



ALMA LABS



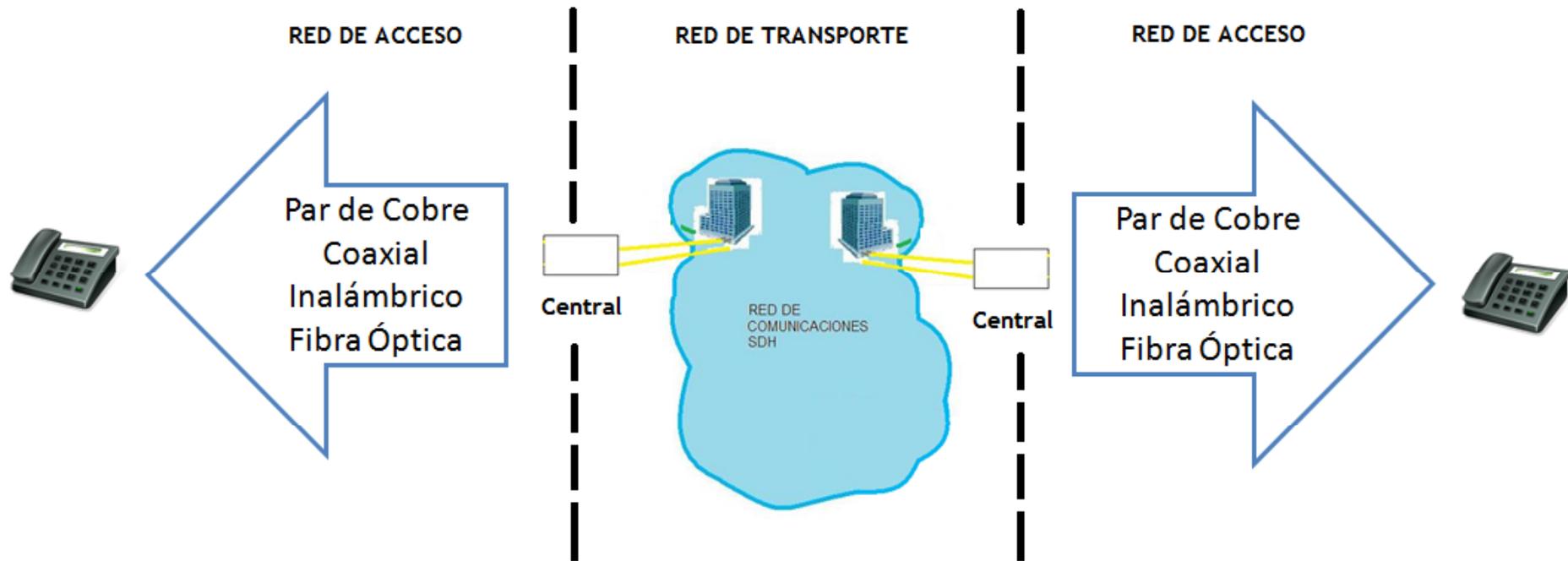
**Encuentro Nacional de
Metrología Eléctrica 2009**
18-20 de noviembre

Establecimiento de un Laboratorio de Calibración en Tiempo y Frecuencia

Ing. Alvaro Marroquín



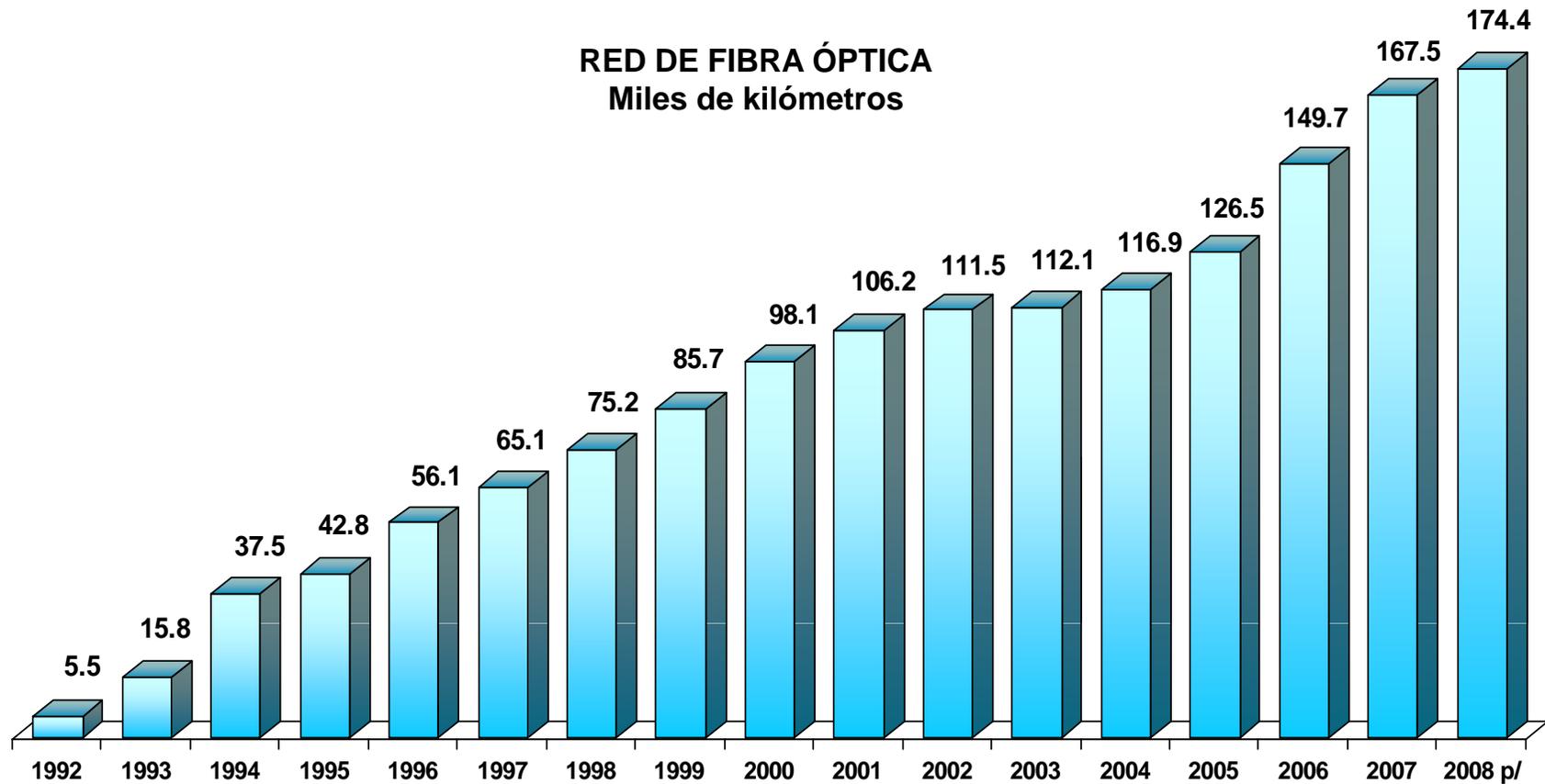
Redes de Comunicaciones



1993
2003

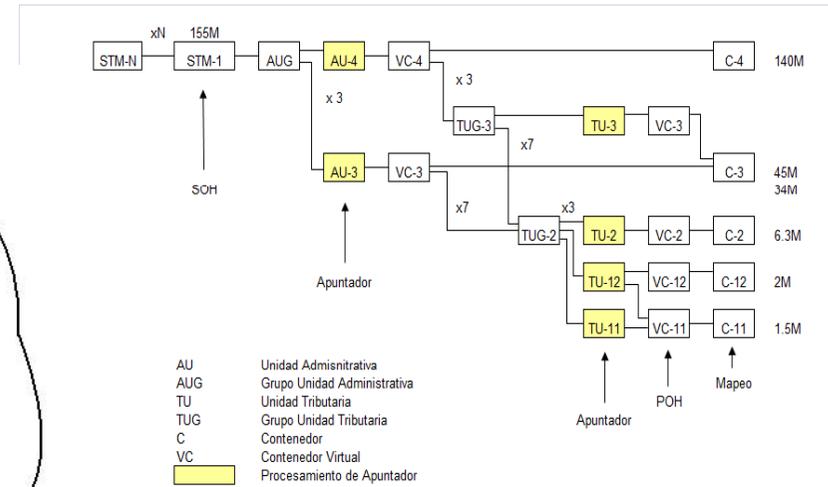
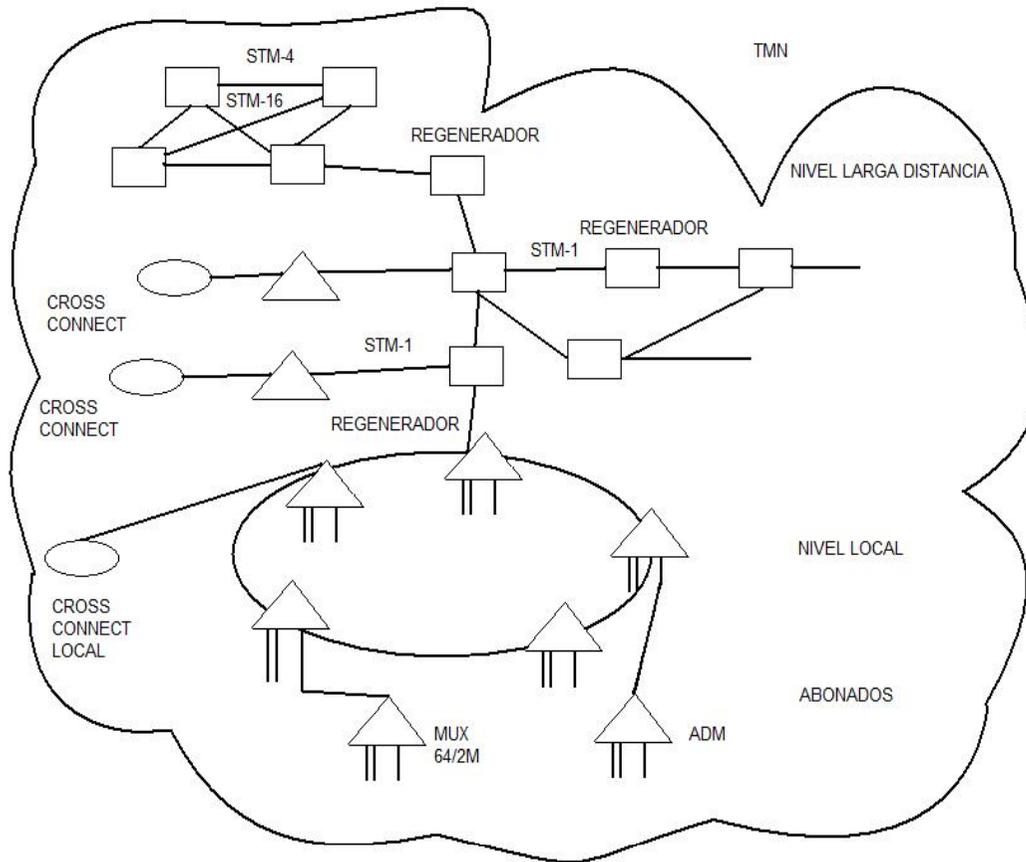
4.2 millones de llamadas
2,143.0 millones de llamadas

Redes de Comunicaciones



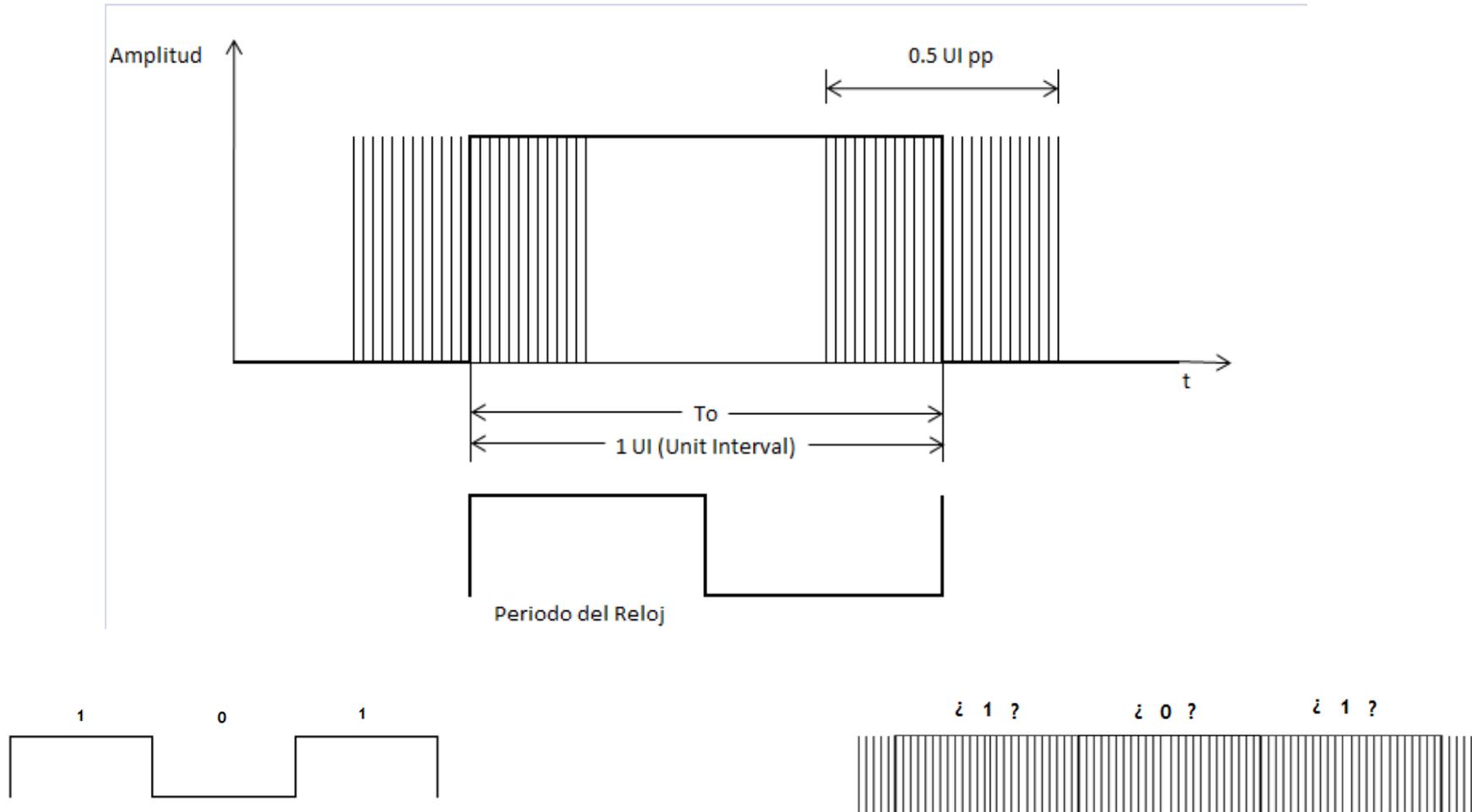
FUENTE: COFETEL

Redes de Comunicaciones

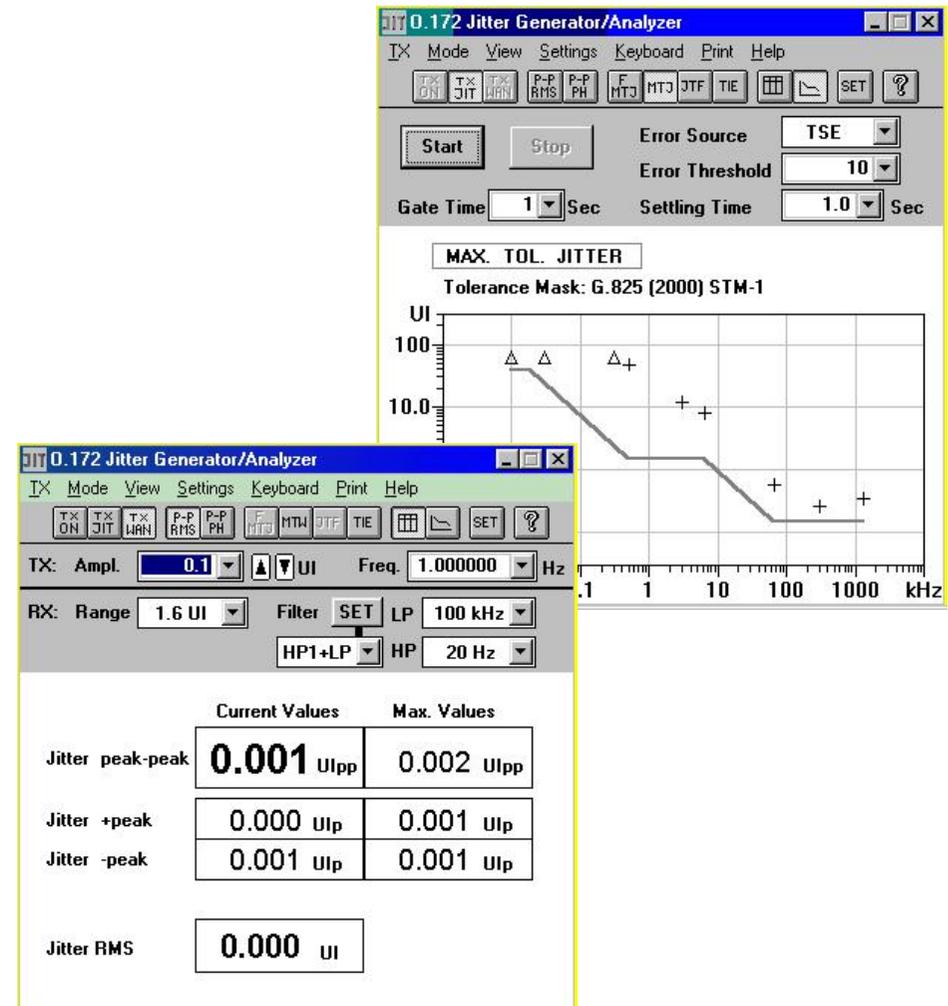
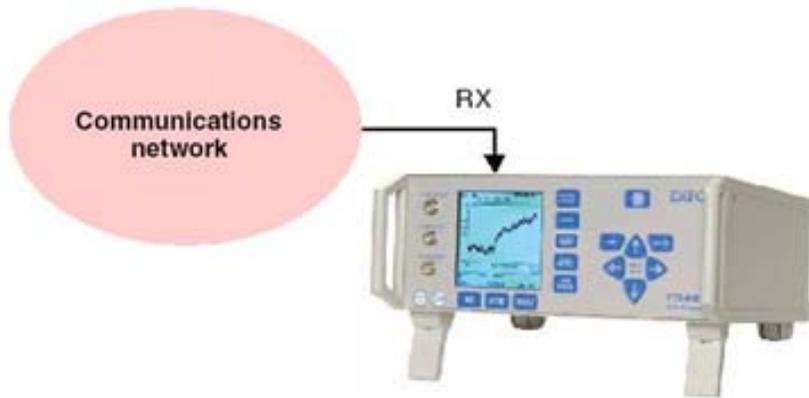


SDH	40Gbit/s	STM-256
	10Gbit/s	STM-64
	2488Mbit/s	STM-16
	622Mbit/s	STM-4
	155Mbit/s	STM-1
PDH	140Mbit/s	E4
	34Mbit/s	E3
	8Mbit/s	E2
	2Mbit/s	E1

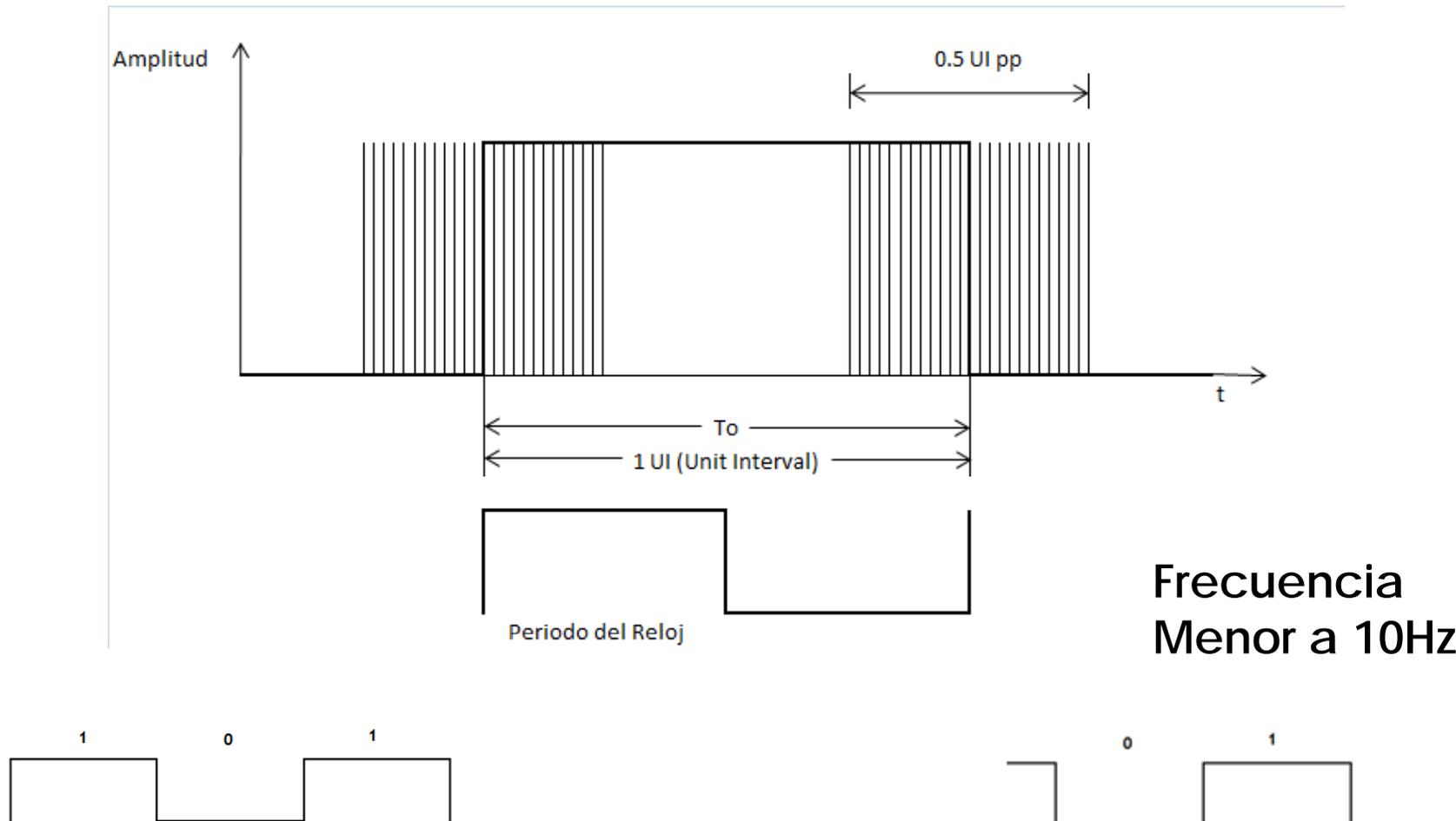
Ruido de Fase (Jitter)



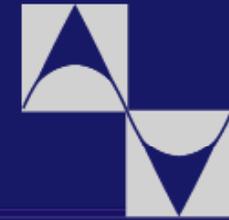
Ruido de Fase (Jitter)



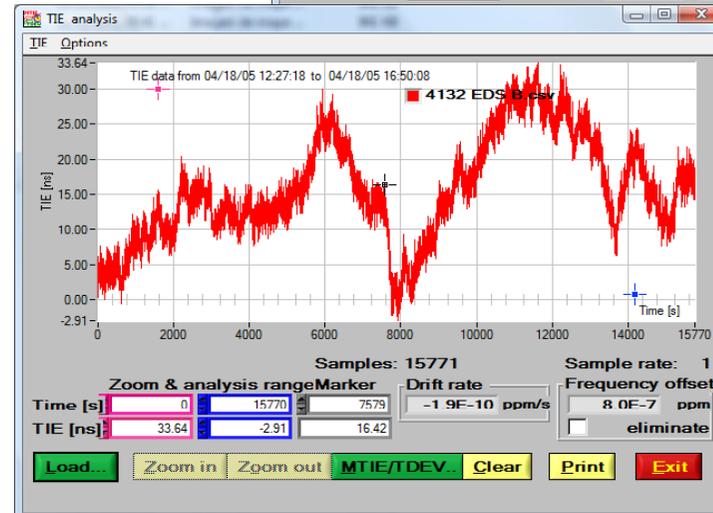
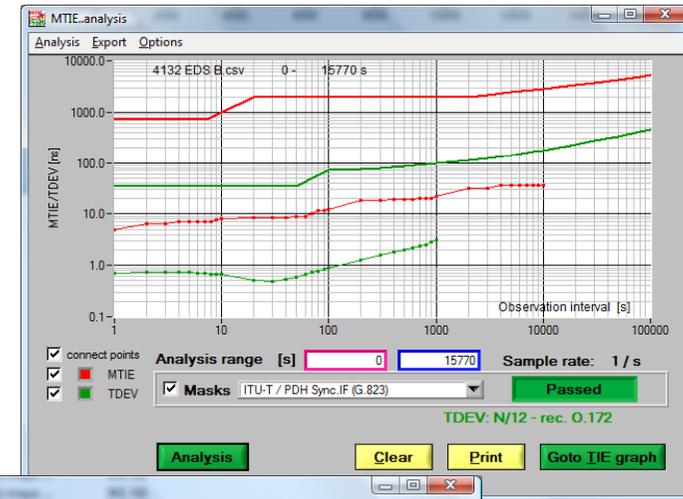
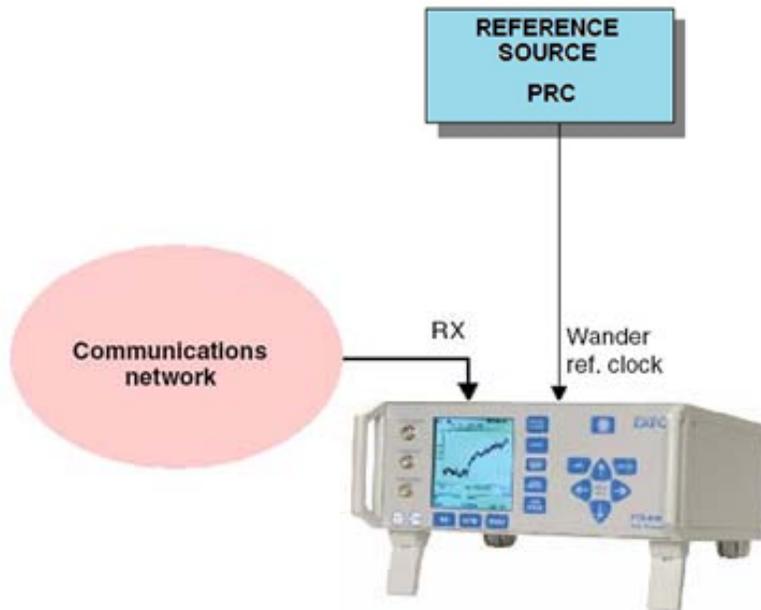
Ruido de Fase (Wander)



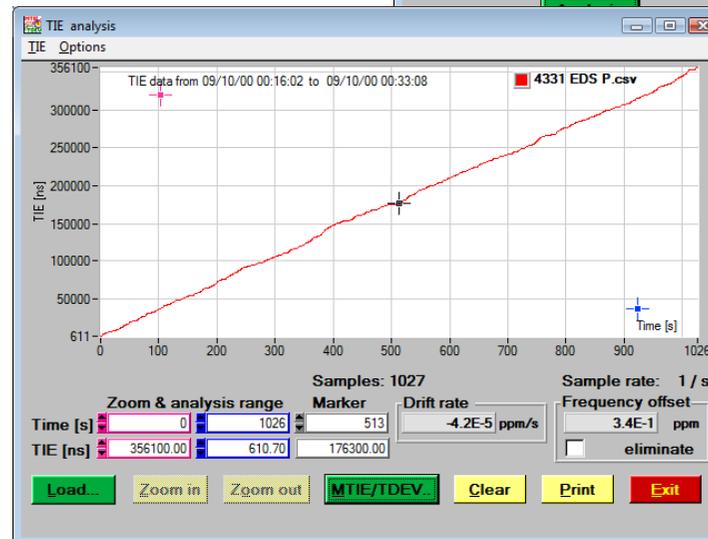
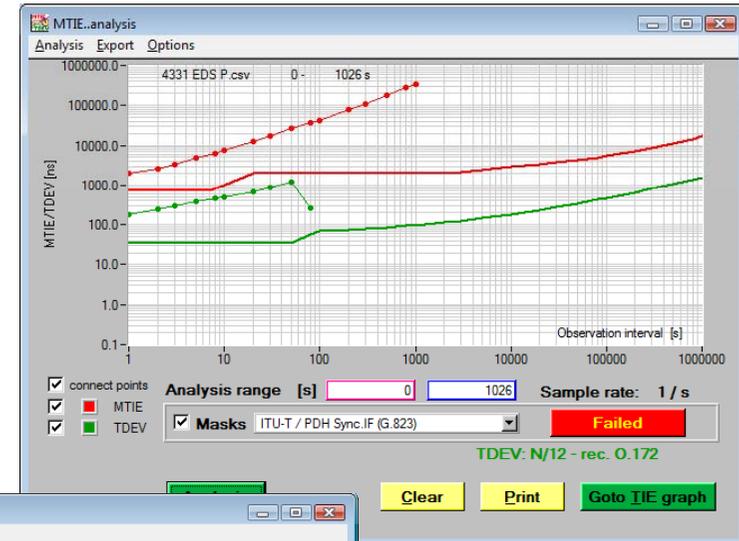
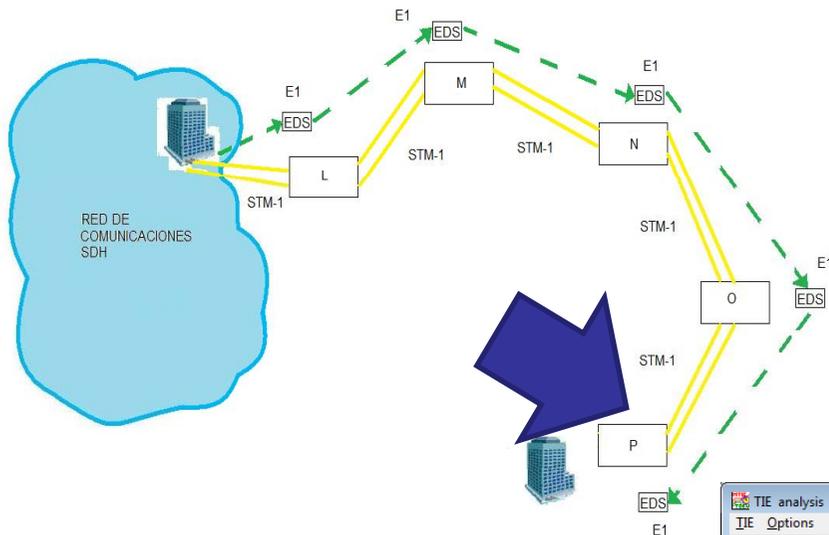
Ruido de Fase (Wander)



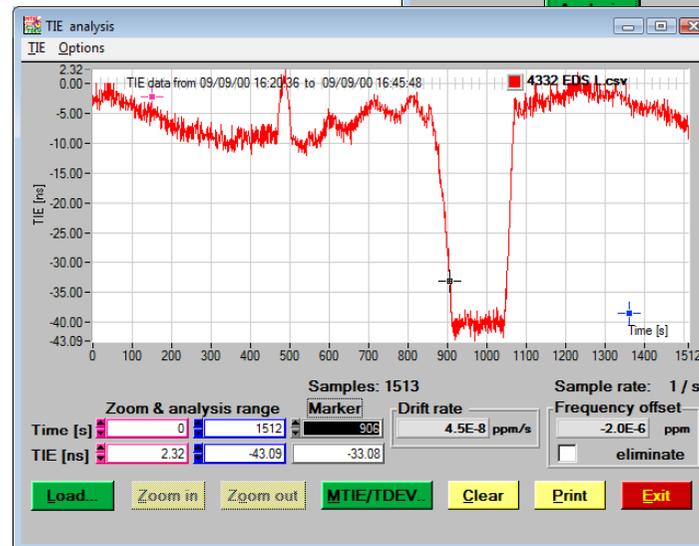
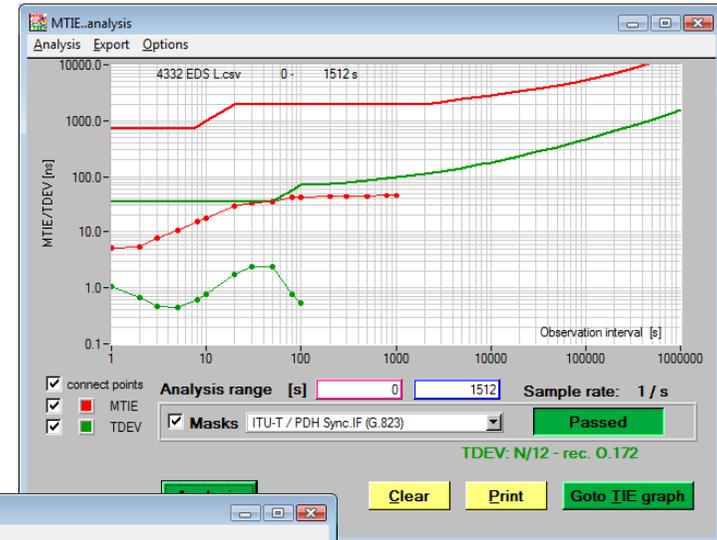
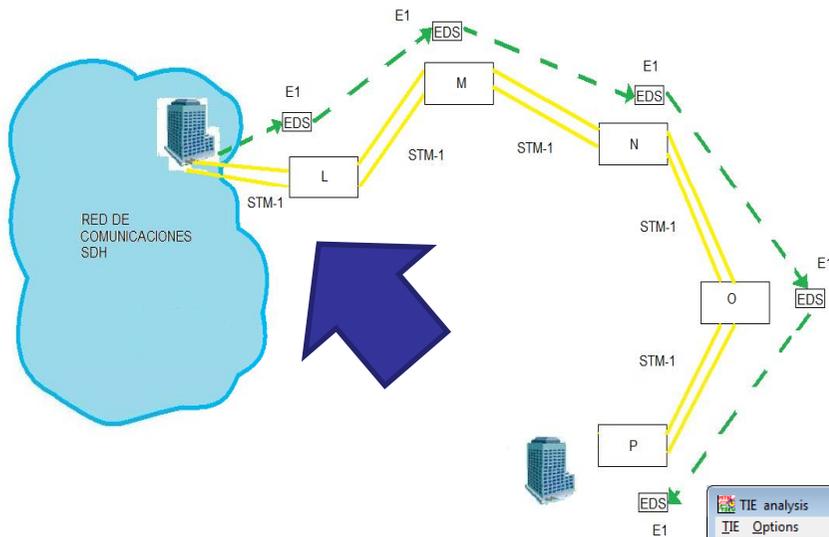
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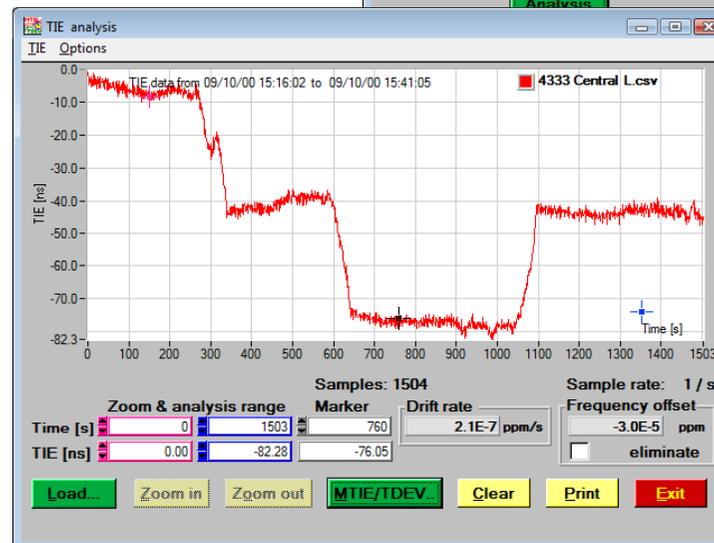
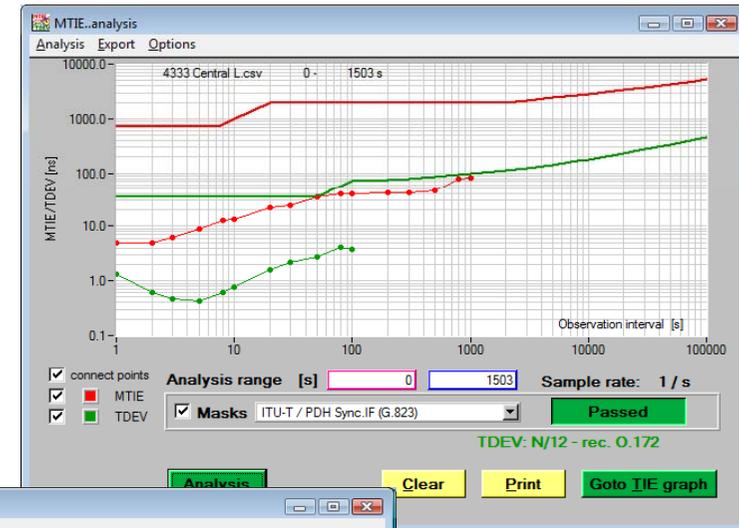
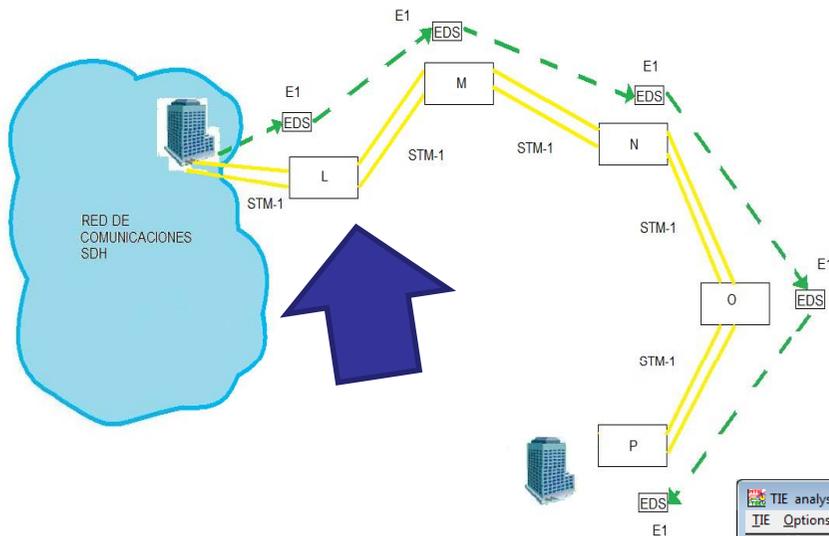
Mediciones en Redes



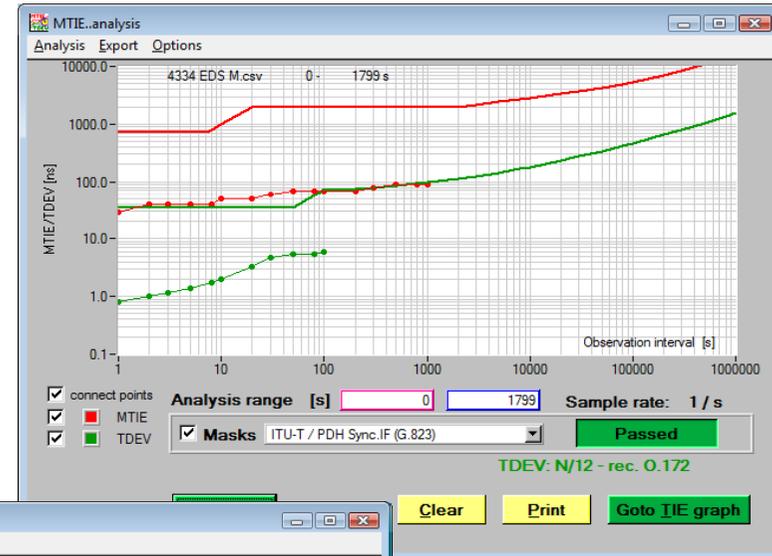
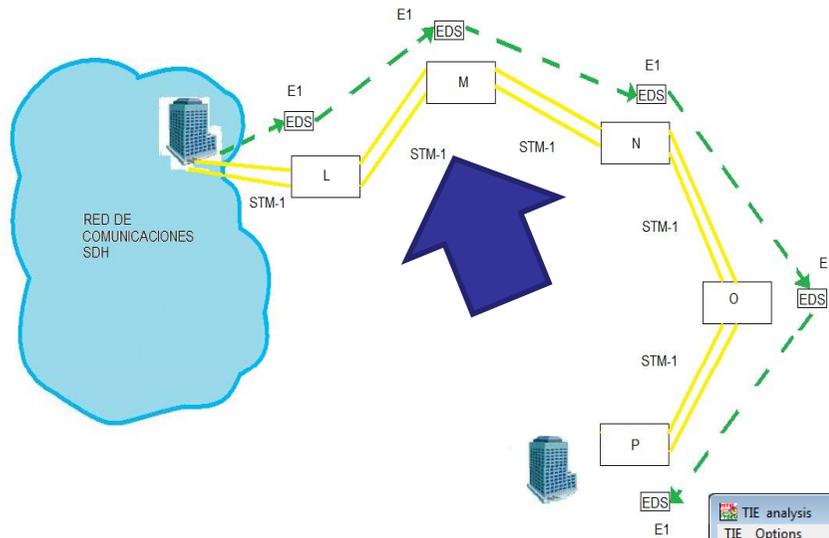
Mediciones en Redes



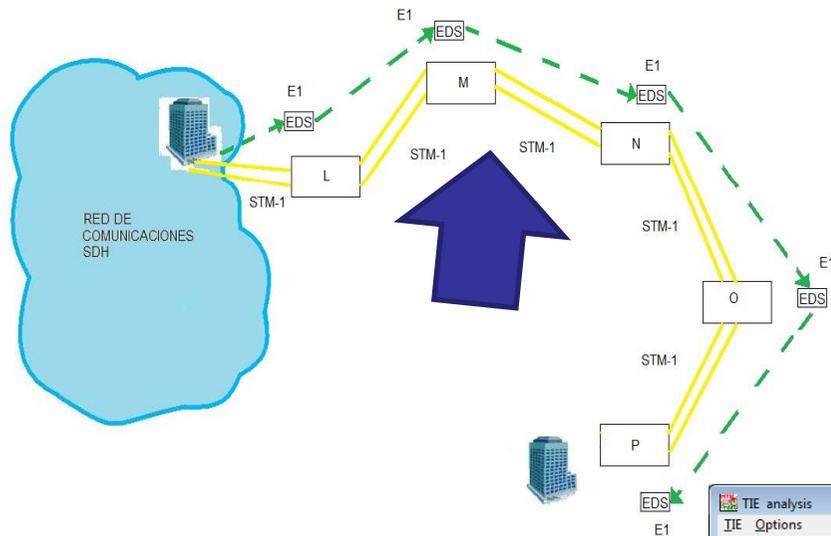
Mediciones en Redes



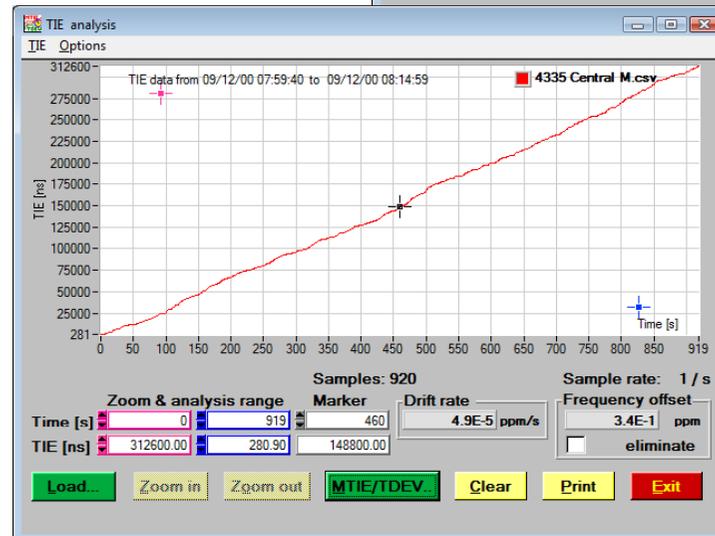
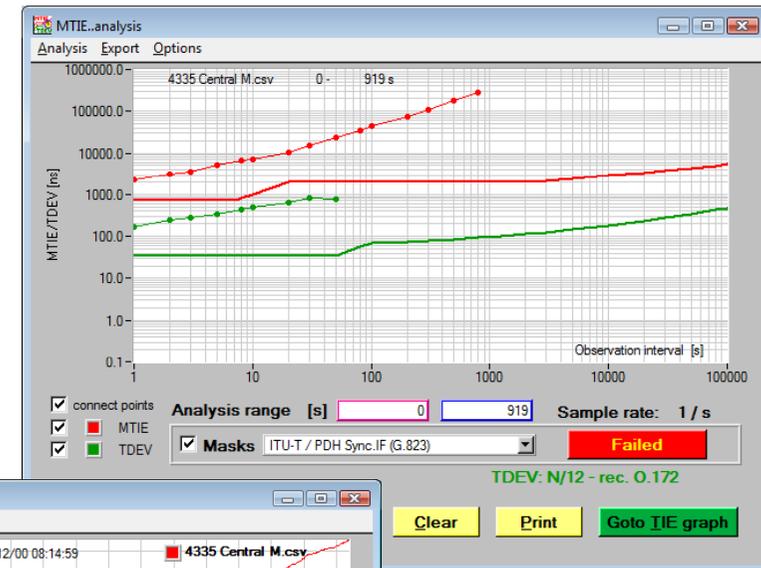
Mediciones en Redes



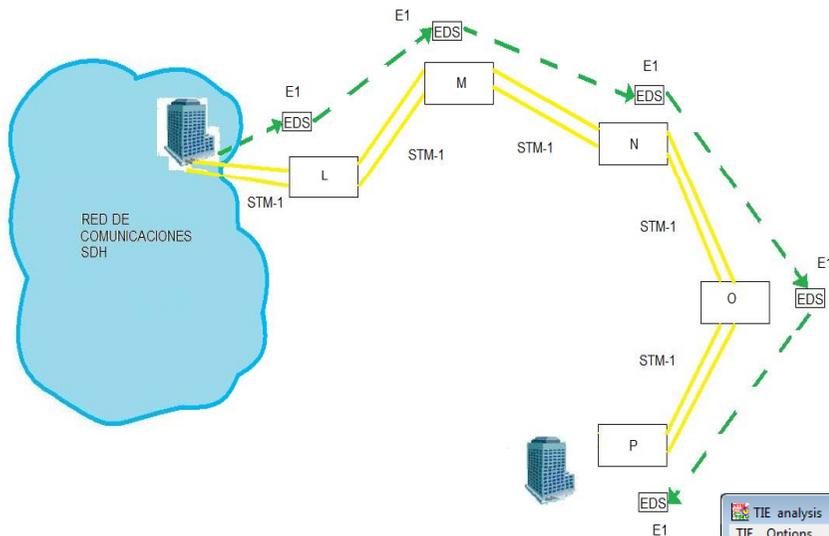
Mediciones en Redes



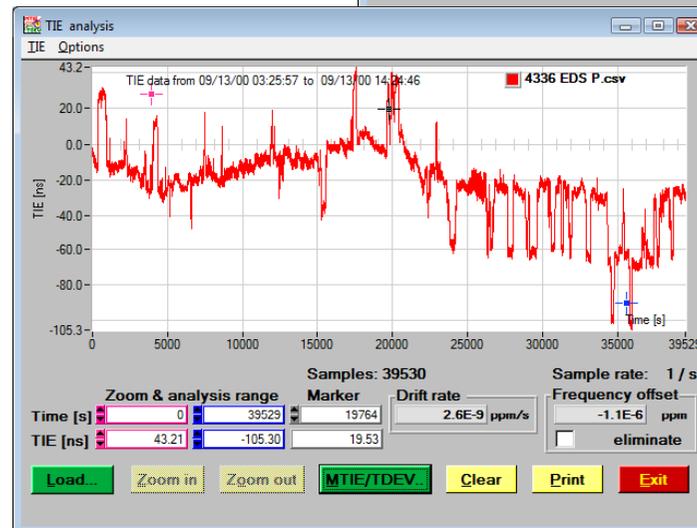
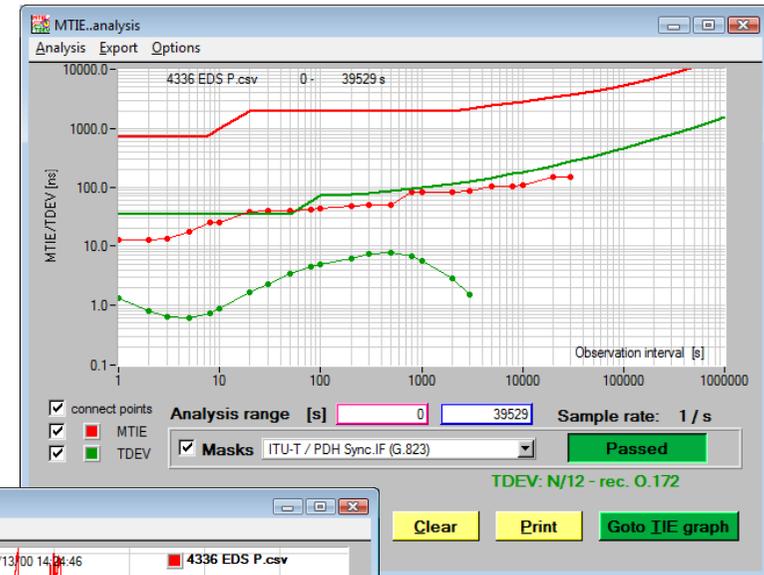
Configuración de Reloj
Equipo SDH en Nodo M
en Modo Local



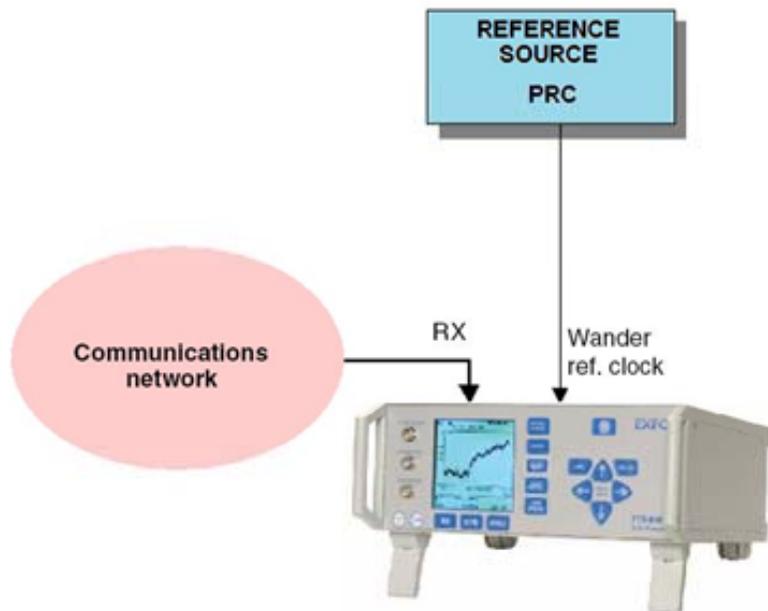
Mediciones en Redes



Configuración de Reloj
Equipo SDH en Nodo M
en Modo Rx



Necesidades de Redes

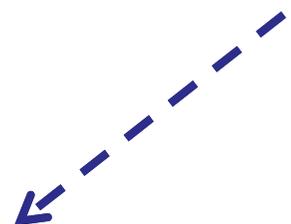


Evaluación Estabilidades
- Relojes Primarios (Cesios, GPS)

Evaluación Estabilidades
- Relojes Secundarios (Rubidio)

Evaluación Equipo de Medición
- Analizadores de Comunicaciones

GPS Vista Común



GPS – Reloj Patrón

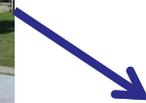
[Main Plot and Statistics](#) [Next Date](#) [Last Date](#)

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	2.69×10^{-14}	1.34 ns

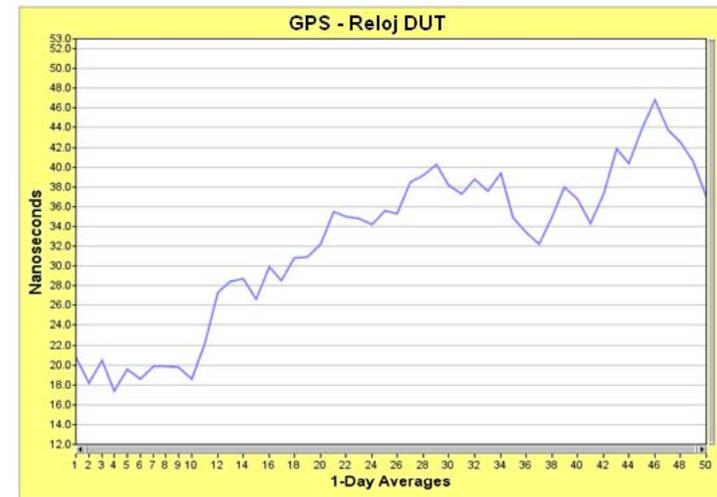
Antena GPS



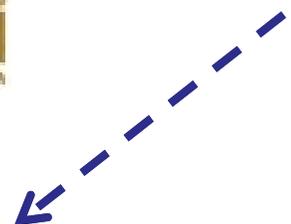
GPS-RT-R



Reloj Patrón



GPS Vista Común



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	2.69×10^{-14}	1.34 ns

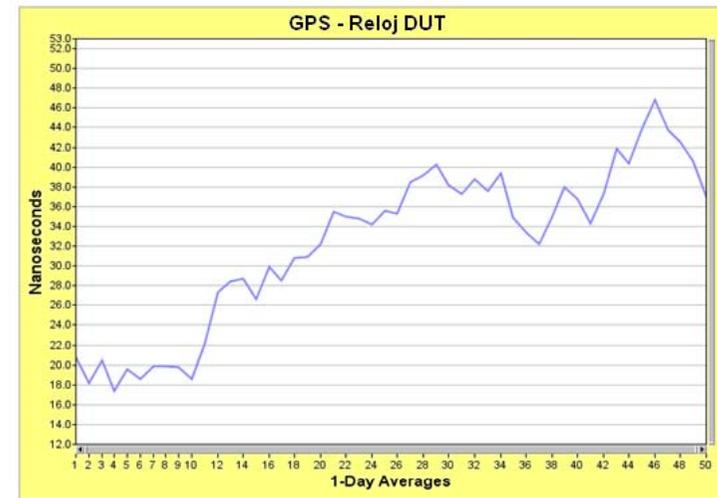
Antena GPS



GPS-RT-R



UTC (CNM)



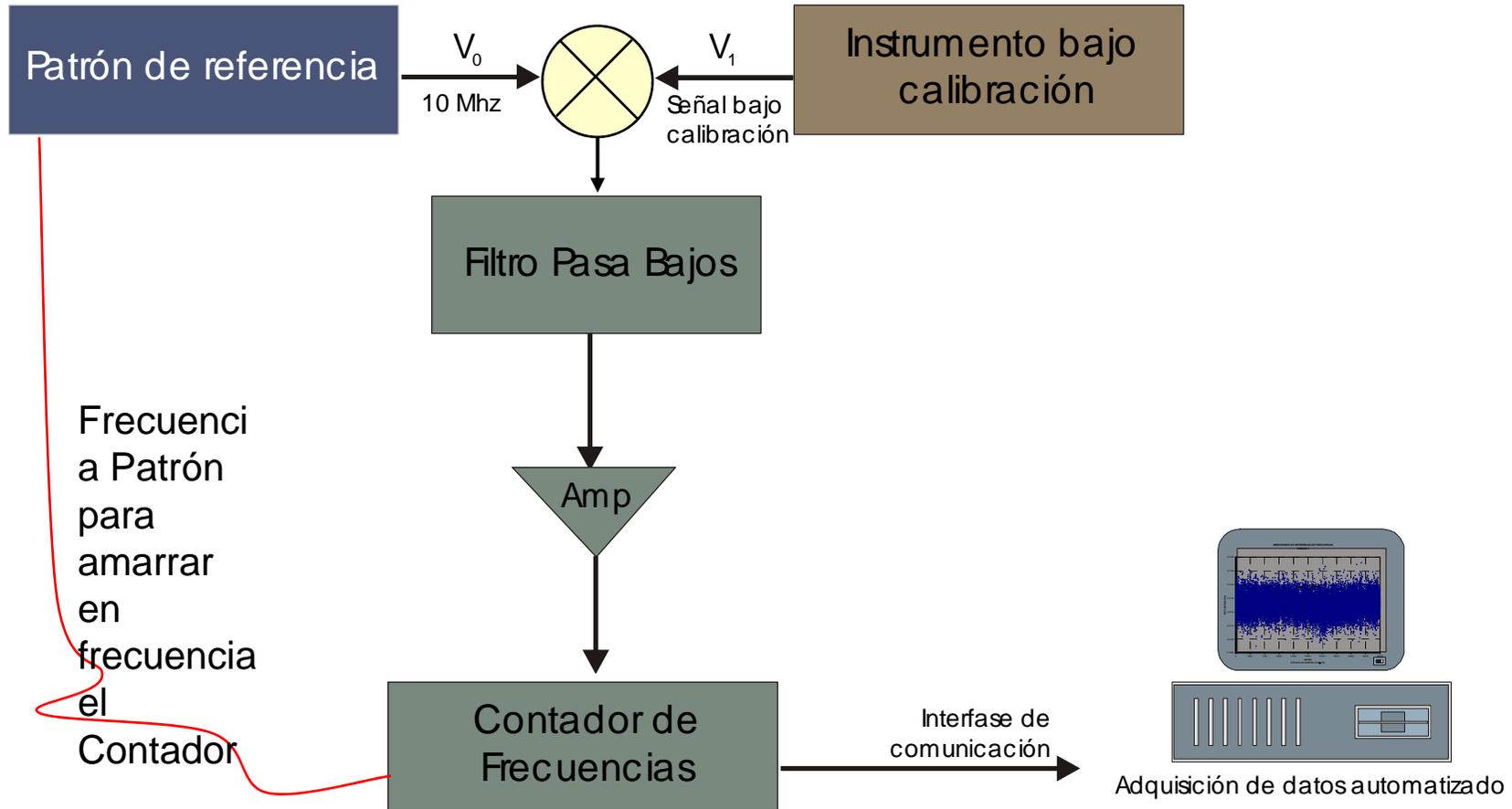
GPS Vista Común



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

= UTC (CNM) – Reloj Patrón

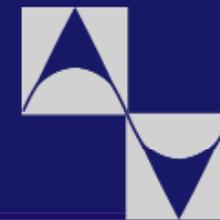
Método de Medición Diferencia de Frecuencias con Mezclador



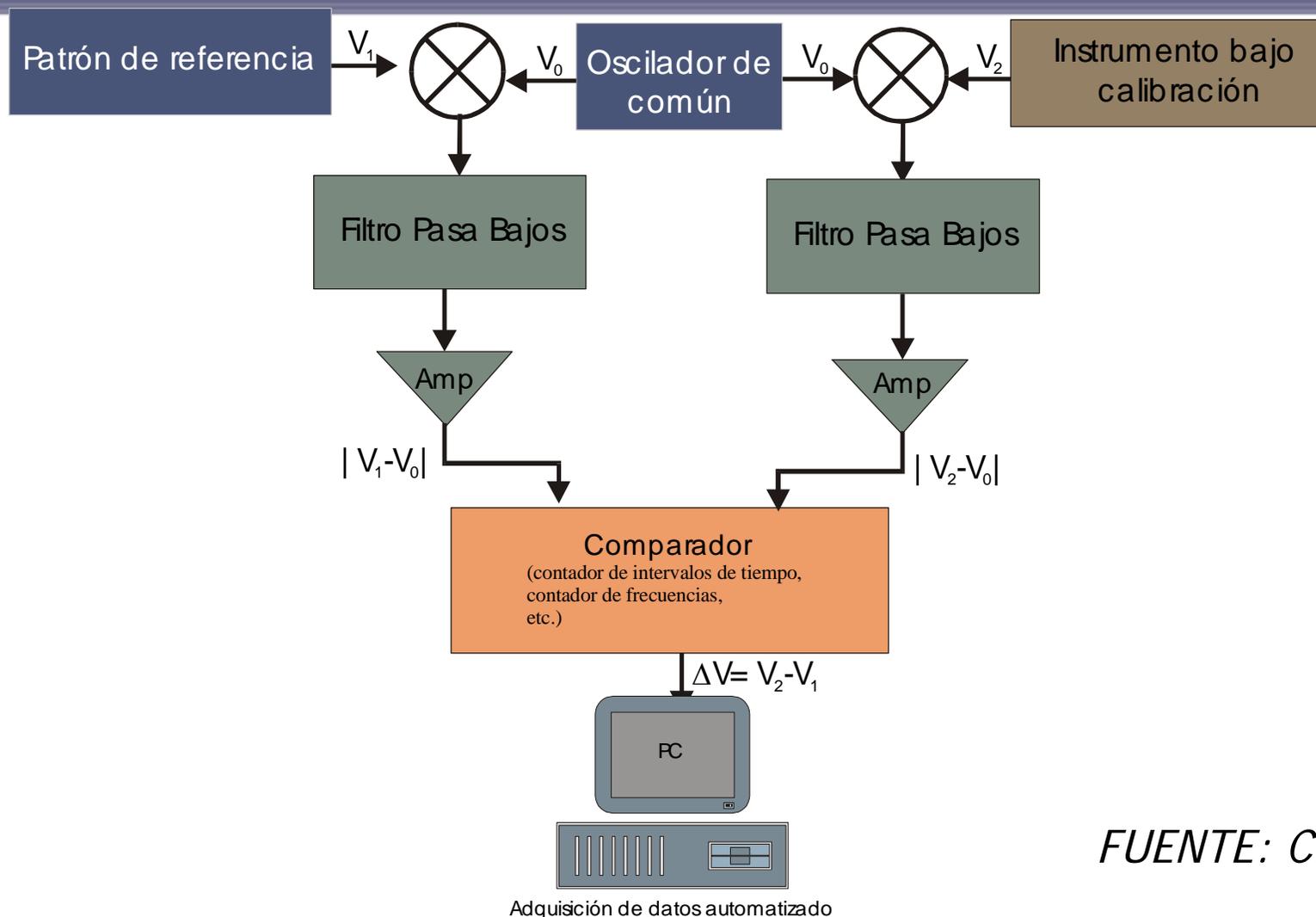
$$V(t) = \frac{A_1 A_2}{2} \cos(\phi_1 - \phi_2)$$

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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