



**ALMA LABS**



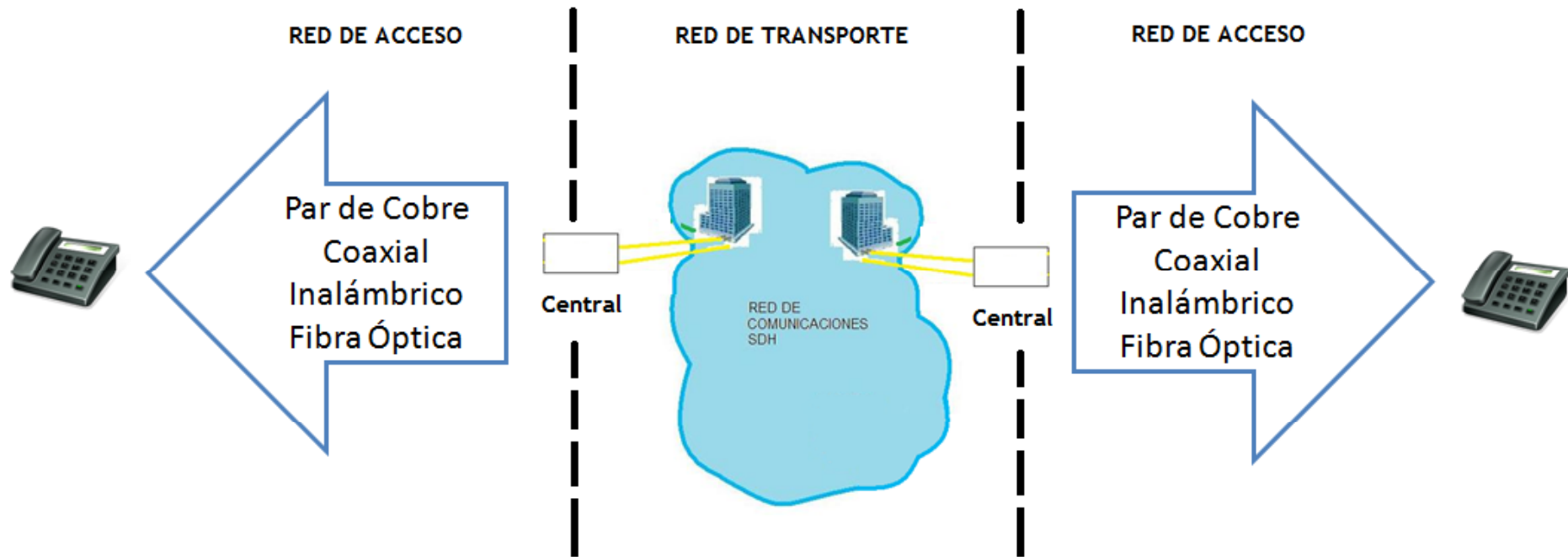
**Encuentro Nacional de  
Metrología Eléctrica 2009**  
18-20 de noviembre

## Establecimiento de un Laboratorio de Calibración en Tiempo y Frecuencia

Ing. Alvaro Marroquín



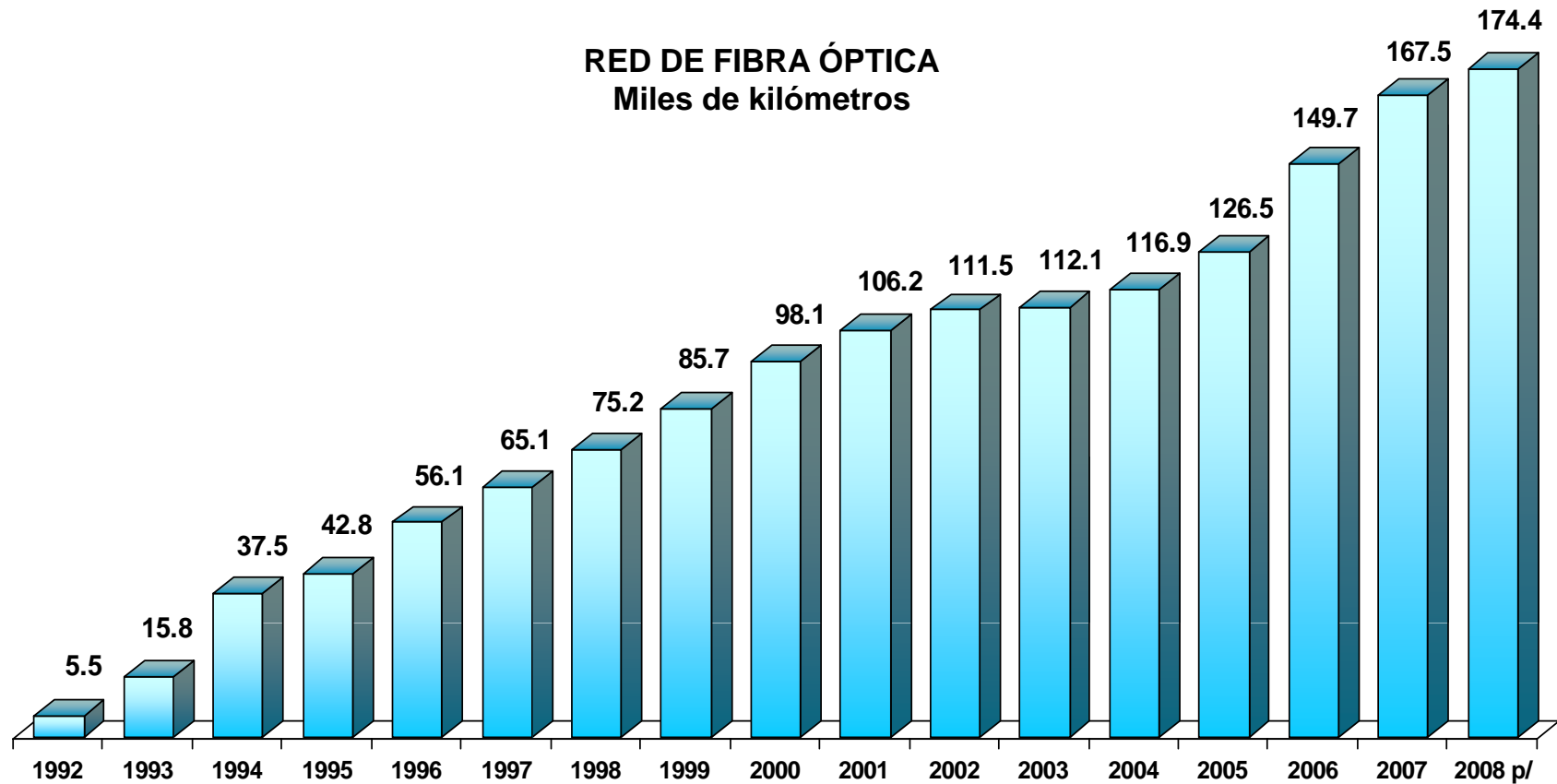
# Redes de Comunicaciones



1993  
2003

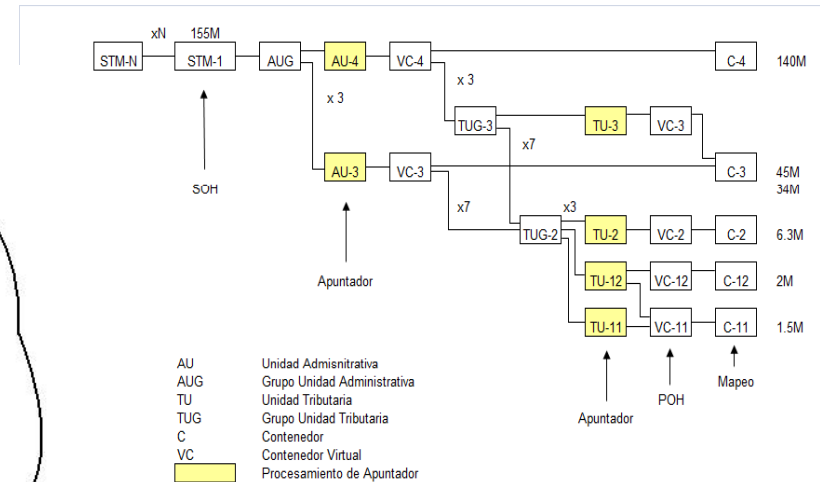
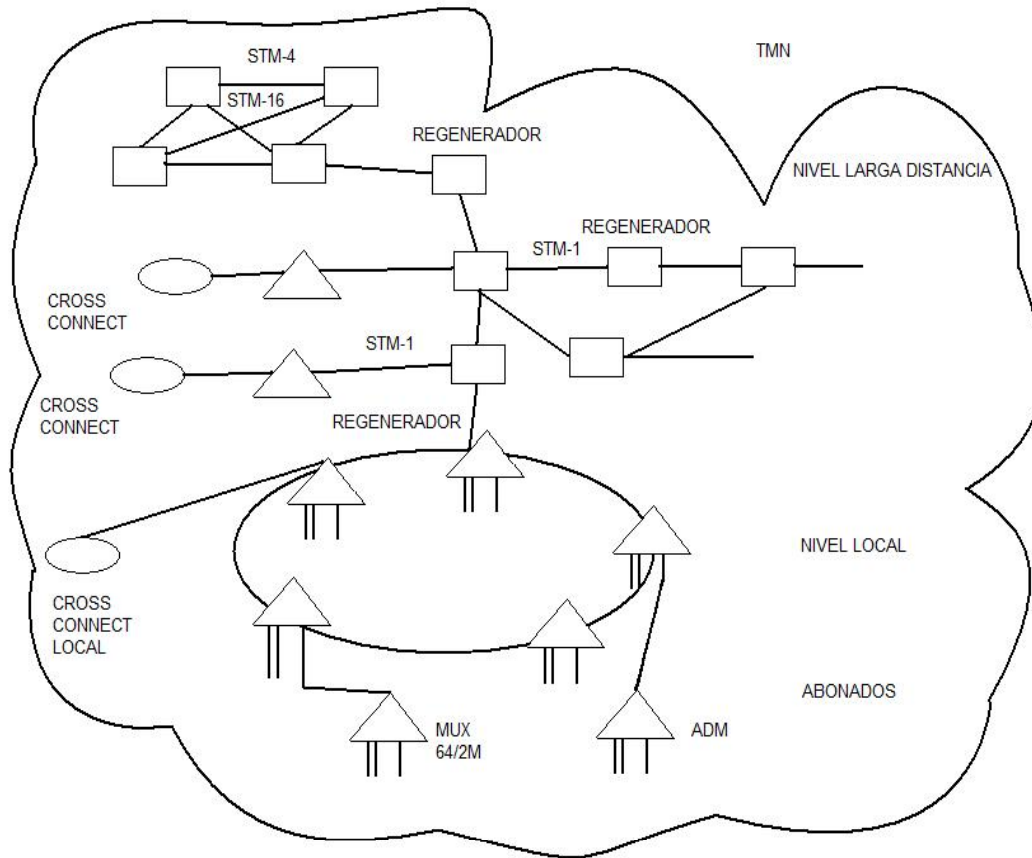
4.2 millones de llamadas  
2,143.0 millones de llamadas

# Redes de Comunicaciones



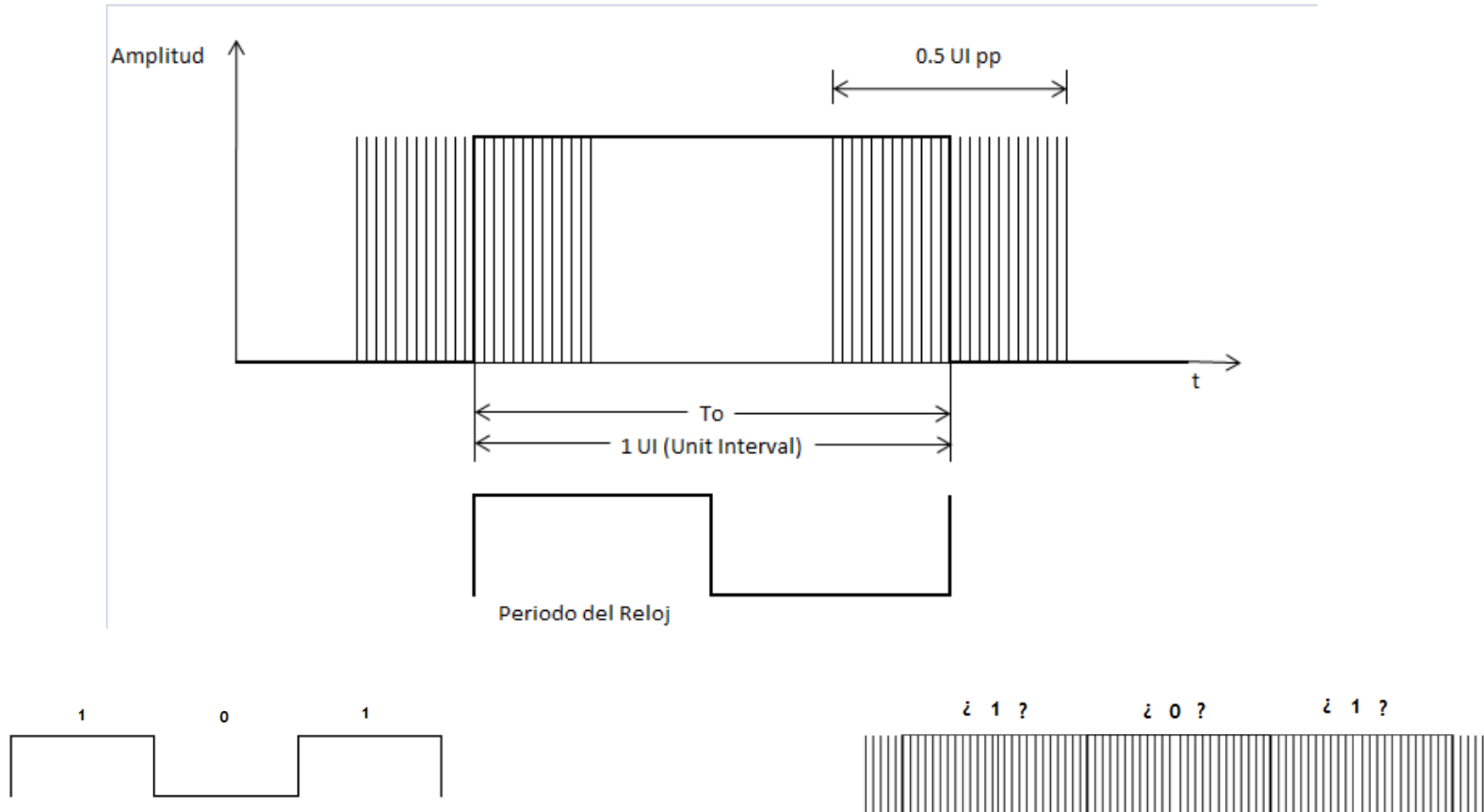
FUENTE: COFETEL

# Redes de Comunicaciones

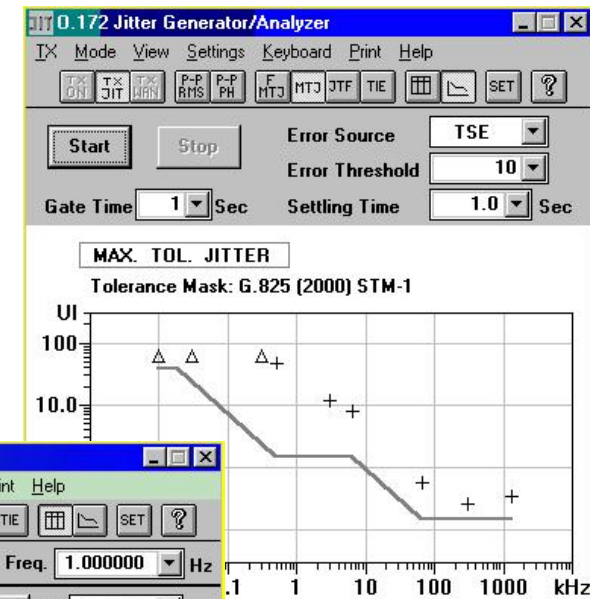
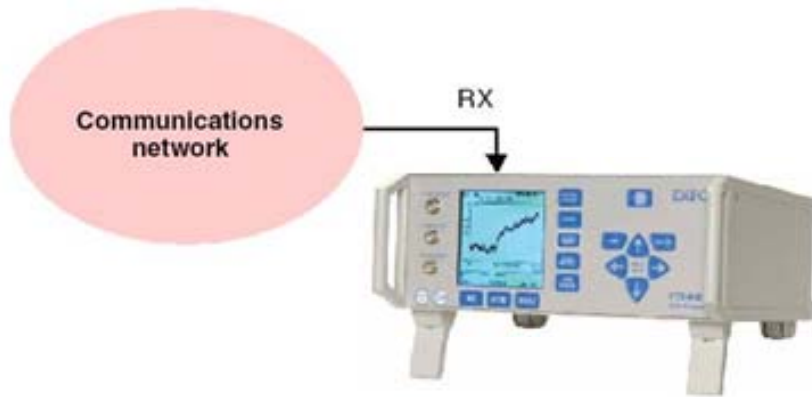


SDH	40Gbit/s	STM-256
	10Gbit/s	STM-64
	2488Mbit/s	STM-16
	622Mbit/s	STM-4
	155Mbit/s	STM-1
PDH	140Mbit/s	E4
	34Mbit/s	E3
	8Mbit/s	E2
	2Mbit/s	E1

# Ruido de Fase (Jitter)



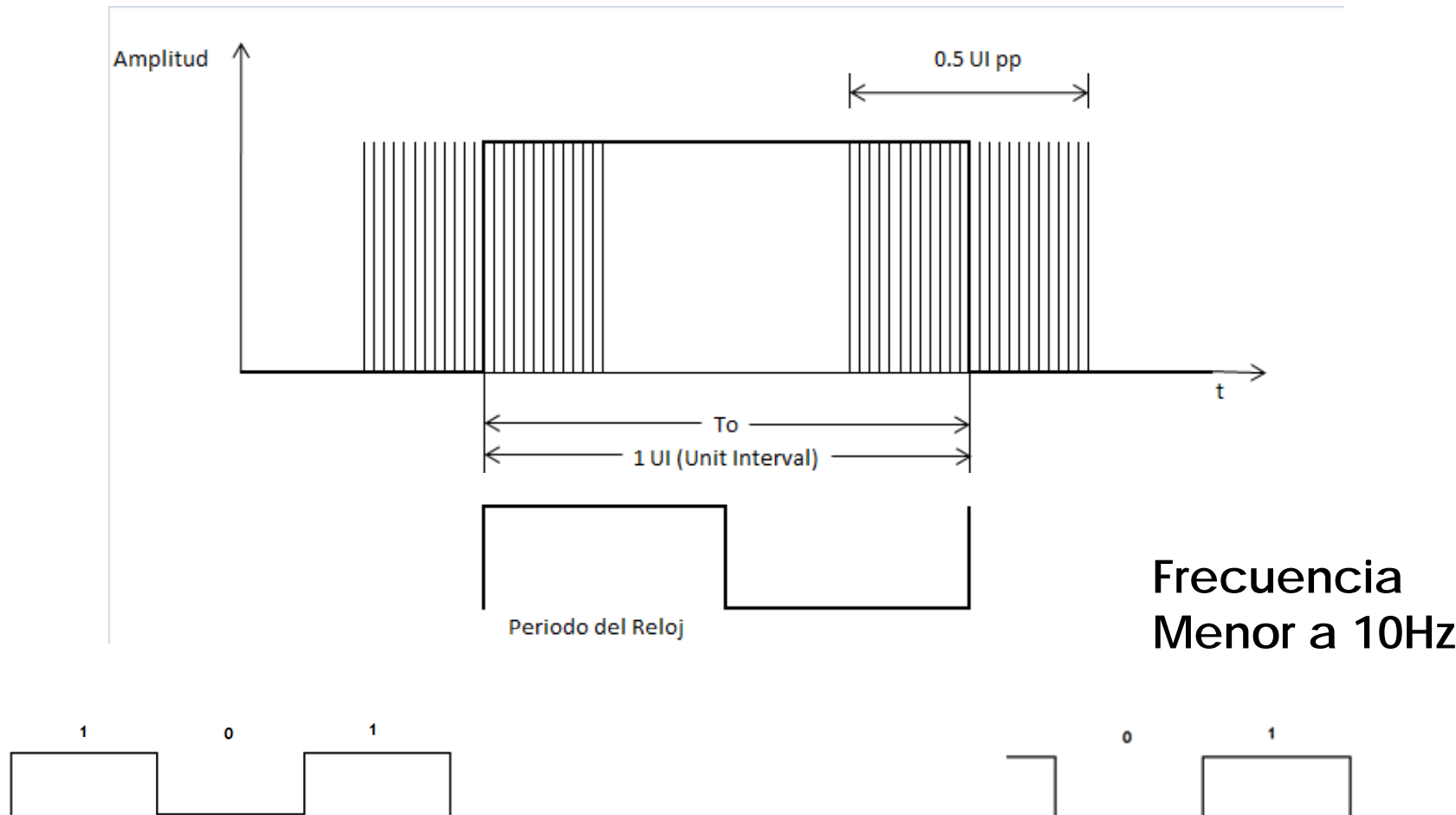
# Ruido de Fase (Jitter)



The screenshot shows the current and maximum jitter values for the measurement. The TX settings are: Ampl. 0.1 UI, Freq. 1.000000 Hz. The RX settings are: Range 1.6 UI, Filter HP1+LP, LP 100 kHz, HP 20 Hz.

	Current Values	Max. Values
Jitter peak-peak	0.001 UI <sub>pp</sub>	0.002 UI <sub>pp</sub>
Jitter +peak	0.000 UI <sub>p</sub>	0.001 UI <sub>p</sub>
Jitter -peak	0.001 UI <sub>p</sub>	0.001 UI <sub>p</sub>
Jitter RMS	0.000 UI	

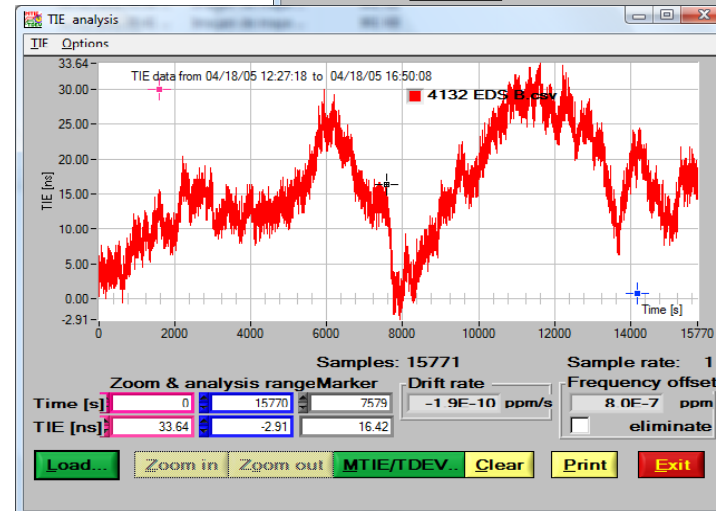
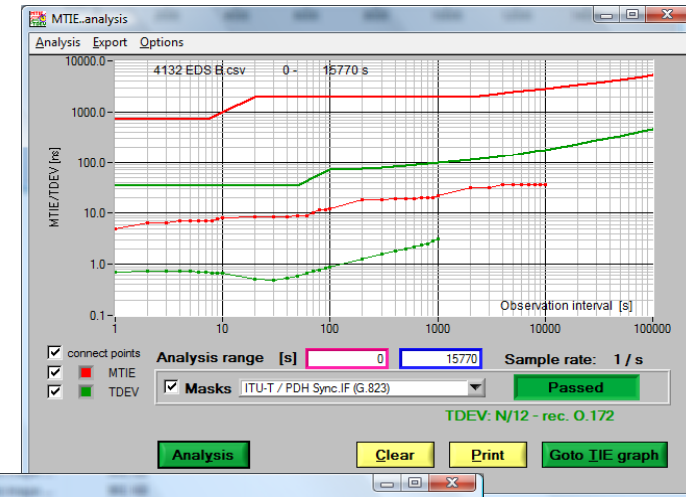
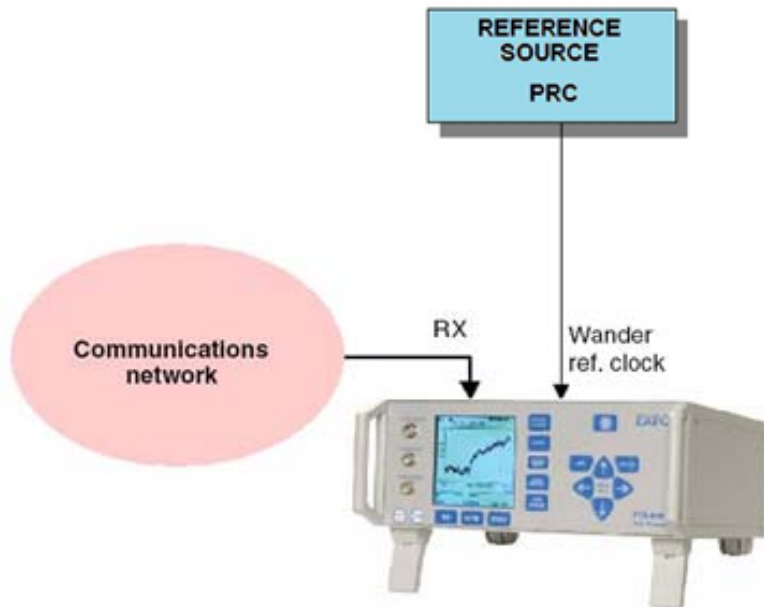
# Ruido de Fase (Wander)



# Ruido de Fase (Wander)

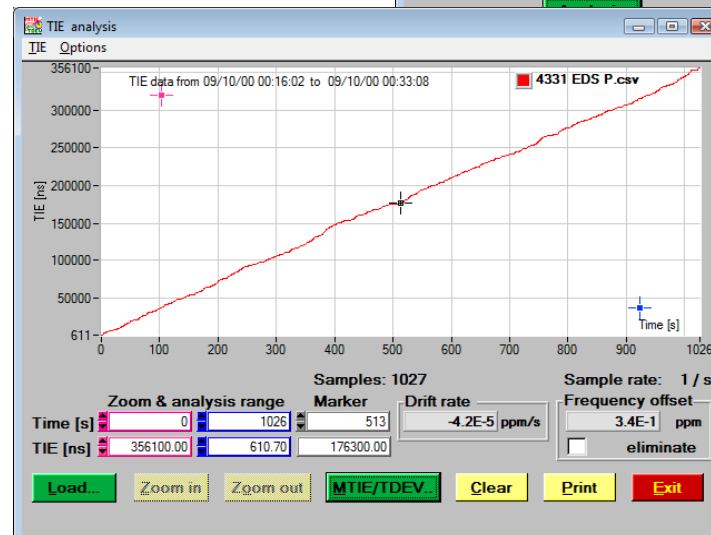
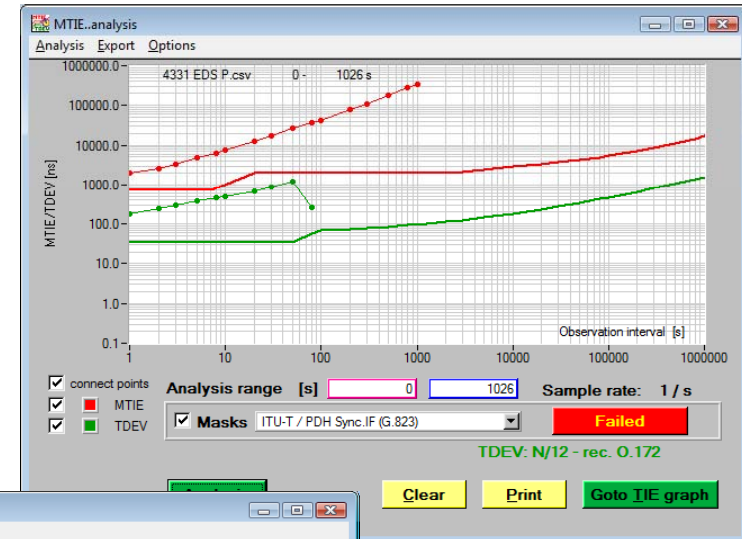
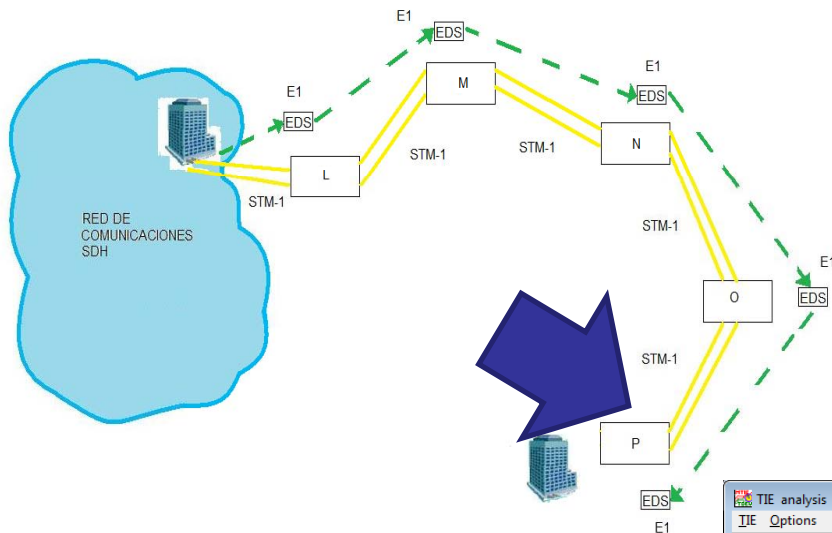


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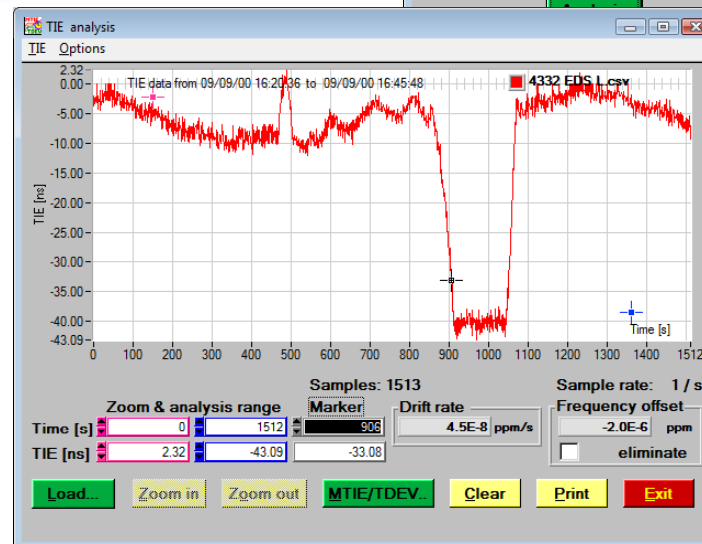
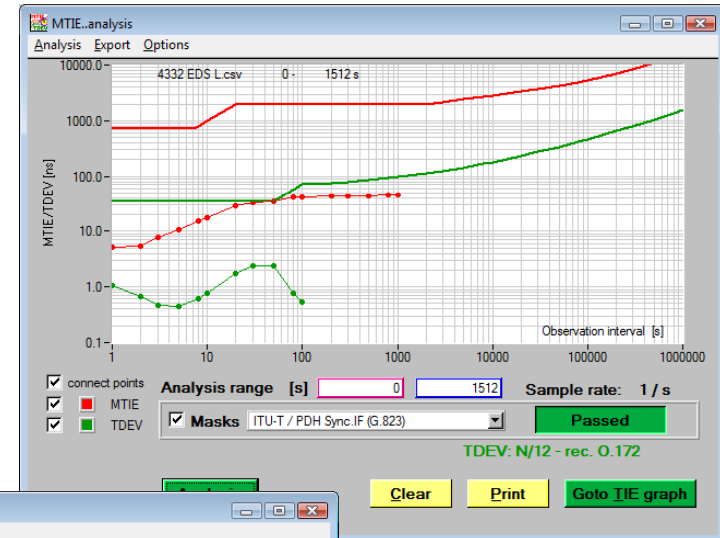
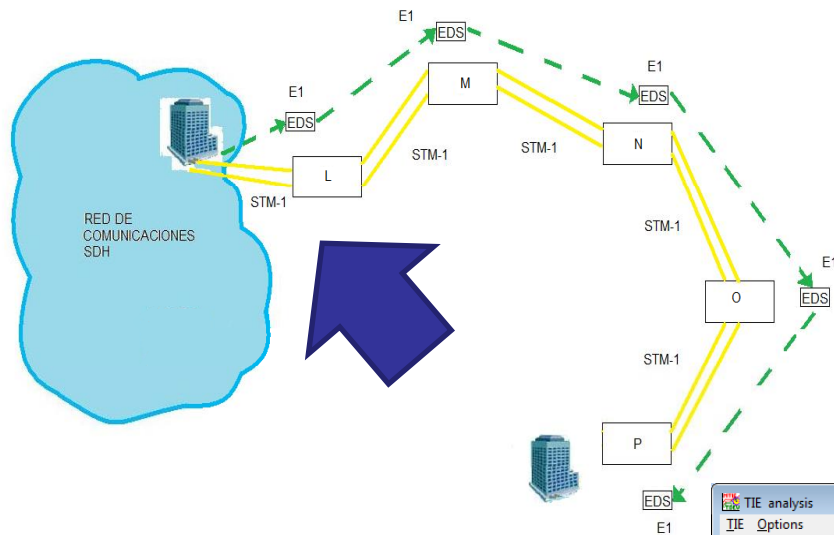




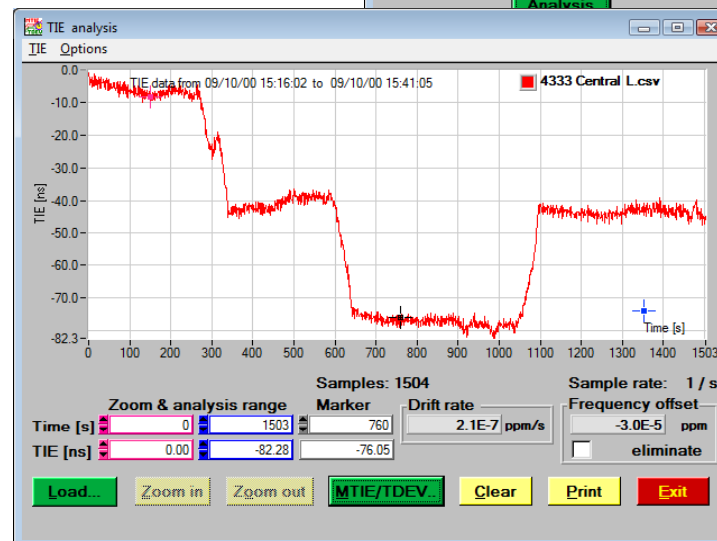
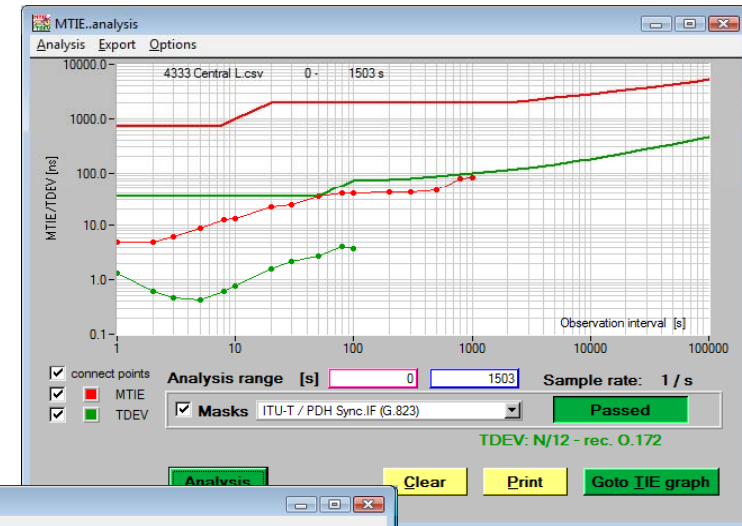
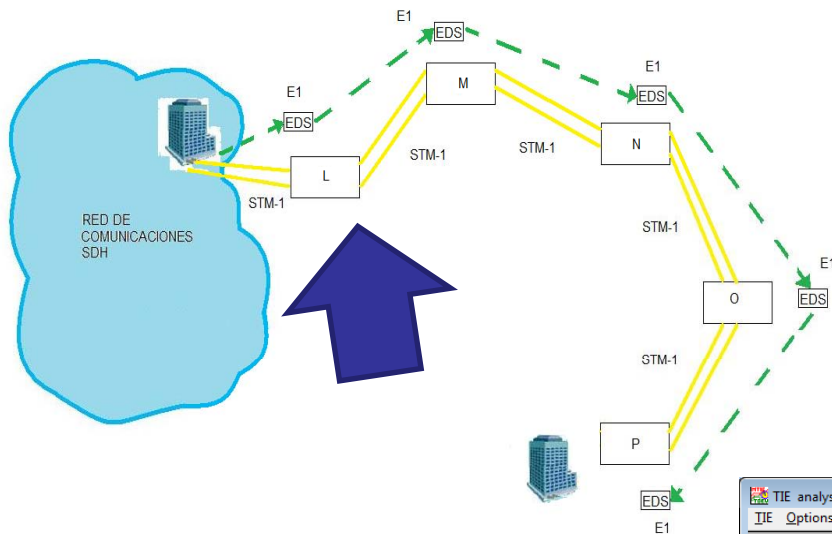
# Mediciones en Redes



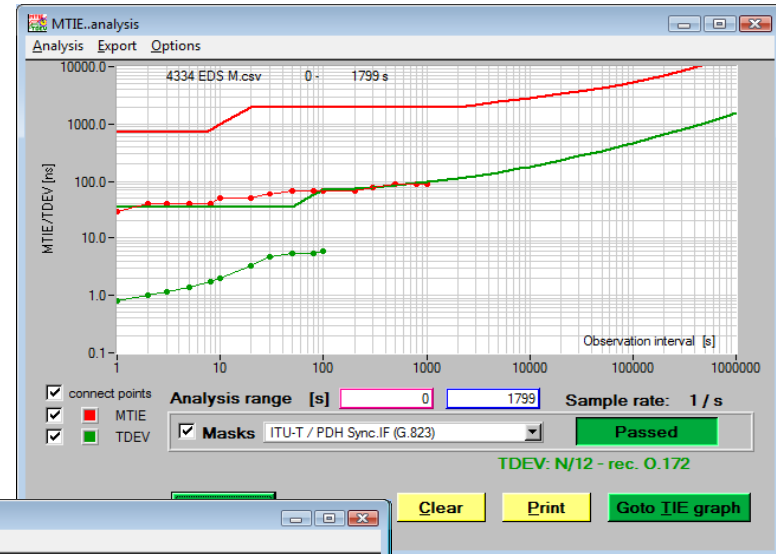
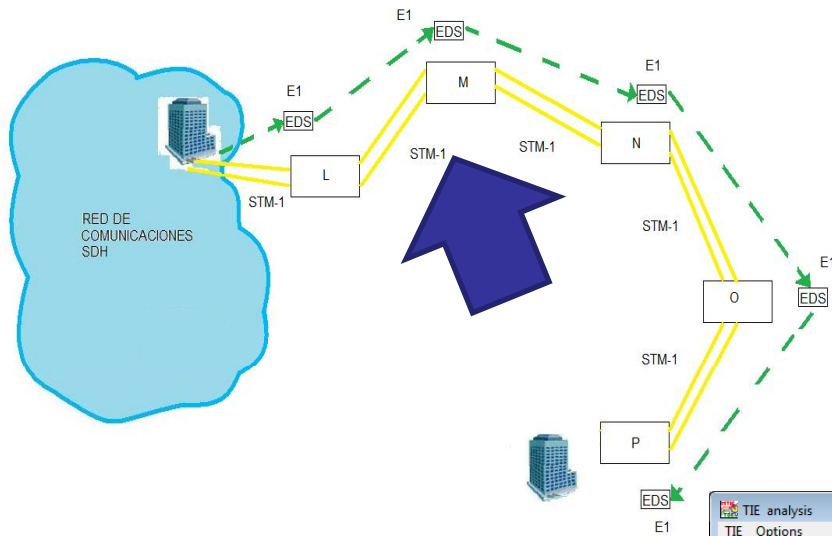
# Mediciones en Redes



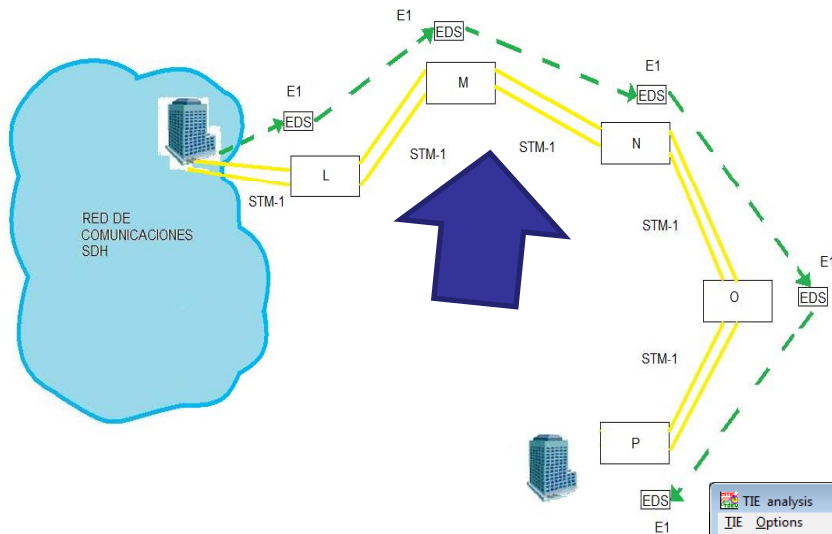
# Mediciones en Redes



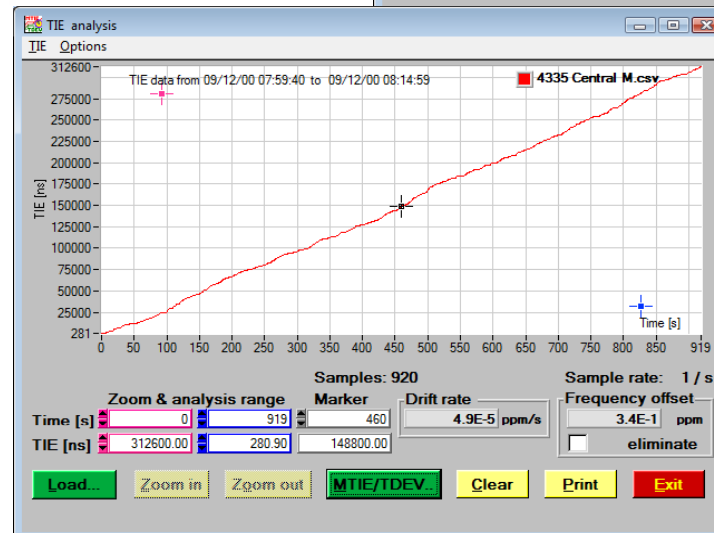
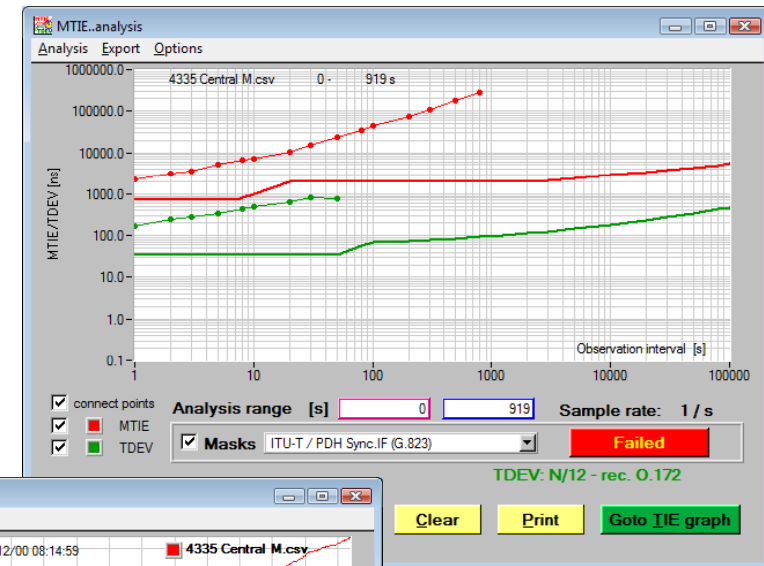
# Mediciones en Redes



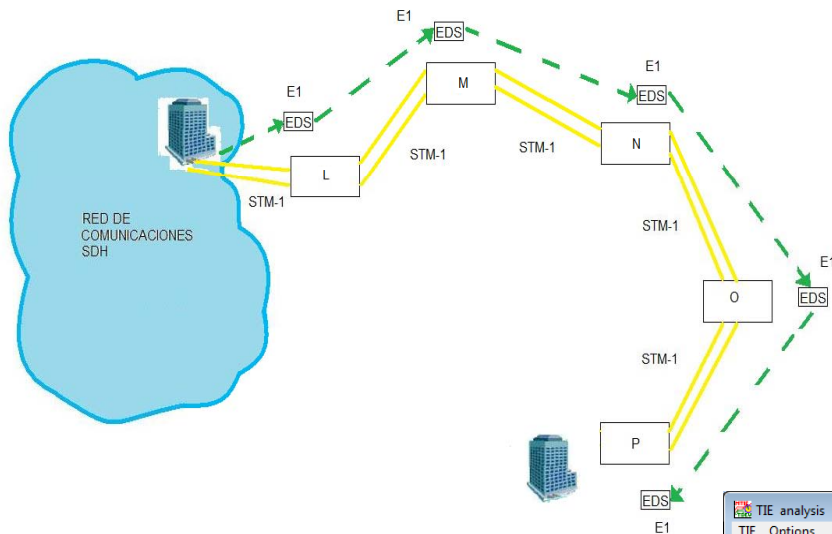
# Mediciones en Redes



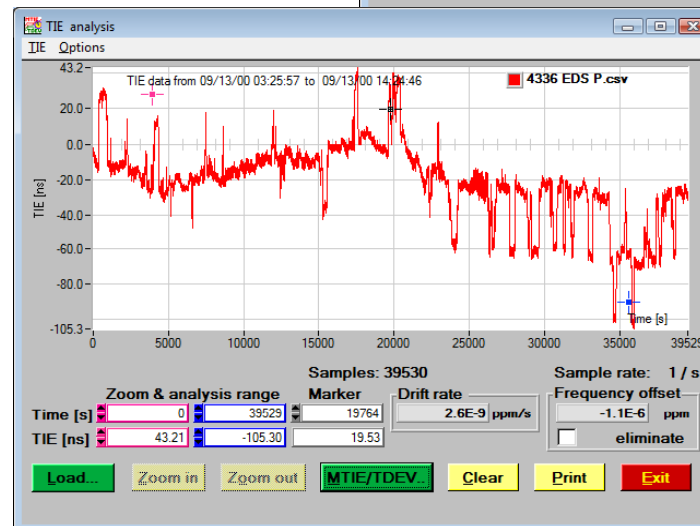
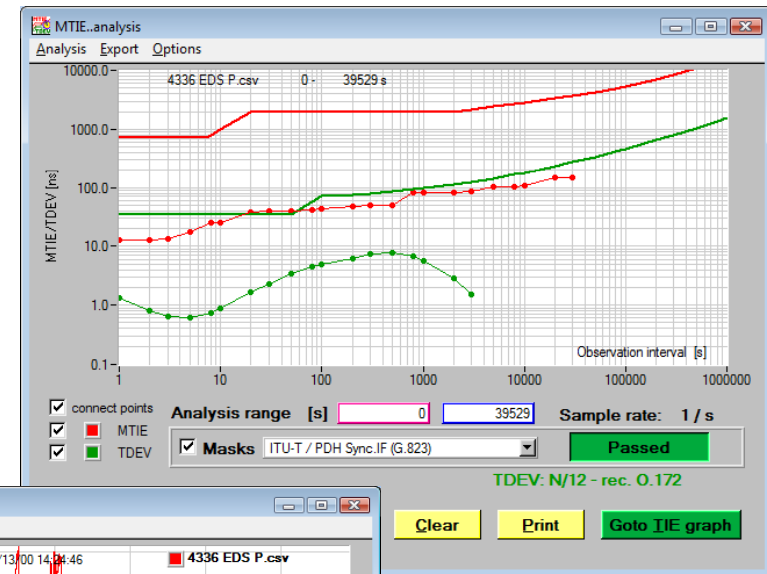
Configuración de Reloj  
Equipo SDH en Nodo M  
en Modo Local



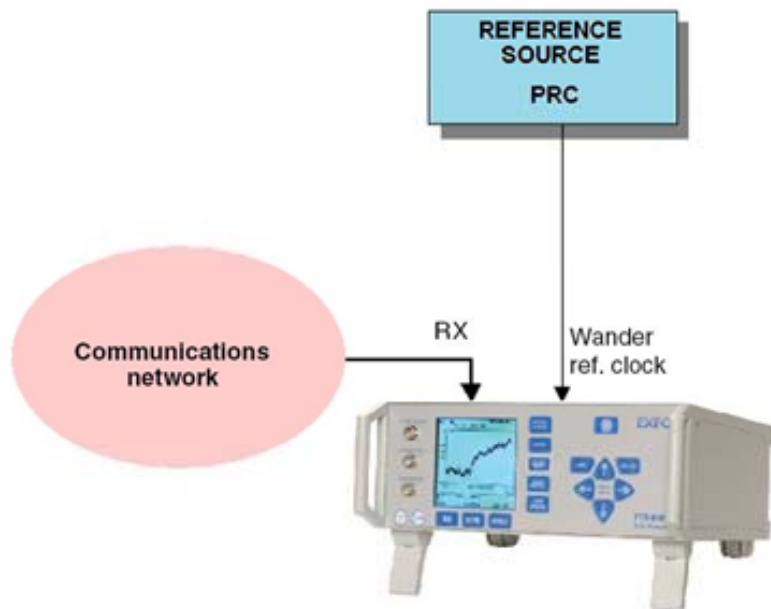
# Mediciones en Redes



Configuración de Reloj  
Equipo SDH en Nodo M  
en Modo Rx



# Necesidades de Redes



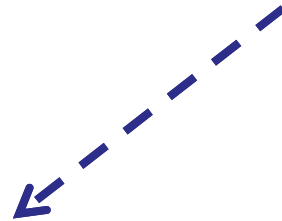
Evaluación Estabilidades  
- Relojes Primarios (Cesios, GPS)

Evaluación Estabilidades  
- Relojes Secundarios (Rubidio)

Evaluación Equipo de Medición  
- Analizadores de Comunicaciones



# GPS Vista Común



## GPS – Reloj Patrón

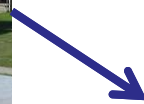
[Main Plot and Statistics](#)   [Next Date](#)   [Last Date](#)

Mean Time Offset (ns)	Range (ns)	Frequency Offset	Confidence (t)	ADEV at 1 day	TDEV at 1 day
32.33	29.48	$+5.78 \times 10^{-15}$	+0.90	$2.69 \times 10^{-14}$	1.34 ns

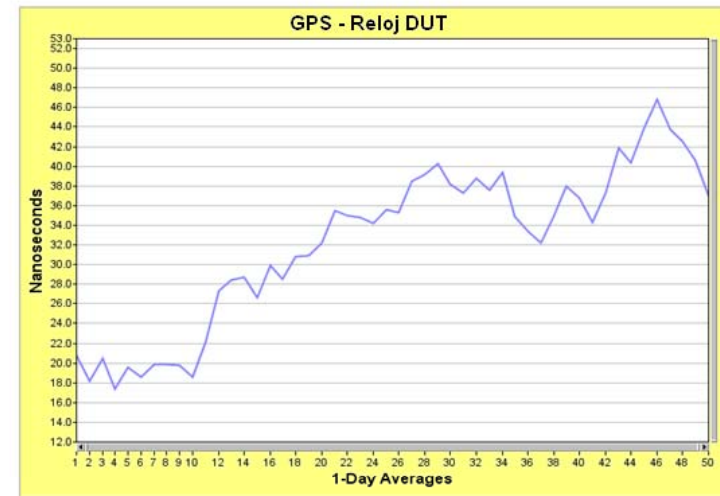
Antena GPS



GPS-RT-R

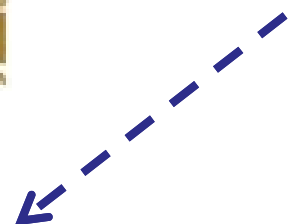


Reloj Patrón





# GPS Vista Común



Antena GPS



GPS-RT-R

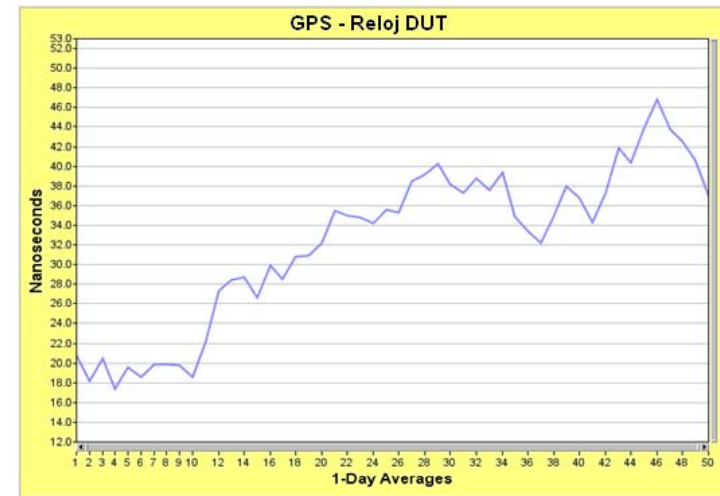


UTC (CNM)

## GPS – UTC (CNM)

[Main Plot and Statistics](#)   [Next Date](#)   [Last Date](#)

Mean Time Offset (ns)	Range (ns)	Frequency Offset	Confidence (t)	ADEV at 1 day	TDEV at 1 day
32.33	29.48	$+5.78 \times 10^{-15}$	+0.90	$2.69 \times 10^{-14}$	1.34 ns



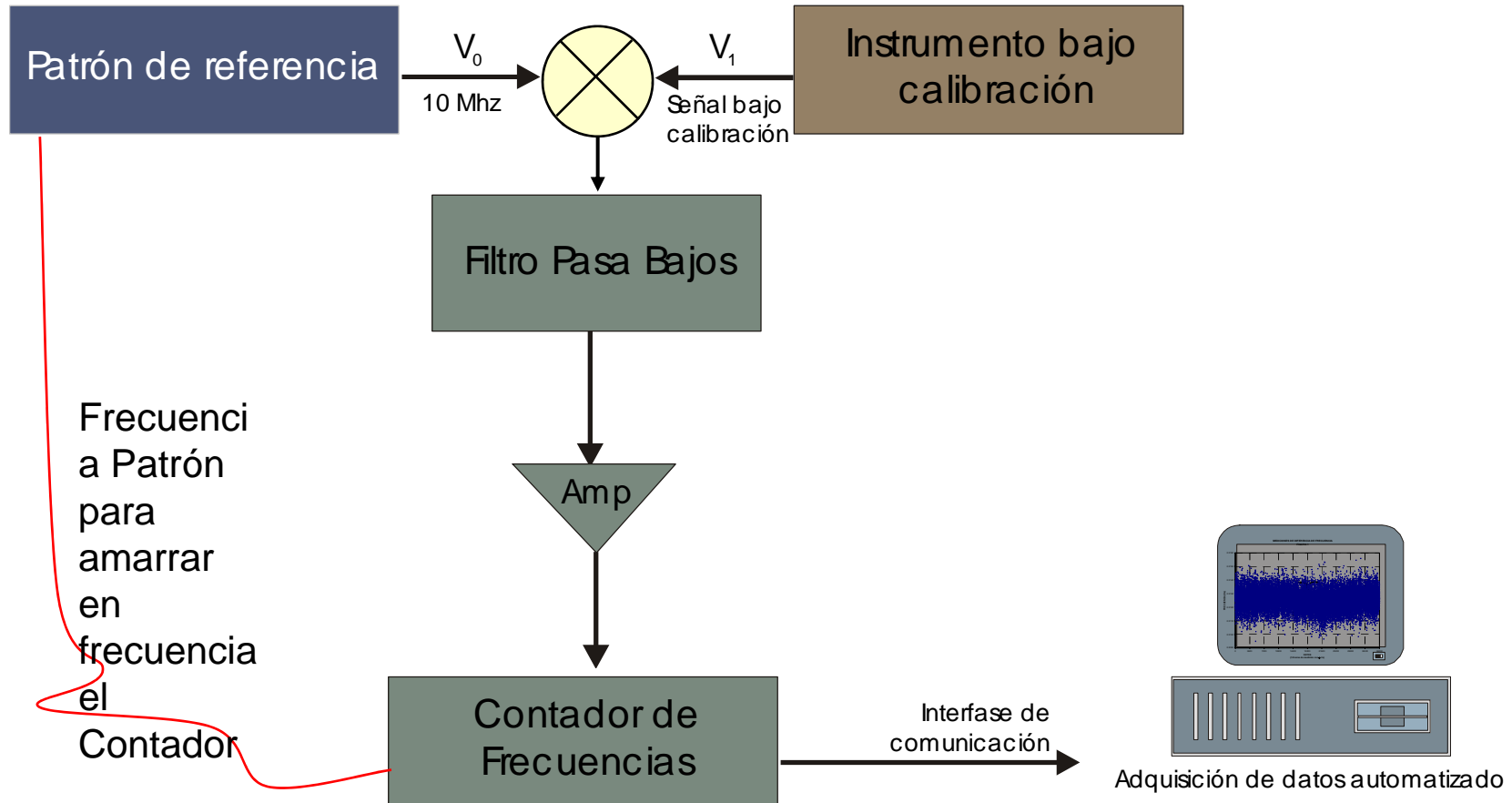
# GPS Vista Común



(GPS – Reloj Patrón) – (GPS – UTC (CNM))

= UTC (CNM) – Reloj Patrón

# Método de Medición Diferencia de Frecuencias con Mezclador



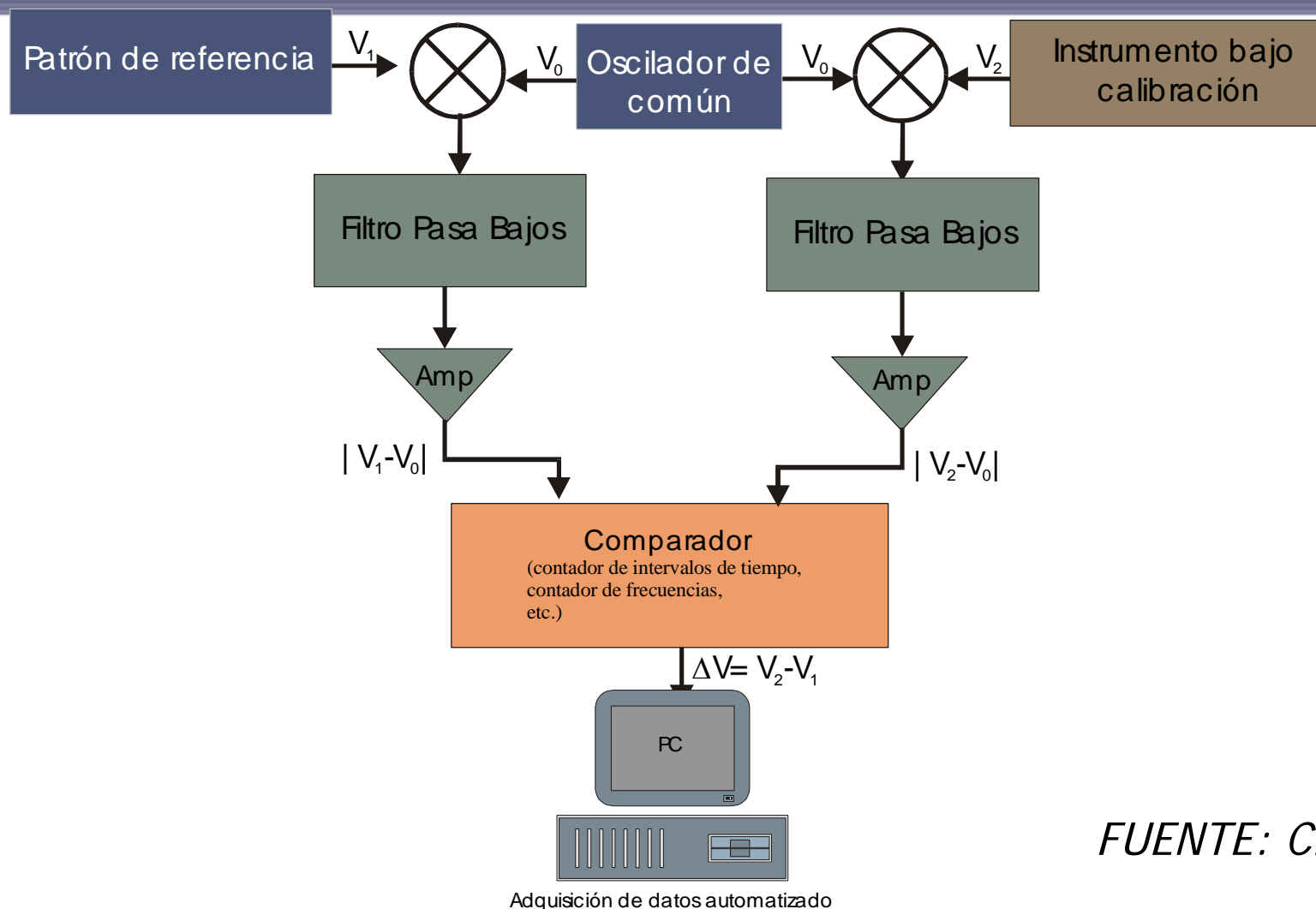
$$V(t) = \frac{A_1 A_2}{2} \cos(\phi_1 - \phi_2)$$

FUENTE: CENAM

# Método de Medición Diferencia de Frecuencias con Mezclador Dual



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FUENTE: CENAM

# Gracias por su atención



## ALMA Laboratorios S.A. de C.V.

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[www.almalaboratorios.com](http://www.almalaboratorios.com)



  
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