



SEMINAR TEXT

MP1570A SONET/SDH/PDH/ATM Analyzer

SDH/SONET Jitter Measurement Solution

MEASUREMENT SOLUTIONS
ANRITSU CORPORATION

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Seminar Text

SDH/SONET Jitter Measurement Solution

MP1570A SONET/SDH/PDH/ATM Analyzer

Anritsu Corporation
Measuring Instruments Division
Marketing Department



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Contents

- **SDH/SONET Jitter Measurement**
 - Jitter Standardization Trends
 - Jitter Measurement Solution
 - Jitter Calibration
- **MP1570A Outline**
 - Market Trends and Function Outline
 - IP Measurement Solution
 - WDM Measurement Solution



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SDH/SONET Jitter Measurement

- **Jitter Standardization Trend**
- **Main Features of MP1570A New Jitter Unit**
- **10Gbit/s Jitter Measurement Solution**
- **Jitter Calibration Method**
- **Measuring Instrument Comparison**



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Main Standardization Bodies (Transmission Systems)

- **ITU-T** (International Telecommunication Union - Telecommunication Sector)
- **ETSI** (European Telecommunications Standards Institute): Europe
- **ANSI** (American National Standard Institute) : N. America
- **Bellcore** (Bellcore): N. America
- **TTC** (Telecommunication Technology Committee): Japan

(Note) ****: STM-64/OC-192 Jitter/Wander Standards & Investigation Bodies



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ITU-T Main Jitter & Wander Standards

SG No.	Rec. No	Recommendation Name
SG4	O.171 O.172	Jitter and wander measuring equipment for PDH Jitter and wander measuring equipment for SDH
SG13	G.811 G.812 G.813 G.823 G.824 G.825	Timing requirements of primary reference clocks Timing requirements of slave clocks Timing characteristics of SDH equipment slave clocks The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy The control of jitter and wander within digital networks which are based on the SDH
SG15	G.958 G.783	Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks



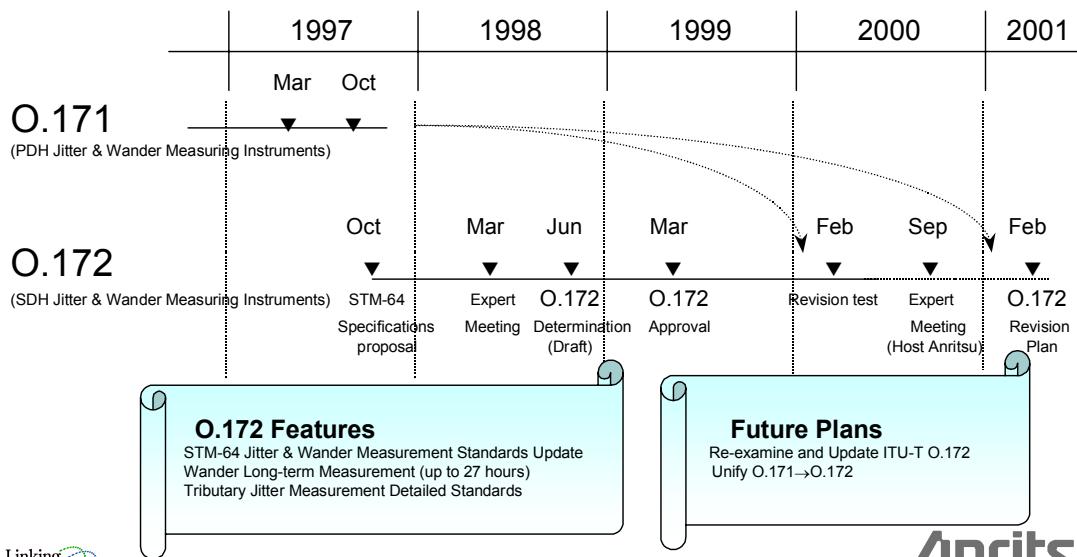
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Trend in Standards Examined by SG4

Question 11: Jitter and wander test and measurement techniques and instrumentation for use on transmission systems and their constituent parts



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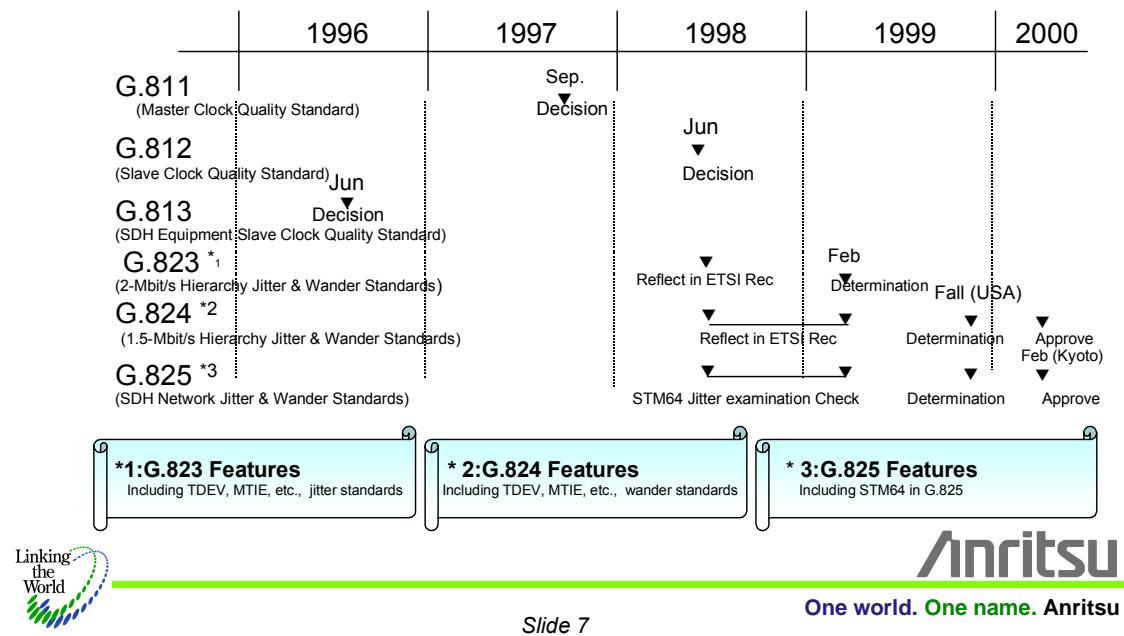
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Trend in Standards Examined by SG13

WP4: Quality

Question 18: Network synchronization and time distribution performance



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Comparison of G and O Standards

G Series	O Series
G.811/G.812 <ul style="list-style-type: none"> • TDEV, MTIE Measuring equipment standards • Frequency drift rate 	O.172 <ul style="list-style-type: none"> • TDEV, MTIE Measuring equipment standards • Frequency drift rate (under study)
G.813 <ul style="list-style-type: none"> • TDEV, MTIE Measuring equipment standards • Noise (TDEV) tolerance measurement • Noise (TDEV) transfer characteristics 	<ul style="list-style-type: none"> • TDEV Noise modulation standards (under study) • TDEV Noise modulation standards (under study)
G.823/G.824/G.825 <ul style="list-style-type: none"> • Tributary jitter measurement standards • Jitter standards (up to STM-64) 	<ul style="list-style-type: none"> • Tributary jitter measuring equipment standards • STM-64 Jitter measuring equipment standards

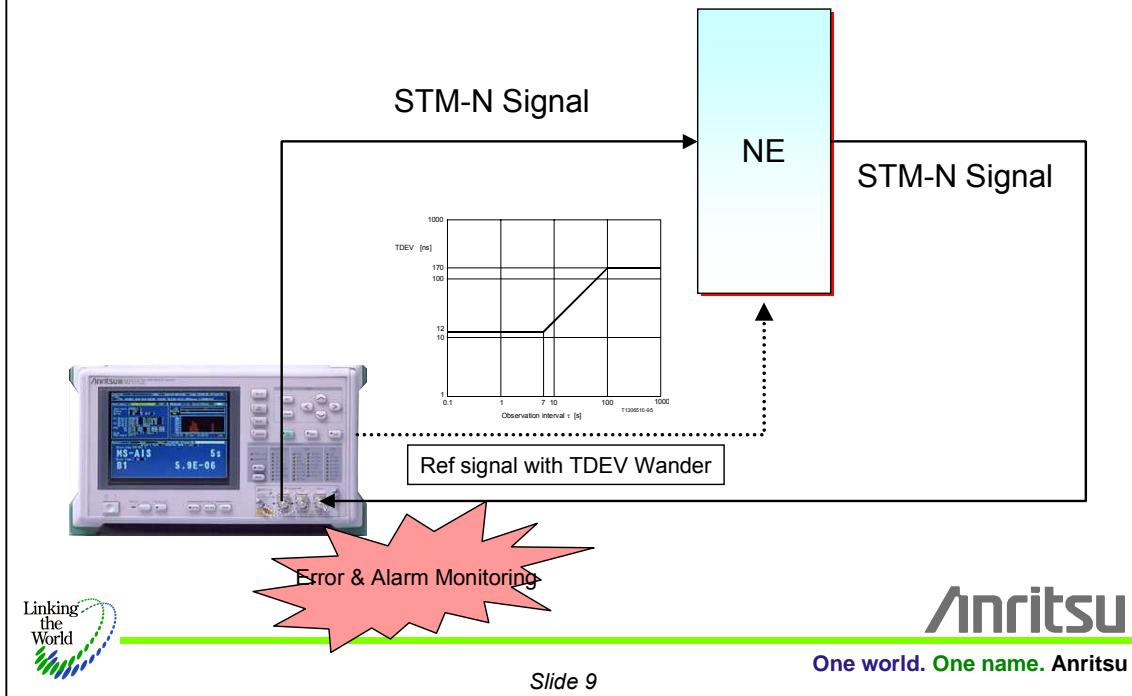


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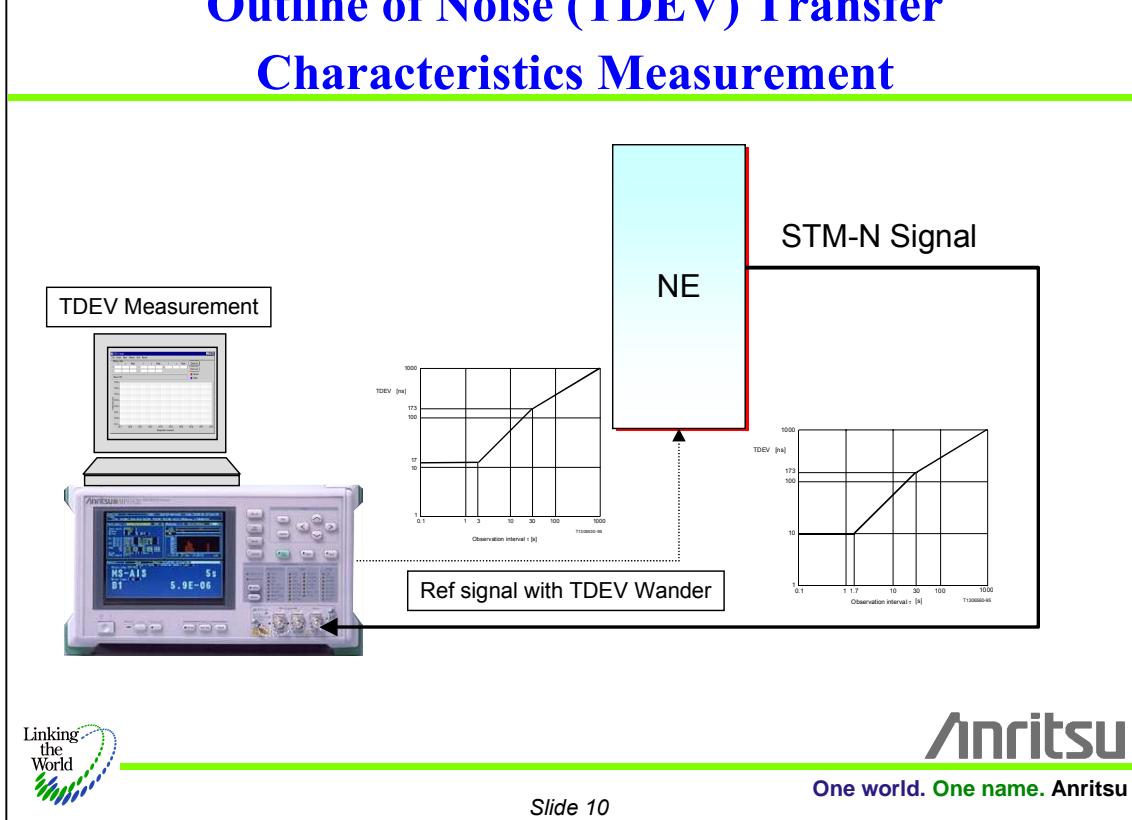
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Outline of Noise(TDEV) Tolerance Measurement



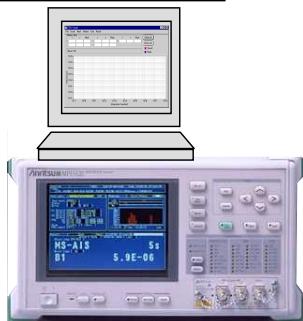
Outline of Noise (TDEV) Transfer Characteristics Measurement



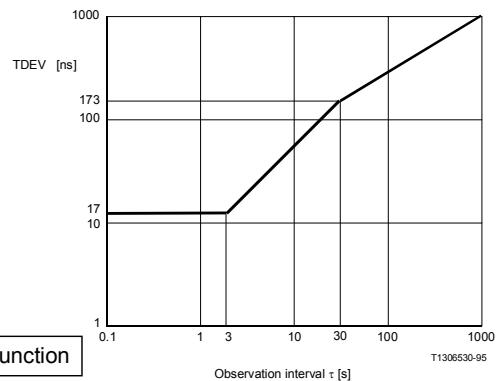
Functions Required for ITU-T G.813 Evaluation

- Noise (TDEV) Modulation Function
- Wander Measurement Function (TDEV)

TDEV Measurement



TDEV Generation Function



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Main Features of New Jitter Unit

- Conforming to ITU-T O.172 Rec. (exceeding O.172)
- Various (7 types) high-speed auto measurements of jitter and wander
- Various wander generation functions (Transient, TDEV wander)
- DSP-based variable jitter filter (up to 622 Mbit/s)
- Combined jitter measurement
- Various wander application software (MX150001B)
- 400,000UIp-p wander generation function (sine wave)
- Selectable bandwidth settable jitter transfer characteristics measurement
- Through jitter function (SDH only)
- Long-term jitter evaluation function (Peak Jitter)



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Various (7) High-speed Jitter & Wander Auto Measurements

- (1) Jitter Tolerance Measurement
- (2) Jitter Sweep Measurement
- (3) Jitter Transfer Measurement
- (4) Frequency Sweep Measurement
- (5) Jitter vs. Frequency Offset Measurement
- (6) Wander Sweep Measurement
- (7) Wander Measurement



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Various Wander Generation Functions

Various wander generation functions for evaluating TDEV wander tolerance, TDEV wander transfer characteristics, holdover, phase transients, etc., specified by the ITU-T, ANSI, ETSI, etc., standards.

- (1) Variable TDEV wander generation
- (2) Phase transient



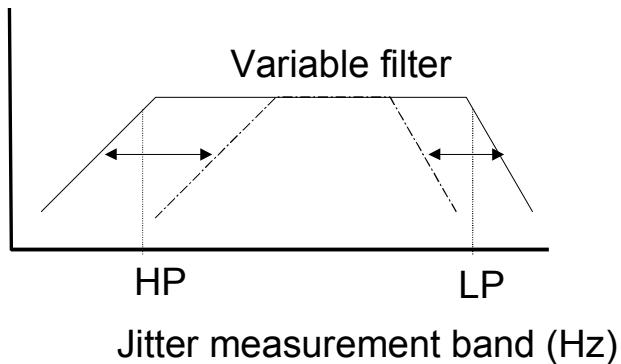
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DSP-based Variable Jitter Measurement Filter (up to 622 Mbit/s)

Provides pre-set filter ITU-T O.172, O.171, G series, ANSI, Bellcore, ETSI, etc., as well as any user settings for analyzing causes of jitter trouble.



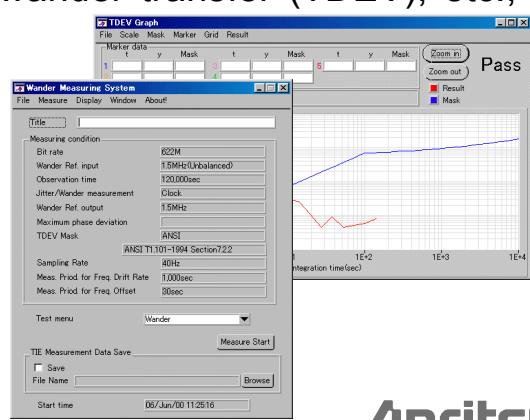
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Various Wander Application Software

Real-time MTIE and TDEV measurements using external host PC and wander application software (MX150001B). In addition, other wander measurements such as holdover, wander tolerance (TDEV), wander transfer (TDEV), etc., also possible.

- (1) Real-time Wander Measurement
- (2) Wander Tolerance (TDEV) Measurement
- (3) Wander Transfer (TDEV) Measurement

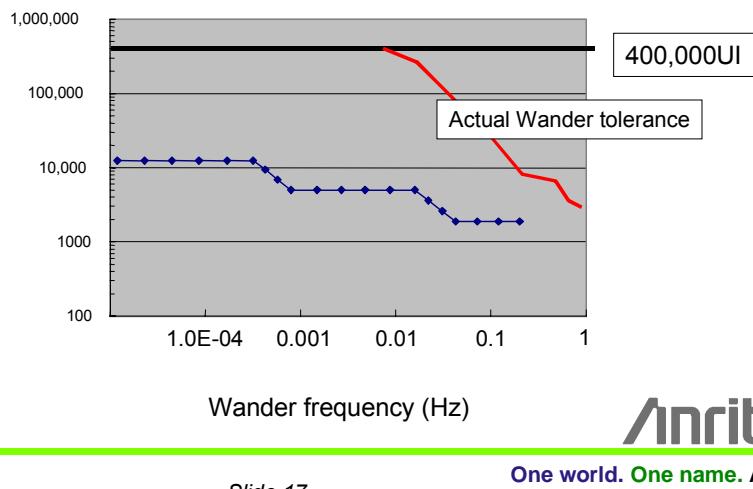


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400,000UI Wander Generation Function (Sine Wave)

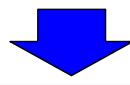
Wander generation up to 400,000UI (excluding 2.5G) required for wander tolerance efficiency evaluation. Moreover, wander tolerance efficiency evaluation also possible by generating by far exceeding wander value specified by ITU-T and G Series.



STM-64/OC-192 Jitter Solution

(Main Standards and Features)

- **GR-1377 (Bellcore): (1994~)**
- **80MHz jitter band** specified in OC-192 transmission equipment standards
- **O.172 (Feb 1999~)**
- Standards for STM-64 jitter & wander measuring instruments (**80MHz jitter band**)
- **G.825 (Feb 2000~)**
- Addition of standards for STM-64 networks (**80MHz jitter band**)



STM-64/OC-192 Jitter Solution

MP1777A 10G Jitter Analyzer



MP9677B 10G E/O, O/E Converter



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MP1777A Features

First Analyzer in World to Implement Evaluation at Jitter Frequencies up to 80 MHz!



- Measurements conforming to ITU-T O.172(3/99) recommendations
- 80 MHz Jitter band width
- 3200UIpp Jitter modulation amplitude
- Addition of bit rates for two undersea systems simultaneously
 - Option 01: 2494.16 MHz, 4988.32 MHz, 9976.64 MHz
 - Option 02*: 2666.0571 MHz, 5332.1142 MHz, 10664.2284 MHz
 - Option 04*: 3062.3625 MHz, 6124.725 MHz, 12.24945 MHz
 - Option 05*: 3069MHz, 6138 MHz, 12.276 MHz
- (* Options 02, 03, 04 and 05 cannot be installed simultaneously)
- Three types of jitter auto measurement (jitter tolerance, jitter transfer)



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MP9677B Features

First O/E Converter in World reaching 80 MHz Clock Recovery Band

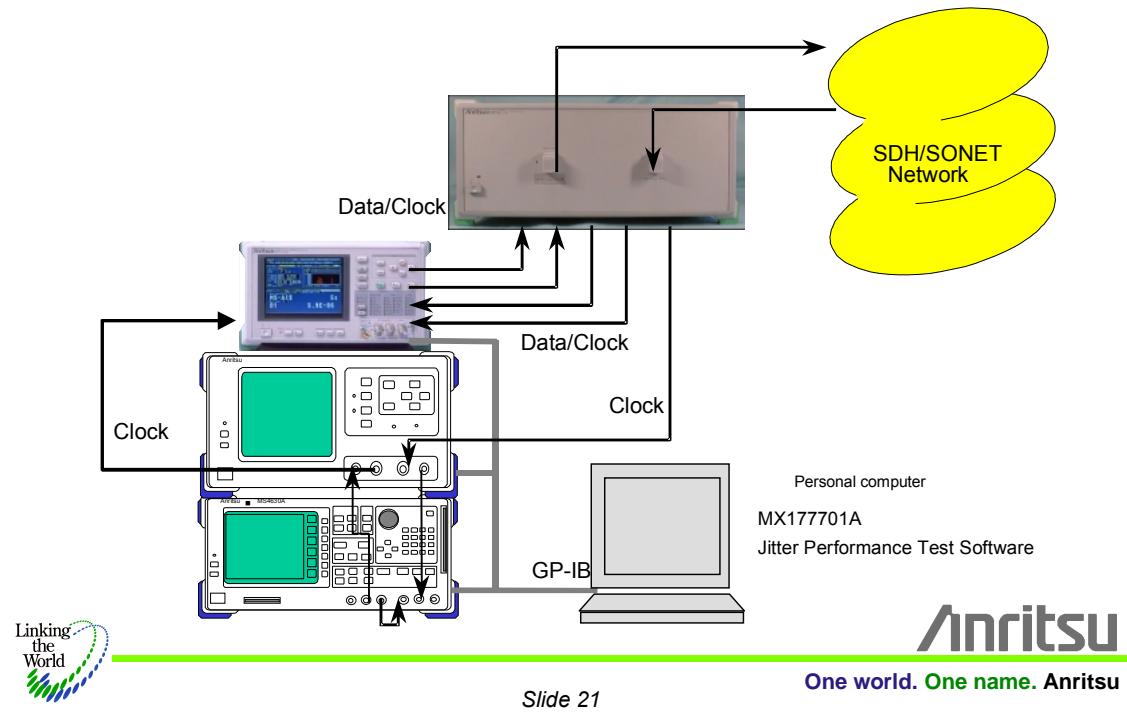
- Measurements conforming to ITU-T O.172(3/99) recommendations
- 80 MHz Jitter band width
- 10.664 Gbit/s Optical jitter measurements by changing units (MU967702A)
- Connection of external TLS (for WDM) by addition of Option 01



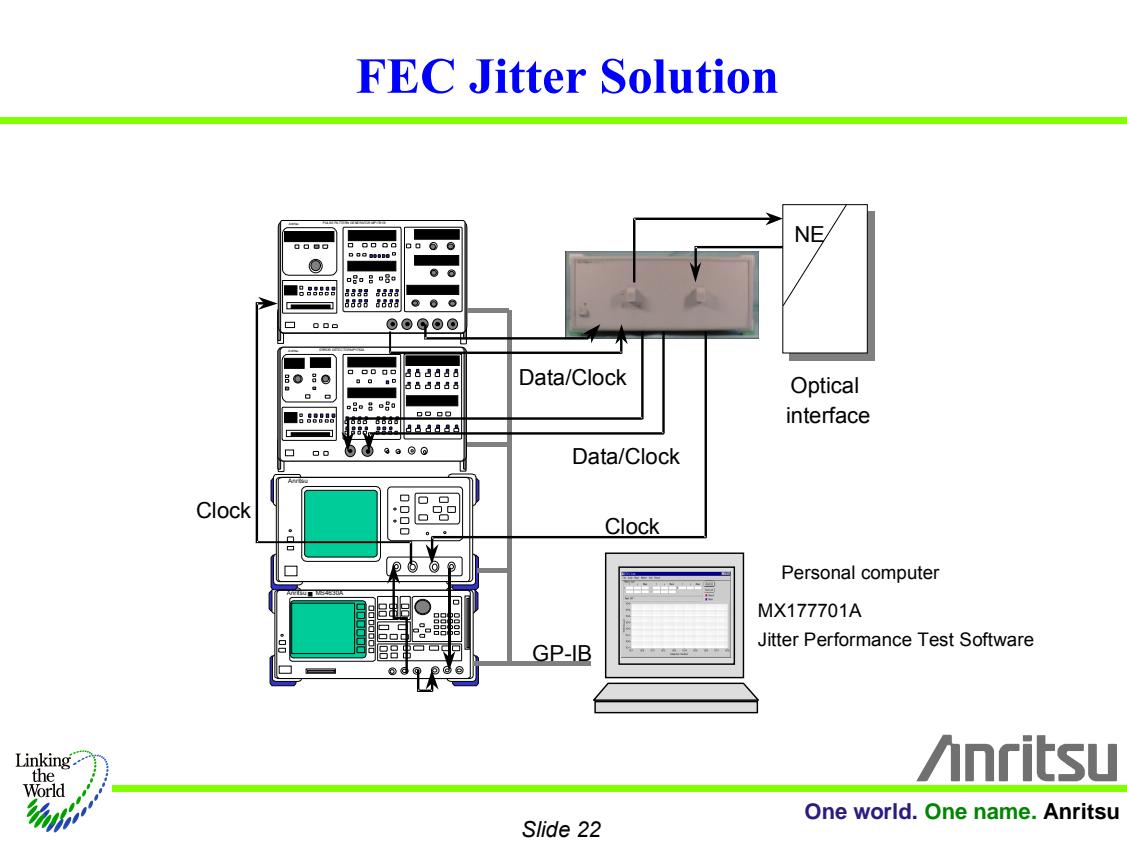
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SDH/SONET Jitter Solution



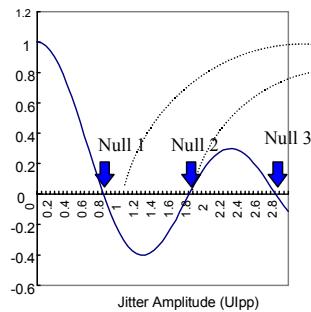
FEC Jitter Solution



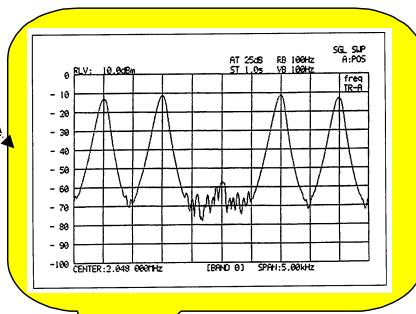
Jitter Measuring Instrument Calibration Method 1 (Transmitter)

- Jitter Generator

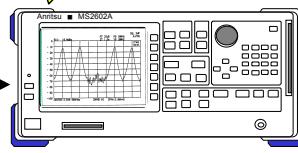
Calibrated using Bessel Null point



Jitter Analyzer (Transmitter)



Spectrum Analyzer



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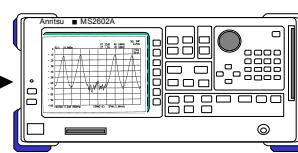
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Jitter Measuring Instrument Calibration Method 1 (Receiver)

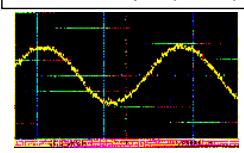
- Jitter Measuring Instrument

Calibrated using Bessel Null point

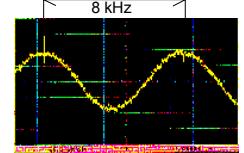
Spectrum Analyzer



Demod. Output (Clock)



Demod. Output (SDH)



Data signal
can't use for
jitter calibration

•Include pattern-dependent jitter

O/E
with CDR

Jitter measuring
instrument

Demod.
Output



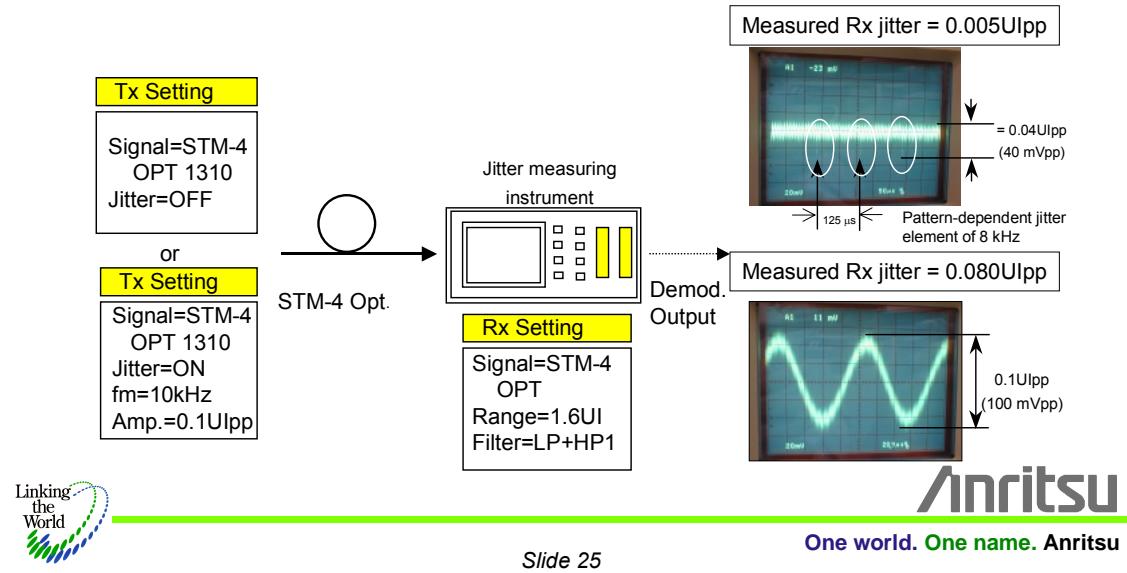
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Choosing Jitter Measuring Instrument

- Can be calibrated at clock interface?
- Demod. output peak value and measured jitter match?
(following measuring instrument not suited to jitter measurement)



Comparison of Jitter Measuring Instruments

Measurement	Anritsu	Agilent	WWG	Tektronix	
[G.813] TDEV/MTIE Noise Tolerance Noise Transfer	MP1570A MP1570A MP1570A	Omni BER718 None None	ANT-20SE None None	CTS-850 None None	TDEV Generation TDEV Generation
[O.172/G.825] 10G Jitter Tributary jitter Wander meas. etc.	MP1777A (Ele) MP9677A (Opt) MP1570A MP1570A	None None Omni BER718 Omni BER718	None None ANT-20SE ANT-20SE	None None CTS-850 CTS-850	Jitter band = 80 MHz Jitter band = 80 MHz



MP1570A product outline



- Market trend and 10Gbit/s measurement solution
- Plug-in structure
- Function outline (APS · Dummy setting · Monitor · TCM)
- IP measurement solution
- WDM measurement solution

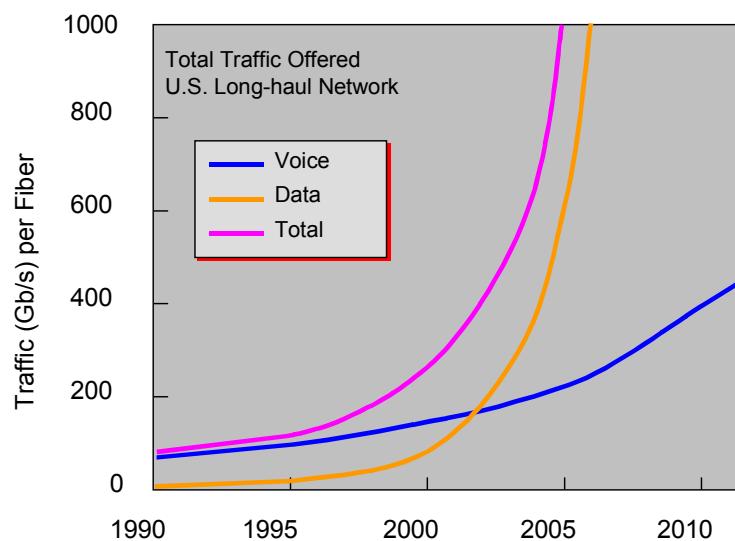
Bit rates from 1.5M to 10Gbit/s in Single unit



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Traffic through Fiber



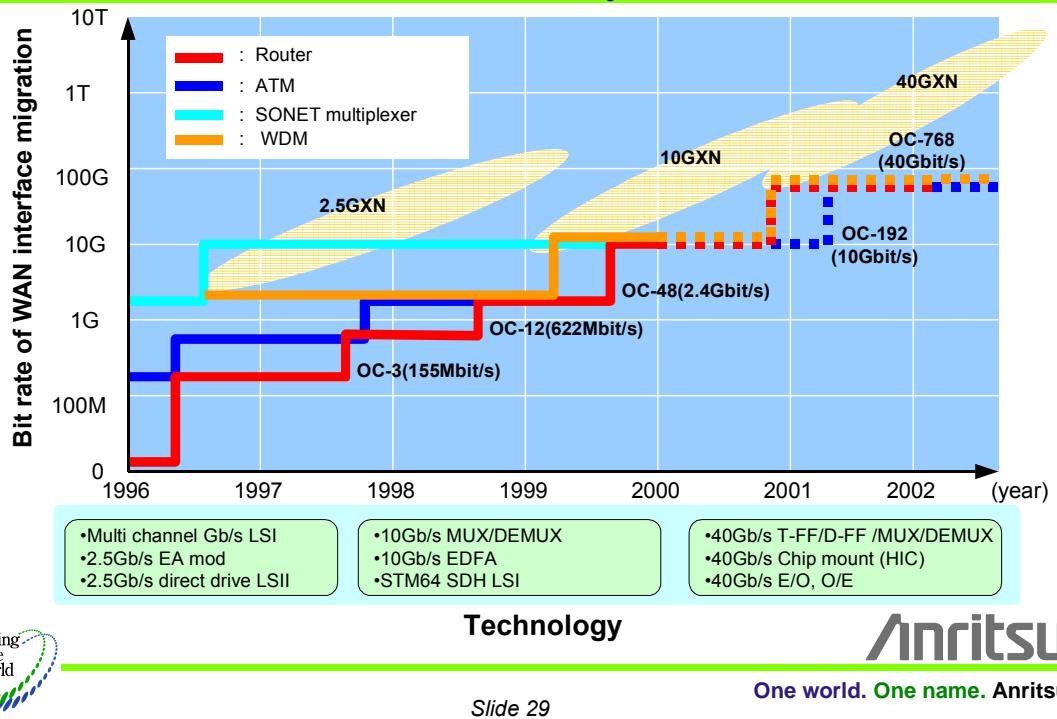
K.Coffman and A.Odlyzko, "The size and growth rate of Internet," October 1998.



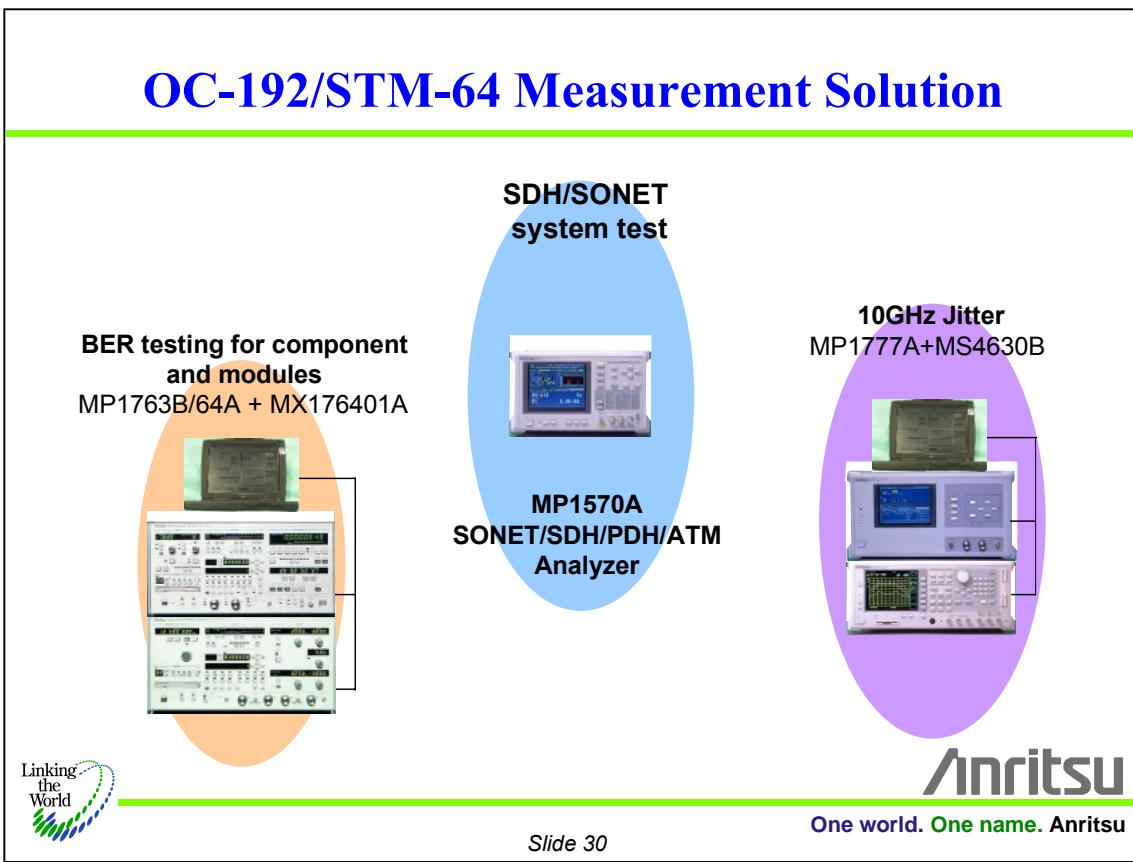
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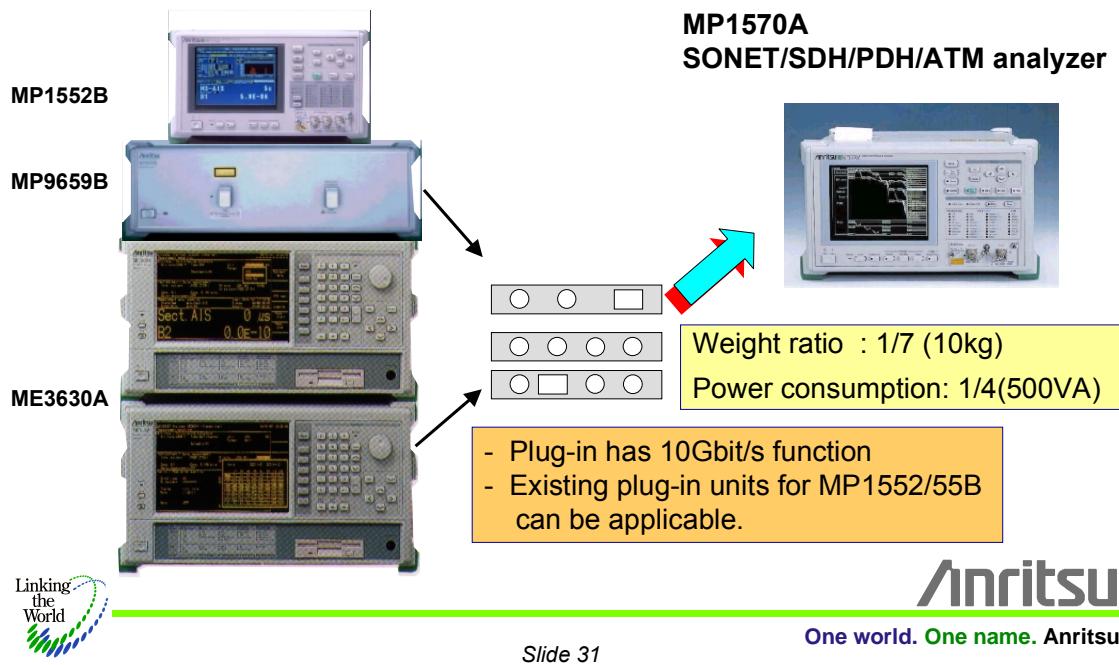
Technical trend of high capacity transmission system



OC-192/STM-64 Measurement Solution



Making small size and saving power consumption



Plug-in Structure

Right Side Cover of MP1570A



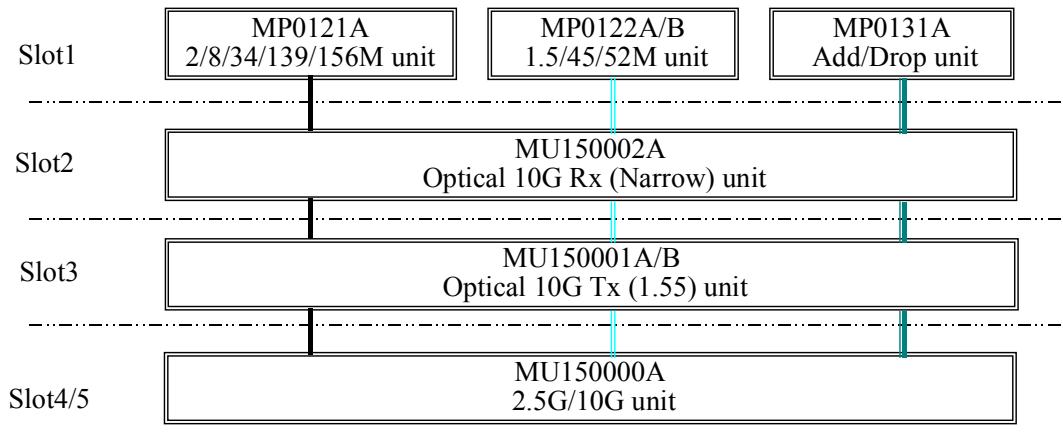
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Plug-in Structure

◆ 10G



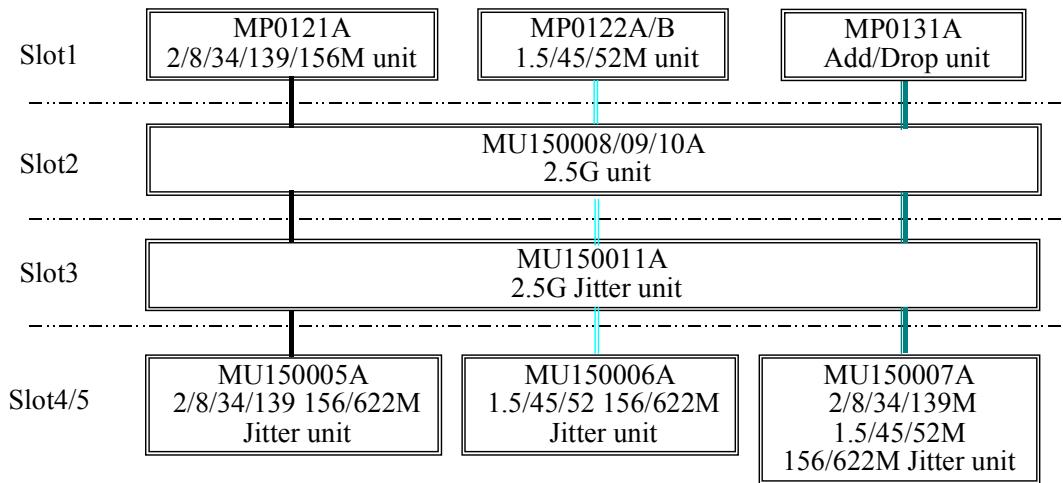
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Plug-in Structure

◆ 2.5G



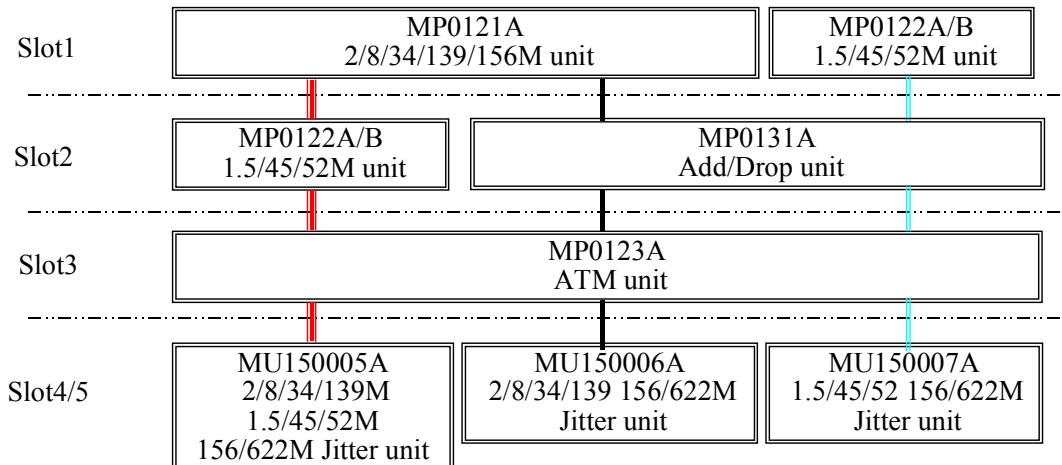
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Plug-in Structure

◆ 622M



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SONET/ITU-T Compliance Tests

- Mixed Payload
- TC (Tandem Connection)
- Alarm Detection/Release Condition Setting
- CID Pattern, Non-frame Pattern Measurement
- APS(Auto-switching) Time Measurement
- OH Test (OH change, PTR 64 Frame, OH BERTS)
- Linear/Ring System K1, K2 Byte Setting
- Two Path Trace Types (16 Byte/64 Byte)



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APS measurement

- Linear/Ring System K1 and K2 Byte Setting

Protocol selection

The screenshot shows a configuration window with the following settings:

- Standard: SDH
- Protection Protocol (K1/K2 Translate): G.783
- Buzzer: G.783 or G.841

Mnemonic setting

The mnemonic setting table for G.783 includes:

K1 Bit1-4	K1 Bit5-8	K2 Bit1-4	K2 Bit5-8	PTR	AU	TU	Payload of	Mode	Notes
0000, No request		0000, No request	0000, No request	0000, No request	1000, Manual switch	1000, SD-Low Priority	1000, SF-Low Priority	1000, Lockout of prot.	Unused
		0001, Do not revert	0001, Do not revert	0001, Do not revert	1001, Unused	1001, SD-High Priority	1001, SF-High Priority		
		0010, Reverse request	0010, Reverse request	0010, Reverse request	1010, SD-Low Priority	1010, SF-Low Priority	1010, SF-High Priority		
		0011, Unused	0011, Unused	0011, Unused	1011, Unused	1011, Unused	1011, Unused		
		0100, Exercise	0100, Exercise	0100, Exercise	1100, Unused	1100, Unused	1100, Unused		
		0101, Unused	0101, Unused	0101, Unused	1101, Unused	1101, Unused	1101, Unused		
		0110, Wait to restore	0110, Wait to restore	0110, Wait to restore	1110, Forced switch	1110, Forced switch	1110, Forced switch		
		0111, Unused	0111, Unused	0111, Unused	1111, Unused	1111, Unused	1111, Unused		

G.783

G.841

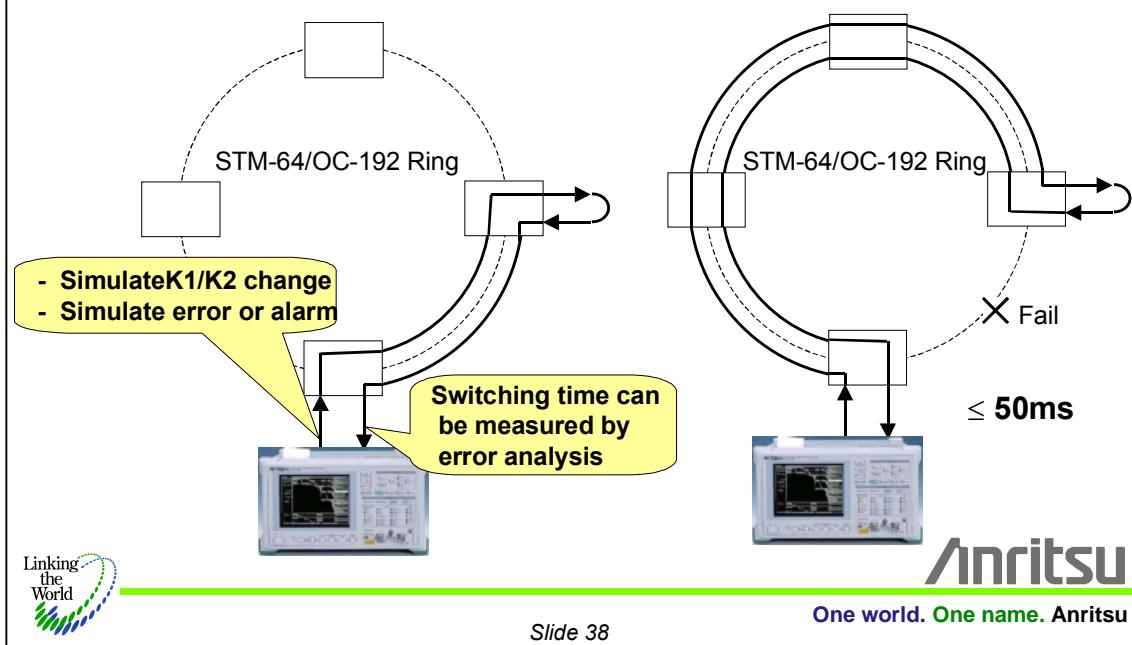
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Linking the World

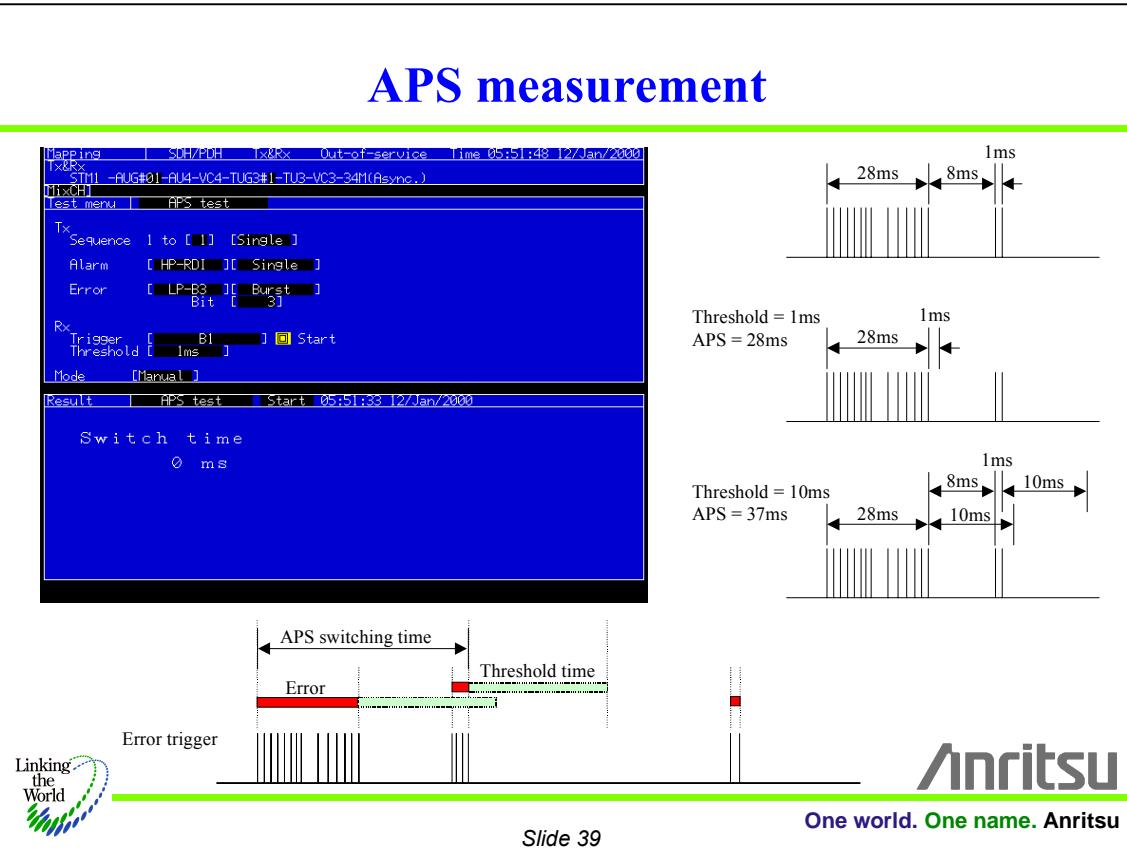
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APS measurement

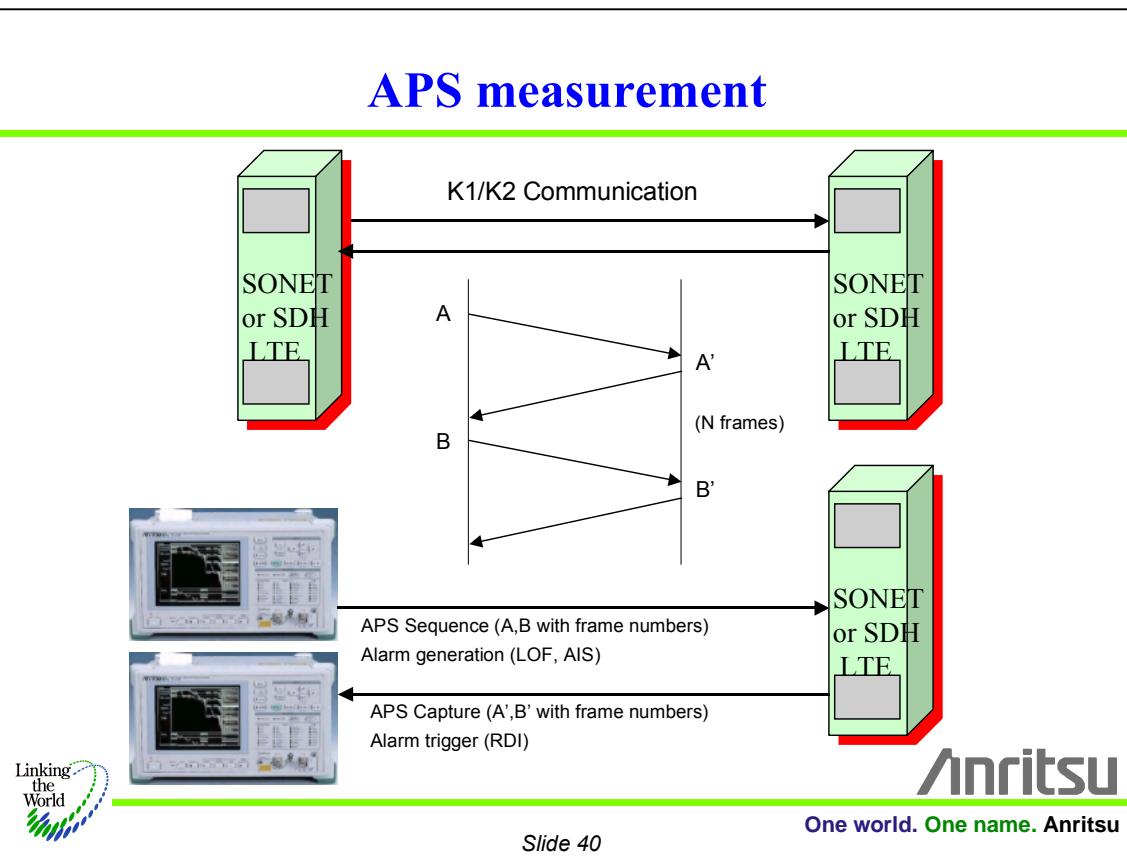
Switching time measurement(ITU-T Rec.G783/841)



APS measurement



APS measurement



APS measurement

Setup | APS programmable data Time 05:42:16 01/07/Jan/2000

K1/K2 Edit

No.	K1	K2	b1-b4	K1	b5-b8	K2	b1-b4	b5	Frame	T
T	01	18	No request	Working #1	Working #1	Working #1	Working #1	:N		
K1	Bit1-4	0000	No request							
K2	Bit5-8	2000	No request	1000	Manual	1000	Mapping	SDH/PDH	Tx&Rx	Out-of-service
Frame			0001, Do not revert	Unused	Unused	0010, Reverse request	Unused	SD-Low		Time 20:29:42 03/Jan/2000
			0011, Unused	Unused	Unused	0100, SF-High	Unused			STM4 -AUG#01-AU4-VC4-139M(Async.)
			0100, Exercise	1100	SF-Low	0110, Wait to restore	1100	Forced		
			0111, Unused	Unused	Unused	0111, Lockout	Unused			

Analyze | APS capture Print: [] to []

Title: APS capture Position: [?] Store

Trigger: Manual [] Capture Jump: [Number] [] 2

No.	K1	b1-b4	b5-b8	K2	b1-b4	b5	Frame	T
1	01	No request	Working #1	Working #1	Working #1	:N	8000	
2	01	No request	Working #1	Working #1	Working #1	:N	8000	
3	01	No request	Working #1	Working #1	Working #1	:N	8000	
4	01	No request	Working #1	Working #1	Working #1	:N	8000	
5	01	No request	Working #1	Working #1	Working #1	:N	8000	
6	01	No request	Working #1	Working #1	Working #1	:N	4405	
7	01	No request	Working #1	Working #1	Working #1	:N	8000	
8	01	No request	Working #1	Working #1	Working #1	:N	8000	
9	01	No request	Working #1	Working #1	Working #1	:N	8000	
10	01	No request	Working #1	Working #1	Working #1	:N	8000	
11	01	No request	Working #1	Working #1	Working #1	:N	8000	
12	01	No request	Working #1	Working #1	Working #1	:N	8000	
13	01	No request	Working #1	Working #1	Working #1	:N	8000	
14	01	No request	Working #1	Working #1	Working #1	:N	8000	
15	01	No request	Working #1	Working #1	Working #1	:N	8000	
16	01	No request	Working #1	Working #1	Working #1	:N	8000	
17	01	No request	Working #1	Working #1	Working #1	:N	8000	
18	01	No request	Working #1	Working #1	Working #1	:N	8000	
19	01	No request	Working #1	Working #1	Working #1	:N	8000	
20	01	No request	Working #1	Working #1	Working #1	:N	8000	
21	01	No request	Working #1	Working #1	Working #1	:N	8000	
22	01	No request	Working #1	Working #1	Working #1	:N	8000	
23	01	No request	Working #1	Working #1	Working #1	:N	8000	
24	01	No request	Working #1	Working #1	Working #1	:N	8000	
25	01	No request	Working #1	Working #1	Working #1	:N	8000	
26	01	No request	Working #1	Working #1	Working #1	:N	8000	
27	01	No request	Working #1	Working #1	Working #1	:N	8000	
28	01	No request	Working #1	Working #1	Working #1	:N	8000	

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Dummy Channel Setting

Copy: Copy measurement channel setting

Dummy: Dummy preset setting

Setup | Dummy Preset Time 22:43:17 15/Jan/2000

Default

POH	POH	POH	Pointer	AU Pointer	TU Pointer	522	SS bit [10]
VC4	VC3	VC2/1	V1	V5	V5		
J1	J1	J1	[**]	[ON]	[ON]		Type1
001	001	001					
B3	B3	--	J2	[ON]	[ON]		Type2
--	--		N2	[ON]	[ON]		
C2	C2	--					
002	002	002					
G1	G1	G1	K4	[00]	[00]		
001	001	001					
F2	F2	F2					
001	001	001					
H4	H4	H4					
001	001	001					
F3	F3	F3					
001	001	001					
K3	K3	K3					
001	001	001					
N1	N1	N1					
001	001	001					

Default

N1	[HP]	[Type]	1	8
			IEC	Data Link
			[0000]	[0000]

N2

1	8
B1P-2	b3 Inc TC OEI b7-8
--	[01] [01] [00] [00] [00]

Set OH send data at dummy selection

Path trace J1-HP [OFF]
J1-LP [OFF]
J2 [OFF]
Pattern [J1-HP]

[TRACE PATTERN Anritsu MP1570A SONET/SDH/PDH/ATM Analyzer 44]

Dummy Payload [PRBS11]
Mixed Payload1 [PRBS11]
Mixed Payload2 [PRBS11]

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Monitor

OH monitor

Analyze | OH monitor Type [OH] Pause

1	2	3	4	5	6	7	8	9	POH	VC4
180	F6	28	28	28	01	AA	AA		J100	
289	00	00	00	00	00	00	00		B389	
300	00	00	00	00	00	00	00		C200	
488	98	98	FF	FF	00	00	00		J100	
58A	64	E2	01	00	00	18	00		F200	
600	00	00	00	00	00	00	00		H400	
700	00	00	00	00	00	00	00		F300	
800	00	00	00	00	00	00	00		K300	
900	00	00	00	00	00	00	00		N100	
									N100	

S1 : Quality Unknown
VC4 C2 : TU6 structure
VC3 C2 : Async. 34M or 45M(0-3)

G1 : No remote defect
G1 : No remote defect

Mnemonic
S1, C2, G1 byte

Analyze | OH monitor Type [Path trace] Pause

J0 :RN Anritsu MP1570A SONET/SDH/PDH/ATM Analyzer TRACE PATTERN
CRC-7: ●
TIM :○
J1-HP:4 TRACE PATTERN Anritsu MP1570A SONET/SDH/PDH/ATM Analyzer
CRC-7: ●
TIM :○
J1-LP:RN Anritsu MP1570A SONET/SDH/PDH/ATM Analyzer
CRC-7: ●
TIM :○

Pattern check

CRC-7, TIM
○ : OK
● : NG

Analyze | Pointer monitor Pause

Pointer TU 107
TU PTR 107
+PJC 11
-PJC 0
NDF 0
Cons. 0

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Linking the World

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Monitor

Optical power meter

Analyze | Opt. Power meter Wave length [1.55μm] Pause

Optical Power - 5.1 dBm

Relative + 0.1 dB

Reference - 5.2 dBm

Frequency monitor

Analyze | Freq. monitor Pause

9,953,280,000.0Hz
0.0Hz
0 ppm

Analyze | Frequency Print:Display

Title: Frequency
Time1: 14:46:09 14/Jan/2000
Freq.: 155,520,000.0Hz
0.0ppm

PPM 10
NO DATA

Linking the World

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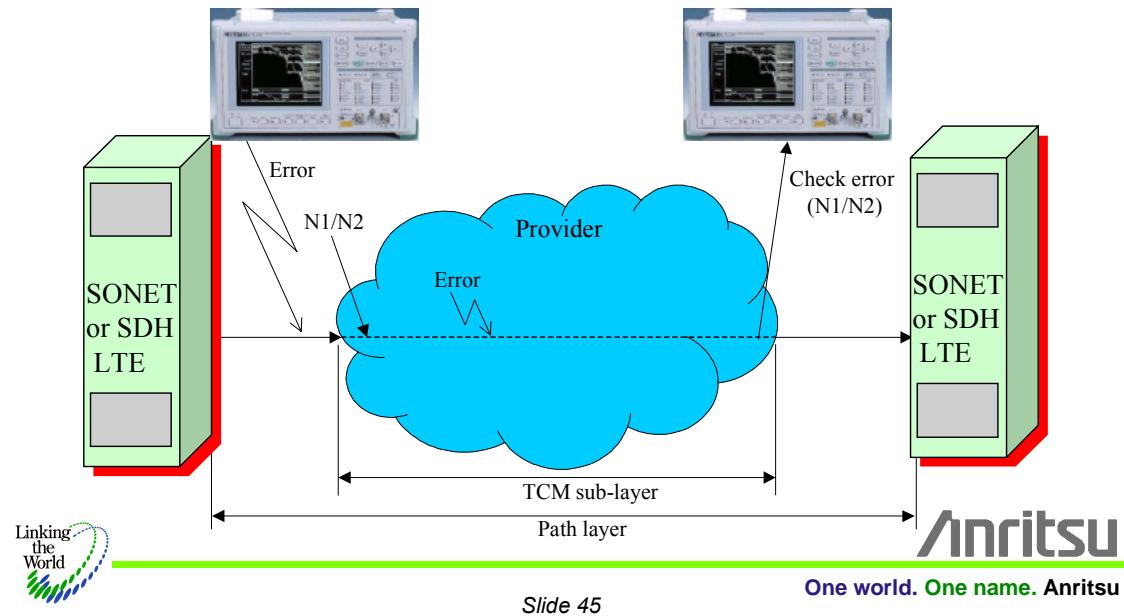
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Tandem Connection Monitoring

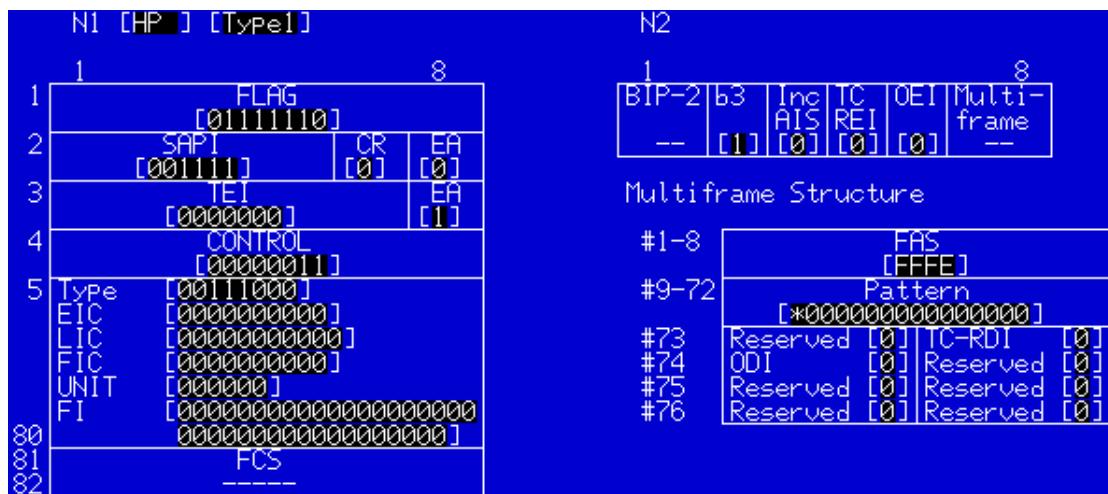
Using N1/N2 byte for network monitoring (ITU-T Rec.G.707)

- discrimination where error has happened among network providers.



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Tandem Connection Monitoring



Alarm measurement: VC-AIS, ISF, FAS, In-coming AIS, RDI, ODI

Error measurement: IEC, REI, OEI

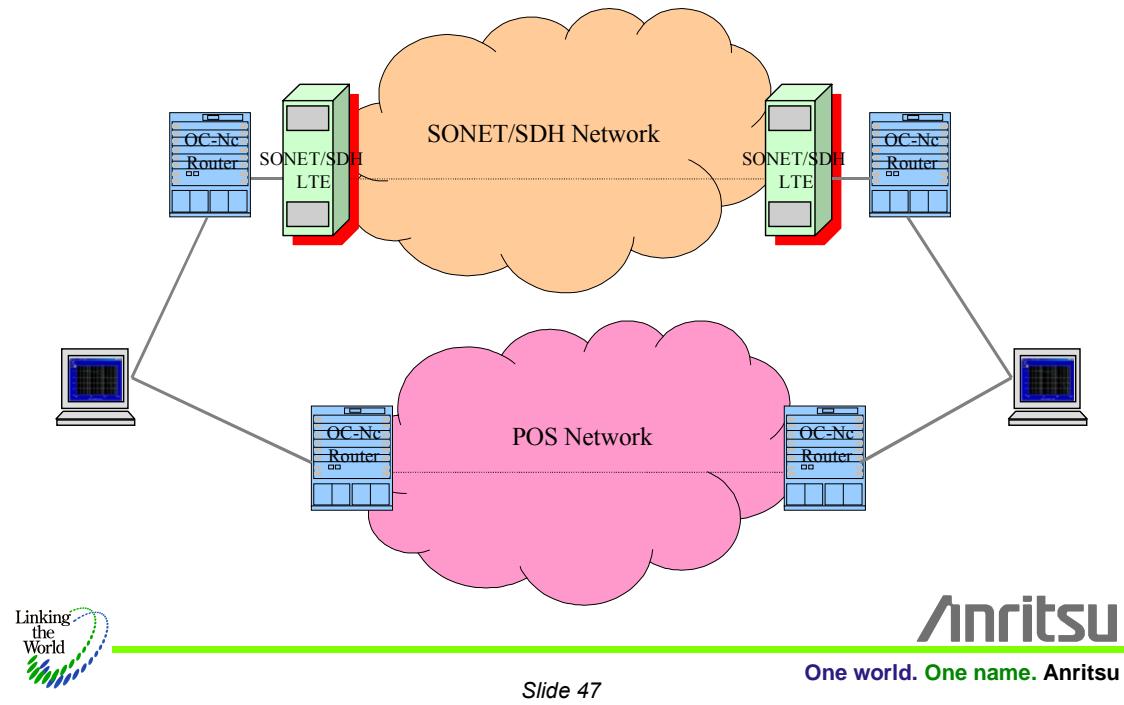


Anritsu

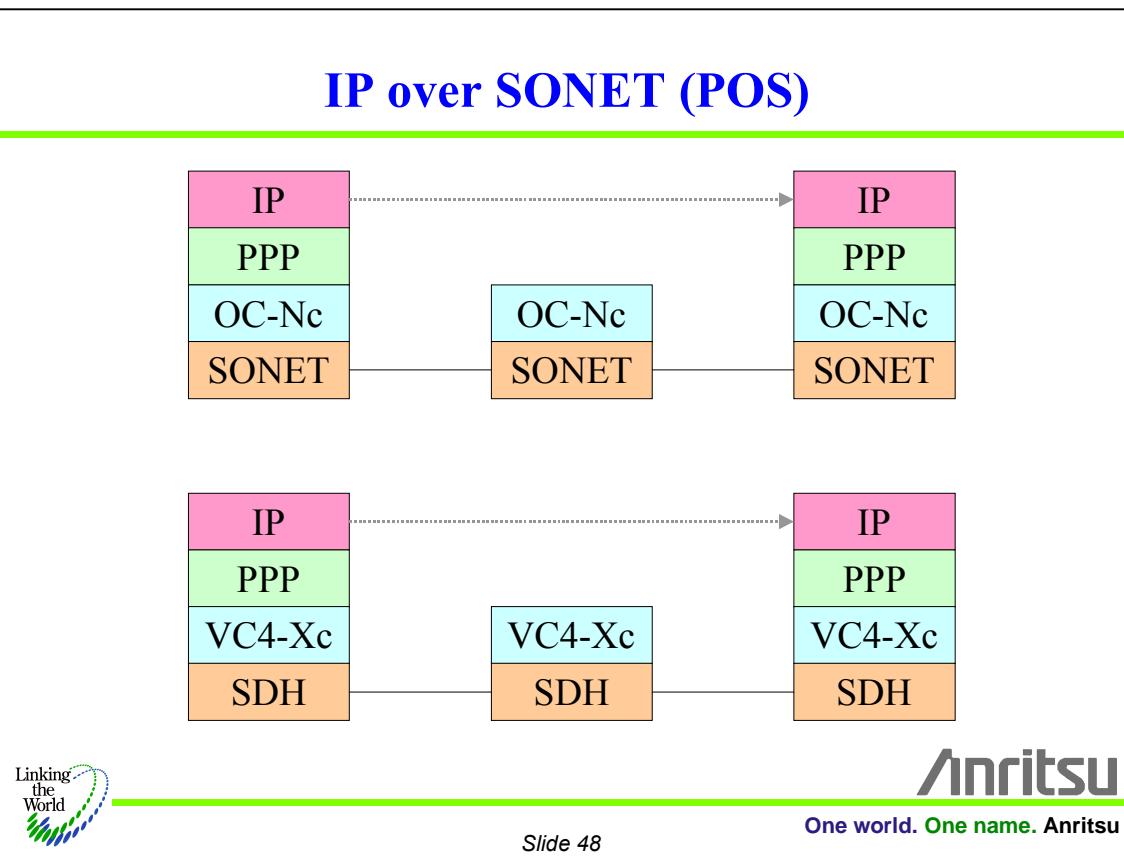
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IP over SONET (POS)

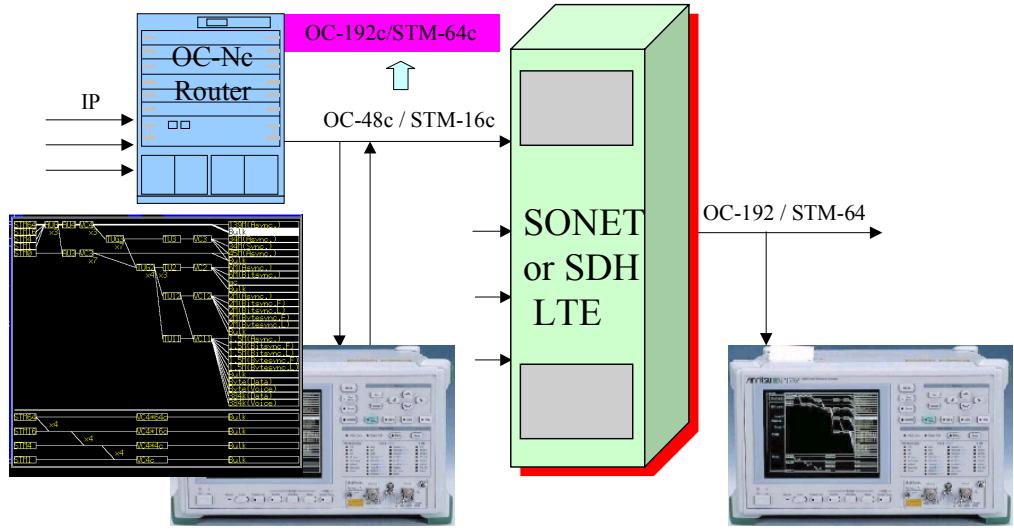


IP over SONET (POS)



Concatenation Mapping Tests

Evaluating router concatenation mapping



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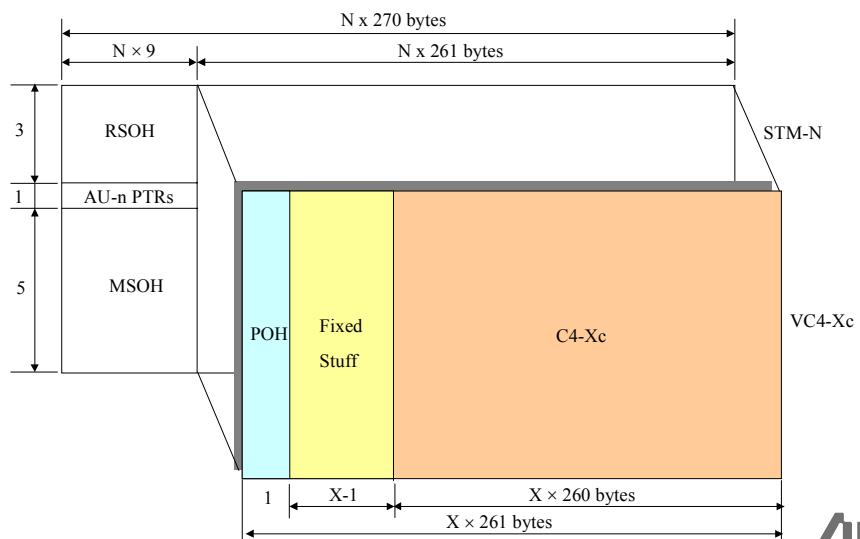
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Concatenation Mapping Tests

Supporting VC4-Xc (ITU-T G.707) and OC-Nc mapping tests

-IP packets are mapped into payloads via the PPP frames.



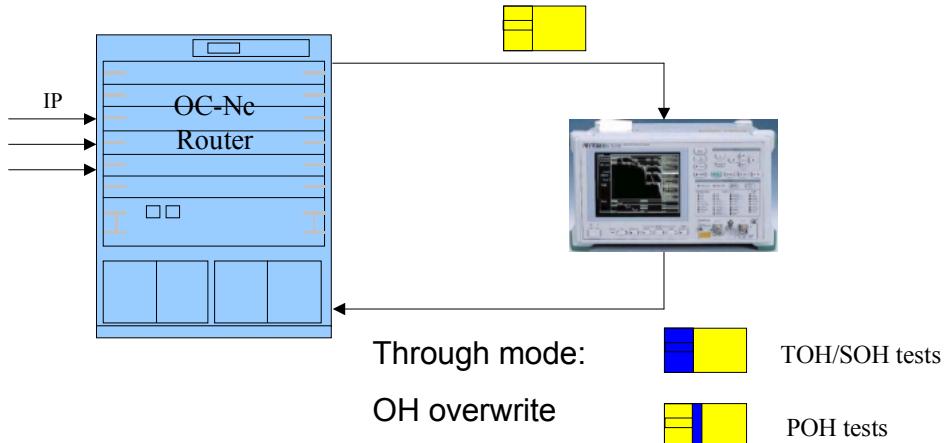
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Tests in Through Mode

Evaluating router SONET/SDH functions



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Frame memory (Option)

Setup		Frame memory	Time 05:30:49 01/Jan/2000
			Print [] to [18]
Bit rate	[622M]		
Concatenation B3 addition	[ON]		
Pointer	[522]	[Recall]	
Frame	[1]		
Jump	[1]		
No.		[18]	
1	A1 A2 A2 A2 A2 A2 A2 [F6][28][28][28][28][28][28]		
2	B1 X21 X21 X21 X22 X22 X22 X23 X23 X23 X23 E1 X24 X24 X24 X25 -- [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
3	D1 X31 X31 X31 X32 X32 X32 X33 X33 X33 D2 X34 X34 X34 X35 [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
4	H1 H2 H2 H2 H2 H2 H2 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --		
5	B2 K1 X54 X54 X54 X55 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --		
6	D4 X61 X61 X62 X62 X62 X62 X63 X63 X63 X63 D5 X64 X64 X64 X65 [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
7	D7 X71 X71 X71 X72 X72 X72 X73 X73 X73 X73 D8 X74 X74 X74 X75 [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
8	D10 X81 X81 X81 X82 X82 X82 X83 X83 X83 X83 D11 X84 X84 X84 X85 [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
9	S1 Z1 M1 Z2 Z2 Z2 Z2 [00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00][00]		
	#01 #02 #03 #04 #01 #02 #03 #04 #01 #02 #03 #04 #01 #02 #03 #04 #01 #02 #04		
	24		



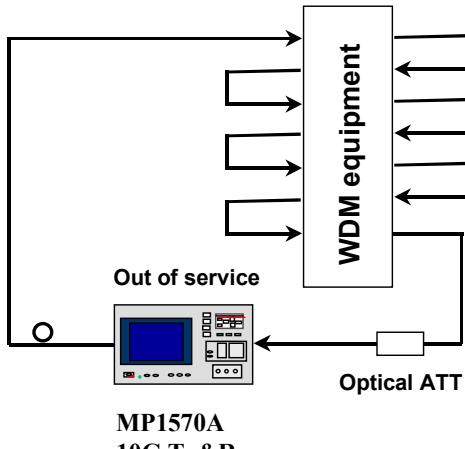
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WDM Measurement Solution

Tx&Rx: 1
Measurement system



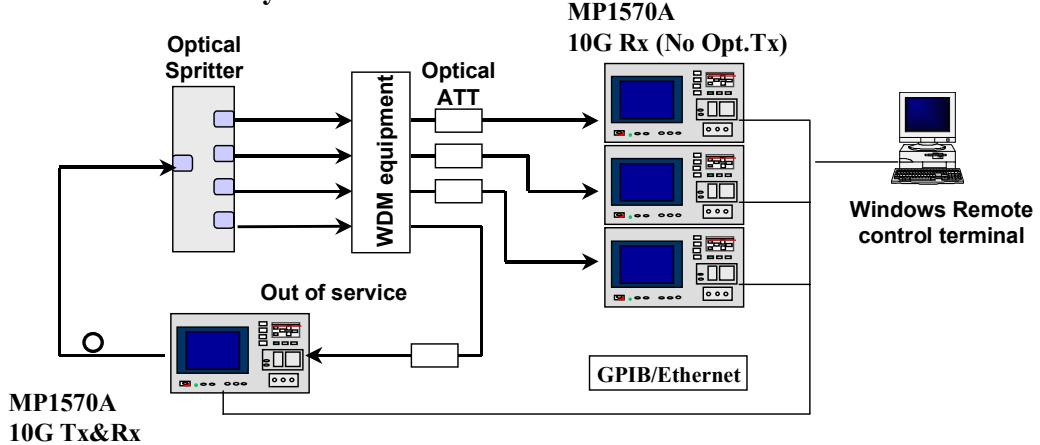
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WDM Measurement Solution

Tx: 1
Rx: 4
Measurement system



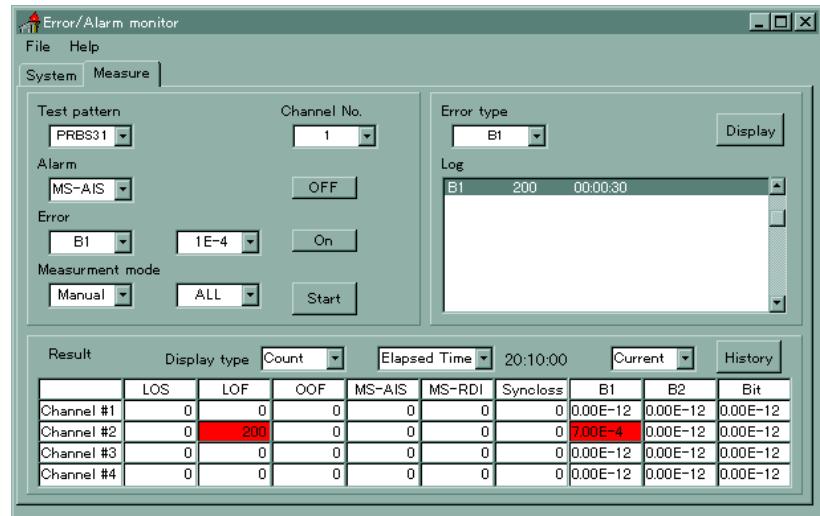
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WDM Measurement Solution (Proposal example)

Screen example



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Specifications are subject to change without notice.

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