

# PTP Mobile Backhauling Acceptance Test

ITFS 2008 Munich  
Atzwanger Joachim

## Slide 1

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AJ2

Hello!

My name is Atzwanger Joachim.

I work for telekom Austra in the business synchronisation since 10 years.

Telekom Austria is the key player on the wireline and wireless market.

I am responsibel for clock concepts, distribution,  
recovery, product selection, customer solutions and last not least clock quality.

Now we have to accept the challange to implemt

PTP in your network

Therefore 1 creat acceptance tests.

Atzwanger Joachim, 02/11/2008

## Overview

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1. Get to know your network
2. Transient response tests
3. Stability tests
4. Holdover tests
5. Performance tests G.8261
6. Robustness tests
7. Source change tests
8. SLA parameter

AJ3

Here you see a overview.  
I decided for this sequence of the different tests

The main issue of this test cases is how robust are the now availbale ptp Solutions

Missing test cases are:

Bandwith consumption  
PTP over VPLS, MPLS ?  
Useability  
Security,  
Grounding  
Surge, Electromagnetic compatibility  
NMS ....

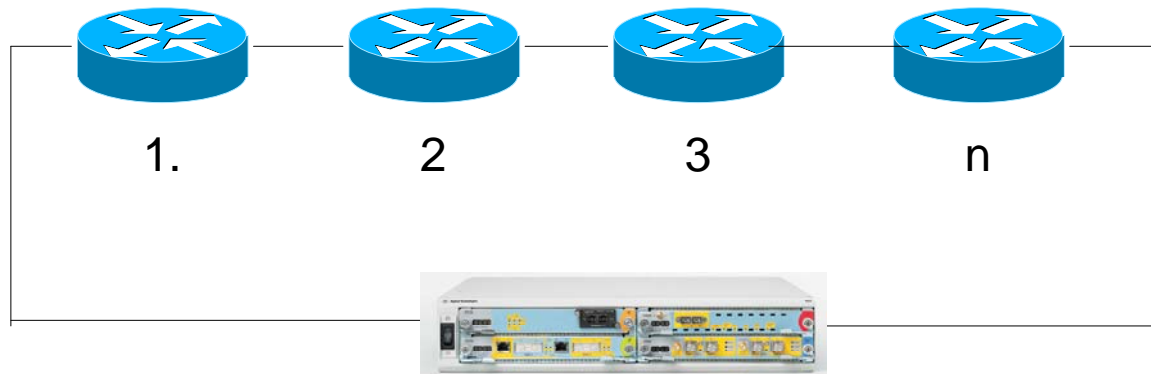
At the beginning we have no idea about PTP.  
First we decided to analyse our network.

Atzwanger Joachim, 02/11/2008

## Get to know your network

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- Measure Live Network with Packet Size 90 byte (IEEE1588)  
Indicator: Delay and Packet delay variation



- Measure Mobil backhauling Components with:  
Traffic load: G.8261 Model 1 Model 2 Case 1, 2, 3  
Indicator: Delay and Packet delay variation  
Pay attention to jumbo frames!

## Slide 3

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AJ4

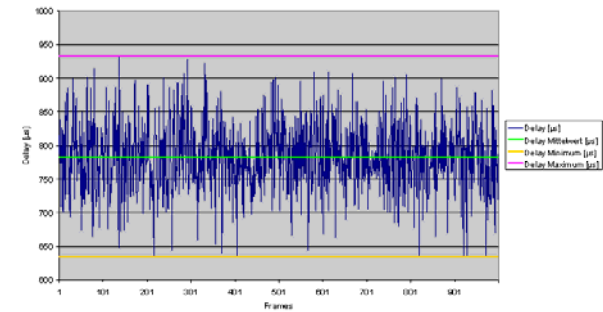
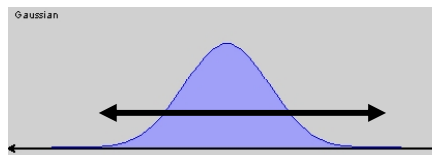
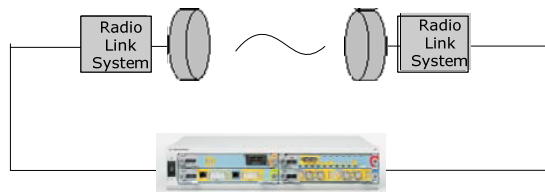
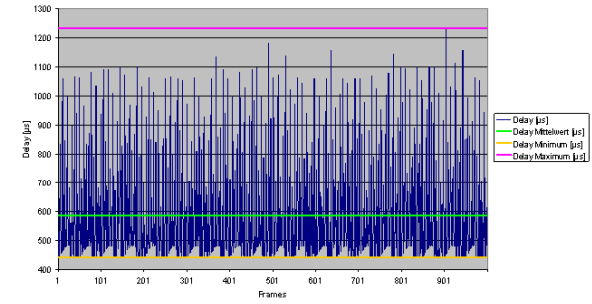
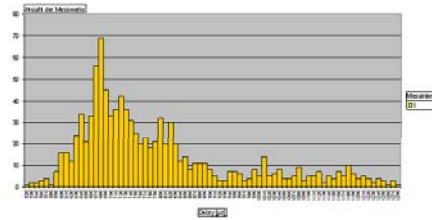
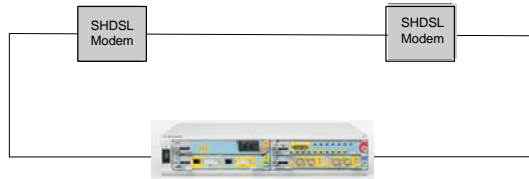
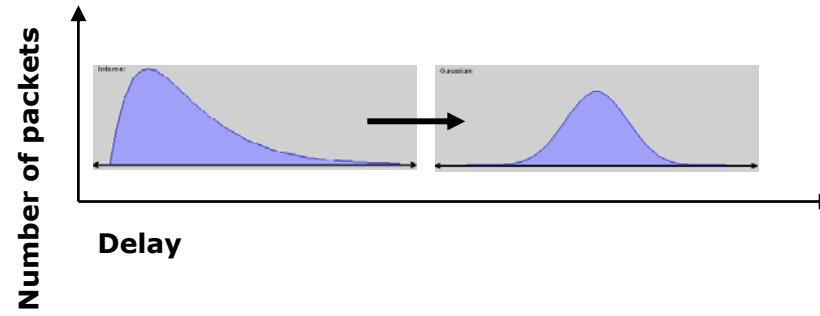
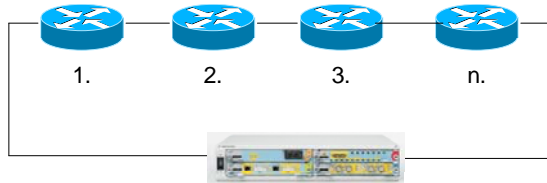
Measurement period; 1h )3600 seconds

10 Frames/sec for synchronization frame <length = 90 Byte = ptp Sync M

Additional frames with different prioritization and  
checked the impact of different network loads

Atzwanger Joachim, 02/11/2008

# Get to know your network: Results:



AJ5

Here you can see an overview.  
I was astonished about radio link and SHDSL.

Differential Service Code Point (DSCP) ist die Bezeichnung für das Type of Service-Feld (ToS) im IP-Header von DiffServ.

In detail:

MPLS nodes with less Traffic generate internet distribution. The more nodes the more traffic the more the distribution changes to quasi Gaussian distribution.

SHDSL:

Distribution:QoS (DSCP differential service code point) extremely dependent;

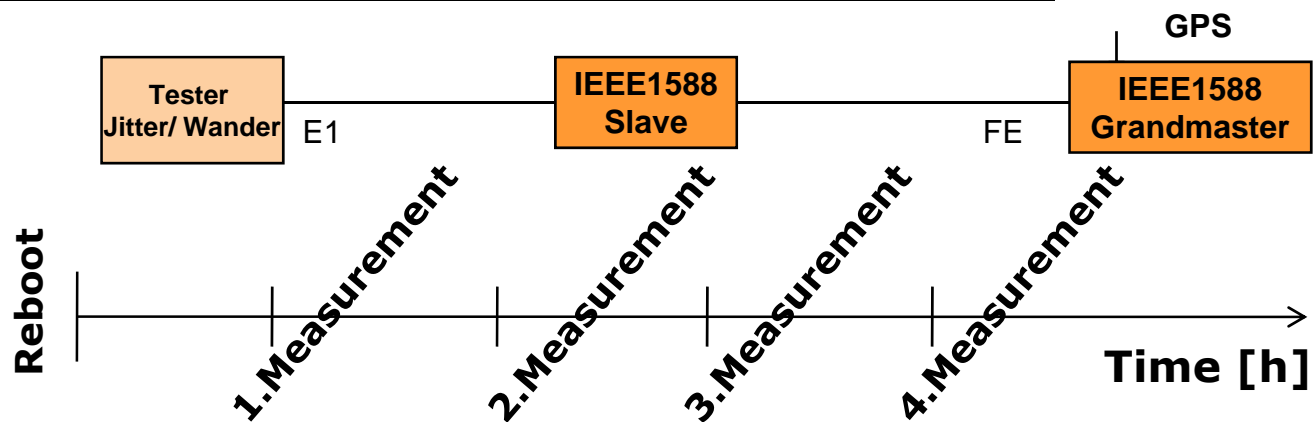
Radio Link: quasi Gaussian distribution.  
modulation and QoS dependent

Atzwanger Joachim, 02/11/2008



# Transient Response back to back

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Transient response		Grandmaster - Slave				
Tester:	Tester Jitter Wander	GM	Slave		Tester Jitter /Wander	
Start time	Measurement period	Sync M/Sec	2. Step Delay R.	Logs	TIE	MTIE,TDEV
x hours after Warm start/ Cold start						
1h	1000	32	Yes			
2h	1000	32	Yes			
3h	1000	32	Yes			
4h	1000	32	Yes			
5h	1000	32	Yes			

After transient response finished => stability tests

AJ6

Practical View:  
Exchange of Equipment  
You will see the Quality of the oscillator

Back to back is a basic test:  
With 2 Testers you can make one Longtime measurement, with the second you check the clock quality at time.

To get to know the grandmaster and slave monitor the logs. There you see the progress of the PTP synchronisation process.

I will encourage to work with Wireshark.  
You can watch the event- general messages  
Sync M , Delay request, Delay Response, Announce M etc.  
You can see message attributes ...  
In this way you really get to know PTP!

Measurement setup:  
Cold start  
warm start

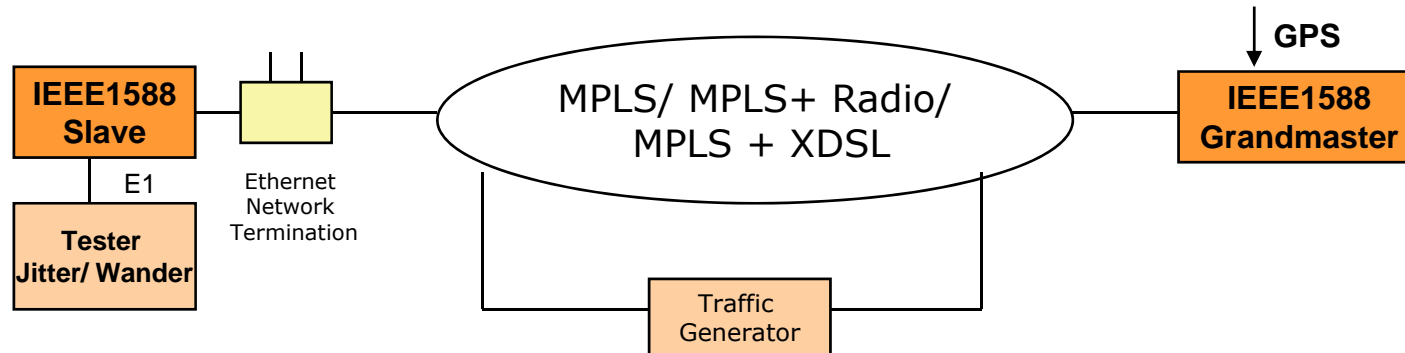
one step clock: A clock that provides time information using a single event message

two step clock: A clock that provides time information using the combination of an event message and a subsequent general message

Event message:  
Sync  
Delay Request  
Pdelay request  
Pdelay response

General M:  
Announce  
Follow up  
Delay Response  
Management  
Signalling

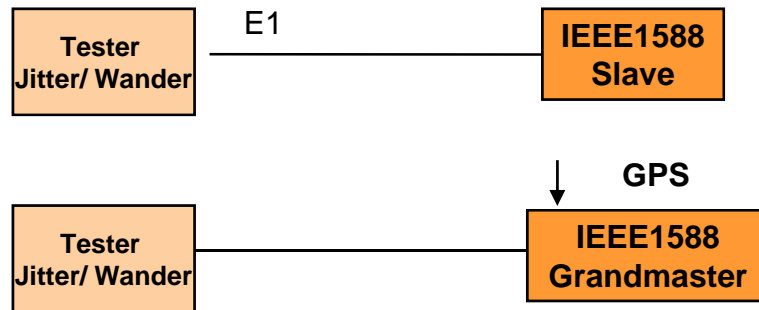
# Stability Test



Stability Tests					
Case	GM	Slave		Traffic Generator	Tester
Measurement Period (sec)	Sync M/Sec	2. Step Delay R.	Logs	Load/ overload different queues	TIE, MTIE, TDEV
10000	32				
10000	64				
10000	128				
100000	32				
100000	64				
100000	128				

## Holdover, Freerun

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Measurement period in h	Slave	Master	Logs	Tester Jitter / Wander TIE	Tester Jitter / Wander MTIE TDEV
24	X				
48	X				
24		X			
48		X			

AJ7

Why is a holdover test important:

Syncchain: GM - Slave - Node B

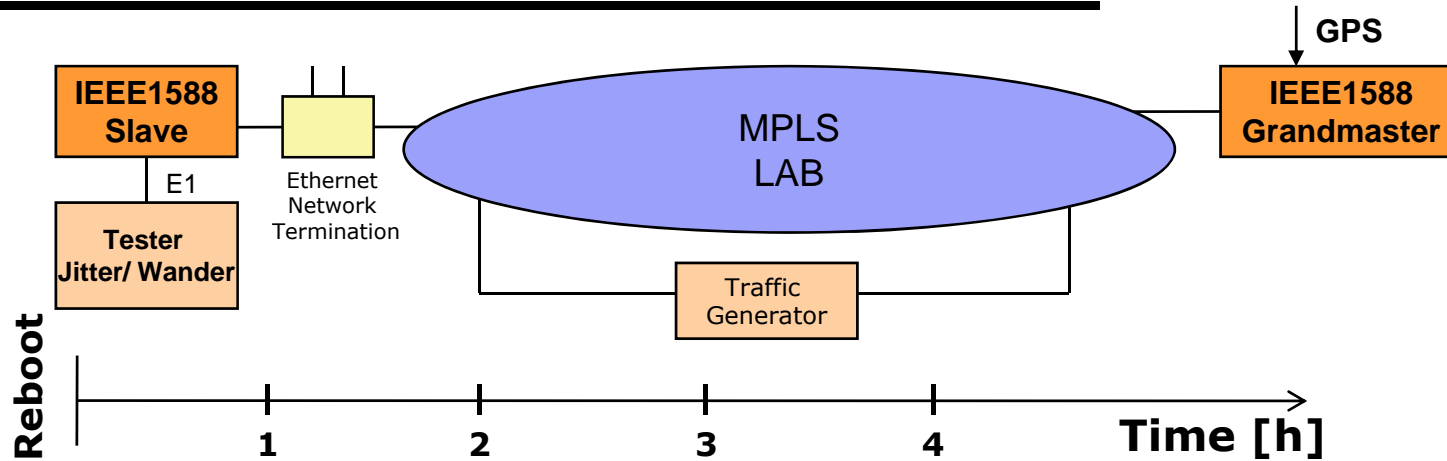
1. Check the "input autonomous time"

2. Good Oscillators can compensate network distortion

2. In the following Test cases the holdover of the slave can be the reason that no Clock quality change will occur

Atzwanger Joachim, 02/11/2008

# Transient Response MPLS Network with prioritisation



Transient response		MPLS-LAB				
Tester:	Tester J & W	GM	Slave		Traffic Generator	Tester
Start time x hours after Warm start/ Cold start	Measurement period	Sync M/Sec	Two Step Delay Req/Sec	Logs	Load/ overload different queues	TIE,MTIE, TDEV
1h	1000	32/64				
2h	1000	32/64				
3h	1000	32/64/				
4h	1000	32/64				
5h	1000	32/64				
After transient response finished => stability tests						

AJ8

The transient response time can be larger as back to back connection  
Atzwanger Joachim, 02/11/2008

## G.8261 Network traffic models

Packet size profile in % of load			
Model 1	Model 2	Packet size	Octets
80	60	minimum	64
15	30	maximum	1518
5	15	medium	576

Maximum size packets will occur in bursts lasting between 0,1 and 3 s

**Test case 1\*:** models the „Static“ packet load  
Network disturbance load with 80% for 1 hour.

**\*G.8261:** Allow a stabilization period according to Appendix II for the clock recovery process to stabilize before doing the measurement



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Repetition concerning G.8261 Timing and synchronization aspects in Packet Networks

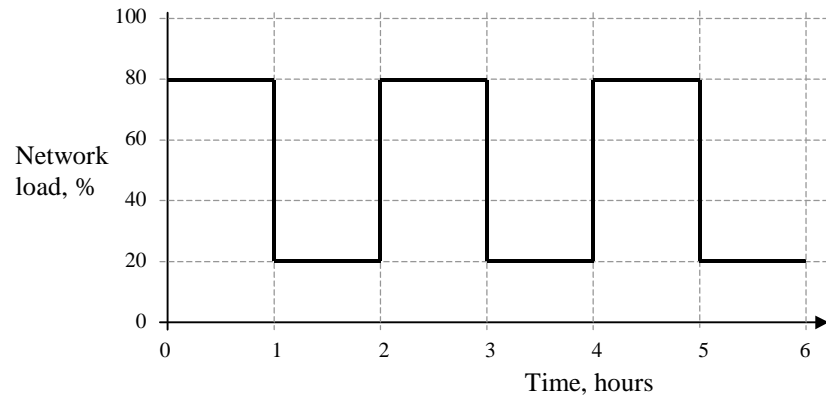
I think that model 2 is better to stress network concerning ptp features.

You see here test case 1

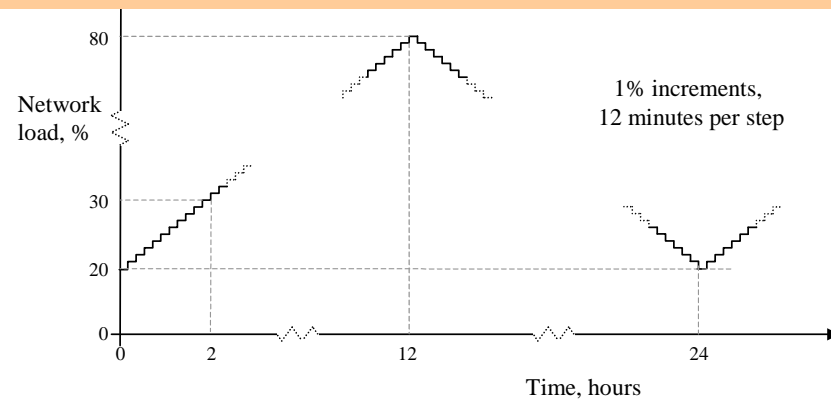
Atzwanger Joachim, 02/11/2008

## G.8261:

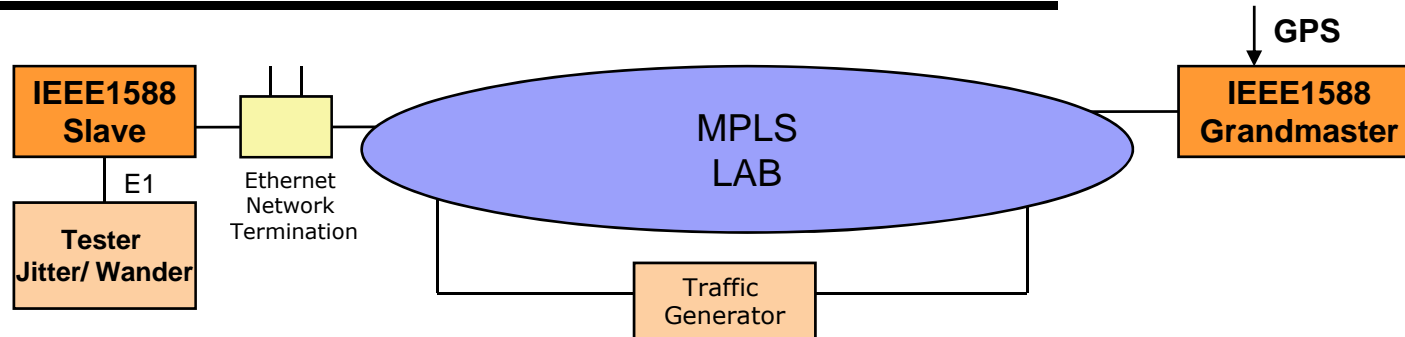
**Test case 2\*:** models sudden large, and persistent changes in network conditions. Network traffic Model 1 and 2



**Test case 3\*:** models a slow change in network load  
Network traffic: Model 1 and 2



# MPLS Network with prioritisation



Performance tests: G.8261 Test Case 1					MPLS LAB	
	GM	Slave		Traffic Generator		Tester Jitter/Wander
Measurement Period in h	Sync M/Sec	2 Step/ Delay R.	Logs	Load	Model 2	TIE, MTIE, TDEV
1h	32	No /				
1h	64	No /				
1h	128	No /				
1h	32	Yes /				
1h	64	Yes /				
1h	128	Yes /				

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery process to stabilize before doing the measurement

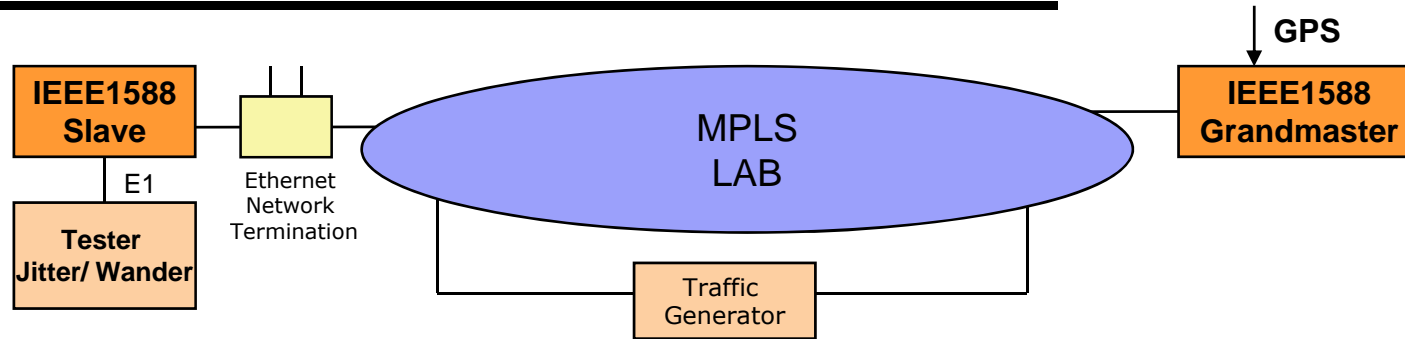
TAA1 WE decided to use Traffic pattern from G.8261.

Advantage: bigger chance to compare to other test results!

In the log where ptp events are memorized you will  
see mor action!

Telekom Austria AG, 02/11/2008

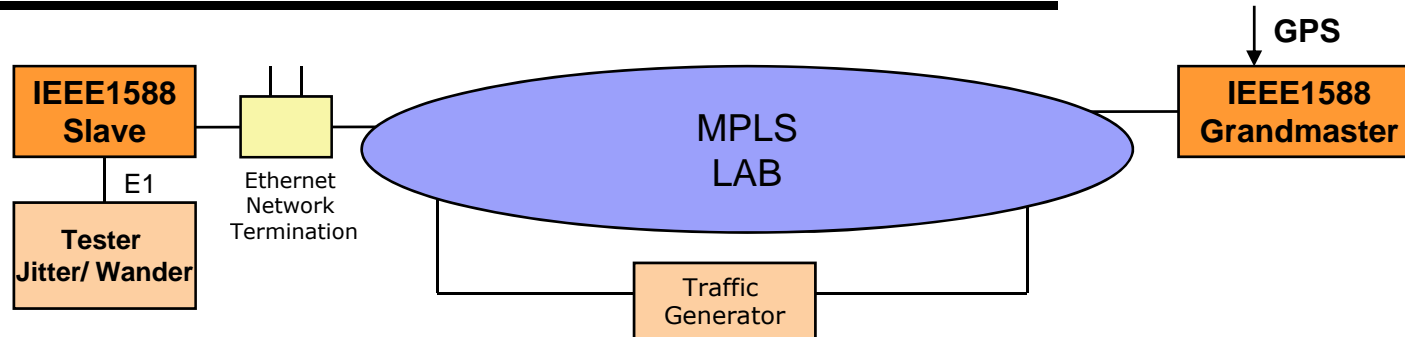
# MPLS Network with prioritisation



Performance tests: G.8261 Test Case 2					MPLS LAB
	GM	Slave		Traffic Generator	Tester Jitter/Wander
Measurement Period in h	Sync M/Sec	2 Step/ Delay R.	Logs	Different Loads Mod 1 ,2	TIE. MTIE, TDEV Model 1, Model 2
4h	32	No /		Distribution, Jitter	
4h	64	No /		Distribution, Jitter	
4h	128	NO /			
4h	32	Yes /		Distribution, Jitter	
4h	64	Yes /		Distribution, Jitter	
4h	128	Yes /			

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery prozess to stabilize before doing the measurement

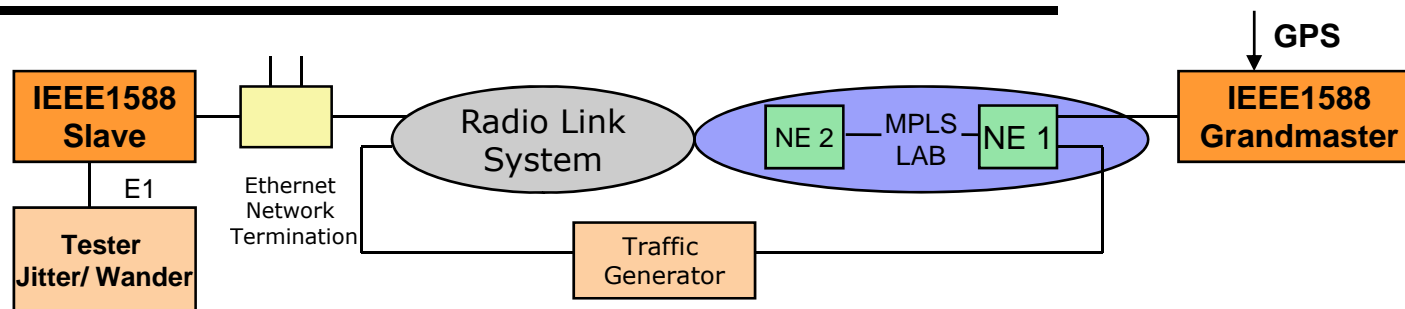
# MPLS Network with prioritisation



Performance tests: G.8261 Test Case 3					MPLS LAB	
	GM	Slave		Traffic Generator	Tester Jitter/Wander	
Measurement period in h	Sync M/Sec	2 Step/ Delay R	Logs	Load Model 1,2	TIE. MTIE, TDEV Model 1	Model 2
24h	32	No /		Distribution, Jitter		
24h	64	No /		Distribution, Jitter		
24h	128	Yes /				
24h	32	Yes /		Distribution, Jitter		
24h	64	Yes /		Distribution, Jitter		
24h	128	Yes /				

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery process to stabilize before doing the measurement

# Radio Link System 32QAM, 16QAM, QPSK+MPLS



Performance Tests: G.8261 Test Case 1				Radio Link + MPLS LAB				
	GM	Slave		Radio Link System			Traffic G Load	Tester Jitter/wander
Test Time	Sync M /Sec	2. Step/ Delay R.	Logs	32QAM	16QAM	PAM	Model 2	TIE, MTIE, TDEV
1h	32	No /						
1h	64	No /						
1h	128	No /						
1h	32	Yes /						
1h	64	Yes /						
1h	128	Yes /						

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery prozess to stabilize before doing the measurement

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In some areas where no fibre is available, therefore radio link systems are the solution.

QAM = QPSK = Quadrature phase shift Keying  
(Vierphasenmodulation)

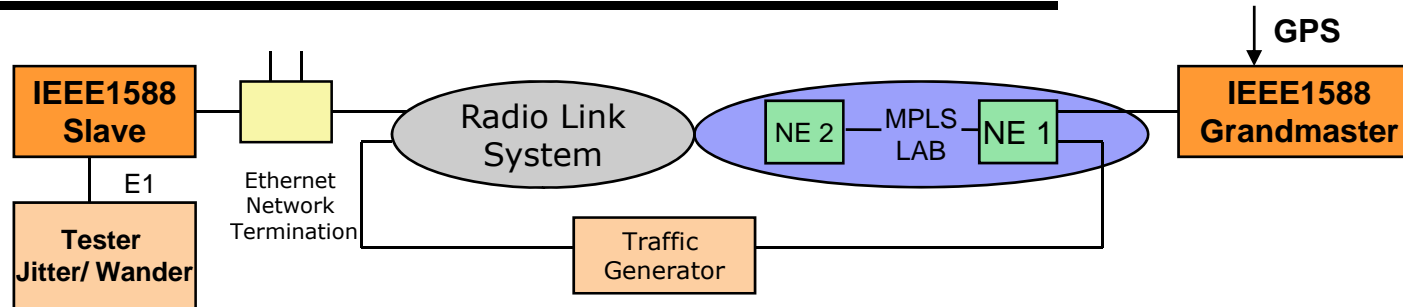
Radio link systems change from 32QAM to 16 QAM  
and so on if the BER is too high / Receive level decreases too much.

Bit: Bei 256-QAM sind die 256 Punkte in einem 16x16-Raster (bei DVB-C wird diese Konstellation z.T. im UHF-Bereich eingesetzt)

Atzwanger Joachim, 02/11/2008



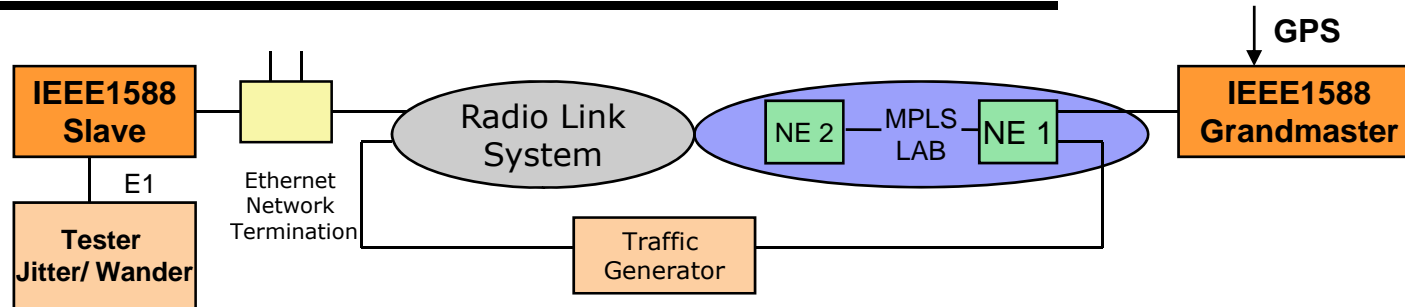
# Radio Link System 32QAM, 16QAM, QPSK+MPLS



Performance tests: G.8261 Test Case 2				Radio Link+ MPLS LAB				
	GM	Slave		Radio Link System			Traffic G. Load	Tester Jitter/ Wander Model 1 Model 2
Test Time	Sync M /Sec	2. Step/ Delay R.	Logs	32QAM	16QAM	PAM	Model 1, 2	TIE, MTIE, TDEV
4h	32	No /						
4h	64	No /						
4h	128	No /						
4h	32	Yes /						
4h	64	Yes /						
4h	128	Yes /						

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery prozess to stabilize before doing the measurement

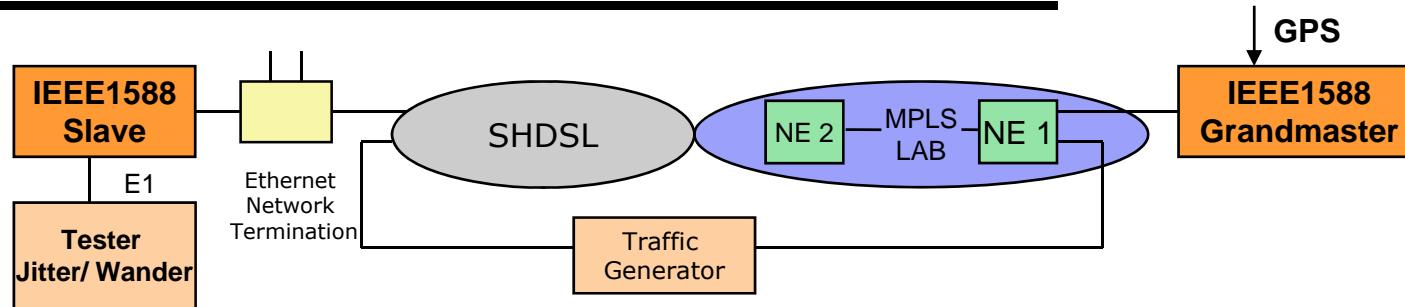
# Radio Link System 32QAM, 16QAM, QPSK+MPLS



Performance tests: G.8261 Test Case 3				Radio Link+ MPLS LAB					
	GM	Slave		Radio Link System			Traffic G. Load	Tester Jitter / Wander	
Test Time	Sync M /Sec	2. Step/ Delay R.	Logs	32QAM	16QAM	PAM	Model 1 , 2	Model 1	Model 2
24h	32	No /							
24h	64	No /							
24h	128	No /							
24h	32	Yes /							
24h	64	Yes /							
24h	128	Yes /							

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery prozess to stabilize before doing the measurement

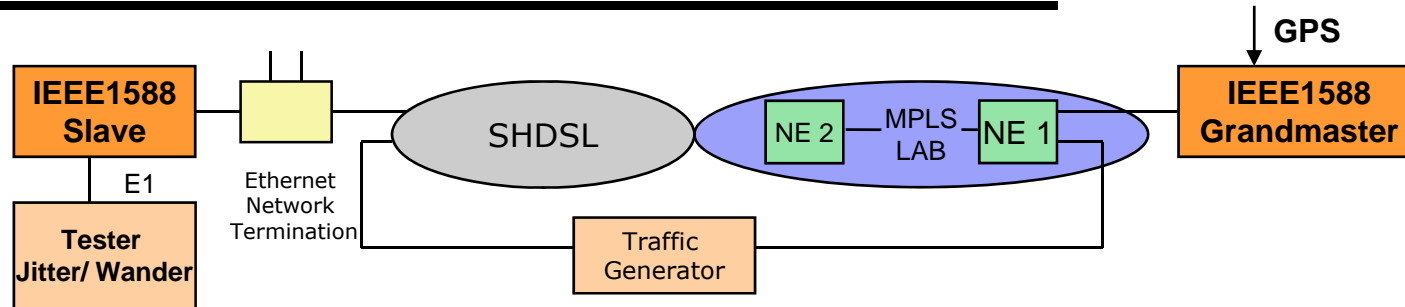
# SHDSL-MPLS Network



Performance Tests: G.8261 Test Case 1					SHDSL MPLS	
	GM	Slave		Traffic Generator		Tester J & W
Test Time in h	Sync M/Sec	2. Step/ Delay R.	Logs	Load	Model 2	TIE,MTIE,TDEV
1h	32	No /				
1h	64	No /				
1h	128	No /				
1h	32	Yes /				
1h	64	Yes /				
1h	128	Yes /				

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery process to stabilize before doing the measurement

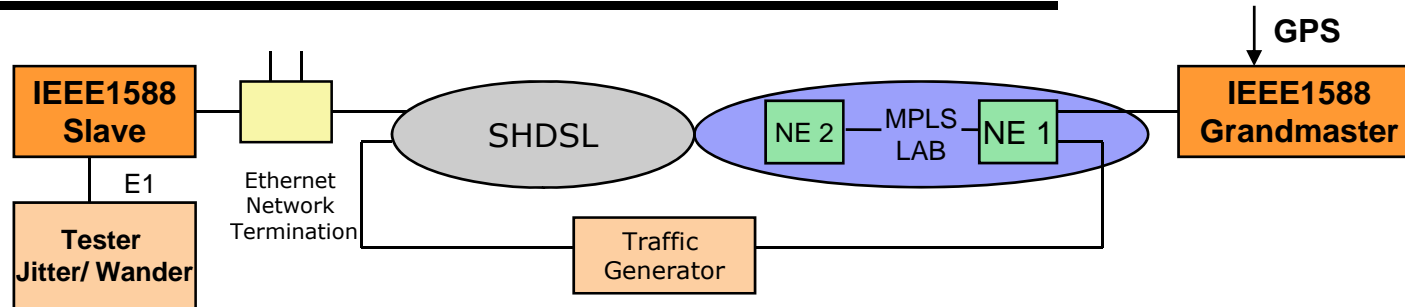
# SHDSL-MPLS Network



Performance Tests: G.8261 Test Case 2				SHDSL MPLS	
	GM	Slave		Traffic Generator	Tester J & W
Test Time in h	Sync M/Sec	2. Step/ Delay R.	Logs	Load Model 1 , 2	TIE,MTIE,TDEV Model 1    Model 2
4h	32	No /			
4h	64	No /			
4h	128	No /			
4h	32	Yes /			
4h	64	Yes /			
4h	128	Yes /			

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery process to stabilize before doing the measurement

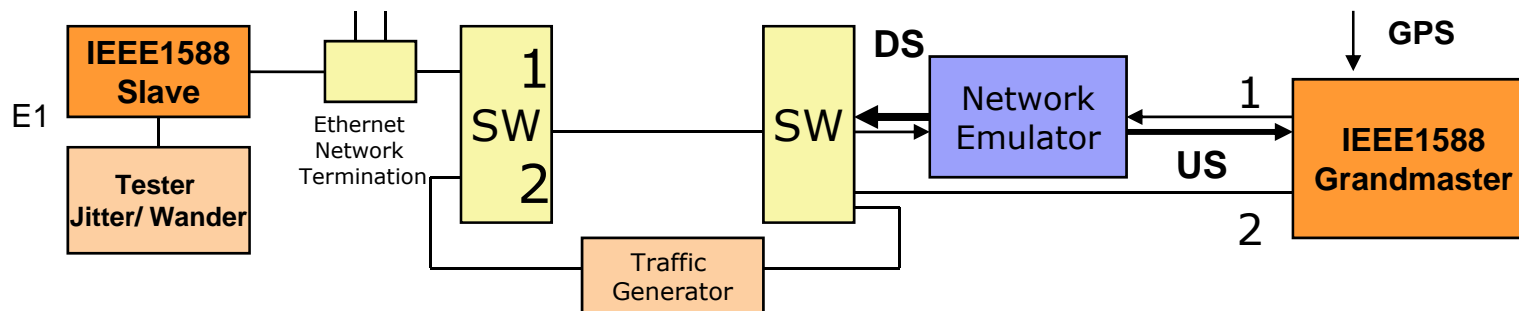
# SHDSL-MPLS Network



Performance Tests: G.8261 Test Case 3				SHDSL MPLS	
	GM	Slave		Traffic Generator	Tester J & W
Test Time in h	Sync M/Sec	2. Step/ Delay R.	Logs	Load Model 1 , 2	TIE, MTIE, TDEV Model 1      Model 2
24h	32	No /			
24h	64	No /			
24h	128	No /			
24h	32	Yes /			
24h	64	Yes /			
24h	128	Yes /			

G.8261: Allow a stabilization period according to Appendix II for the clock Recovery process to stabilize before doing the measurement

# Source selection



Change over port 1 to 2 of Grandmaster							
	GM	Slave		Network Emulator			Tester
Measurement period	Sync M/ Sec	Delay Request/sec	Logs/ Alarms	DS	US	Impairment	TIE, MTIE TDEV

AJ11

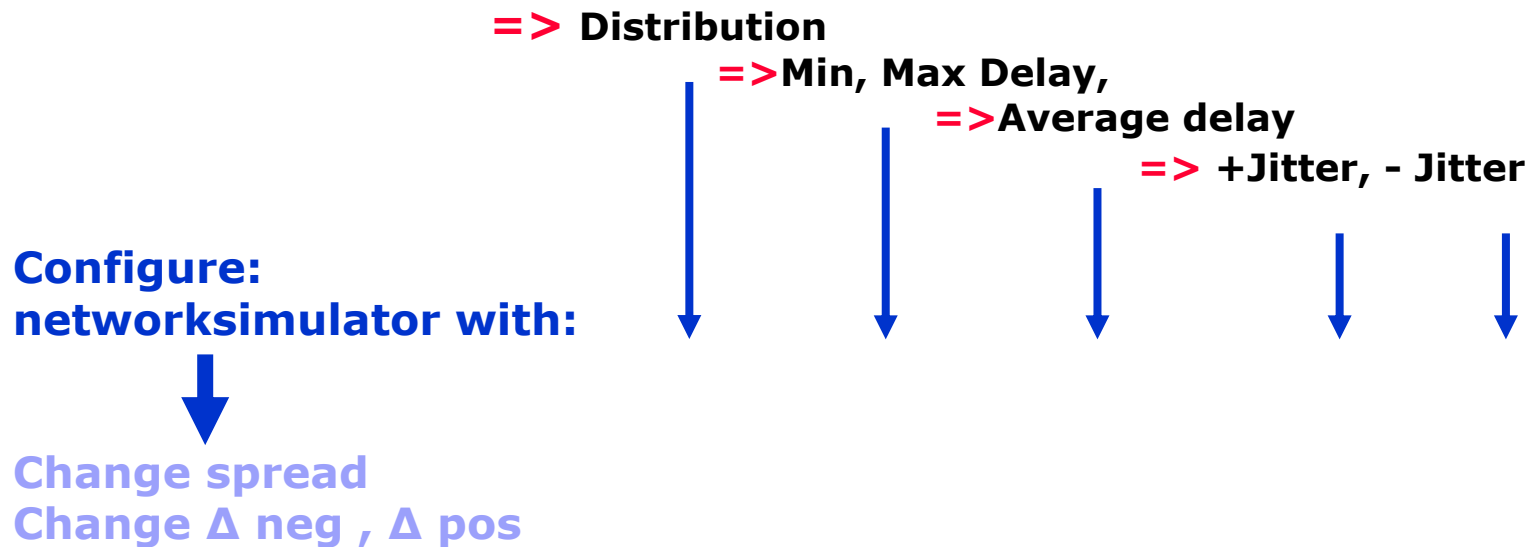
Goal: which network disturbance causes a change of the ptp source

Atzwanger Joachim, 02/11/2008

## Robustness tests: explanation

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**Export results of measured network (MPLS etc. ) in to excel, and calculate**



**Measure: TIE, TDEV, MTIE; Monitor 1588 Slave alarms and logs**



AJ12

Why robustness tests?

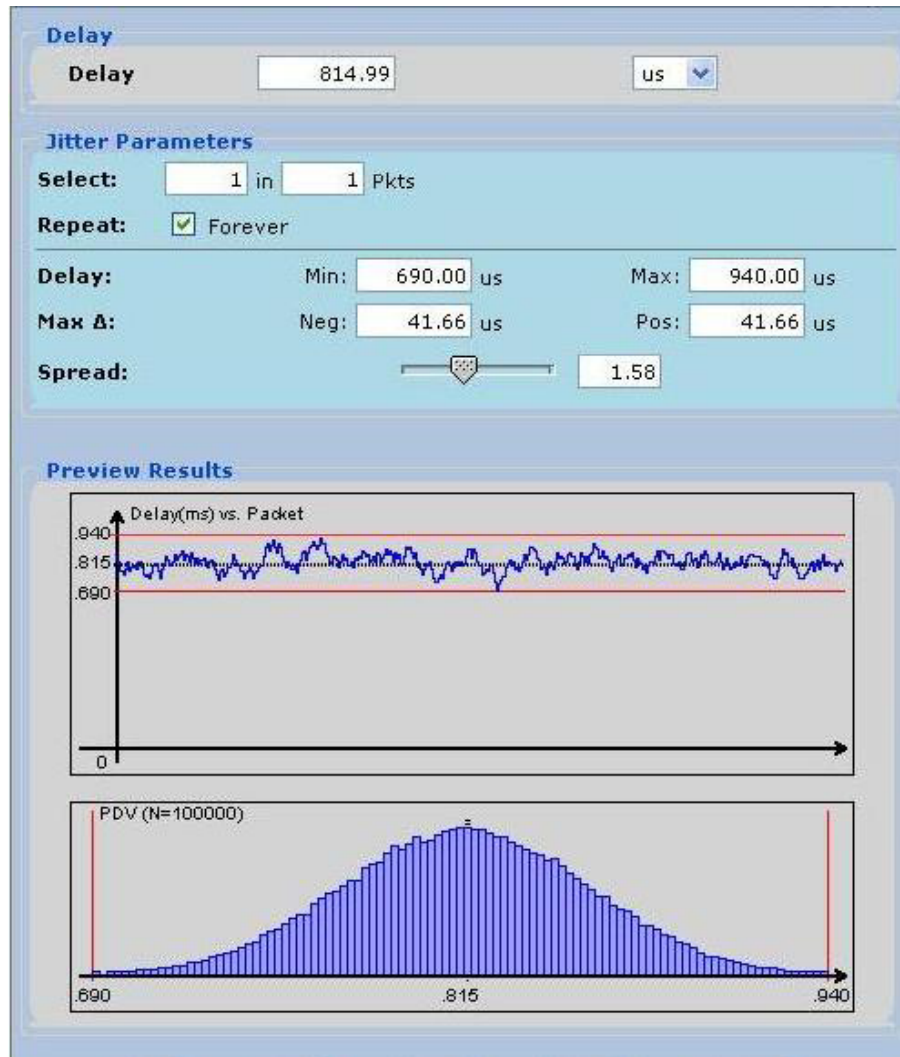
normally test Labs are too small to represent the live network.

One possibility to reach live network disturbance is to add delay and PDV with a network emulator

Here it is one way described how to do it.

Atzwanger Joachim, 02/11/2008

# Robustness



AJ13

increase spread =>  
increase the number of  
Max Δ Neg or Max Δ Pos  
consecutively =>  
PDV distribution change

## Slide 22

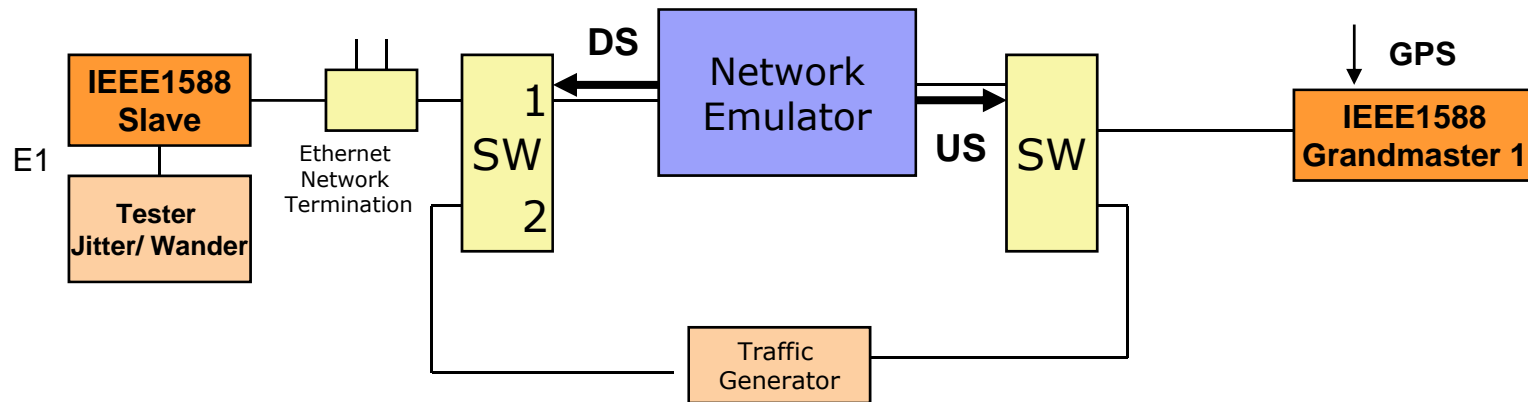
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AJ13

The picture is a screen shot of a network emulator.  
You configure average delay, Min, Max, Max  
Max  $\Delta$  Negative or positive and the spread.

Atzwanger Joachim, 02/11/2008

# Robustness; symmetric /asymmetric



Measurement	Min Delay	Max Delay	Average Delay	Abbreviation Nr
MPLS	X1	X2	X3	1A to 3D
MPLS + Radio Link				
MPLS + SHDSL				



## Robustness test symmetric;

Network Simulator					1588 Slave			Grand master	Tester Jitter / Wander		
Nr	Max $\Delta$ ( $\mu$ sec) neg= Pos)	Spread about	Down	Up	Delay Requests	Follow up Delay Requests	Logs	Sync M/ sec	Metric G.823 SEC	PDH	Offest df/F
<b>1A</b>	15	1	x	x							
<b>1B</b>		5	x	x							
<b>1C</b>		7,5	x	x							
<b>1D</b>		10	x	x							
<b>1E</b>		15	x	x							
<b>2A</b>	20	1	x	x							
<b>2B</b>		5	x	x							
<b>2C</b>		7,5	x	x							
<b>2D</b>		10	x	x							
<b>3A</b>	25	1	x	x							
<b>3B</b>		5	x	x							
<b>3C</b>		7,5	x	x							
<b>3D</b>		10	x	x							

## Robustness test asymmetric; impairment downstream

Network Simulator					1588 Slave			Grand master	Tester Jitter / Wander		
Nr	Max $\Delta$ ( $\mu$ sec) neg= Pos)	Spread about	Down	Up	Delay Requests	Follow up Delay Requests	Logs	Sync M/sec	Metric G.823 SEC	PDH	Offest df/F
<b>1A</b>	15	1	x								
<b>1B</b>		5	x								
<b>1C</b>		7,5	x								
<b>1D</b>		10	x								
<b>1E</b>		15	x								
<b>2A</b>	20	1	x								
<b>2B</b>		5	x								
<b>2C</b>		7,5	x								
<b>2D</b>		10	x								
<b>3A</b>	25	1	x								
<b>3B</b>		5	x								
<b>3C</b>		7,5	x								
<b>3D</b>		10	x								

## Robustness test asymmetric; impairment upstream

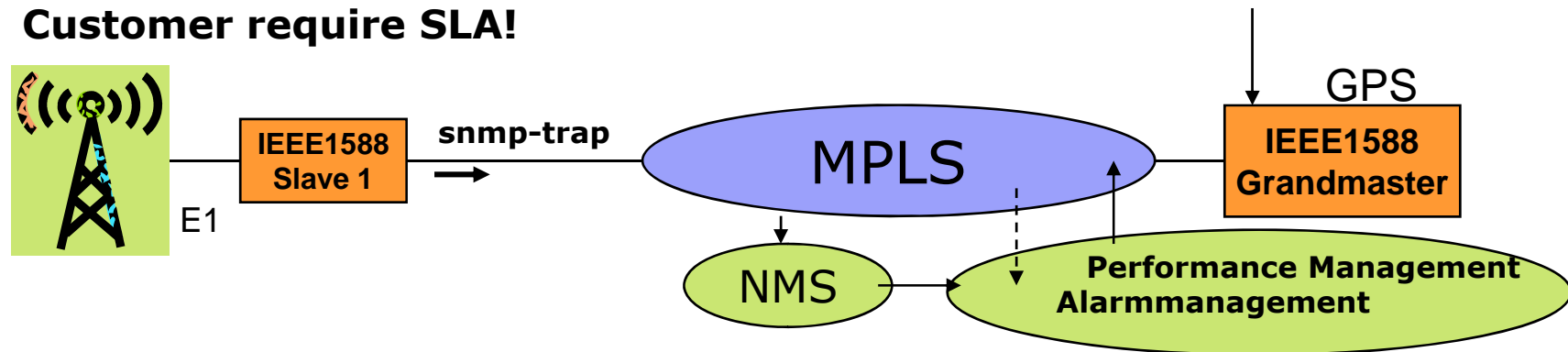
Network Simulator					1588 Slave			Grand master	Tester Jitter / Wander		
Nr	Max $\Delta$ ( $\mu$ sec) neg= Pos)	Spread about	Down	Up	Delay Requests	Follow up Delay Requests	Logs	Sync M/ sec	Metric G.823 SEC	PDH	Offest df/F
<b>1A</b>	15	1		x							
<b>1B</b>		5		x							
<b>1C</b>		7,5		x							
<b>1D</b>		10		x							
<b>1E</b>		15		x							
<b>2A</b>	20	1		x							
<b>2B</b>		5		x							
<b>2C</b>		7,5		x							
<b>2D</b>		10		x							
<b>3A</b>	25	1		x							
<b>3B</b>		5		x							
<b>3C</b>		7,5		x							
<b>3D</b>		10		x							



## Szenario:

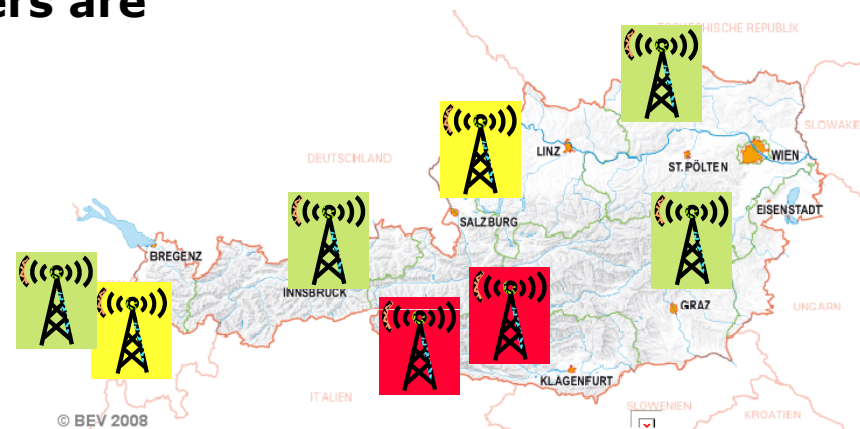
Many Node B will be synchronized with IEEE1588 Slaves:

## Customer require SLA!



## Which clock relevant parameters are available in slaves?

- Operation availability
- Clock quality



AJ16

Demanding customer ask for SLA regarding Clock Quality at Node

Atzwanger Joachim, 02/11/2008

Many Thanks!

**Questions?**

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