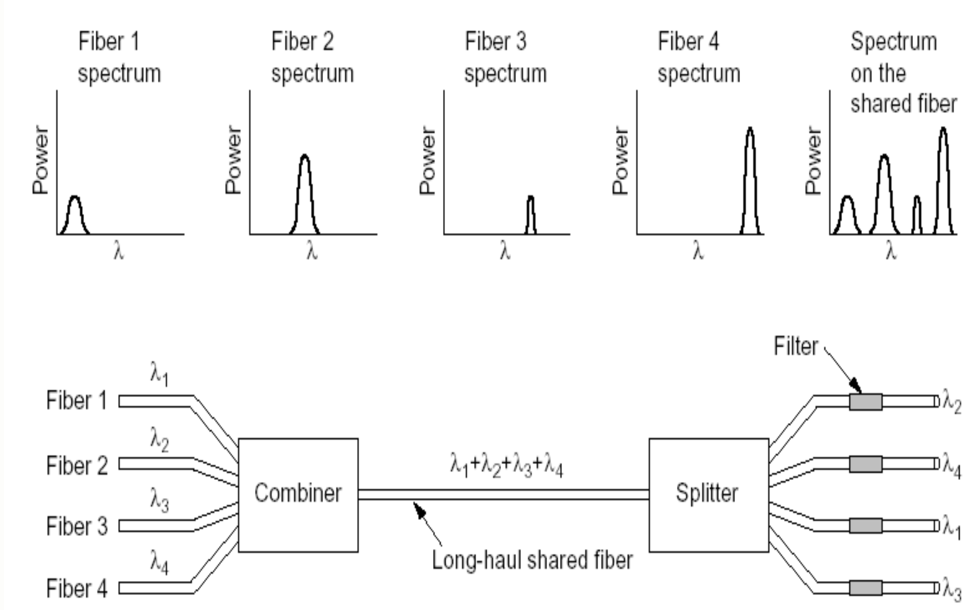
Jerarquía en FDM según organismos .

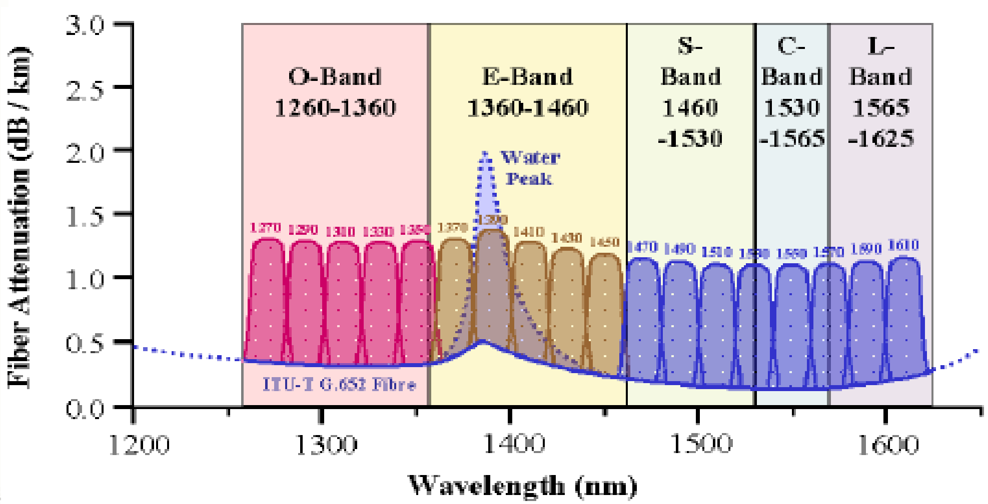
Número de canales de voz	Ancho de banda	Espectro	AT&T	ITU-T
12	48KHz	60-108KHz	Grupo	Grupo
60	240KHz	312-552KHz	Supergrupo	Supergrupo
300	1,232MHz	812-2044KHz		Grupo maestro
600	2,52MHz	564-3084KHz	Grupo maestro	
900	3,872MHz	8,516-12,388MHz		Grupo supermaestro
Nx600			Grupo maestro multiplexado	
3600	16,984MHz	0,564-17,548MHz	Grupo jumbo	
10800	57,442MHz	3,124-60,566MHz	Grupo jumbo multiplexado	

10

Ejemplos actuales de FDM:

WDM (Wavelength Division Multiplexing) (transporte)





TVCABLE (last Mille)

Channel Number	Band (MHz)	Channel Number	Band (MHz)	Channel Number	Band (MHz)
2	54-60	22	168-174	42	330-336
3	60-66	23	216-222	43	336-342
4	66-72	24	222-228	44	342-348
5	76-82	25	228-234	45	348-354
6	82-88	26	234-240	46	354-360
7	174-180	27	240-246	47	360-366
8	180-186	28	246-252	48	366-372
9	186-192	29	252-258	49	372-378
10	192-198	30	258-264	50	378-384
11	198-204	31	264-270	51	384-390
12	204-210	32	270-276	52	390-396
13	210-216	33	276-282	53	396-402
FM	88-108	34	282-288	54	402-408
14	120-126	35	288-294	55	408-414
15	126-132	36	294-300	56	414-420
16	132-138	37	300-306	57	420-426
17	138-144	38	306-312	58	426-432
18	144-150	39	312-318	59	432-438
19	150-156	40	318-324	60	438-444
20	156-162	41	324-330	61	444-450
21	162-168				

Transporte digital

Para transportar la voz ,debemos digitalizarla en un canal digital …

¿Porque digital ? :

Ventajas :

Desventajas:

Digitalizando la voz : Codificadores/decodificadores

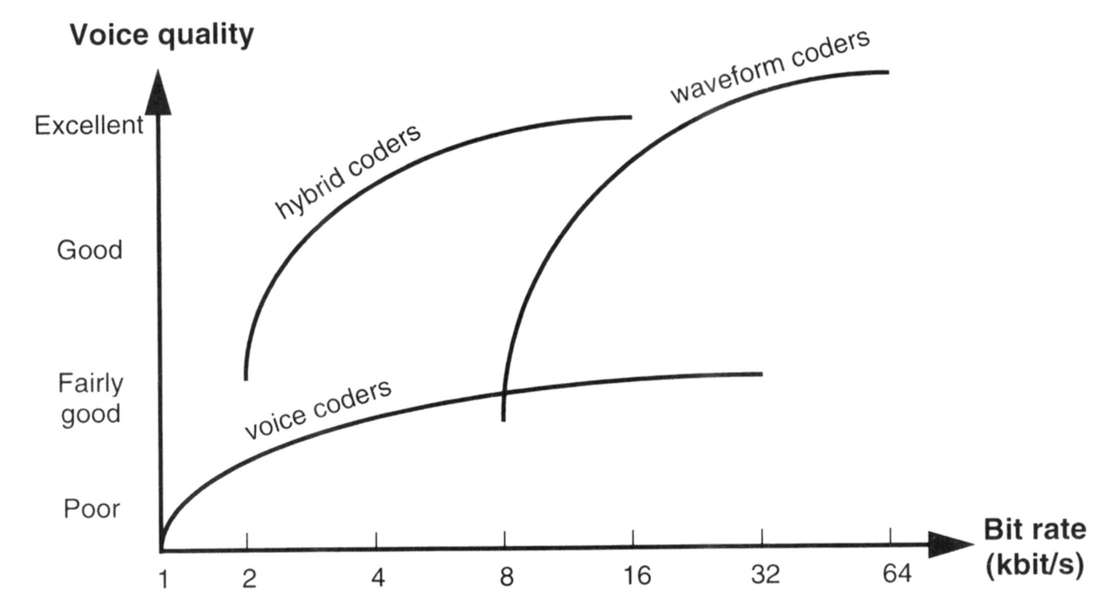
Codificadores de voz: clasificación

- Los codificadores de voz pueden dividirse en 3 grupos:
  - **Codificadores de forma de onda**
    - Conservan la forma de onda de la señal
    - Calidad alta: 16 – 64 kbps.
  - **Vocoders (codificadores paramétricos)**
    - Explotan la naturaleza de la señal de voz para reducir el *bitrate*
    - Calidad baja/media: 1.2 – 4.8 kbps
  - **Codificadores híbridos**
    - Mezcla de los dos anteriores
    - Calidad media/alta: 2.4 – 16 kbps

Digitalizando la voz :

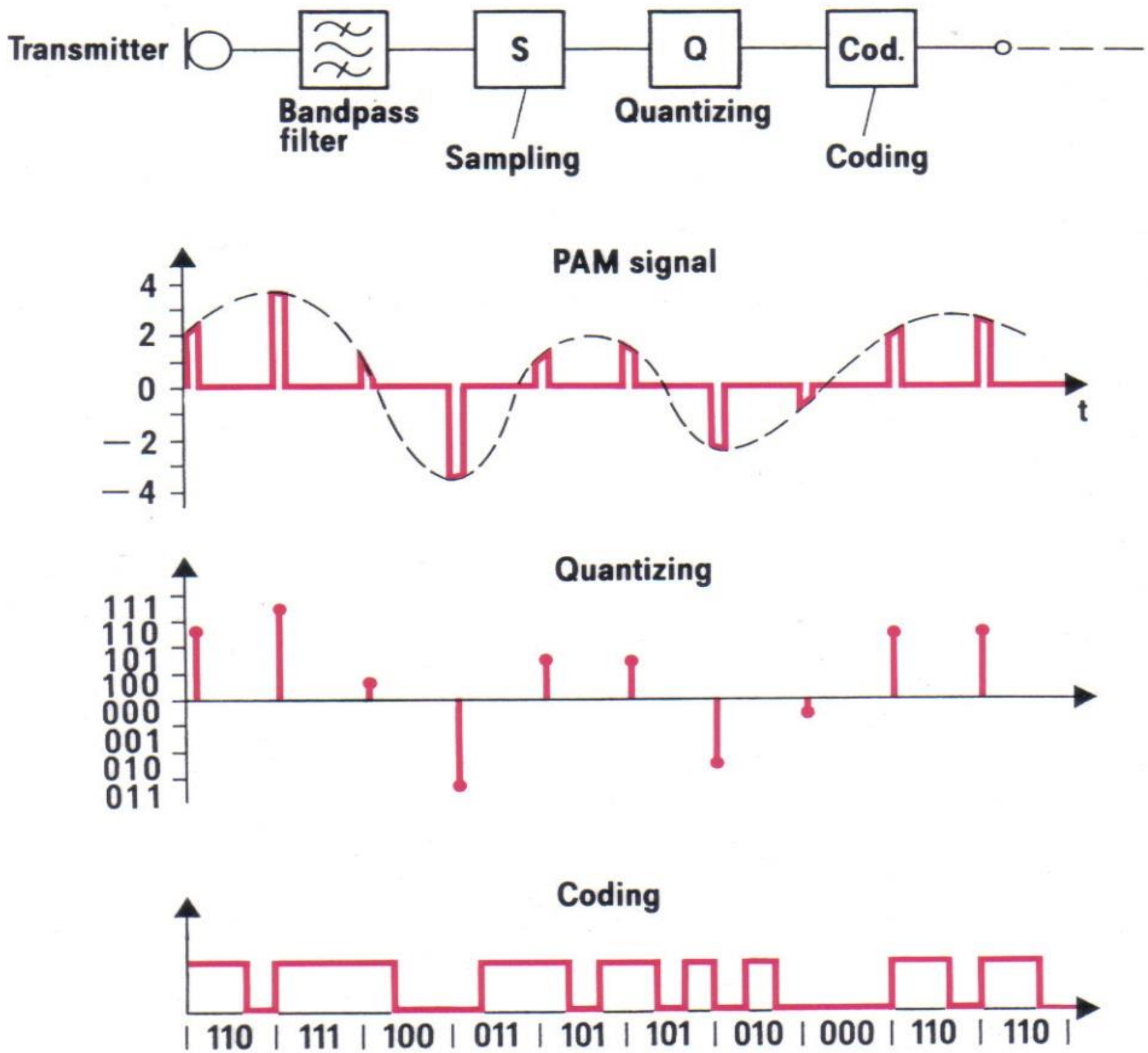
El canal de voz (ancho de banda): : 3 khz ;
Nysquist: …Frecuencia de muestreo: : 8 khz;
Cuantización : : 8 bit por muestra …;
entonces..**Velocidad requerida: 64 kbps**

PCM Codificaciones de voz



PCM : El canal de voz

TRANSPORTE



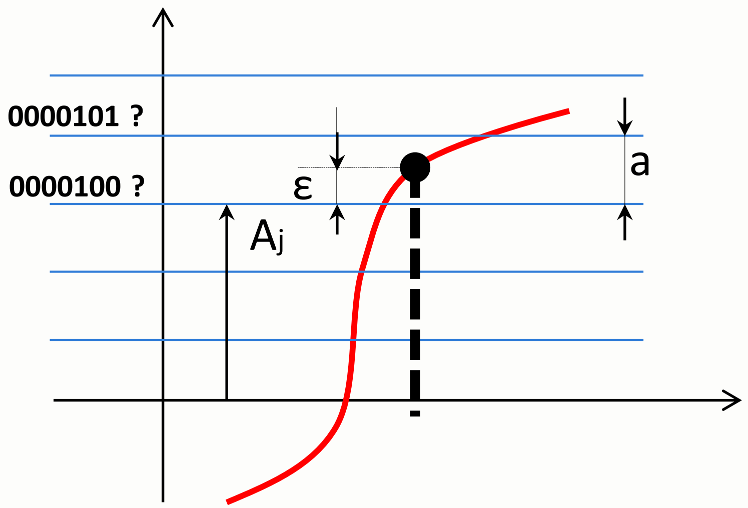
Ruido de cuantización

El valor de la señal es : $A_j + \varepsilon$

$$\varepsilon \leq \frac{a}{2}$$

$$\bar{\varepsilon}^2 = \int_{-\infty}^{\infty} \varepsilon^2 p(\varepsilon)\, d\varepsilon \quad = \frac{a^2}{12}$$

$$S = \frac{(n^2-1)}{12} a^2$$



$$\left[\frac{S}{R}\right] = 4{,}8\, db + 20 \log n = 4{,}8 + 6m \qquad n = 2^m$$ En binario

Quantization noise decreases by 6dB/bit

CODIFICADORES BAJO RECOMENDACIÓN DEL ITU y otros :

Table 2. A Representative Sample of Speech Coding Standards

Application	Rate (kbps)	BW (kHz)	Standards Organization	Standard Number	Algorithm	Year
Landline telephone	64	3.4	ITU	G.711	μ-law or A-law PCM	1988
	16–40	3.4	ITU	G.726	ADPCM	1990
	16–40	3.4	ITU	G.727	ADPCM	1990
Tele conferencing	48–64	7	ITU	G.722	Split-band ADPCM	1988
	16	3.4	ITU	G.728	Low-delay CELP	1992
Digital	13	3.4	ETSI	Full-rate	RPE-LTP	1992
cellular	12.2	3.4	ETSI	EFR	ACELP	1997
	7.9	3.4	TIA	IS-54	VSELP	1990
	6.5	3.4	ETSI	Half-rate	VSELP	1995
	8.0	3.4	ITU	G.729	ACELP	1996
	4.75–12.2	3.4	ETSI	AMR	ACELP	1998
	1–8	3.4	CDMA-TIA	IS-96	QCELP	1993
Multimedia	5.3–6.3	3.4	ITU	G.723.1	MPLPC, CELP	1996
	2.0–18.2	3.4–7.5	ISO	MPEG-4	HVXC, CELP	1998
Satellite telephony	4.15	3.4	INMARSAT	M	IMBE	1991
	3.6	3.4	INMARSAT	Mini-M	AMBE	1995
Secure communications	2.4	3.4	DDVPC	FS1015	LPC-10e	1984
	2.4	3.4	DDVPC	MELP	MELP	1996
	4.8	3.4	DDVPC	FS1016	CELP	1989
	16–32	3.4	DDVPC	CVSD	CVSD	

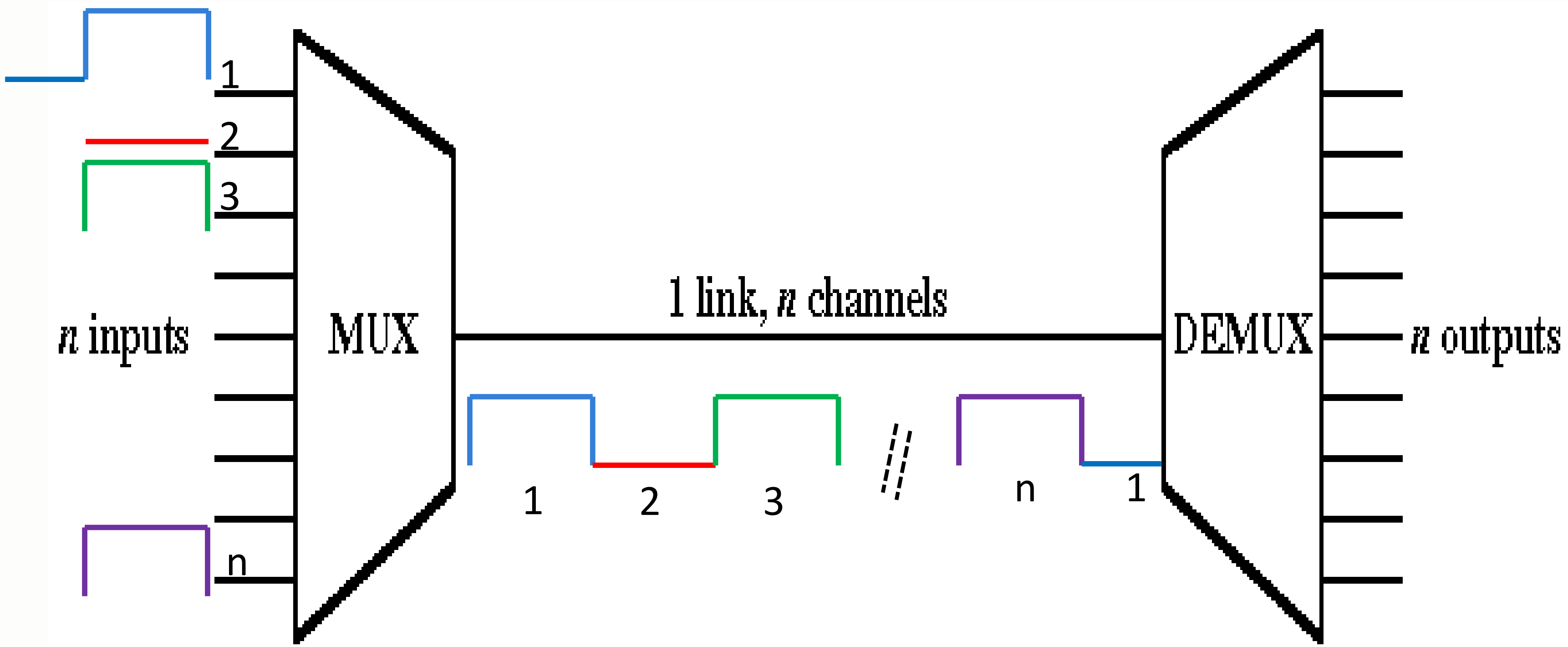
CODIFICADORES BAJO RECOMENDACIÓN DEL ITU y otros :

MECANISMOS DE CODIFICACION/COMPRESION

NOMBRE	TECNOLOGIA	REQ. (Kbps)	CALIDAD	MUESTRA	PROCESAM. COMPLEJID
G.711	PCM	64	Red Publica.	0.125 ms	Bajo
G.723.1	ACELP MP-MLQ	5.4 6.3	Buena (-)	30 ms 30 ms	Muy alto
G.727	ADPCM	40-16	Buena	0.125	Bajo
G.728	LD-CELP	16	Buena	0.625 ms	Muy bajo
G.729	CS-CELP	8	Buena	10 ms	Alto
G.729A	CS-CELP	8	Buena	10 ms	Alto

MULTIPLEXACION POR DIVISION DE TIEMPO , *TDM.*

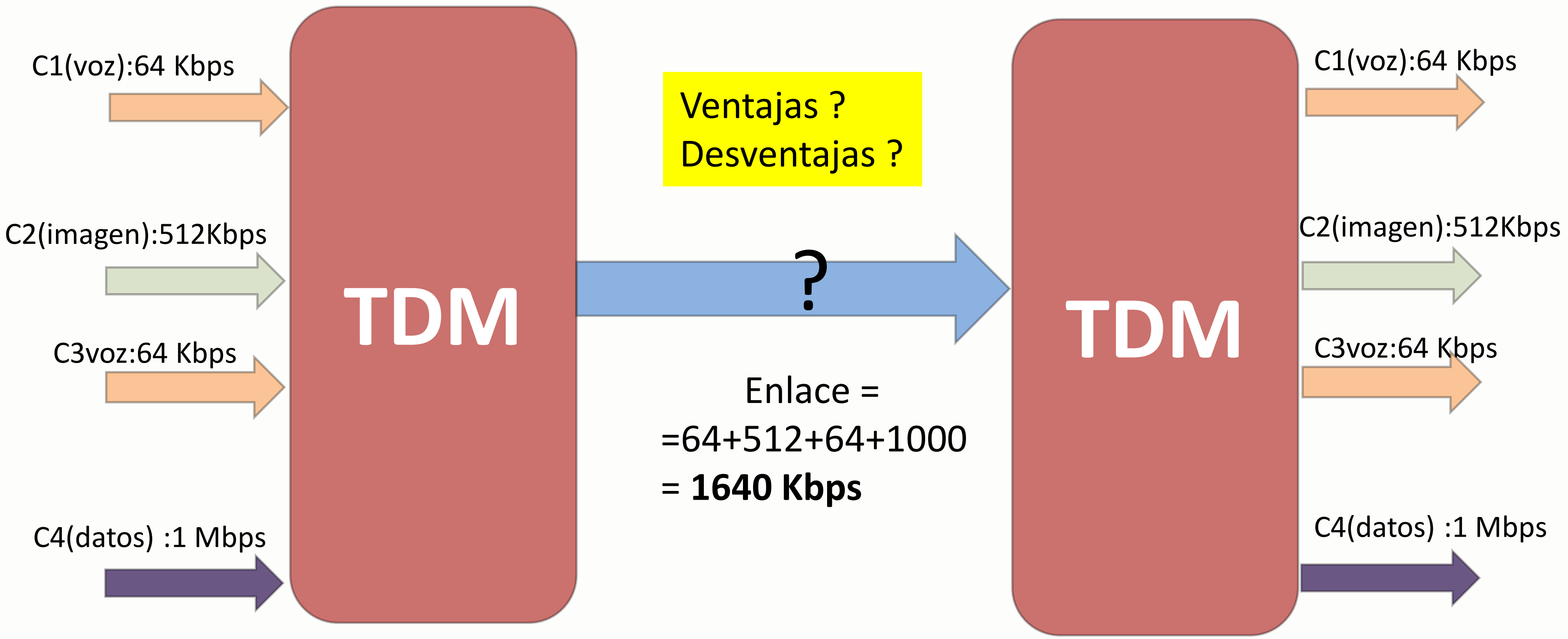
TRANSPORTE



Velc. enlace ≥ ∑ Velc. tributarios

<u>M</u>ULTIPLEXACION POR <u>D</u>IVISION DE <u>T</u>IEMPO , *TDM.*

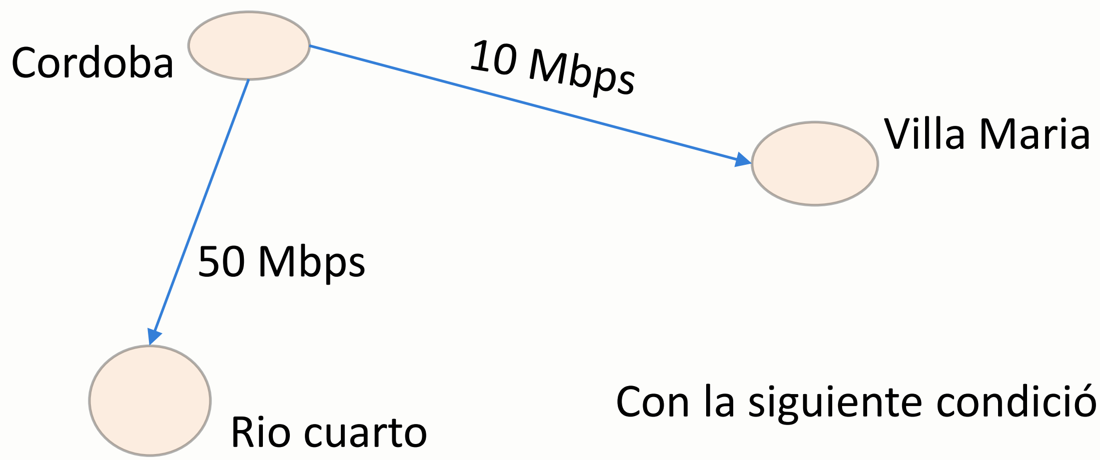
Ejemplo



Enlace =
=64+512+64+1000
= **1640 Kbps**

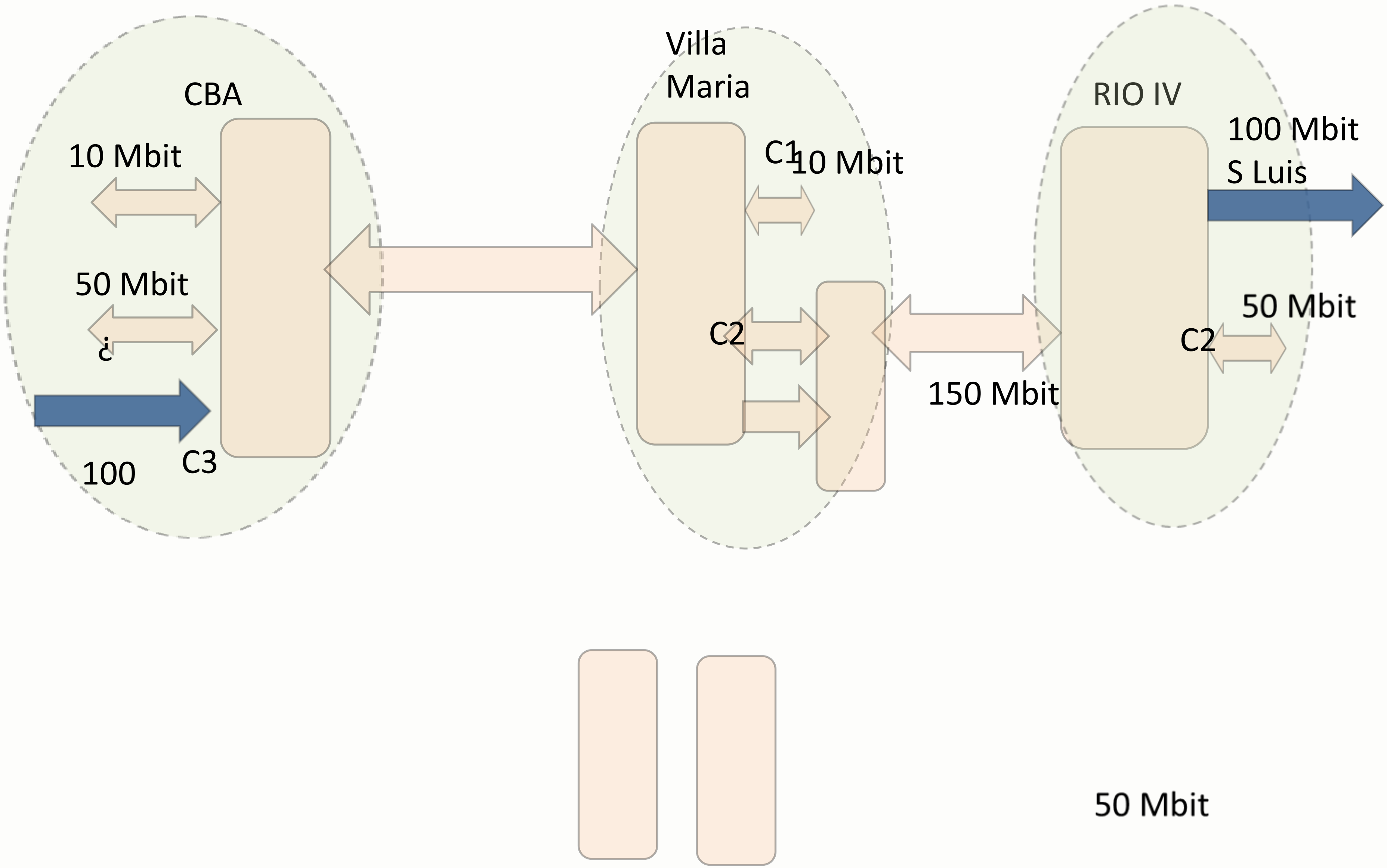
Ejemplo TDM

Como se realiza una conexión en TDM con la siguiente premisa:



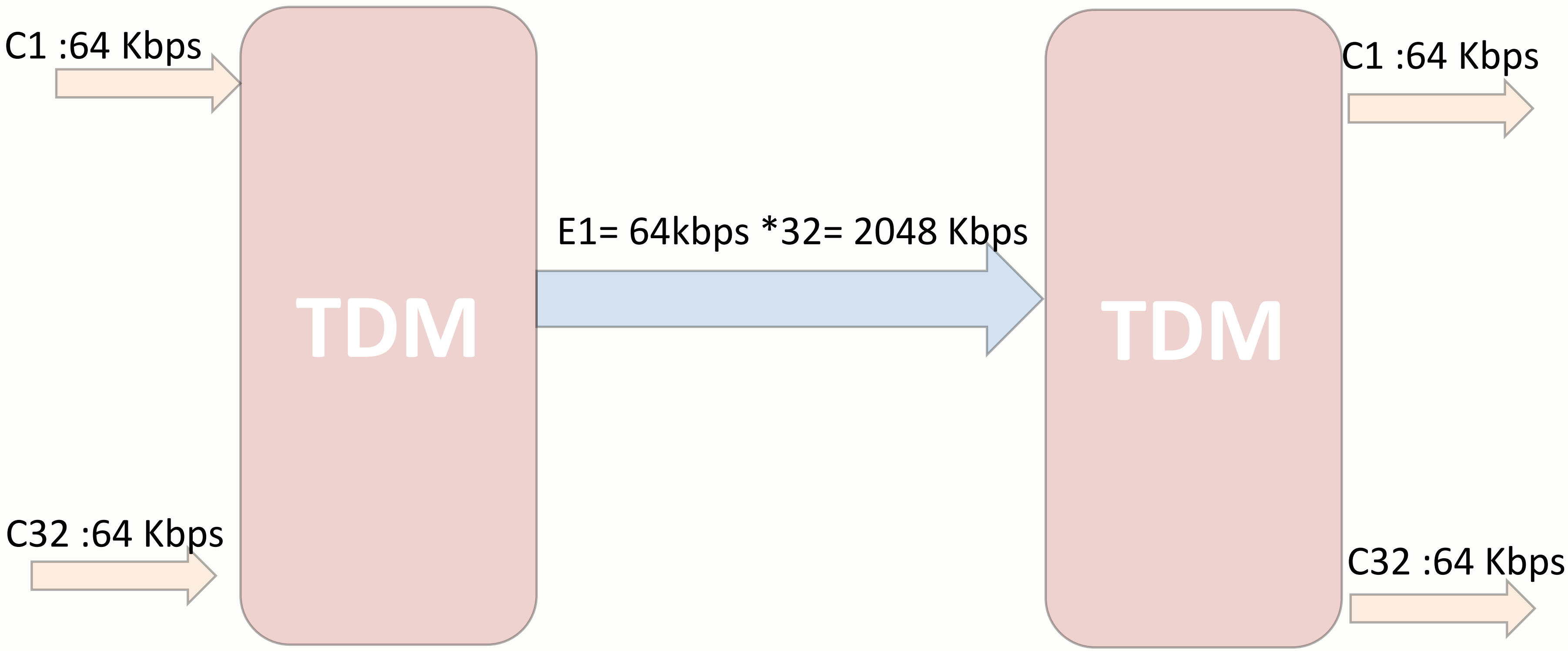
Con la siguiente condición

Ejemplo TDM

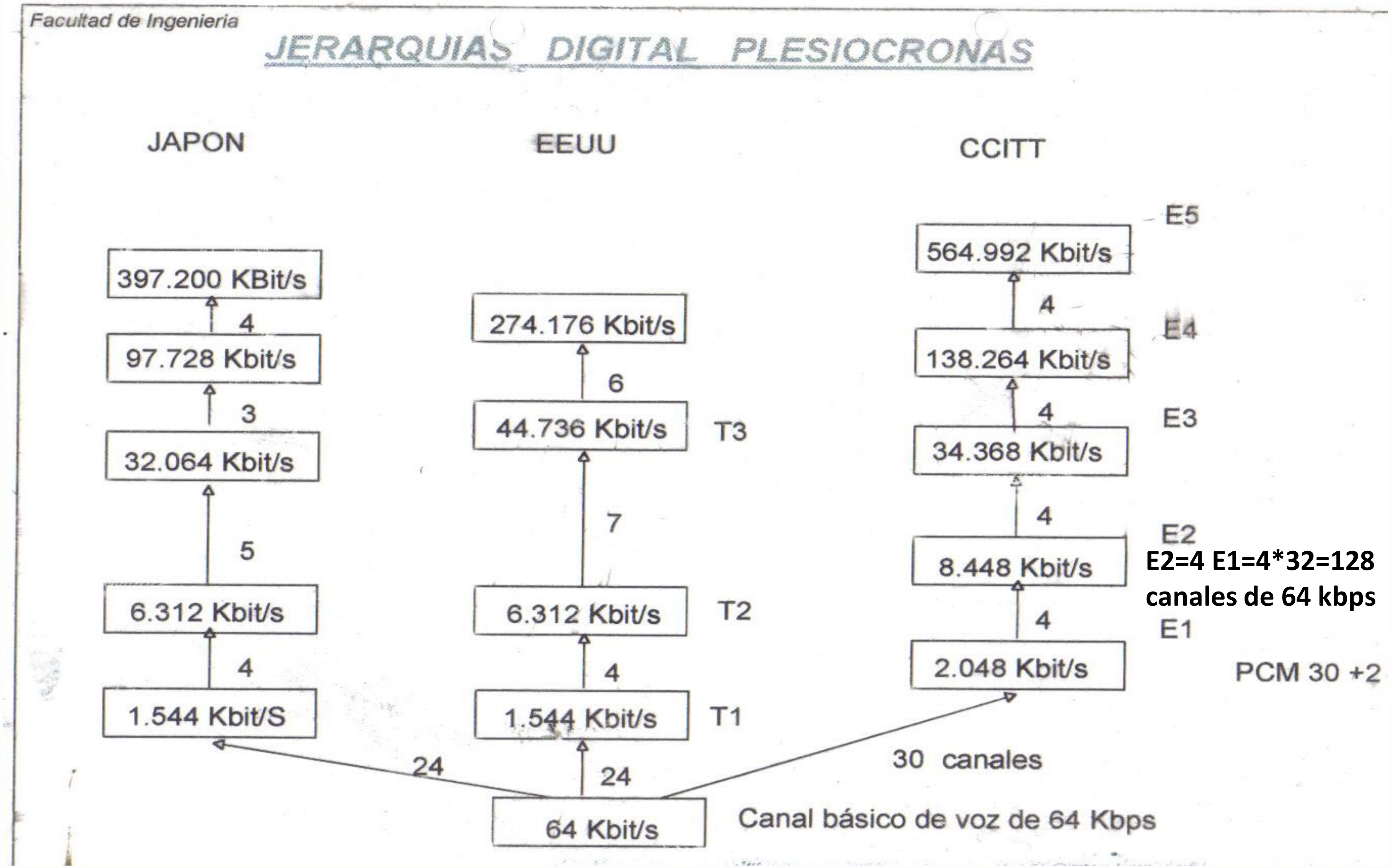

CBA
10 Mbit
50 Mbit
¿
100
C3
Villa
Maria
C1
10 Mbit
C2
150 Mbit
RIO IV
100 Mbit
S Luis
50 Mbit
C2
50 Mbit

2.4.3.1 Ejemplo de TDM : redes PDH

Jerarquía de transporte de canales de voz en TDM :
PDH (P*lesiochronous* D*igital* H*ierarchy*, Jerarquía digital plesióncrona)



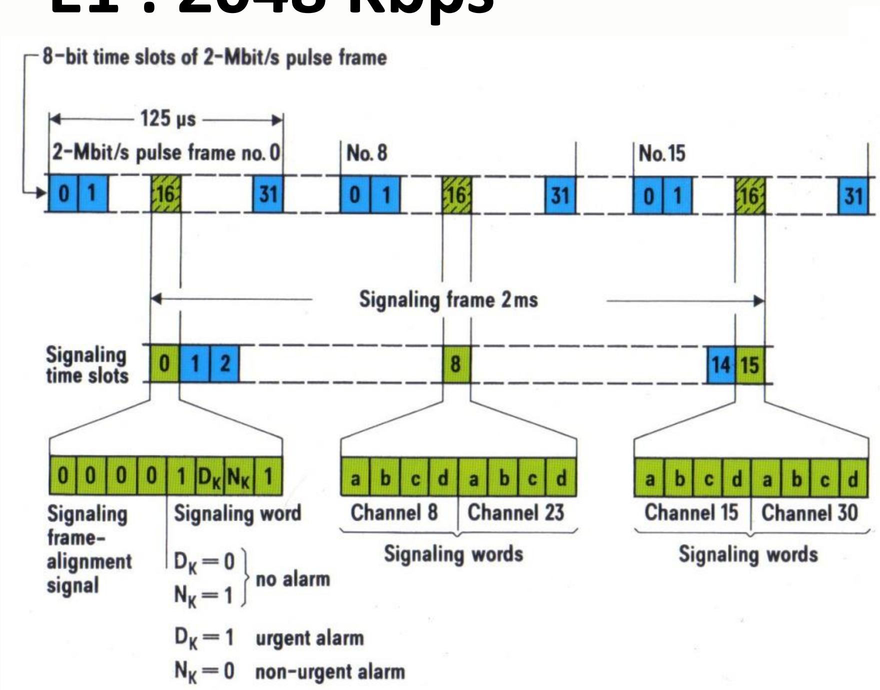
2.4.3.1 Ejemplo de TDM : redes PDH

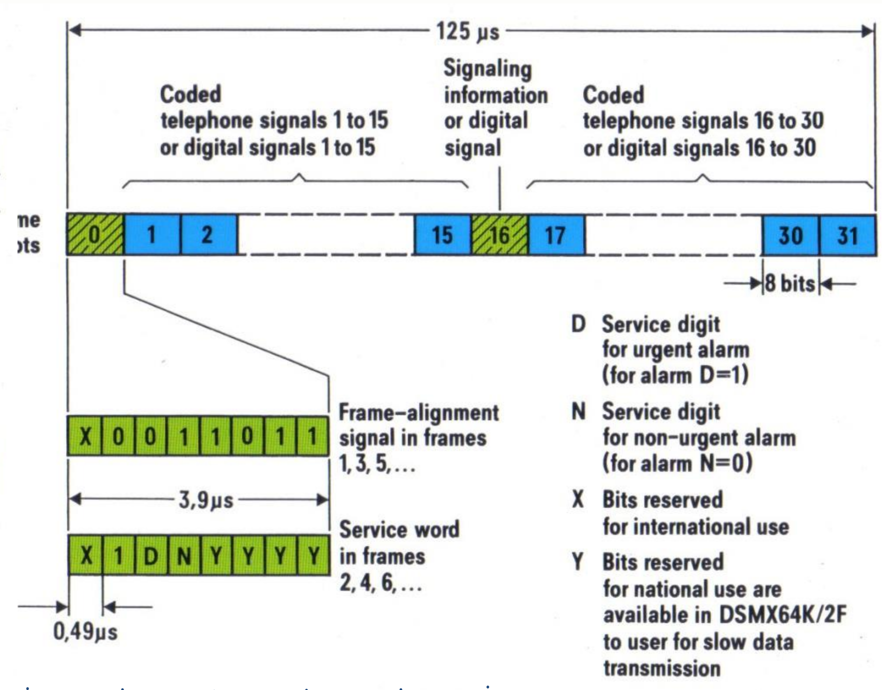


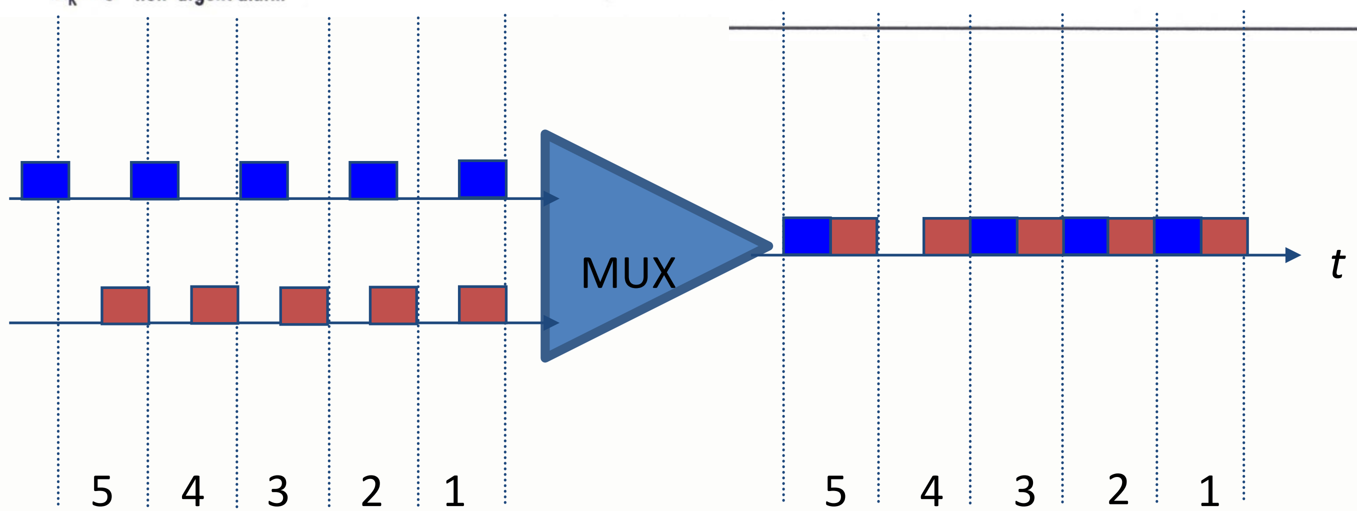
E2=4 E1=4*32=128 canales de 64 kbps

TRANSPORTE

E1 : 2048 Kbps







JERARQUIA DIGITAL PLESIOCRONA, PDH

Estructura de las Telecomunicaciones

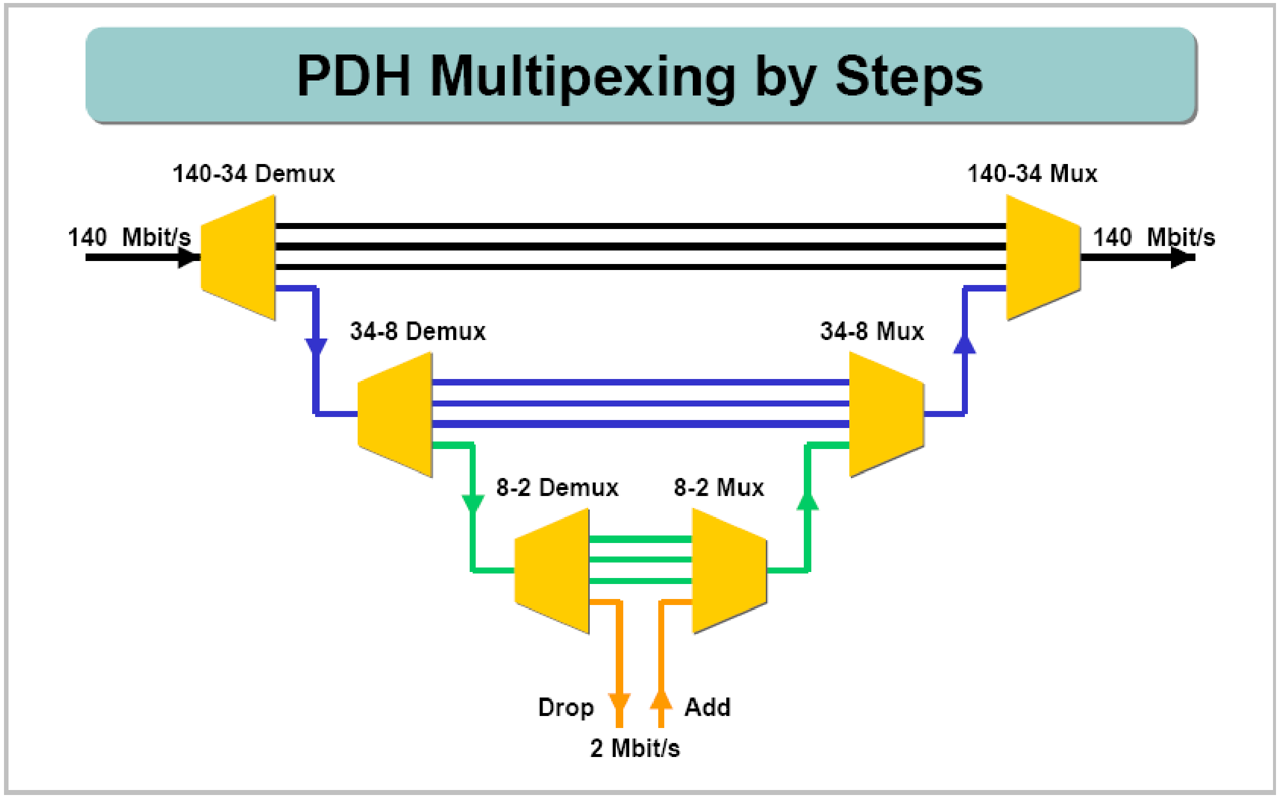
TRANSPORTE

Signal	Digital Bit Rate	Channels
E0	64 Kbit/s	One 64 Kbit/s
E1 64*32=2048	2.048 Mbit/s	32 E0
E2 64*128 =8192..??	8.448 Mbit/s	128 E0
E3 64*16*32 =32768.??	34.368 Mbit/s	16 E1
E4	139.264 Mbit/s	64 E1

Table 1 Non-Synchronous, PDH hierarchy

La dificultad .....

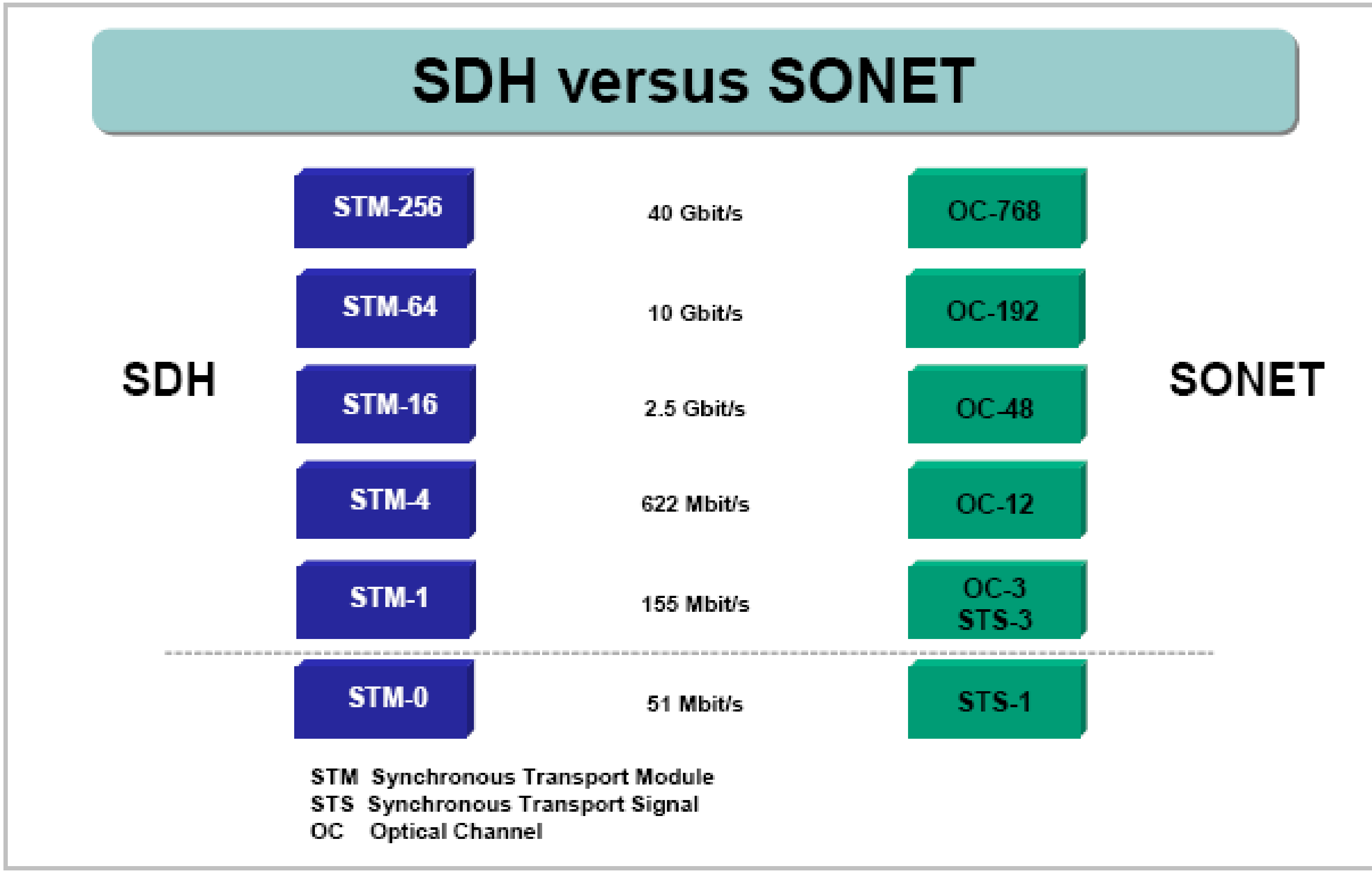
La PDH es una tecnología costosa



Evolución de PDH : SDH

Estructura de las Telecomunicaciones
TRANSPORTE

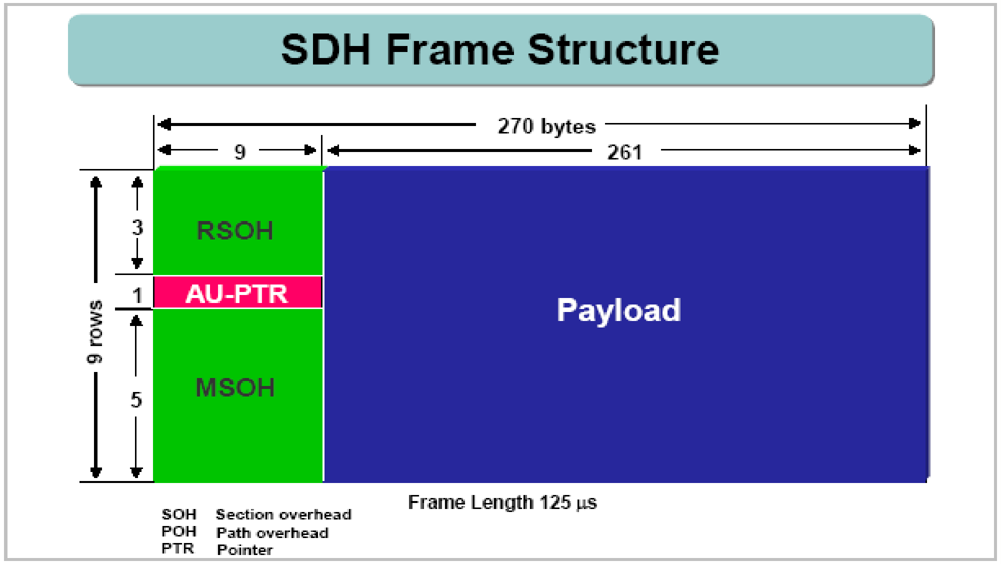
JERARQUIA DIGITAL SINCRONA, SDH (ITU) : G.707 *(1988 1°ed)*
RED OPTICA DIGITAL, SONET (BELL)



JERARQUIA DIGITAL SINCRONA, SDH

Estructura de las Telecomunicaciones

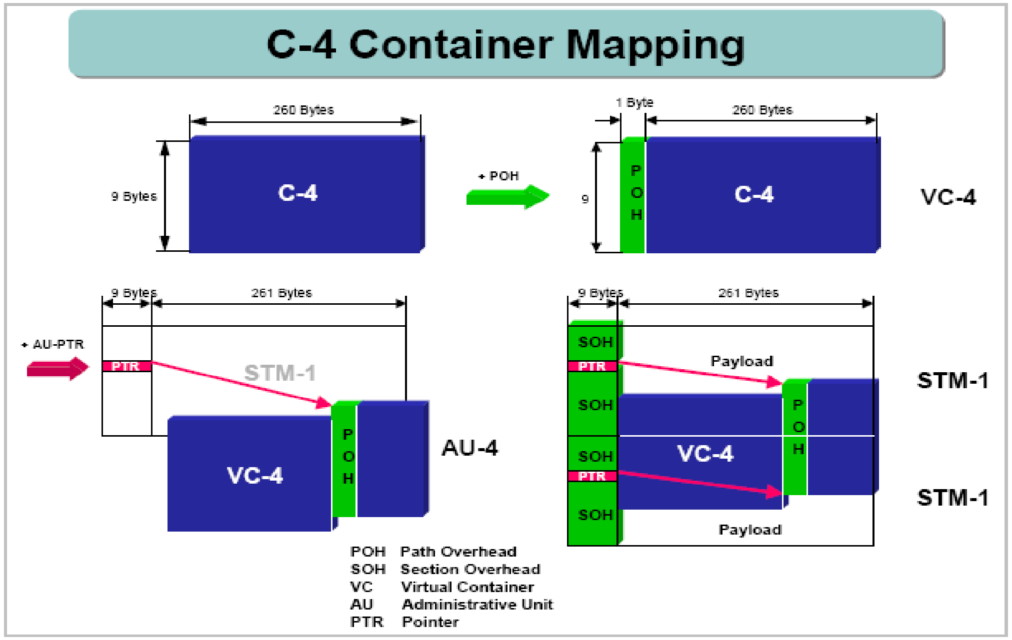
TRANSPORTE



270*9*8= 19440

En 125 microseg

La velocidad es :
STM1



Estructura de las Telecomunicaciones

TRANSPORTE

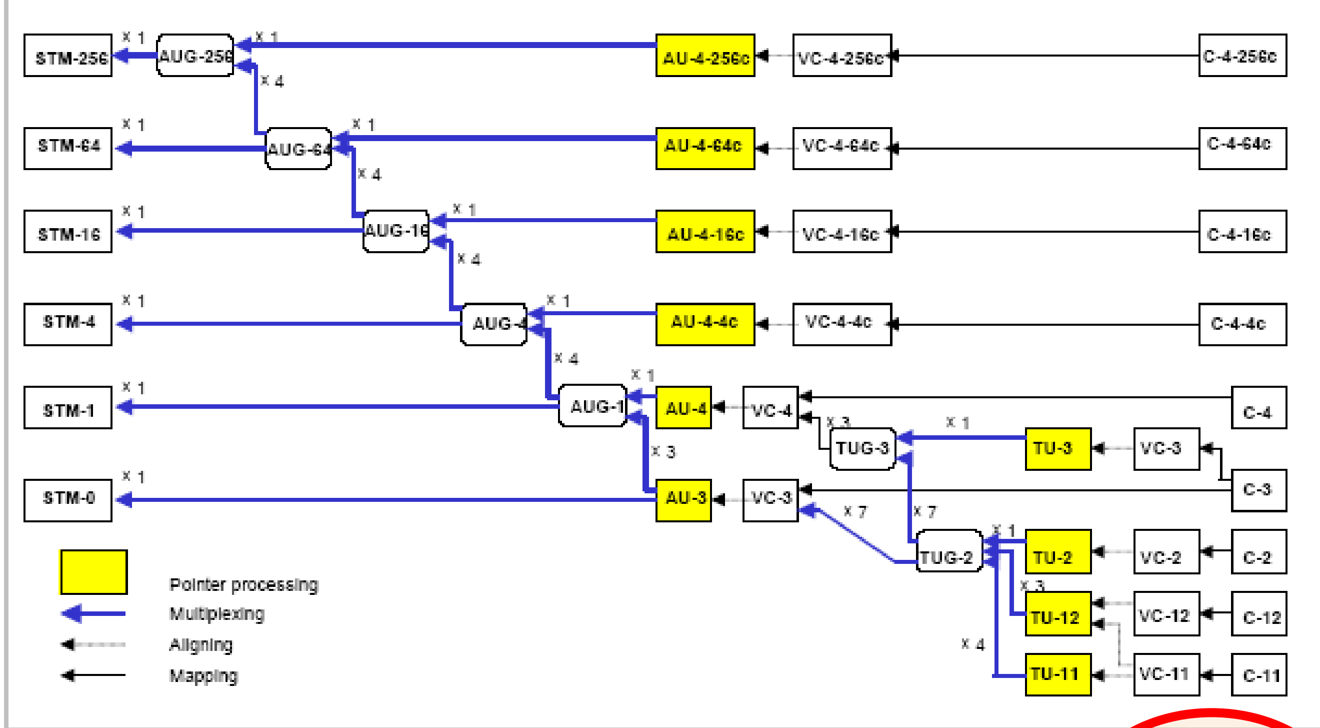
SONET		SDH	Data rate (Mbps)		
Electrical	Optical	Optical	Gross	SPE	User
STS-1	OC-1		51.84	50.112	49.536
STS-3	OC-3	STM-1	155.52	150.336	148.608
STS-9	OC-9	STM-3	466.56	451.008	445.824
STS-12	OC-12	STM-4	622.08	601.344	594.432
STS-18	OC-18	STM-6	933.12	902.016	891.648
STS-24	OC-24	STM-8	1244.16	1202.688	1188.864
STS-36	OC-36	STM-12	1866.24	1804.032	1783.296
STS-48	OC-48	STM-16	2488.32	2405.376	2377.728
STS-192	OC-192	STM-64	9953.28	9621.504	9510.912

JERARQUIA DIGITAL SINCRONA, SDH

Estructura de las Telecomunicaciones

POH = Path Overhead
C = Container
TU = Tributary Unit
AU = Administrative Unit
VC = Virtual Container
TUG = Tributary Unit Group
STM = Synchronous Transport Module

SDH Multiplexing Structure



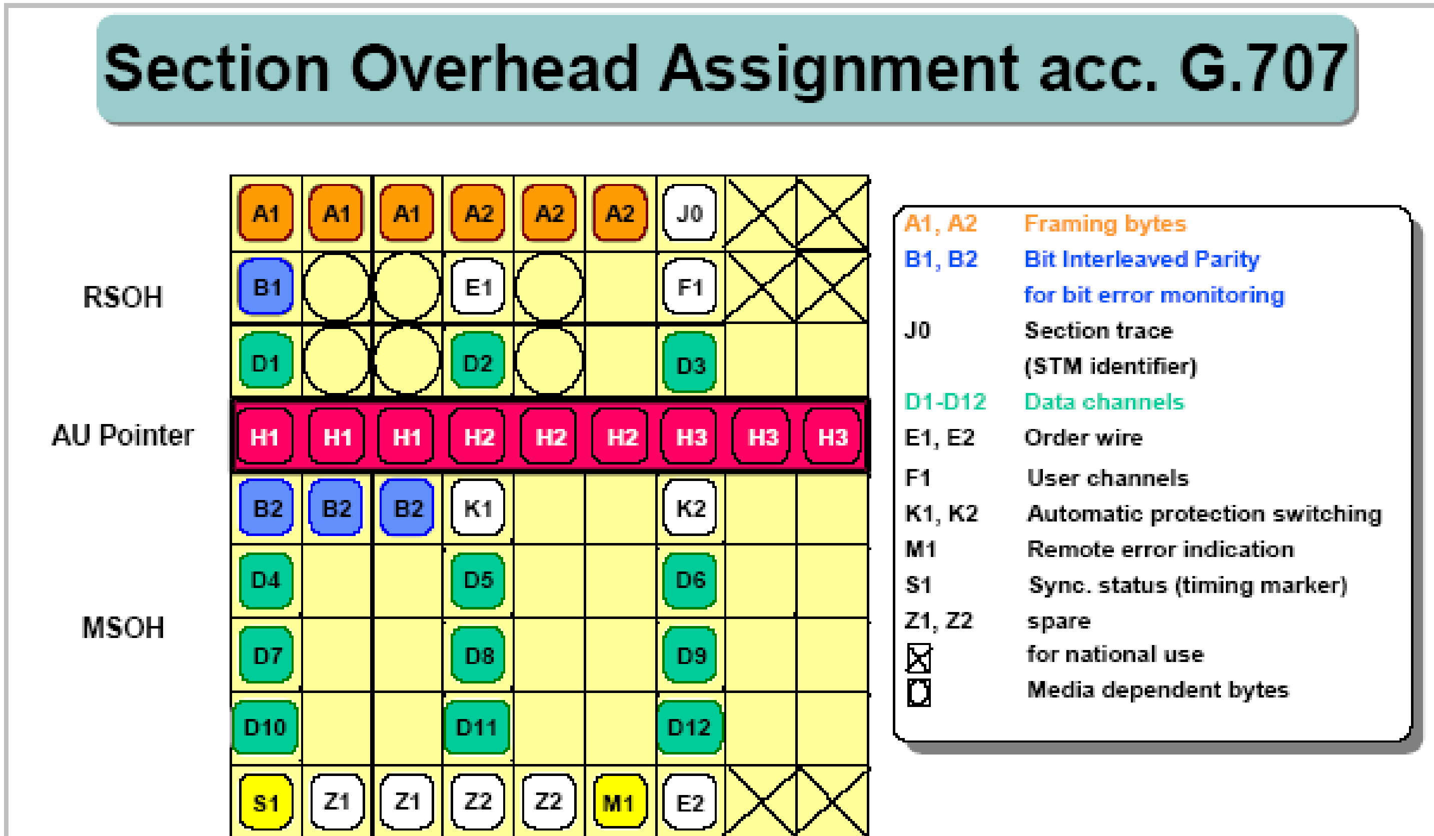
Term	Contents	User
C-N	N = 1 to 4	Payload at lowest multiplexing level
VC-N	N = 1, 2 (Lower-Order)	Single C-n plus VC POH
VC-N	N = 3, 4 (Higher-Order)	C-N, TUG-2s, or TUG-3s, plus POH for the specific level
TU-N	N = 1 to 3	VC-N plus tributary unit pointer
TUG-2	1, 3 or 4 (TU-N)	Multiplex of various TU-Ns
TUG-3	TU-3 or 7 TUG-2s	TU-3 or multiplex of 7 TUG-2s
AU-N	N = 3, 4	VC-N plus AU pointer
AUG	1, 3 (AU-n)	Either 1 AU-4 or multiplex of 3 AU-3s
STM-N	N = 1, 4, 16, 64 AUGs	N synchronously-multiplexed STM-1 signals

C11 = T1
C12 = E1

Name	Digital Bit Rate	Size of VC
VC-11	1.728 Mbit/s	9 rows, 3 columns
VC-12	2.304 Mbit/s	9 rows, 4 columns
VC-2	6.912 Mbit/s	9 rows, 12 columns
VC-3	48.960 Mbit/s	9 rows, 85 columns
VC-4	150.336 Mbit/s	9 rows, 261 columns

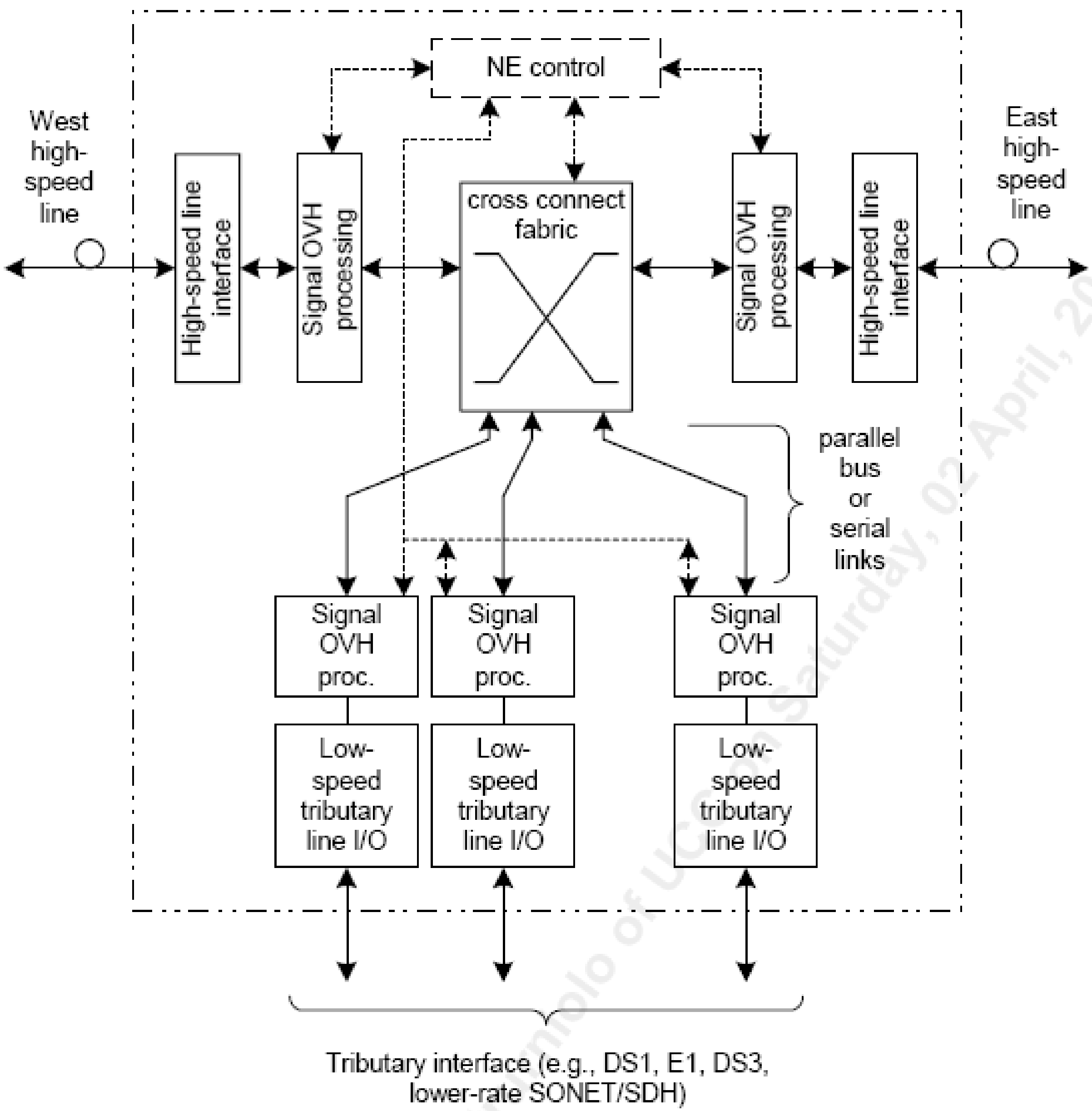
JERARQUIA DIGITAL SINCRONA, SDH

Estructura de las Telecomunicaciones

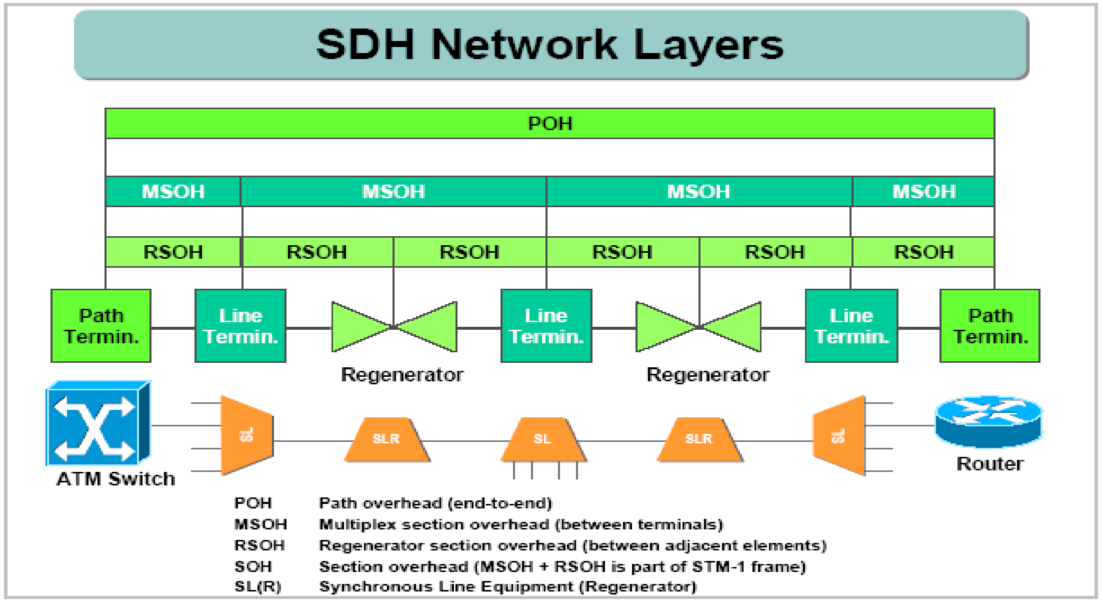


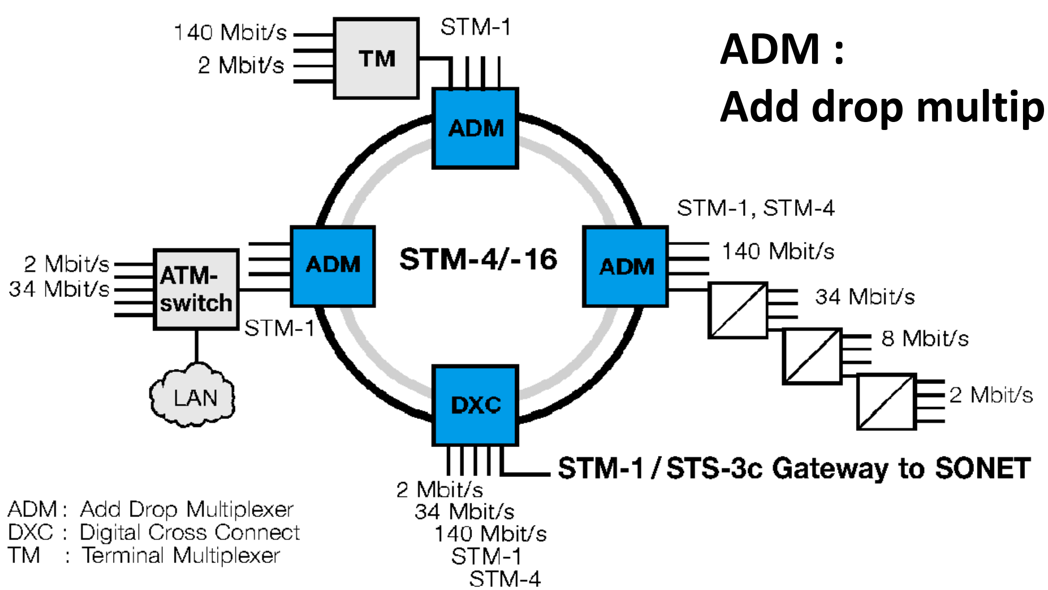
ADM : Add Drop Multiplexer

Figure 2 Illustration of an Add-Drop Multiplexer (ADM)



JERARQUIA DIGITAL SINCRONA, SDH: elementos constitutivos





ADM :

Add drop multiplexer

UIT-T G.709/Y.1331

(02/2001)

SECTOR DE NORMALIZACIÓN
DE LAS TELECOMUNICACIONES
DE LA UIT

SERIE G: SISTEMAS Y MEDIOS DE TRANSMISIÓN, SISTEMAS Y REDES DIGITALES

Equipos terminales digitales – Generalidades

SERIE Y: INFRAESTRUCTURA MUNDIAL DE LA INFORMACIÓN Y ASPECTOS DEL PROTOCOLO INTERNET

Aspectos del protocolo Internet – Transporte

Interfaces para la red de transporte óptica

Óptical Transport Network (OTN)

5 Why use OTN

OTN offers the following advantages relative to SONET/SDH:

- Stronger Forward Error Correction
- More Levels of Tandem Connection Monitoring (TCM)
- Transparent Transport of Client Signals
- Switching Scalability

OTN has the following disadvantages:

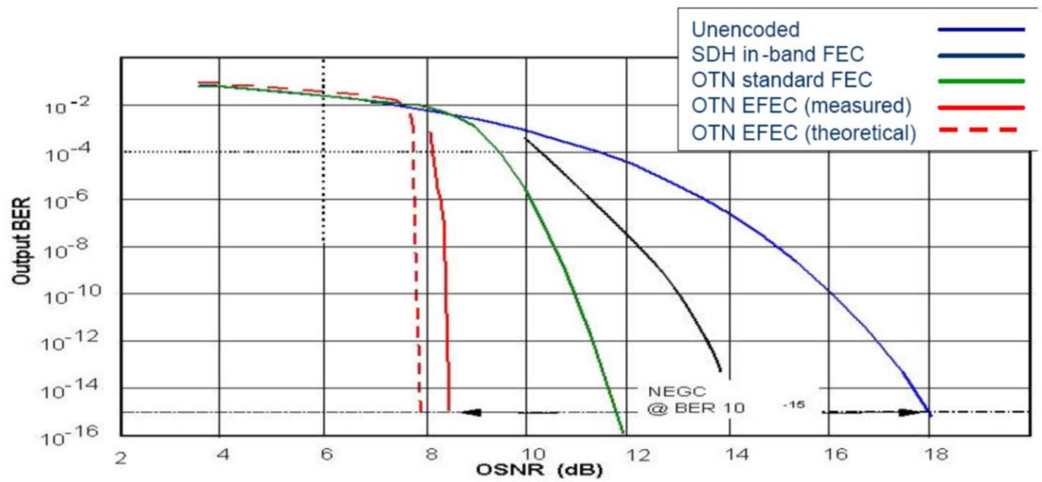
- Requires new hardware and management system

We will discuss the advantages and disadvantages in the following sections.

5.1 Forward Error Correction (FEC)

Forward error correction is a major feature of the OTN.

Already SDH has a FEC defined. It uses undefined SOH bytes to transport the FEC check information and is therefore called a in-band FEC. It allows only a limited number of FEC check information, which limits the performance of the FEC.



G.709 defines a stronger Forward Error Correction for OTN that can result in up to 6.2 dB

Background

The core of most telecom operator networks today is SDH/SONET (Synchronous Digital Hierarchy/Synchronous Optical NETwork), which has always offered good fault management, performance monitoring, predictable latency, a protection mechanism and, of course, synchronization. This very stable network has become the expected minimum in performance objectives for network operators today and is often described as having "five 9s" (and higher) performance, meaning at least 99.999% up time.

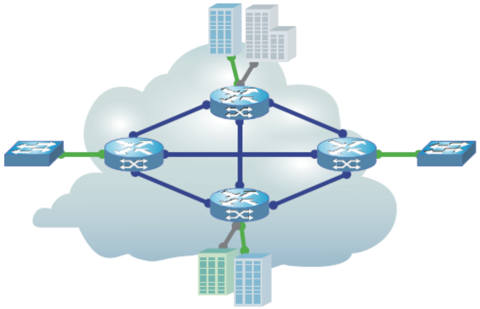


Figure 1: Simplified Network

Ethernet is often discussed as a replacement for SDH/SONET, but the two technologies are different in every way. The reason for the difference can be tracked back to the original design requirements where SDH/SONET was designed to carry voice, while Ethernet was designed to carry data. However, as with all companies, cost efficiency always has to be considered. While Ethernet allows for greatly improved cost points, in comparison to SDH/SONET it lacks in the areas of fault management, performance monitoring, protection mechanisms and predictable latency and jitter. Due to the cost benefits of Ethernet, many operators have looked at and in some cases have switched parts of their network to Ethernet-based systems, but this has often meant having to manage two independent (or nearly independent) networks, reducing the cost benefits of Ethernet.

Many operators are now looking into or have already implemented a P-OTS (Packet-Optical Transport Systems) network supporting integration of ROADM/WDM (Reconfigurable Optical Add/Drop Multiplexer/Wavelength Division Multiplexing) and L2 (Layer 2) switching as well as SDH/SONET. The combination of circuit-based TDM (Time Division Multiplexing) and packet-based Ethernet standards that can be transported over the network is a logical step forward for any operator. A P-OTS network can carry flexible payloads within a common transport framing, such as MPLS-TP (MultiProtocol Label Switching–Transport Profile), PBB-TE (Provider Backbone Bridges–Traffic Engineering) and OTN (Optical Transport Network), with the latter being able to carry SDH/ SONET.

As a result of operators' expectations and needs to achieve "five 9s" performance as well as cost reductions, a new standard was required and OTN is seen as the solution by many people. Although OTN was developed first for long-distance submarine networks, it evolved and was deployed later in core networks, but its true strength is only now being capitalized on in the metro market. The transition into the metro market was achieved with the updates finalized in the latest ITU-T (International Telecommunication Union Telecommunication Standardization Sector) G.709 standards between 2009 and 2012.

With OTN transitioning from submarine and core networks into metro and access networks, the ability of operators to manage fault-finding across a broader network has become essential. Recently, ITU-T added OTN functions to the G.709 standard, such as multistage multiplexing, ODUflex (ODU: Optical channel Data Unit), ODU0 and the GMP (Generic Mapping Procedure) protocol combined with TCM (Tandem Connection Monitoring), giving operators the required visibility. Combining this with an understanding of the maintenance signals available within the OTN overhead assures the network stability required by today's modern networks.

Benefits of P-OTS

There are many benefits for operators combining all technologies over a single network, such as optimizing the network structure, which includes dynamic control of services across the network, dynamic real-time bandwidth allocation for on-demand services and minimizing layers within a network, which reduces complexity and cost.

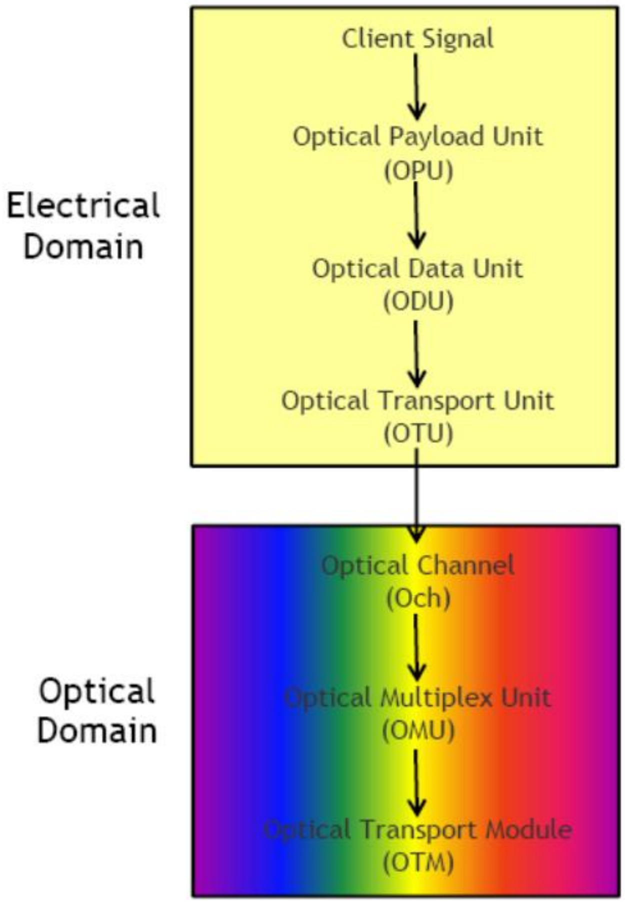
Concerns about P-OTS

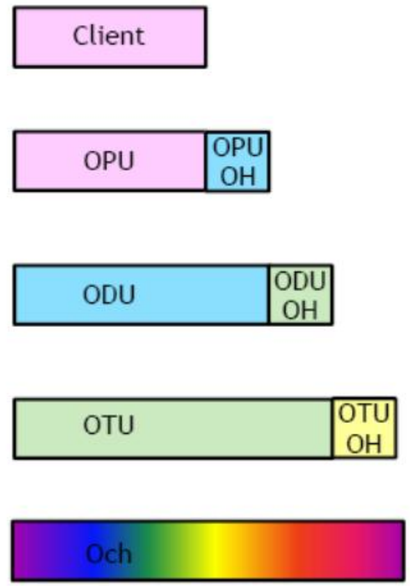
Today, P-OTS is a combination of technologies. This means operators still have to manage multiple systems when configuring or maintaining a single circuit. Increased complexities as well as concerns about interoperability between equipment vendors and increasing customer demand for more bandwidth-sensitive services all contribute to operator cost. Engineers need to be trained in multiple technologies, which the training can be complicated and still maintain expertise across multiple technologies is quite difficult.

The Solution

Making OTN the underlying P-OTS technology carrying Ethernet, MPLS-TP, PBB-TE, SDH/SONET or other traffic on top of it solves many issues. Although extending OTN from the Core network to the Metro network or even to the customer edge solves the above concerns, it has only become possible recently with the newer OTN standards.

Building an OTN Container





OTN Rates

OTU	ODU	Marketing Rate	True Signal (OTU)	True Payload (OPU)
	0	1.25G	NA	1.238G/s
1	1	2.5G	2.666G/s	2.488G/s
2	2	10G	10.709G/s	9.953G/s
3	3	40G	43.018G/s	39.813G/s
4	4	100G	111.809G/s	104.794G/s

ODUflex is also defined by G.709. Similar to Virtual Concatenation, but avoids differential delay problem and is managed as a single entity

Optical Transport Network (OTN): **G.709 interfaces**

Table 7-1 – Set of ODU clients and their ODU servers

ODU Clients	ODU Server
1.25 Gbit/s bit rate area	ODU0
–	
2.5 Gbit/s bit rate area	ODU1
ODU0	
10 Gbit/s bit rate area	ODU2
ODU0, ODU1, ODUflex	
10.3125 Gbit/s bit rate area	ODU2e
–	
40 Gbit/s bit rate area	ODU3
ODU0, ODU1, ODU2, ODU2e, ODUflex	
100 Gbit/s bit rate area	ODU4
ODU0, ODU1, ODU2, ODU2e, ODU3, ODUflex,	
CBR clients from greater than 2.5 Gbit/s to 100 Gbit/s, or GFP-F mapped packet clients from 1.25 Gbit/s to 100 Gbit/s.	ODUflex
–	

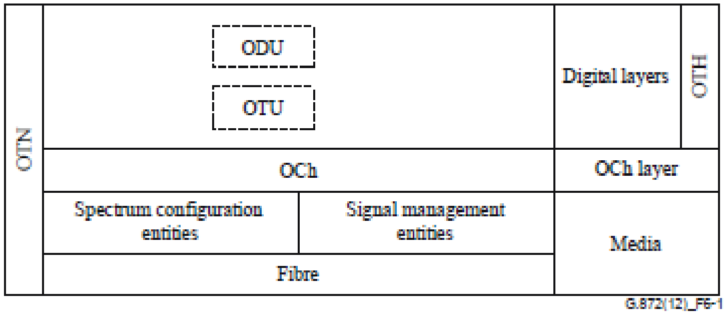


Figure 6-1 – Overview of the OTN

Described in the ITU-T Recommendation G.709 (2003).

Optical Transport Network (OTN)

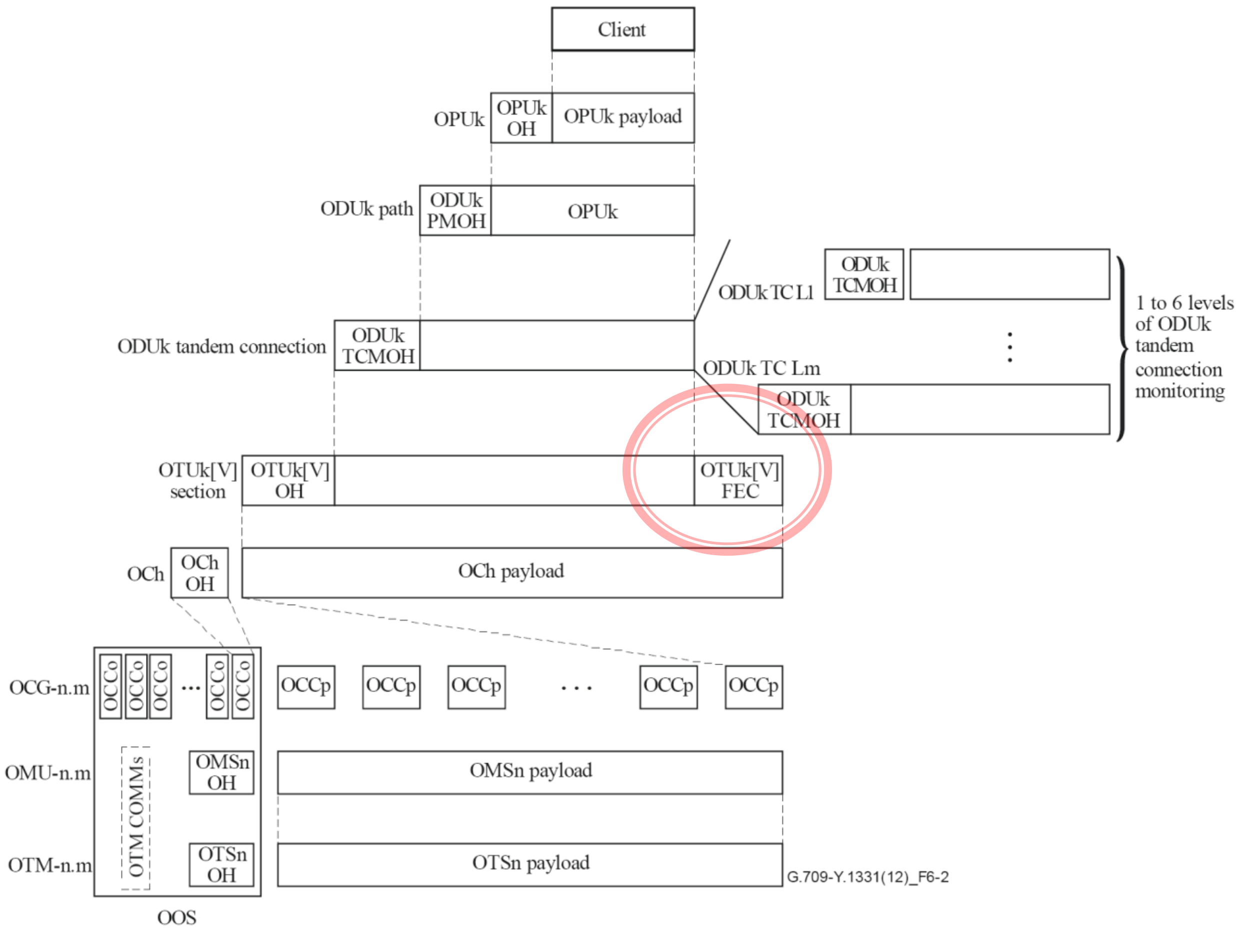


Figure 6-2 – OTM-n.m principal information containment relationships

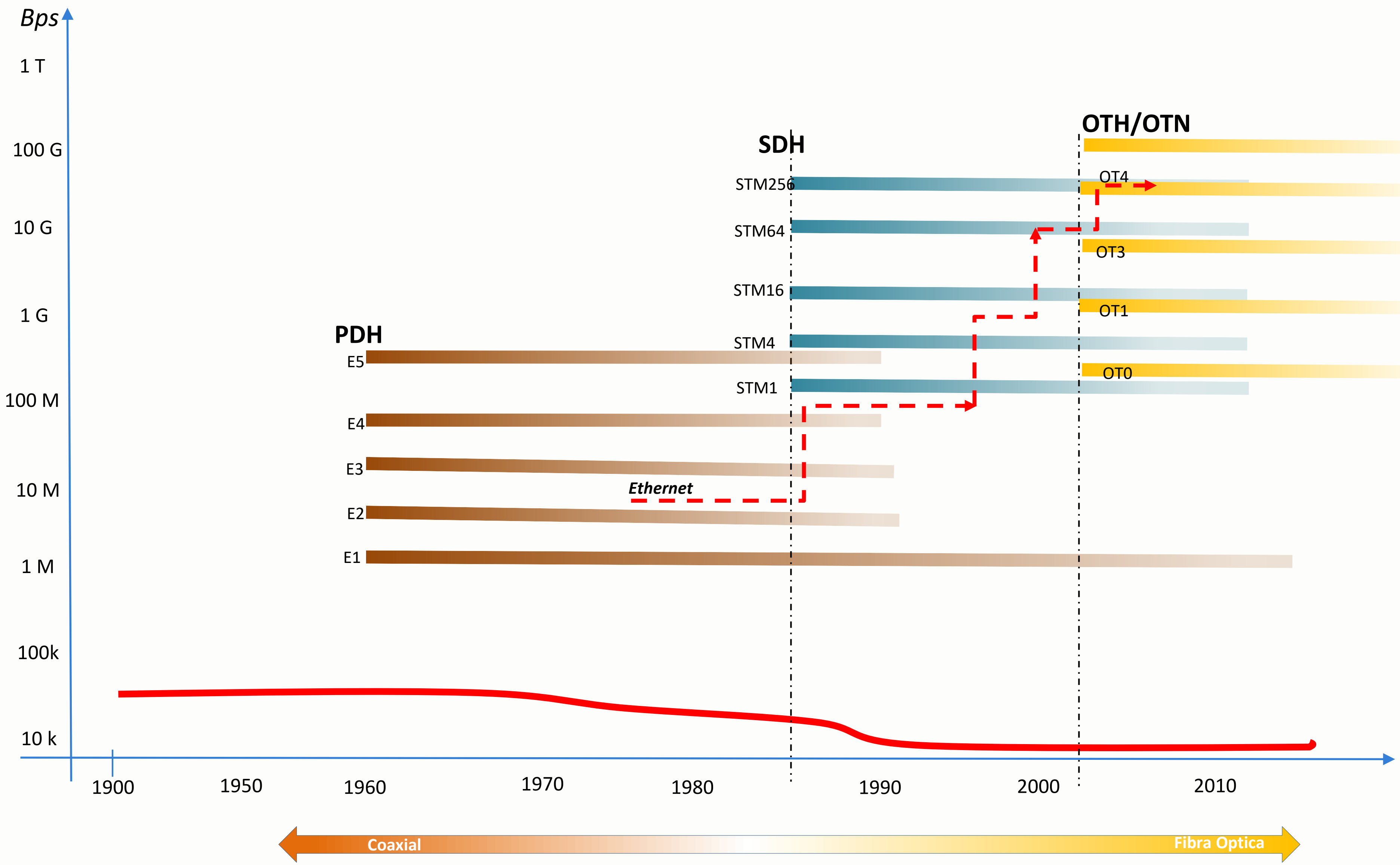
Coexistencia de redes

Necesidad de analizar redes existentes

Anritsu Optical Transport Portfolio

	Protocol	Bench-top Optical Transport		Hand-held Optical Transport		
		MD1230B Data Quality Analyzer 	MP1590B Network Performance Tester 	MT9090A Network Master 	MT1000A Network Master Pro 	MT1100A Network Master Flex 
Ethernet	100 GigE					✓
Ethernet	40 GigE					✓
Ethernet	10 GigE	✓	✓		✓	✓
Ethernet	10 M/100 M/1000 Mbps	✓	✓	✓	✓	✓
Ethernet	Synchronous Ethernet IEEE 1588 v2 & ITU-T G.826x				✓	✓
TDM	100G OTN					✓
TDM	40G SDH/SONET, 43G OTN					✓
TDM	Up to 10 Gbps SDH/SONET, OTN		✓		✓	✓
TDM	Ethernet over SDH/SONET (EoS)		✓			
TDM	PDH (DS1, DS3, E1, E3, E4)		✓		✓	✓
Misc	Fibre Channel - 1GFC, 2GFC, 4GFC, 8GFC, 10GFC				✓	✓
Misc	Jitter Tolerance / Transfer		✓			

Evolución en Transporte



TRANSPORTE

Abbreviations

- PCM – Pulse Code Modulation
- FDM - Frequency Division Multiplexing
- TDM - Time division multiplexing
- PDH - Plesiochronous Digital Hierarchy
- SONET - Synchronous Optical Network
- SDH - Synchronous Digital Hierarchy
- RBOCS - Regional Bell operating companies
- LATA - Local access and transport areas
- LEC - Local Exchange Carrier
- IXC - Inter Exchange Carrier
- LX - Local exchange
- DLC – Digital Loop Carrier
- WDM – Wavelength Division Multiplexing
- POP – presence of point
- CAS- Channel Associated Signaling
- CCS - common-channel-signaling
- ADM : add Drop multiplex
- DCX : Digital cross connect

The World's Top 10 Telecommunications Companies

By MELISSA PARIETTI | Updated Mar 5, 2020

TABLE OF CONTENTS

- AT&T
- Verizon Communications
- Nippon Telegraph & Tel
- Deutsche Telekom
- América Móvil
- China Mobile
- Vodafone
- Softbank
- Telefónica
- China Telecom

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- 1G, 10G and 100G Ethernet- Physically separated circuits- Network managed failover- Service level guarantees	- Up to 44 wavelengths of OTN, 10/40/100Gbps and Fiber Channel services - Ring topology, no single point of failure in network design -	- 1, 10, 40 and 100GbpsOTU3, OTU4- Custom routing- 1Gb IOC on Auto-restorable mesh network- Service Level guarantees
Contact us	Contact us	Contact us

Features

Scalability	1G, 10G, and 100G Ethernet. OTU1 to OTU4	Up to 44 wavelengths of OTN, 10/40/100Gbps and Fiber Channel services	1, 10, 40, and 100Gbps OTU3, OTU4
Diversity	Physically separated circuits	Ring topology, no single point of failure in network design	Custom routing
Protection	Yes. Network managed failover	Several channel protection options available	1Gb IOC on Auto-restorable mesh network
Service level guarantees	Yes.	Yes.	Yes.

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Conectividad

INTERNET
- Asimétrico
- Simétrico
- Dedicado

DATOS
- Enlaces
- VPN

Enlaces

Los servicios de Enlaces de Datos están orientados a cubrir las necesidades de interconexión de las empresas de manera eficiente y sencilla.

Esta solución brinda toda la conectividad necesaria para garantizar la transmisión de datos entre redes punto a punto o múltiples puntos.

A partir de la diversidad de tecnologías de accesos disponibles, es posible interconectar cada uno de los sitios de manera confiable, segura y que mejor se adapte al negocio.

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- Amplia variedad de tecnologías de acceso: Fibra óptica, Coaxial, ADSL, G. SHDSL, VDSL, 4G-LTE y Satelital.
- Los datos se transmiten entre extremos mediante transporte IP/MPLS.
- Posibilidad de transmitir datos, video y voz
- Equipo CPE Carrier Class

Beneficios

- Interconexión de los puntos en forma transparente, confiable y segura.
- Ancho de banda variable y escalable con bajos tiempos de implementación, ajustable a las necesidades del negocio.
- Asesoramiento por parte del equipo de Ingeniería de Redes de Telecom.
- Operación, soporte y mantenimiento las 24 horas los 365 días del año.

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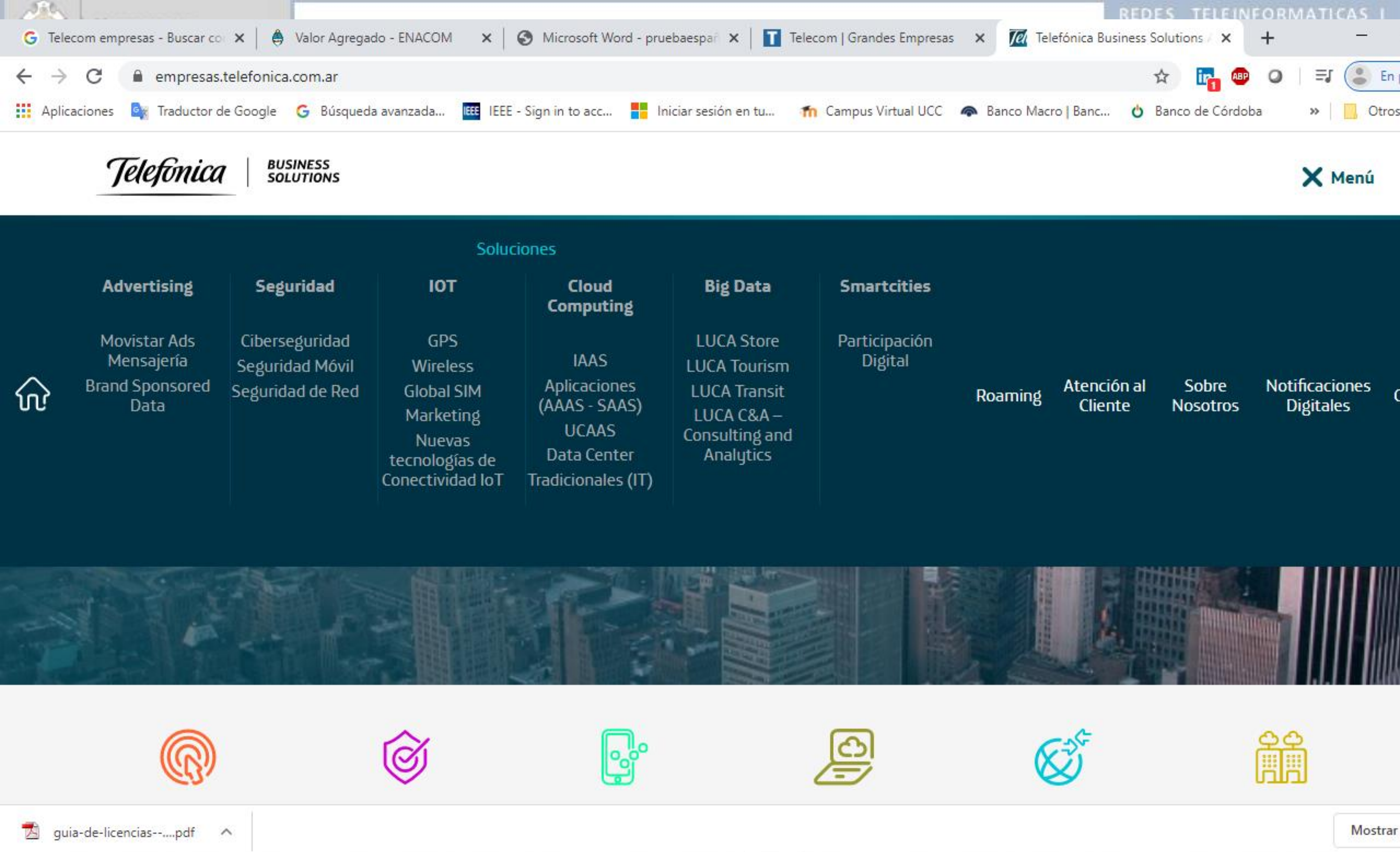

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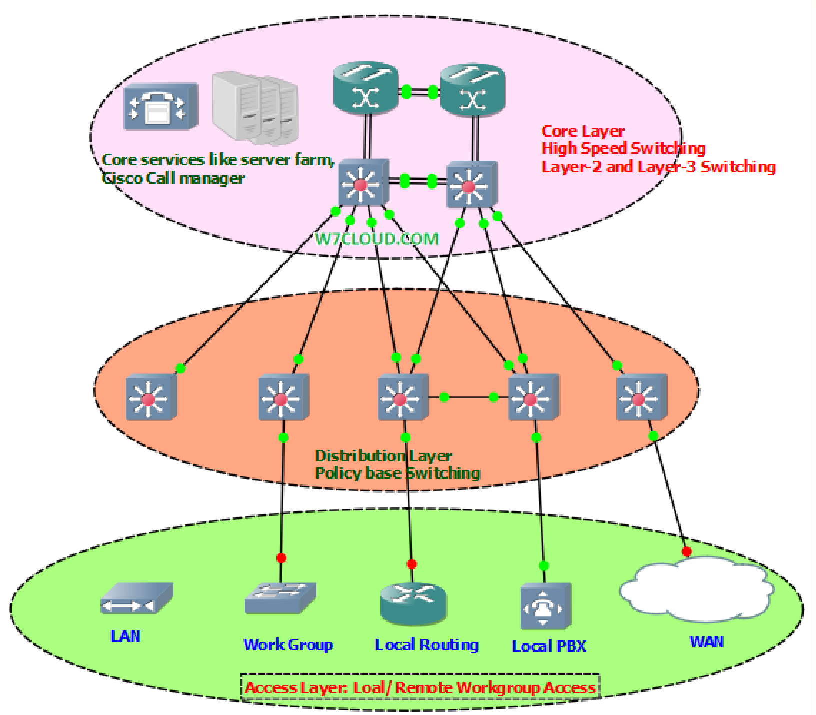
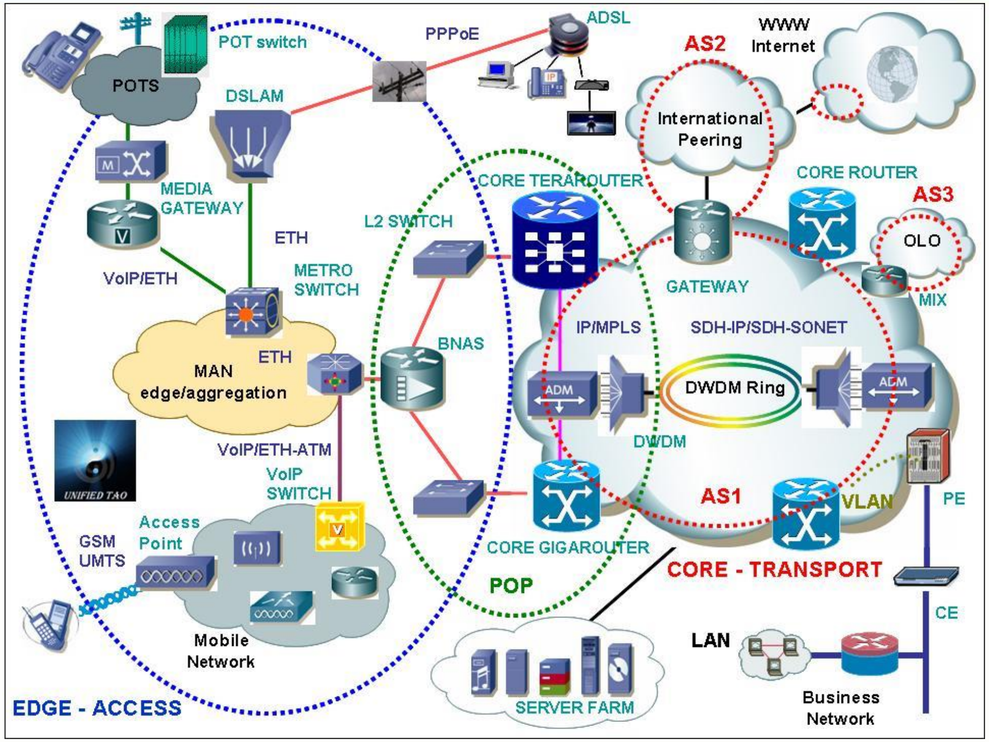
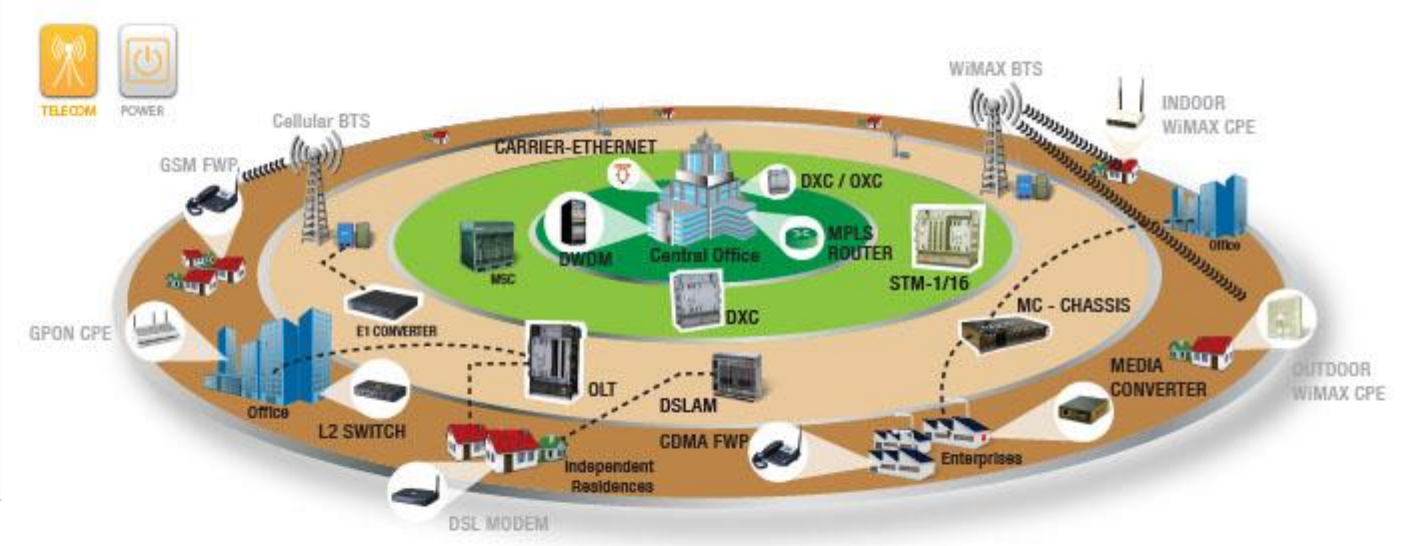
Jerarquía de redes: Terminología en redes de datos







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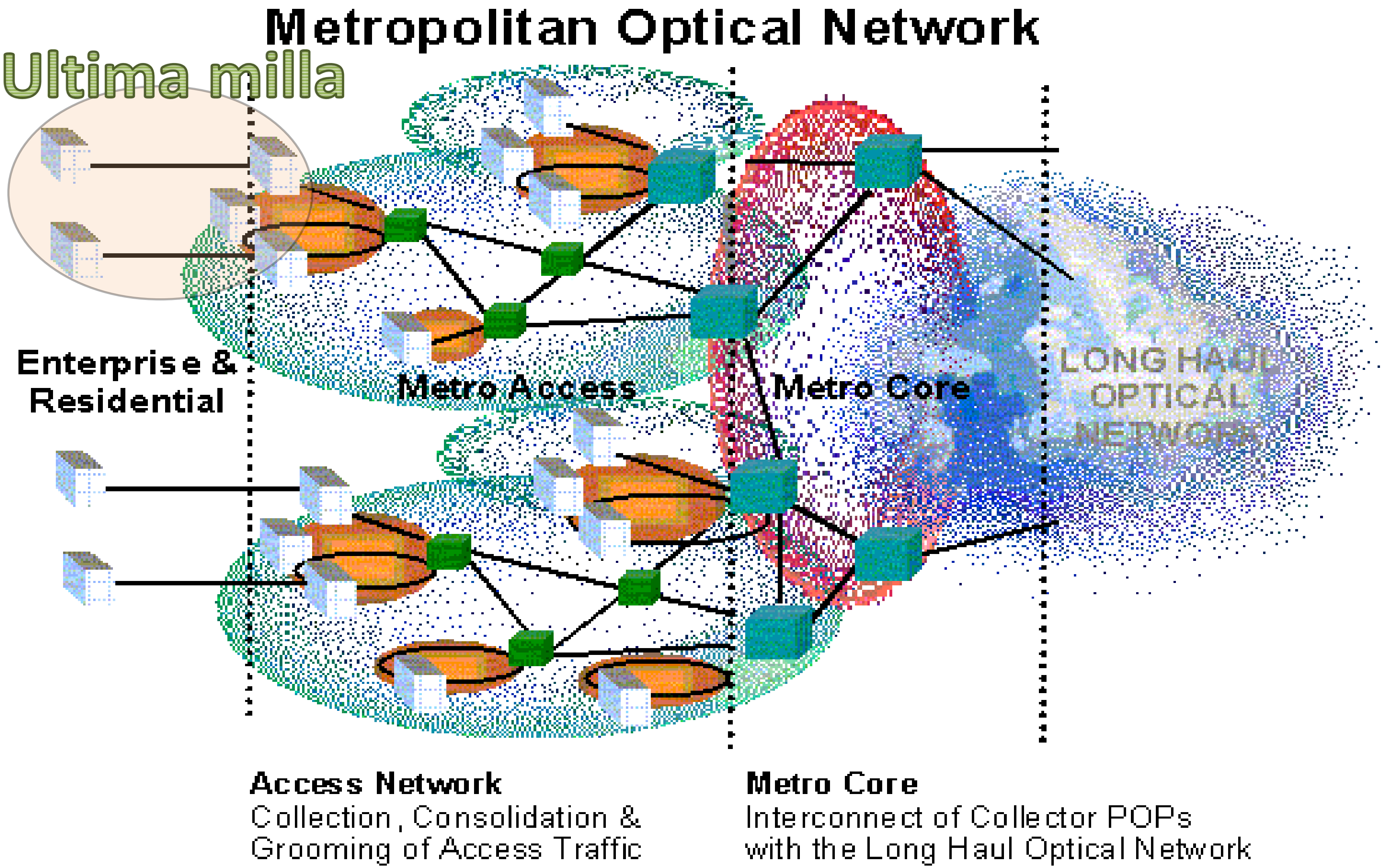
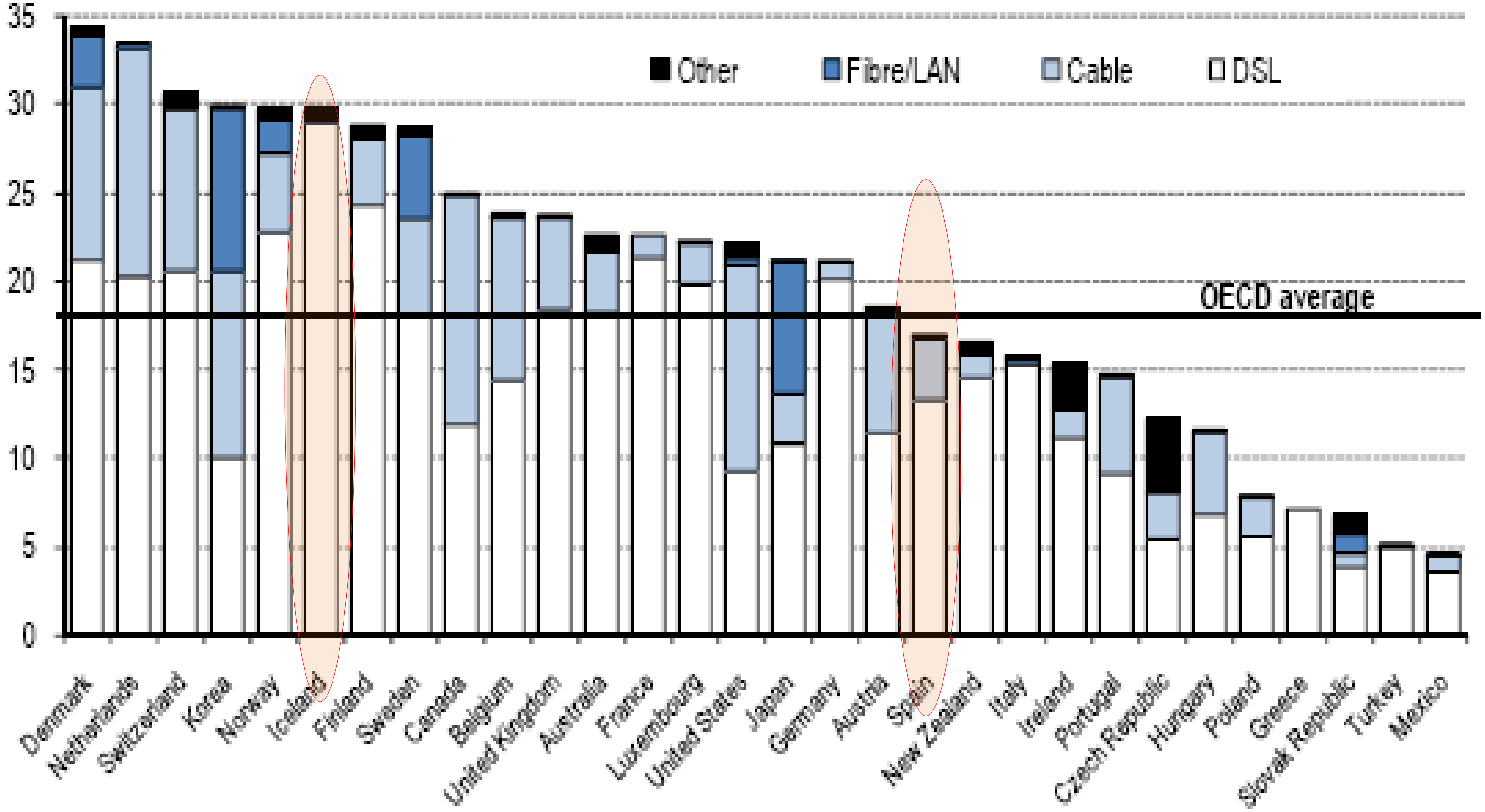


ACCESO de BANDA ANCHA EN DISTINTOS PAISES

Banda Ancha

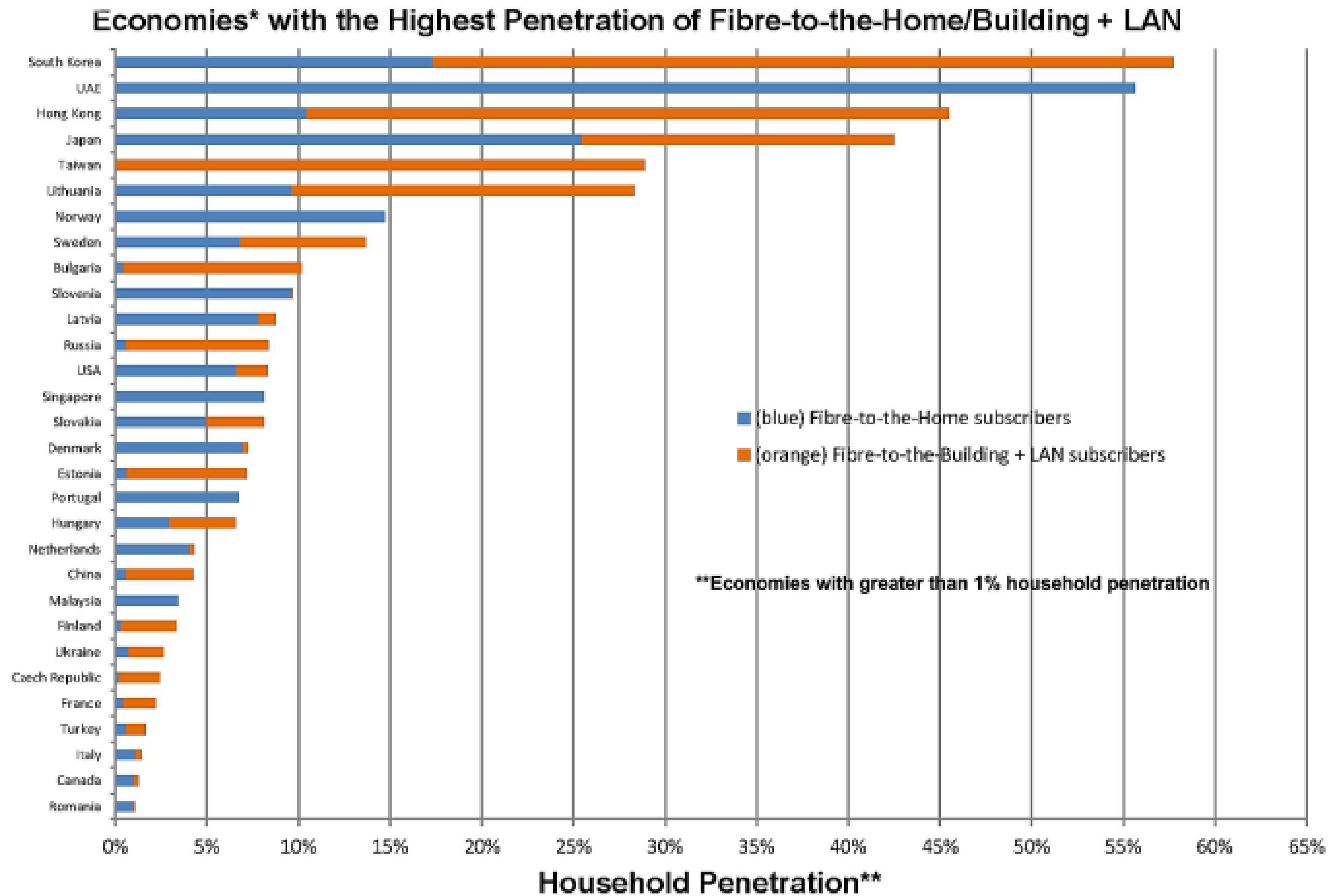
Figure 1.4. Broadband penetration, June 2007

Broadband subscribers per 100 inhabitants, by technology



ROADBAND GROWTH AND POLICIES IN OECD COUNTRIES – ISBN-978-92-64-04668-9 © OECD 2008

Implementación de Fibra óptica como última milla en distintos países.

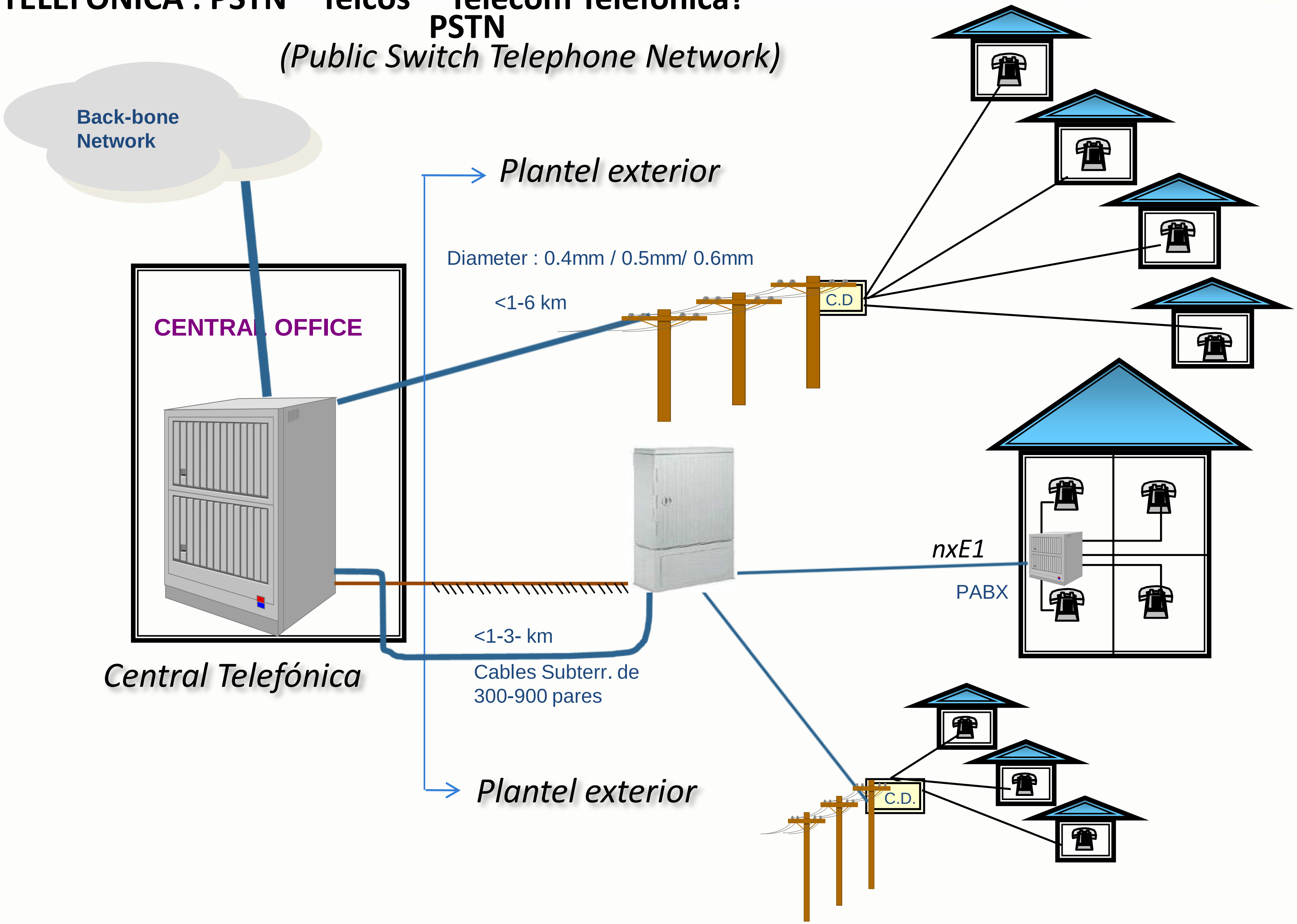


December 2011 Ranking
Source: Fibre-to-the-Home Council
February 2012

*Economies with at least 200,000 households

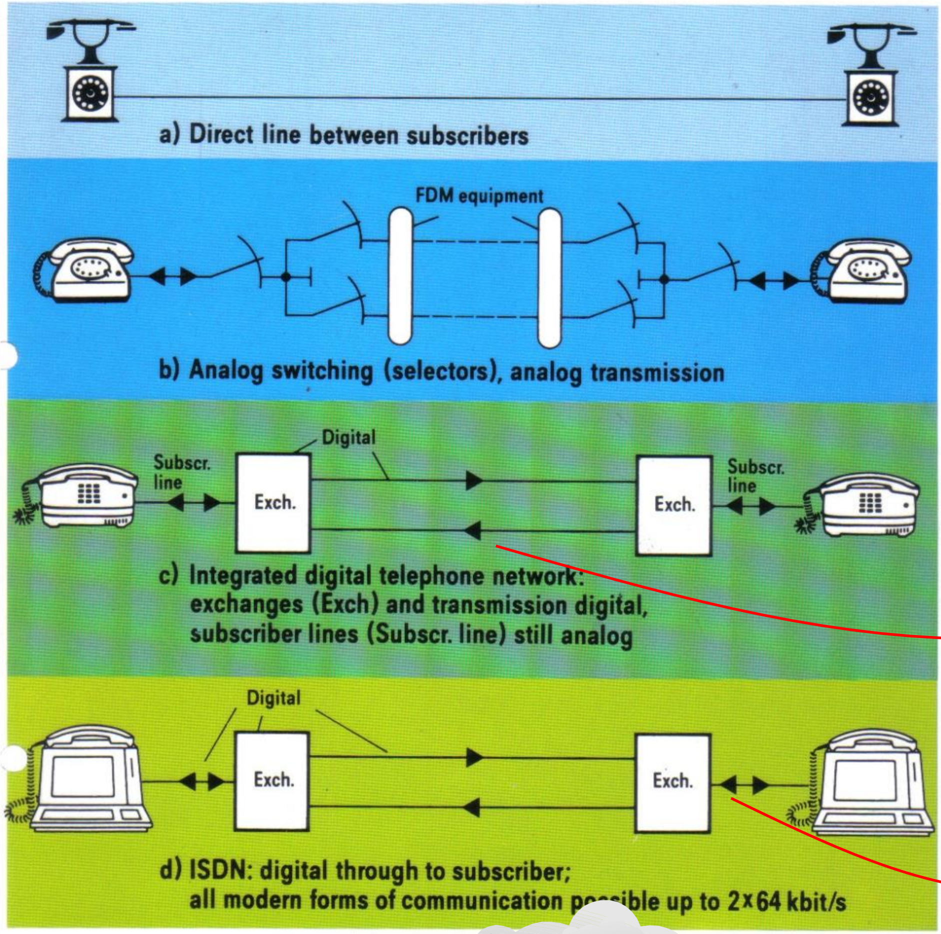
RED TELEFONICA : PSTN "Telcos" ¨Telecom Telefonica?

PSTN
(Public Switch Telephone Network)

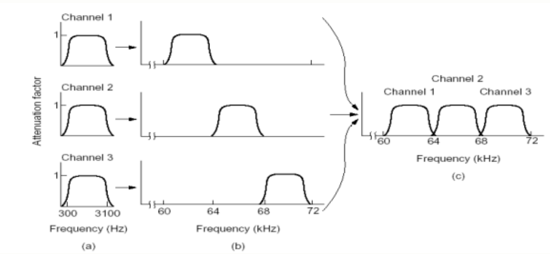


Canal telefónico … vs…. servicio Telefónico…

Tecnología……



Tipo de muotiplexado



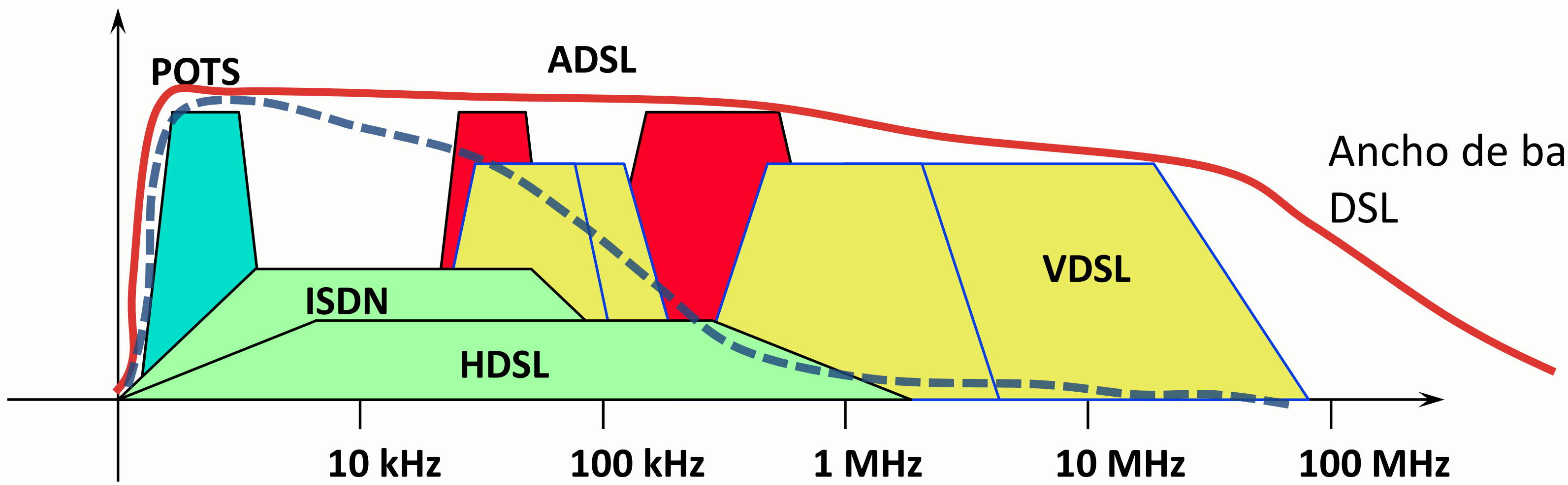
FDM

TDM → PDH, SDH

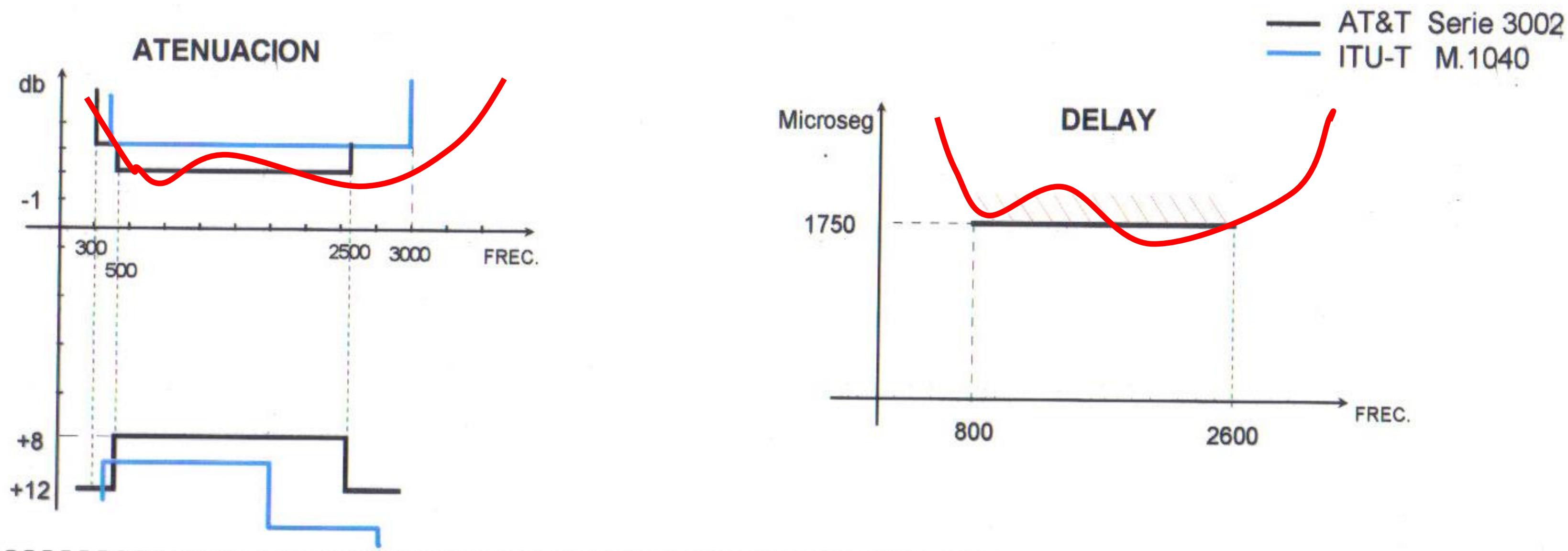
TDM ISDN

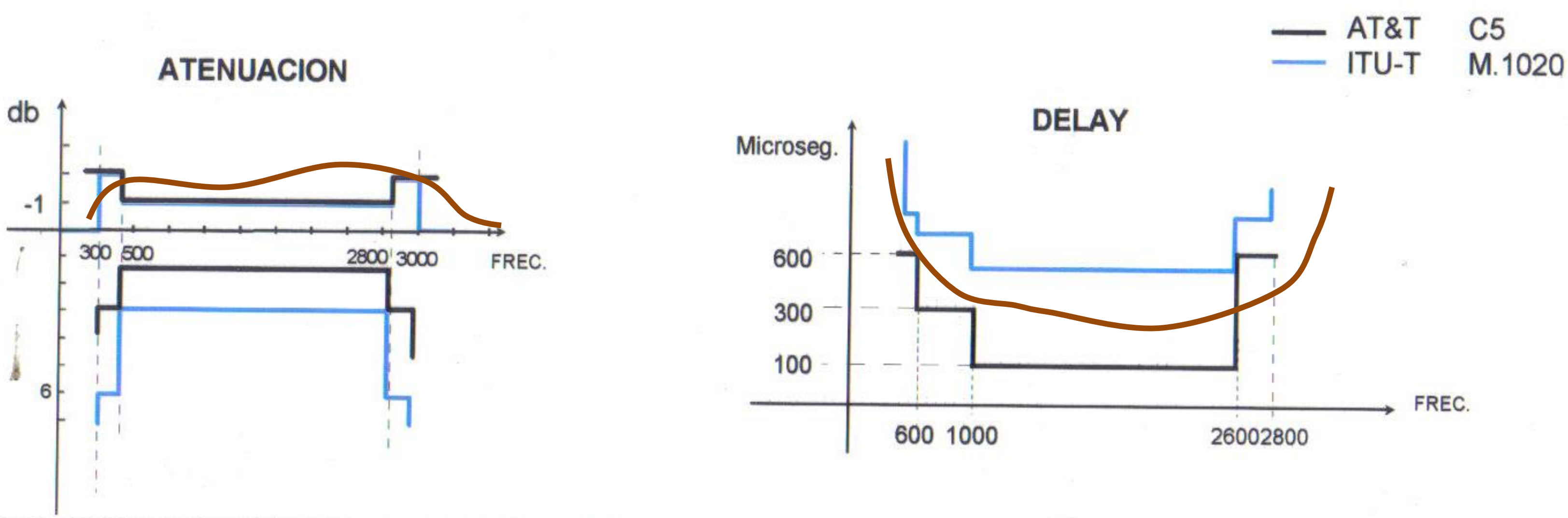
NGN IP, packet switching

Tecnologías y el espectro utilizado en DSL



RECOMENDACIONES SOBRE CANAL TELEFONICO (AT&T y ITU-T)





IMPERFECCIONES DE UN CANAL TELEFONICO..

Tipos..

1. **Ruido impulsivo.**
2. **Distorsión armónica.**
3. **Desviación de frecuencia.**
4. **Hit de ganancias o atenuación.**
5. **Jitter.**
6. **Retardo.**
7. **Diafonía.**

Calidad de Servicio ……………..

El ruido impulsivo debe medirse con un aparato conforme a la Recomendación O.71 . Como límite provisional, en un periodo de 15 minutos no podrán producirse más de 18 impulsos de ruido con crestas superiores a –21 dBm0.

Cuando en el extremo de emisión de un circuito punto a punto se aplique una frecuencia de prueba de 700 Hz con un nivel de –13 dBm0, el nivel de **toda frecuencia armónica** en el extremo de recepción será, provisionalmente, 25 dB inferior, como mínimo, al nivel de la frecuencia fundamental recibida.

El error de frecuencia introducido por el circuito no podrá ser superior a ± 5 Hz. Se espera que en la práctica el error se mantendrá dentro de límites más estrechos.

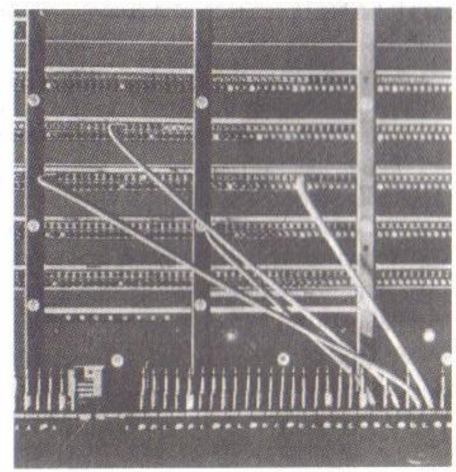
El valor de fluctuación de fase medido en las instalaciones del arrendatario depende de la constitución real del circuito (por ejemplo, el número de equipos de modulación que intervengan). Es de esperar que en las medidas de fluctuación de
fase efectuadas con un aparato que satisfaga las cláusulas de la Recomendación O.91 [4], los valores no excedan normalmente de 10° cresta a cresta

La atenuación diafónica en el extremo cercano (entre los sentidos de transmisión de ida y retorno del circuito arrendado) no debe ser inferior a 43 dB. La atenuación diafónica entre distintos circuitos (entre circuitos arrendados y entre un circuito arrendado y cualquier otro circuito de tipo telefónico) no debe ser inferior a 58 dB.

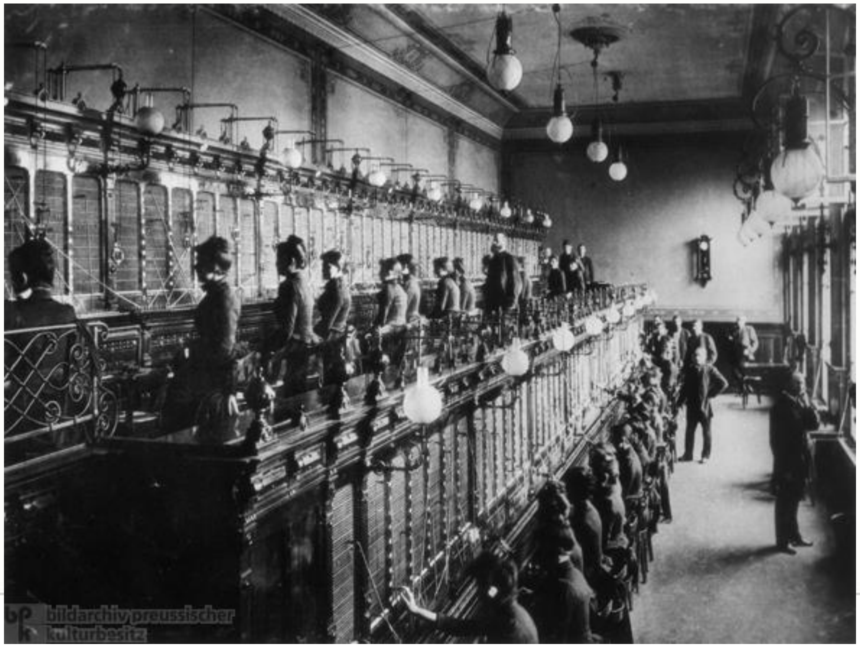
Los comienzos en los servicios telefónicos … : La conmutación de circuitos

Ericsson "Eiffel Tower" Telephone ca. 1892

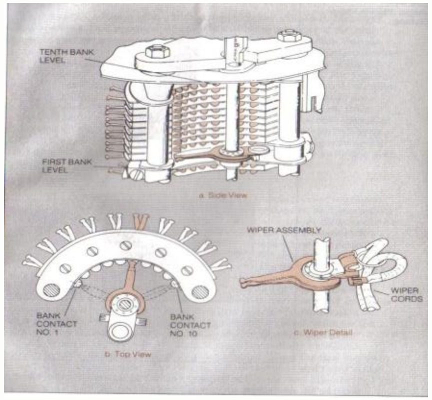
Conmutación Manual

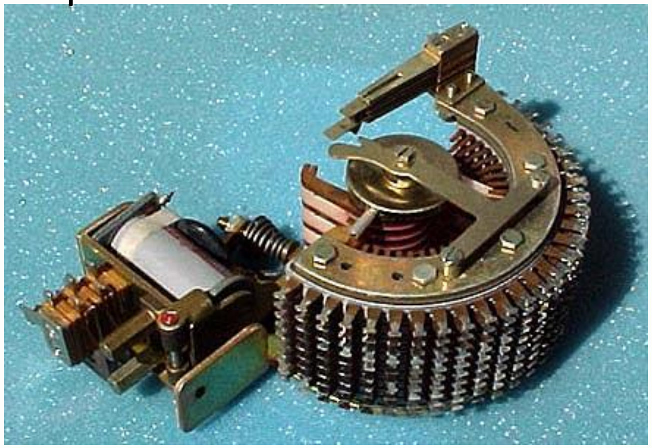


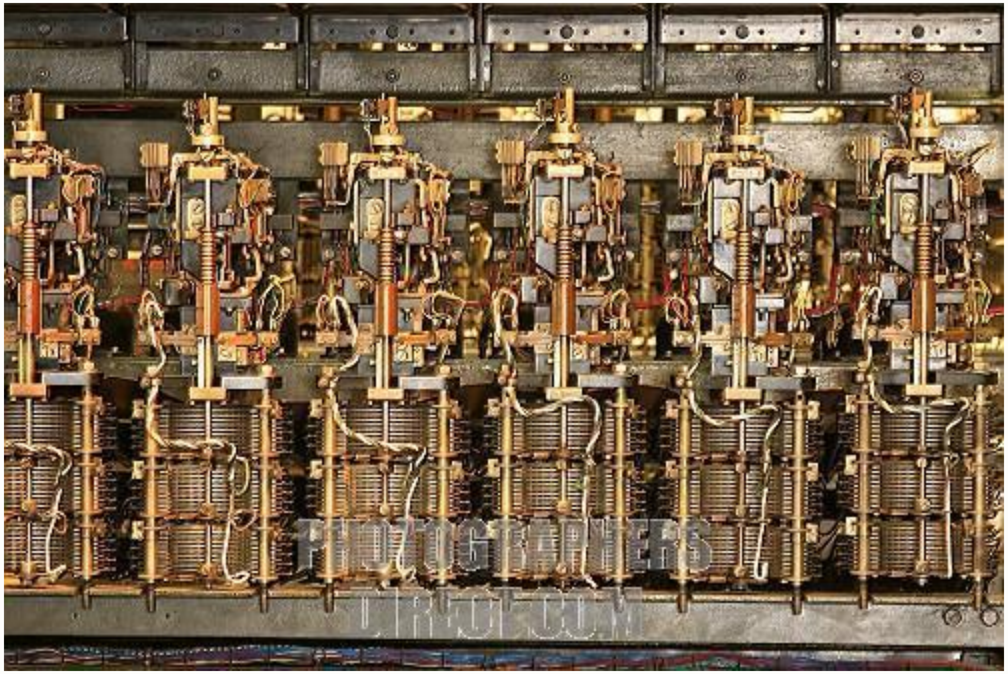
La central Telefónica tenia la capacidad de conmutación de : ***n*** operadores….

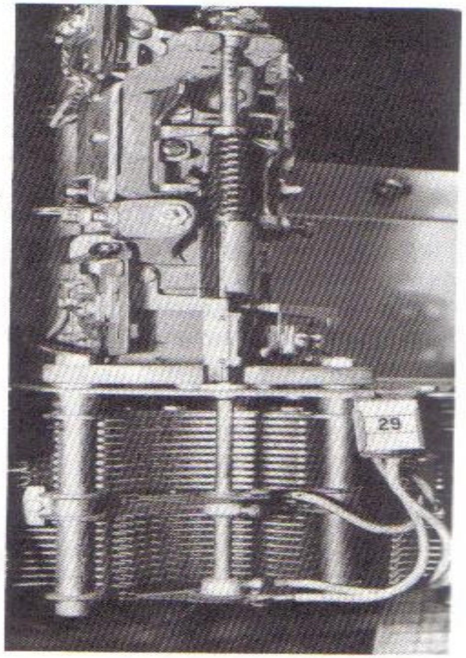


Conmutación electromecánica … Marcación mediante pulsos

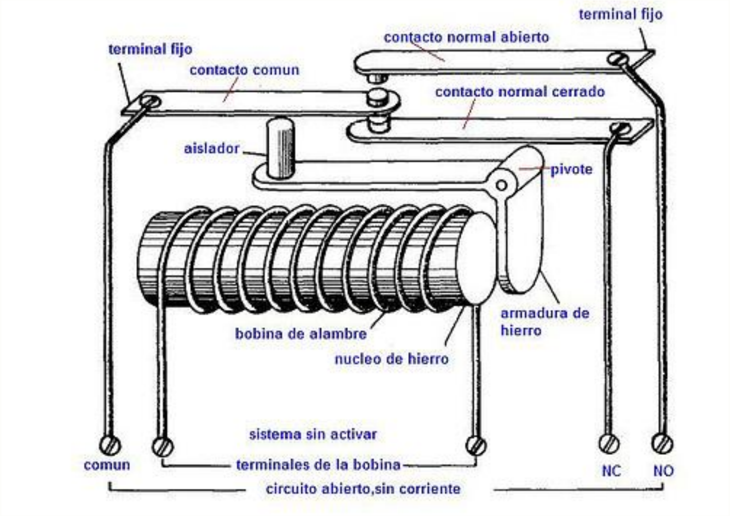


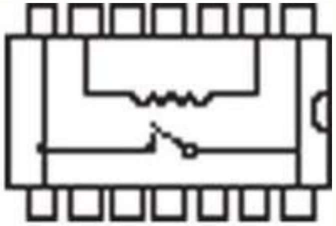






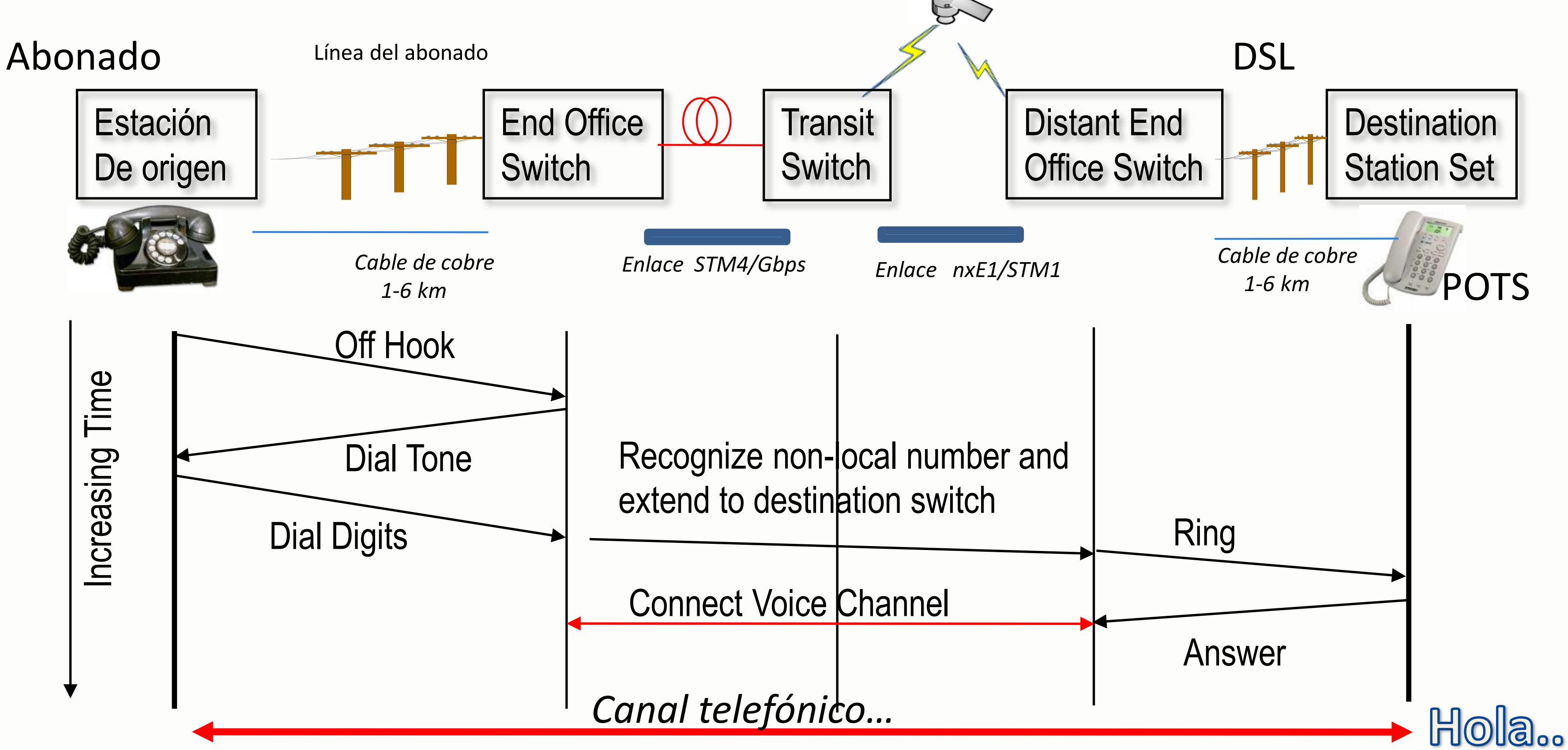
Conmutación electrónica

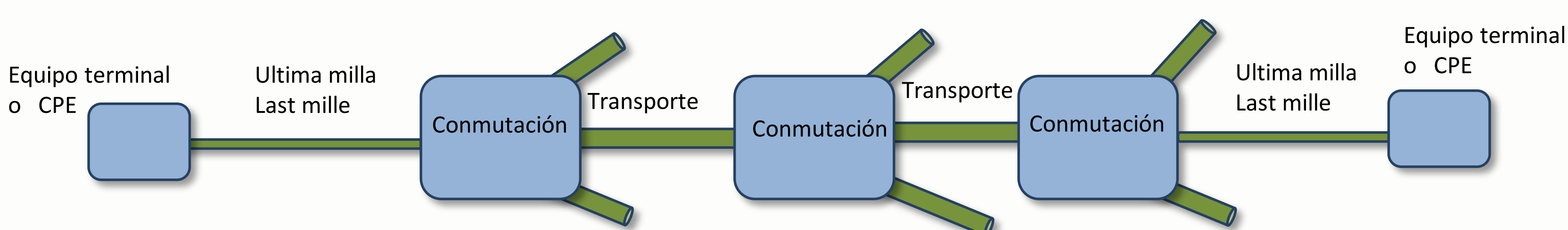




El entorno de un central telefónica

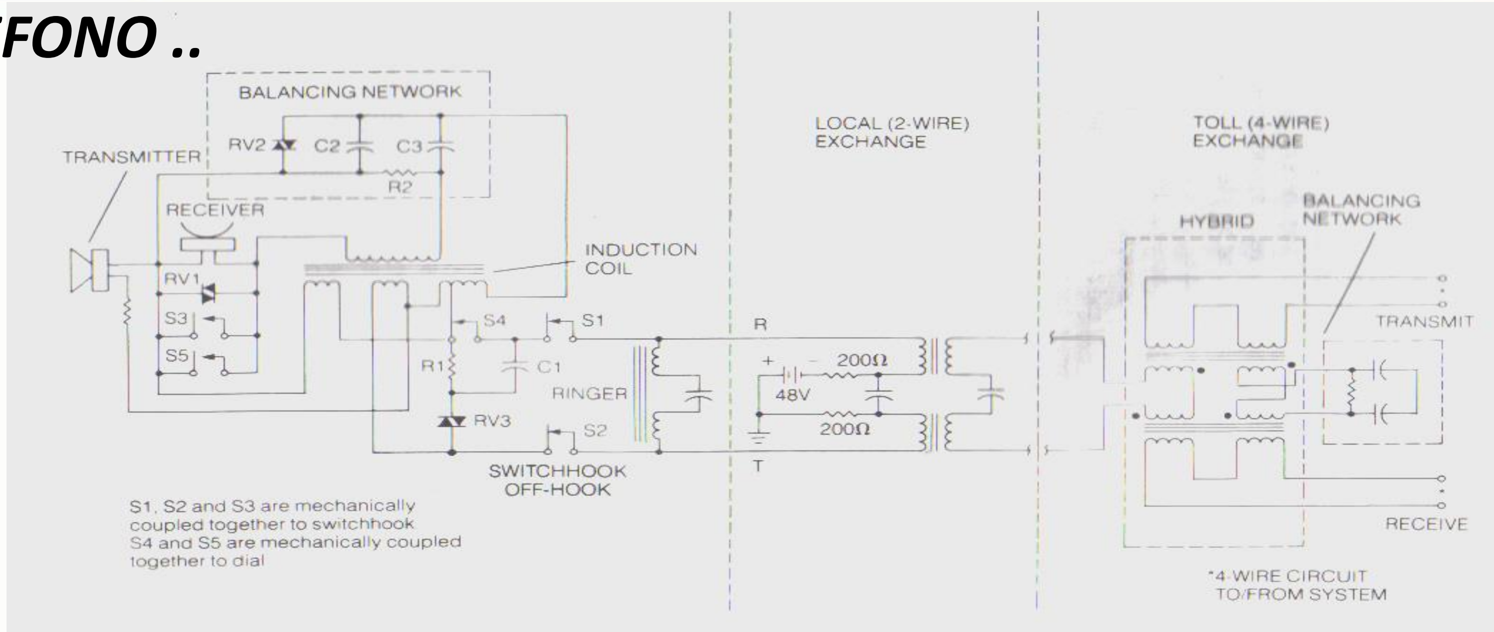
Establecimiento de un canal telefónica en una PSTN





Bellamy : Digital Telephony

El TELEFONO ..



TIPO DE DISCADO …

Por pulsos..

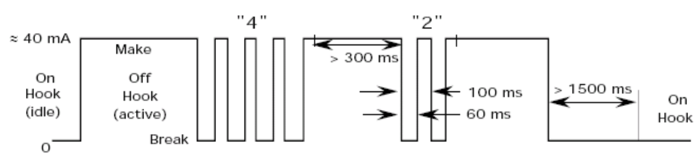
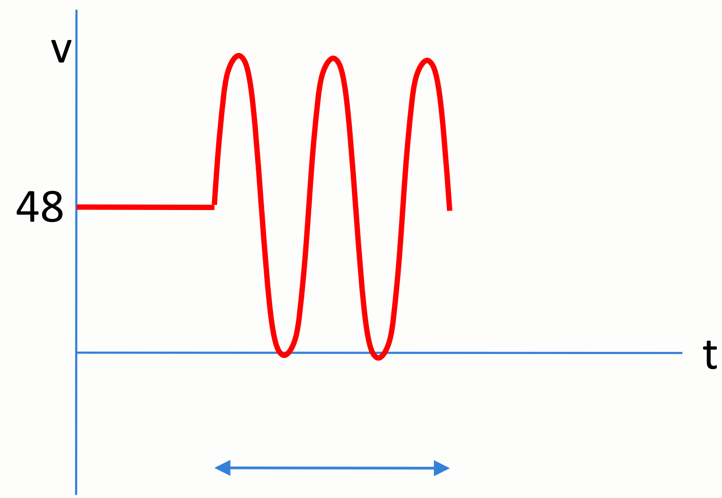
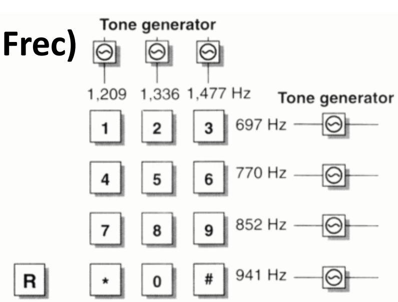


Fig. 2.2-2 Dial Pulse Address Signaling



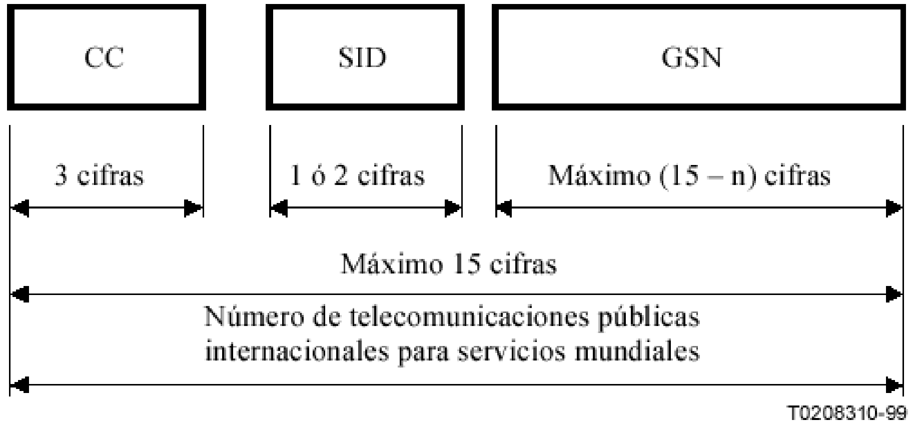
Por DTMF (Dual Tone Multi Frec)

"tonos"…



NUMERACION TELEFONICA

Señalización



CC	Indicativo de país para servicios mundiales
SID	Identificación del servicio
GSN	Número de abonado mundial
n	Número de cifras del indicativo de país más identificación del servicio (SID)

Figura 3/E.193 – Estructura de número de telecomunicaciones públicas internacionales para servicios mundiales

2.4.1 - DCE (Digital Communication Equiment) , MODEM

MODEM TELEFONICO (BANDA VOCAL)

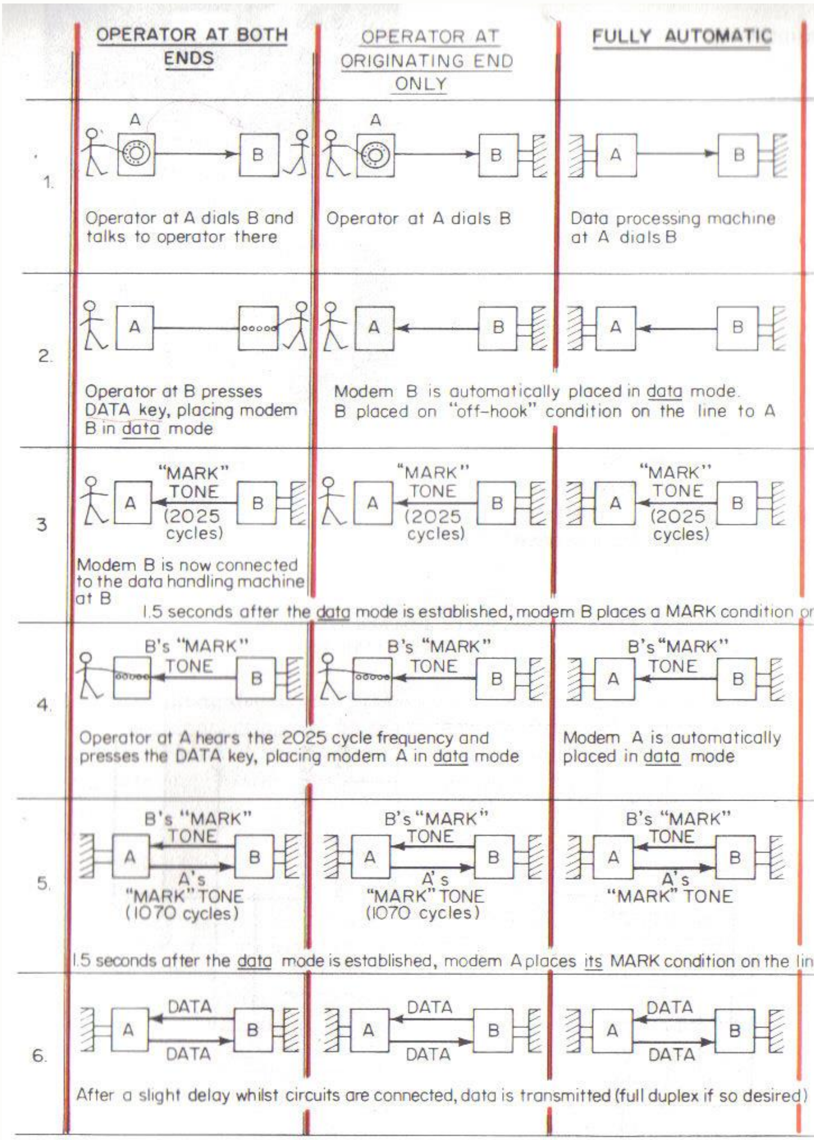
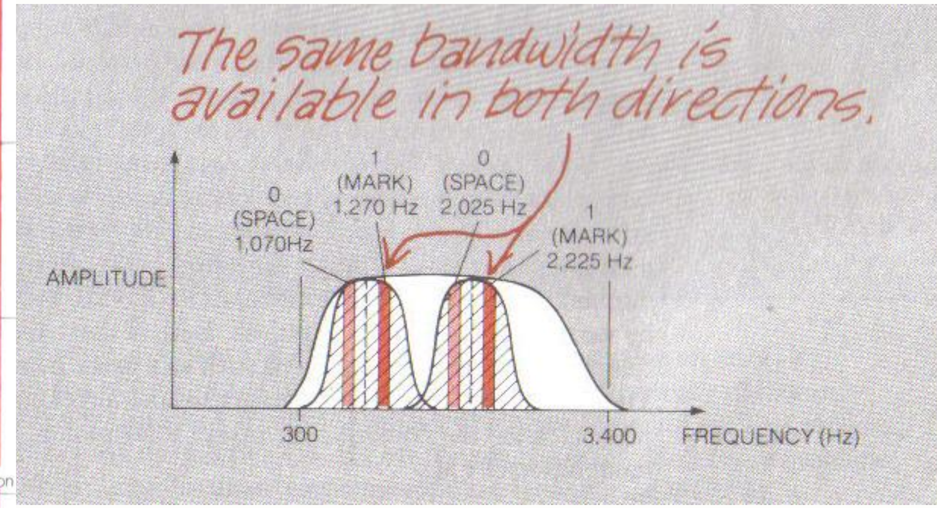
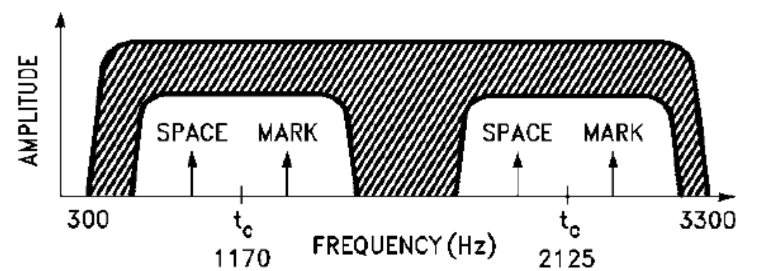


Figure 17.5 Setting up a call, manually or automatically, with the Bell type 103A data set.

MODEM DE BANDA VOCAL





TL/F/8691–2

IGURE 2. The HC942 modem chip converts incoming ›nes and zeros to mark and space frequencies when digital data enters the chip's TXD input

MODEM V.90

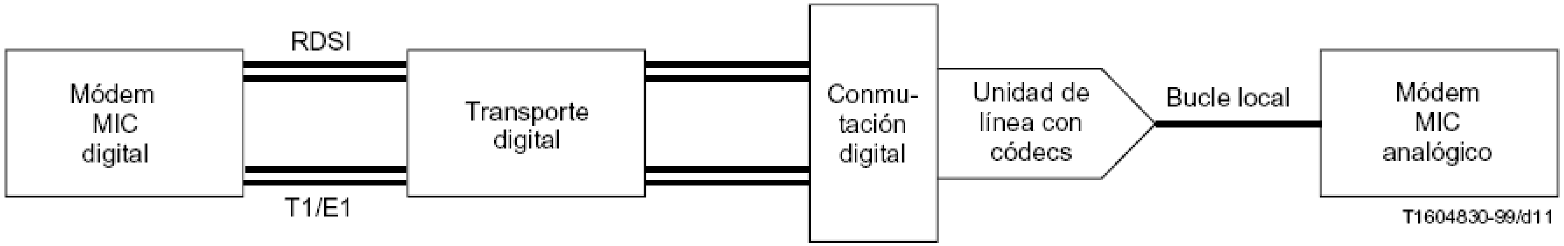


Figura I.1/V.90 – Ejemplo de configuración de red

Resumen

Se contemplan módems digitales y analógicos para su utilización en la red telefónica pública conmutada (RTPC) a velocidades de señalización de datos de hasta 56 000 bit/s en sentido descendente y hasta 48 000 bit/s en sentido ascendente, con un tiempo de inicialización reducido en las conexiones reconocidas y procedimientos para soportar el módem en espera como respuesta a los eventos de indicación de llamada en espera o de petición de llamada saliente.

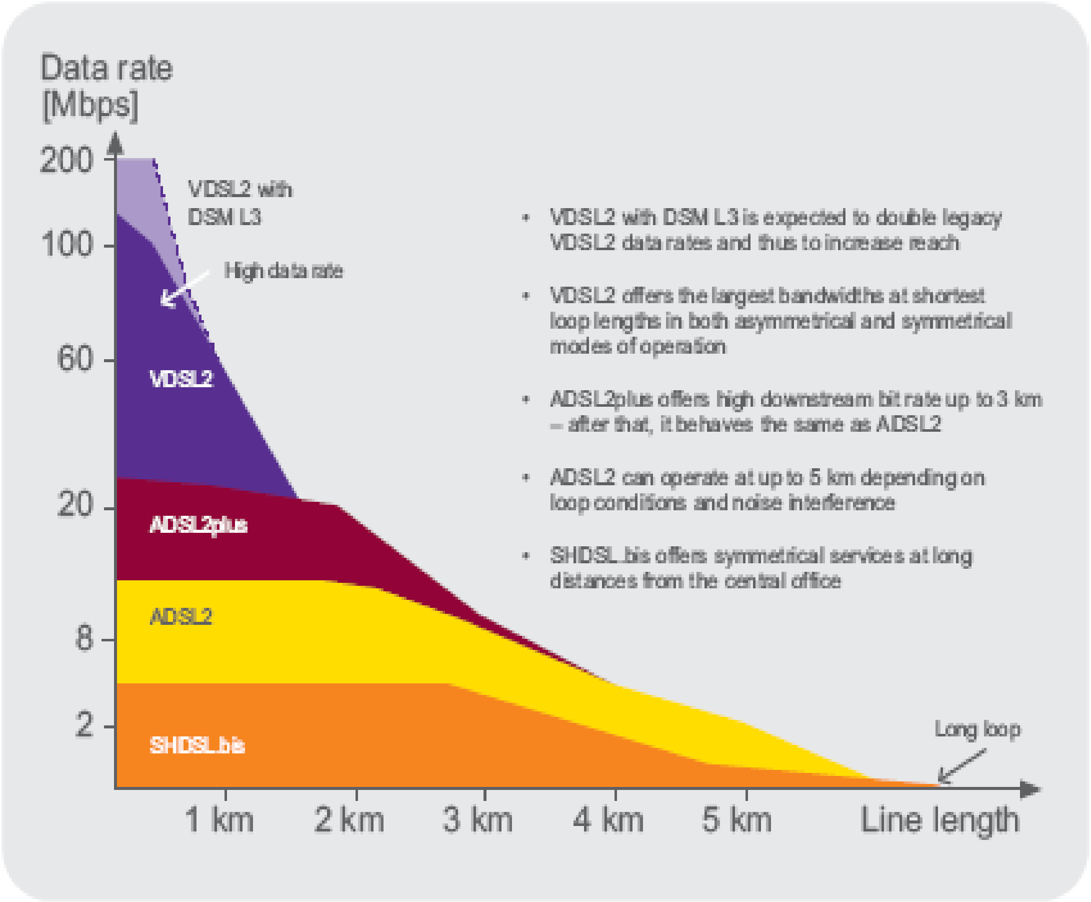
ULTIMA MILLA ..de cobre..
(Adicionalmente al servicio PSTN .. _)

- **Asymmetric**

  Faster downstream than upstream transfer rate
  - ADSL
  - G.lite ADSL
  - RADSL
  - VDSL

- **Symmetric**

  - SDSL
  - SHDSL
  - HDSL
  - HDSL2
  - IDSL



RED HFC : DOCSIS

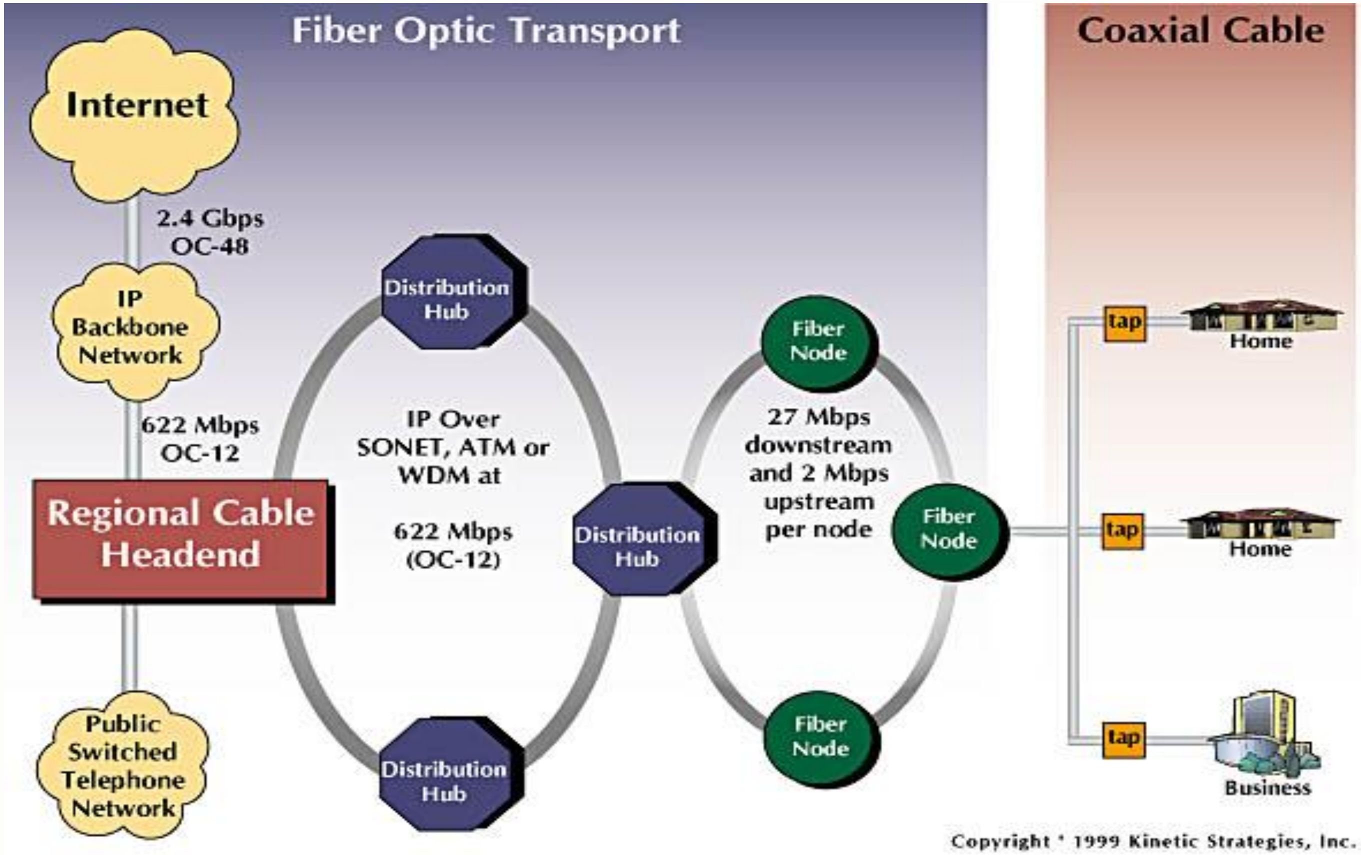


Diagram: http://www.cabledatacomnews.com/cmic/diagram.html

PON (*Pasive Optical Networks*).

ULTIMA MILLA

	Broadband PON BPON	Ethernet PON EPON	Gigabits PON GPON
Estándar	UIT-T G.983.x	IEEE 802.3ah	UIT-T G.984.x
Caudales	▪ 155,52 Mbit/s Down y 155,52 Mbit/s Up. ▪ 622,08 Mbit/s Down y 155,52 Mbit/s Up. ▪ 622,08 Mbit/s Down y 622,08 Mbit/s Up. ▪ 1.244,16 Mbit/s Down y 155,52 Mbit/s Up. ▪ 1.244,16 Mbit/s Down y 622,08 Mbit/s Up.	▪ Régimen de línea: 1.250 Mbit/s, simétrico. ▪ Codificación de línea 8B/10B. ▪ Régimen de trama: 1.000 Mbit/s, simétrico.	▪ 1.244,16 Mbit/s Down y 155,52 Mbit/s Up. ▪ 1.244,16 Mbit/s Down y 622,08 Mbit/s Up. ▪ 1.244,16 Mbit/s Down y 1.244,16 Mbit/s Up. ▪ 2.488,32 Mbit/s Down y 155,52 Mbit/s Up. ▪ 2.488,32 Mbit/s Down y 622,08 Mbit/s Up. ▪ 2.488,32 Mbit/s Down y 1.244,16 Mbit/s Up. ▪ 2.488,32 Mbit/s Down y 2.488,32 Mbit/s Up.
Tipo de fibra	Monomodo (UIT-T G652)	Monomodo (UIT-T G652)	Monomodo (UIT-T G652)
Número de fibras	1 ó 2 fibras	1 fibras	1 ó 2 fibras

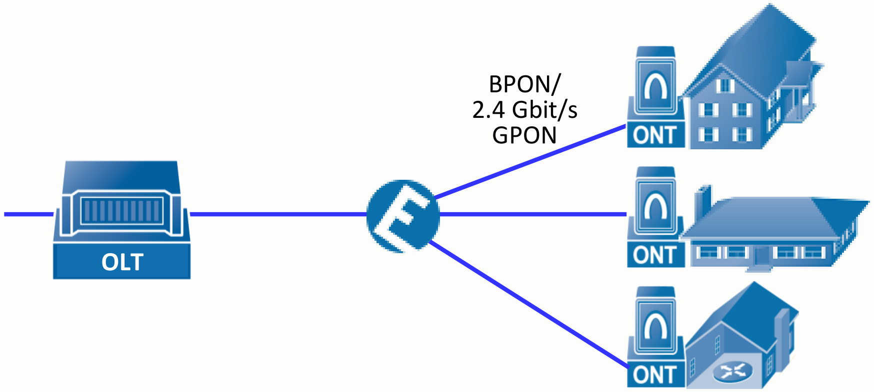
REDES OPTICAS PASIVAS ,
PON (*Pasive Optical Networks*).

	BPON	EPON	GPON
Longitudes de onda	Con una sola fibra: ▪ Down: ◦ 1.480 a 1.500 nm para datos. ◦ 1.550 a 1.560 nm para distribución vídeo. ▪ Up: 1.260 a 1.360 nm. Con dos fibras: una para cada sentido de transmisión. En todas ellas se trabaja en la banda de 1.260 a 1.360 nm (se mantiene la banda de 1.550 a 1.560 nm para distribución de video en sentido descendente).	▪ Down: 1.550 a 1.560 nm para distribución de vídeo. ▪ Up: 1.260 A 1.360 nm.	Con una sóla fibra: ▪ Down: ◦ 1.480 a 1.500 nm para datos. ◦ 1.550 a 1.560 nm para distribución vídeo. ▪ Up: 1.260 a 1.360 nm. Con dos fibras: una para cada sentido de transmisión. En todas ellas se trabaja en la banda de 1.260 a 1.360 nm (se mantiene la banda de 1.550 a 1.560 nm para distribución de video en sentido descendente).
Split ratio	Hasta 32	Hasta 16	Hasta 128
Alcance máximo	20 km	20 km	60 km
Variación máxima de distancia entre ONUs	20 km	20 km	20 km
Encapsulado de la información entre OLT y ONU	Sobre celdas ATM	Sobre tramas ethernet	Sobre celdas ATM, o bien empleando Ethernet o TDM, usando para ello GEM (*GPON Encapsulation Mode*), basado en GFP (*Generic Framing Procedure*), o dual

Distintas tecnologías de última milla .

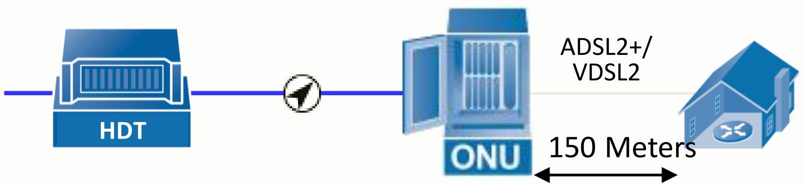
Fiber to the Premises (FTTP)

- Shared 2.4 Gbps (GPON)
- Eliminate actives and copper from the OSP
- Triple-Play (High Speed Internet, Voice, Video)



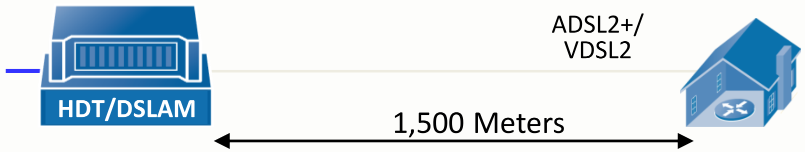
Fiber to the Curb (FTTC)

- 80-100 Mbps per subscriber
- Reuse existing copper drops
- Triple-Play (High Speed Internet, Voice, Video)

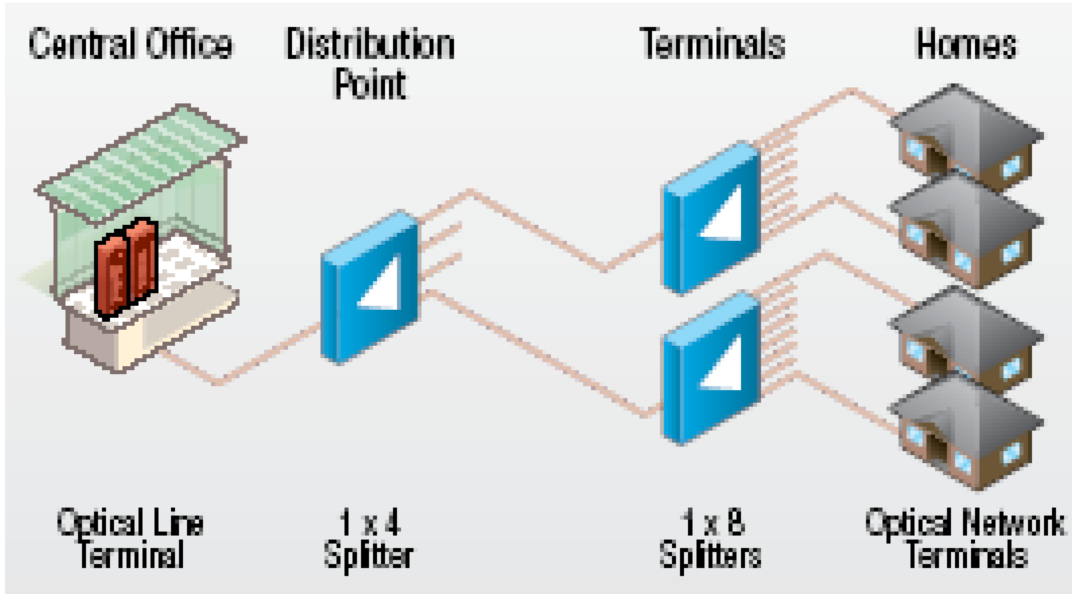


Fiber to the Node (FTTN)

- Least expensive initially, but…
- Least bandwidth capable – up to 24 Mbps
- High Speed Internet and Voice

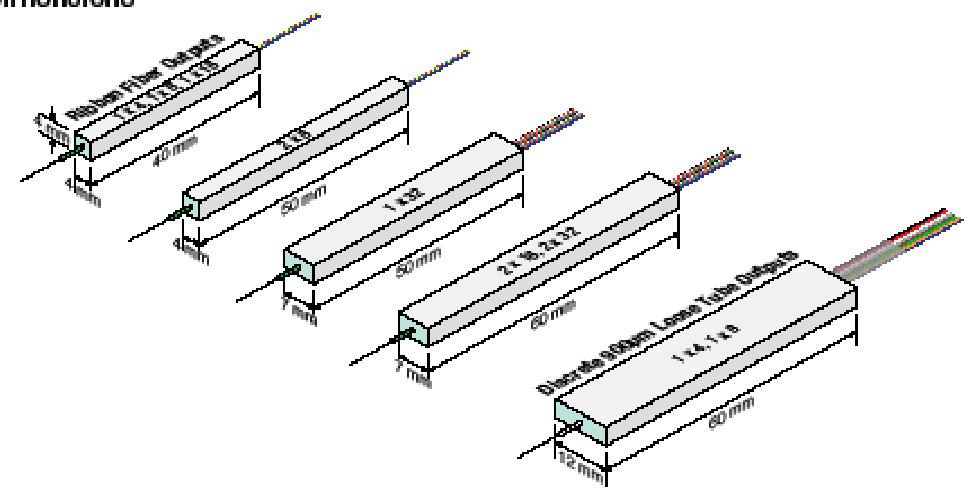


REDES OPTICAS PASIVAS : topología al usuario

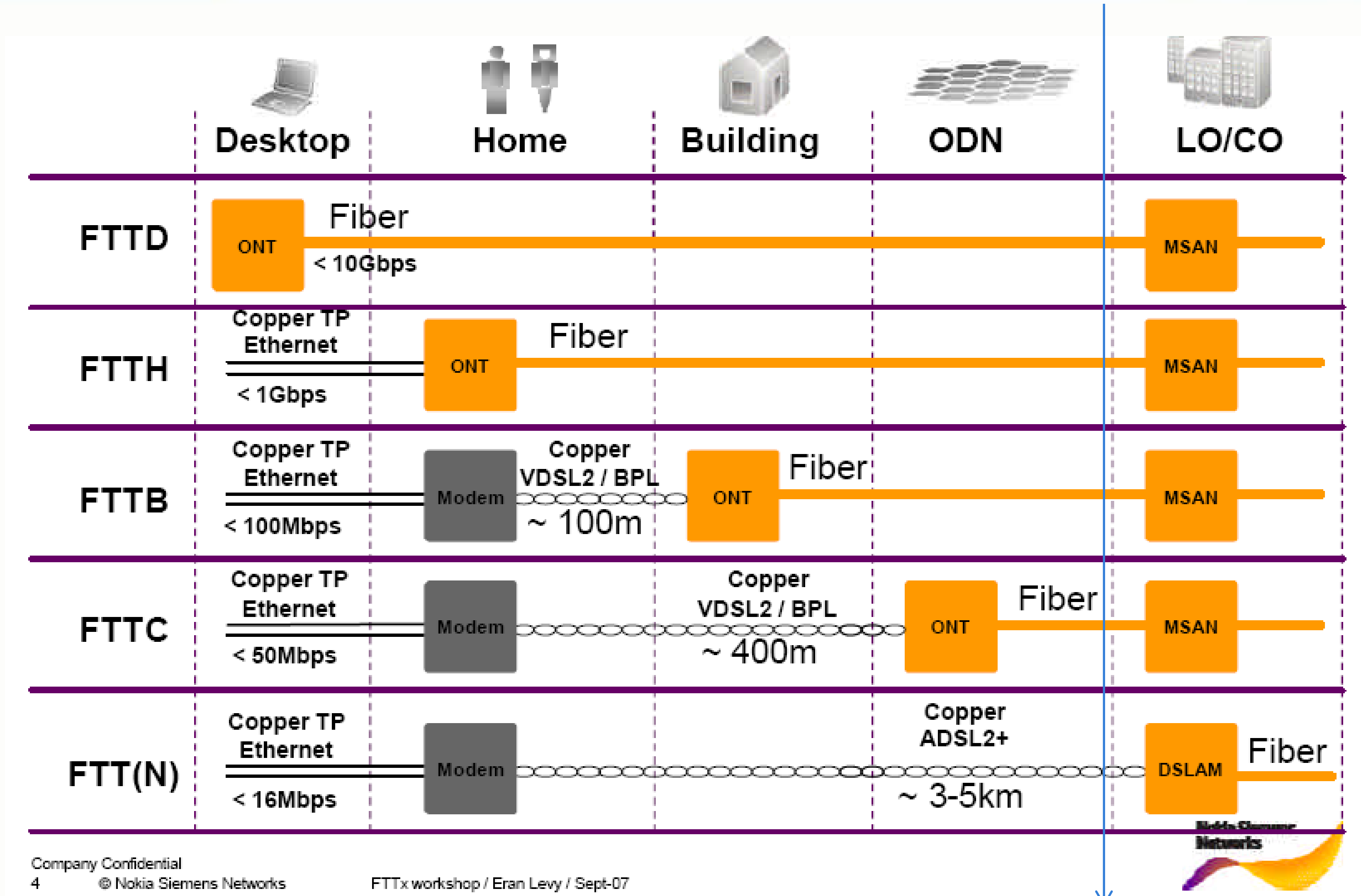


Distributed Splitting with combination of 1x4 and 1x8 PLC

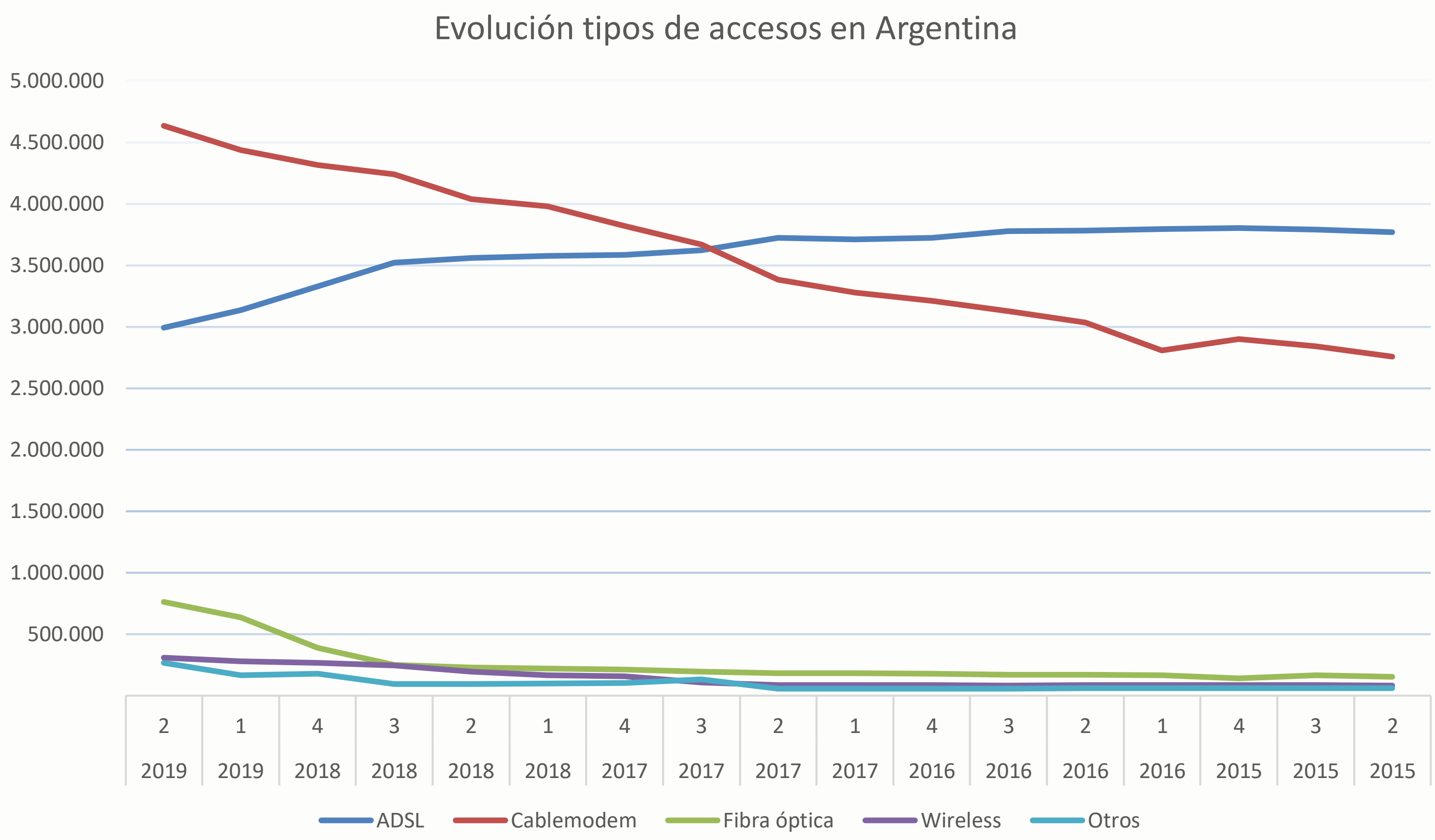
Dimensions



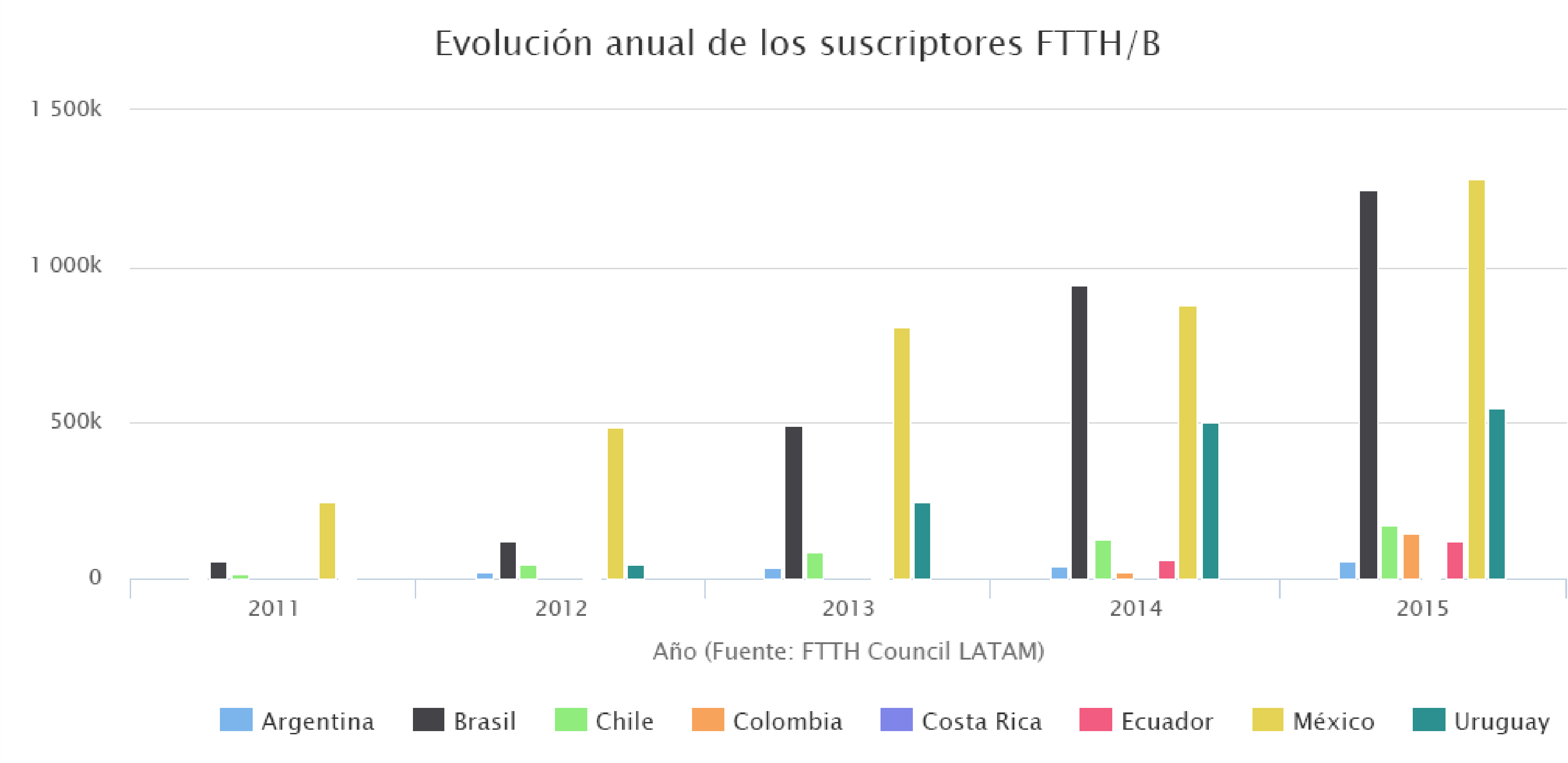
Distintas tecnologías de última milla



MSAN: Multi-Service Access Node (Broadband Access *DSLAM* : Digital Subscriber Line Access Multiplexer


Evolución tipos de accesos en Argentina
5.000.000
4.500.000
4.000.000
3.500.000
3.000.000
2.500.000
2.000.000
1.500.000
1.000.000
500.000
2 2019
1 2019
4 2018
3 2018
2 2018
1 2018
4 2017
3 2017
2 2017
1 2017
4 2016
3 2016
2 2016
1 2016
4 2015
3 2015
2 2015
ADSL
Cablemodem
Fibra óptica
Wireless
Otros

En la región sudamericana



Precios ....

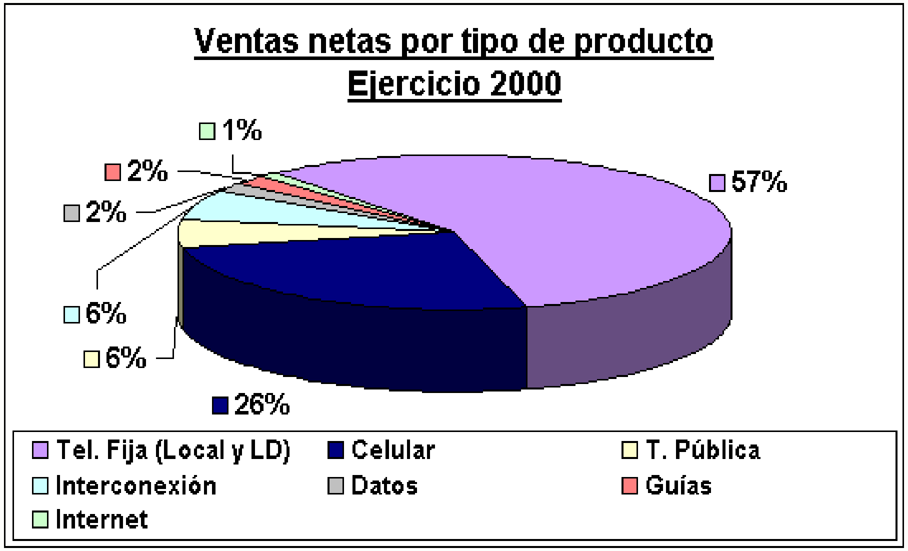
Figure 7.1: Top 25 broadband economies, by number of subscribers, 2006

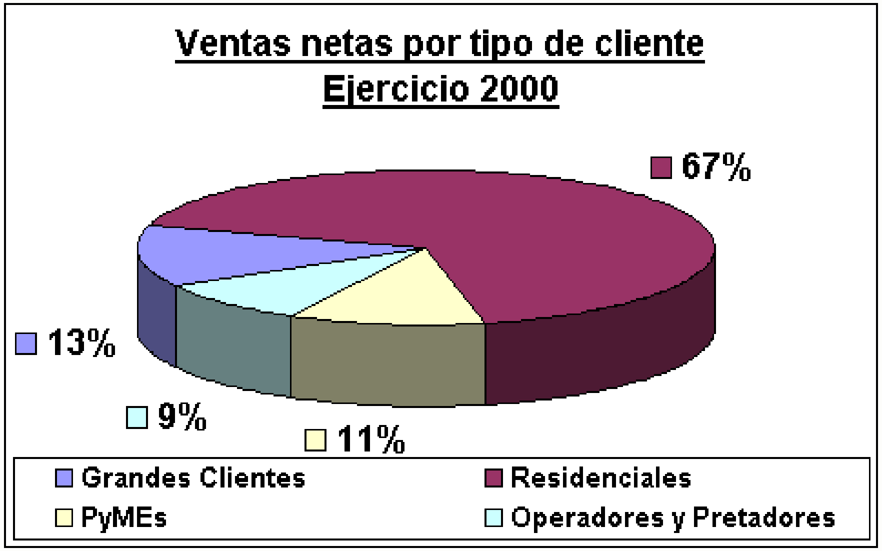
World rank	Economy	Total fixed broadband subscribers (000s)	Broadband subscribers (per 100 inhabitants)	Price per 100 kbit/s per month, in USD, 2006
1	United States	58 137	19.3	0.49
2	China	50 916	3.8	1.47
3	Japan	25 755	20.1	0.06
4	Germany	14 085	17.0	0.52
5	Korea (Rep.)	14 043	29.3	0.08
6	United Kingdom	12 995	21.7	0.63
7	France	12 699	20.9	0.37
8	Italy	8 639	14.9	0.31
9	Canada	7 676	23.6	1.08
10	Spain	6 655	15.3	4.89
11	Brazil	5 922	3.1	1.20
12	Netherlands	5 192	31.7	0.14
13	Taiwan, China	4 506	19.8	0.18
14	Australia	3 900	19.1	3.41
15	Mexico	3 728	3.4	6.24
16	Russia	2 900	2.0	28.13
17	Turkey	2 774	3.7	9.85
18	Poland	2 640	6.9	1.27
19	Belgium	2 354	22.6	1.22
20	Sweden	2 346	25.9	0.24
21	India	2 300	0.2	3.56
22	Switzerland	2 140	29.5	1.57
23	Hong Kong, China	1 796	25.2	0.83
24	Denmark	1 728	31.7	3.28
25	Argentina	1 568	4.0	2.46
	Top 25	**257 394**	**16.6**	**2.94**
	WORLD	**279 678**	**4.3**	**76.01**

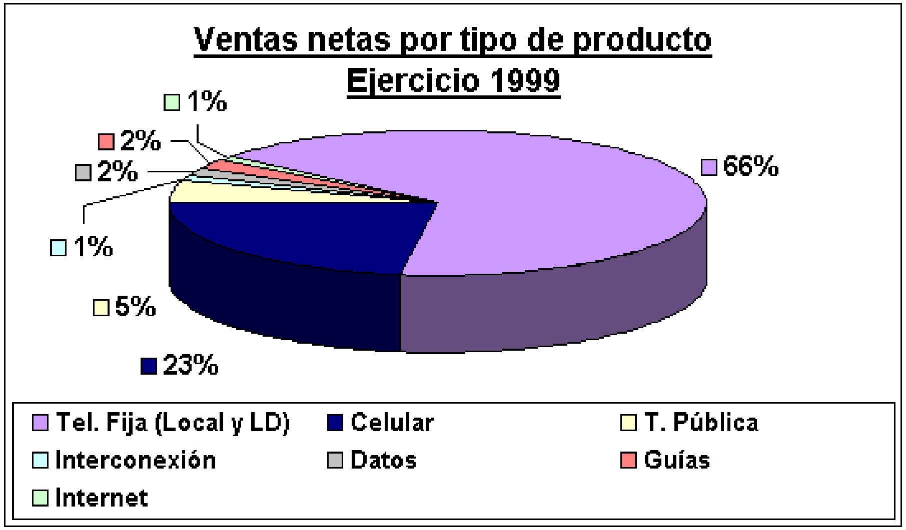
Note: Broadband is ≥ 256 kbit/s in one or both directions.

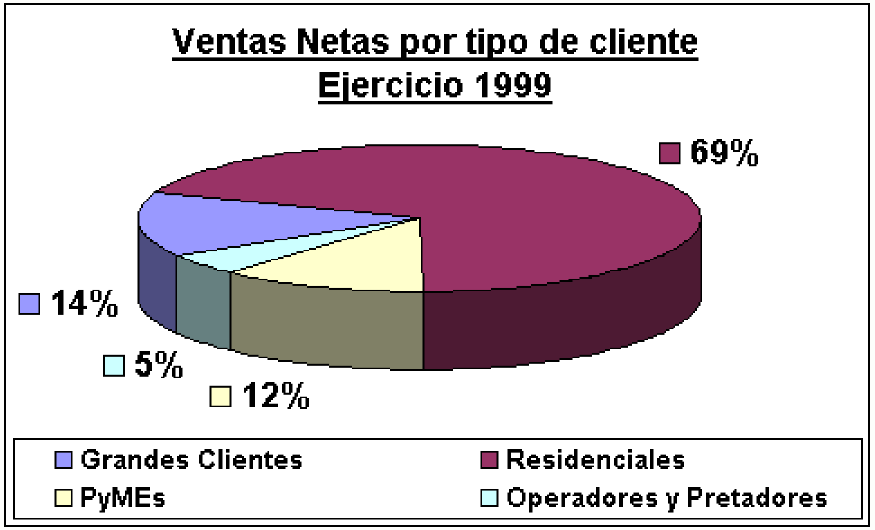
Source: ITU World Telecommunication/ICT Indicators Database, 2006.

El mercado de las Telecomunicaciones (ventas de TELECOM)









BALANCE…

	31-Dic 2007	31-Dic 2006
Telefonía Fija Nacional	**2.331**	**2.225**
Servicio medido		
Urbano	462	456
Interurbano	498	485
Abonos	746	716
Telefonía pública	117	131
Interconexión	**373**	**318**
Otros	135	119
Telefonía Internacional	270	242
Transmisión de Datos e Internet	701	586
Datos	173	156
Internet	528	430
Servicio medido	60	82
Abono	464	346
Modems	**4**	**2**
Telefonía Celular	**5.772**	**4.319**
Telecom Personal	**5.339**	**3.964**
Abono y servicio medido	1.181	842
Tarjetas prepagas	807	562
Calling party pays	558	484
TLRD *	592	416
SVA	**1.264**	**815**
Venta de terminales	**583**	**536**
Otros	354	309
Núcleo	433	355
Abono y servicio medido	63	64
Tarjetas prepagas	238	180
Calling party pays	41	41
TLRD *	**53**	**43**
SVA	**5**	**1**
Venta de terminales	7	8
Otros	26	18
VENTAS NETAS	**9.074**	**7.372**