



Trend's Gigabit Ethernet

Pocket Guide

AuroraTango Gigabit Ethernet

Multi-technology Personal Test Assistant Platform for simple, fast and effective testing of Gigabit Ethernet, ADSL, SHDSL, and ISDN. Aurora Tango Gigabit Ethernet has an exceptional range of features ensuring reliable delivery of end-to-end services over Metropolitan networks based on Gigabit Ethernet. It includes a full range of tests and measurements, such as RFC-2544, top ten addresses, real-time Ethernet statistics, multilayer BERT, etc. Two Gigaport transceivers allow terminate, loopback and monitor connections to networks, plus a 10/100/1000BASE-T cable port for legacy testing. A PDA provides an intuitive graphical menu structure for testing and workflow organization.



OSI model

802.3 model

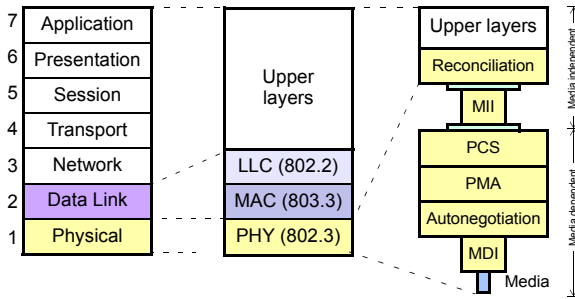


Figure 1 Ethernet layers, 802.3 model compared with OSI. MII and Autonegotiation are optional.

Standard	Interface	Media Type	FDX	Encoding				
				Data	Symbol	MFS	Distance	
Ethernet IEEE 802.3a-t (clauses 1-20) AUI	10BASE-2	One 50 Ohm thin coaxial cable	H	4B/5B	Manchester	64	<185 m	
	10BASE-5	One 50 Ohm thick coaxial cable	H	4B/5B	Manchester	64	<500 m	
	10Broad36	One 75 Ohm coaxial (CATV)	H	4B/5B	Manchester	64	<3600 m	
	10BASE-T	Two pairs of UTP 3 (or better)	H/F	4B/5B	Manchester	64	<100 m	
	10BASE-FP	Two optical 62.5 µm MMF passive hub	H	4B/5B	Manchester	64	<1000 m	
	10BASE-FL	Two optical 62.5 µm MMF asyn hub	F	4B/5B	Manchester	64	2000 m	
	10BASE-FB	Two optical 62.5 µm MMF sync hub	H	4B/5B	Manchester	64	<2000 m	
	100BASE-T4	Four pairs of UTP 3 (or better)	H	8B/6T	MLT3	64	<100 m	
	100BASE-T2	Two pairs of UTP 3 (or better)	H/F	PAM5x5	PAM5	64	<100 m	
	100BASE-TX	Two pairs of UTP 5 (or better)	H/F	4B/5B	MLT3	64	<100 m	
Fast Ethernet IEEE 802.3u (clauses 21-28) MII	100BASE-TX	Two pairs of STP cables	F	4B/5B	MLT3	64	200 m	
	100BASE-FX	Two optical 62.5 µm MMF	F	4B/5B	NRZI	64	2 km	
	100BASE-FX	Two optical 50 µm SMF	F	4B/5B	NRZI	64	40 km	
	1000BASE-CX	Two pairs 150 Ohm STP (twinx)	F	8B/10B	NRZ	416	25 m	
Gigabit Ethernet IEEE 802.3z/ab (clauses 34-42) GMII	1000BASE-T	Four pair UTP 5 (or better)	H/F	4D-PAM5	PAM5	520	<100 m	
	1000BASE-SX	Two 50 µm MMF, 850 nm	F	8B/10B	NRZ	416	500/750 m	
	1000BASE-SX	Two 62.5 µm MMF, 850 nm	F	8B/10B	NRZ	416	220/400 m	
	1000BASE-LX	Two 50 µm MMF, 1310 nm	F	8B/10B	NRZ	416	550/2000 m	
	1000BASE-LX	Two 62.5 µm MMF, 1310 nm	F	8B/10B	NRZ	416	550/1000 m	
	1000BASE-LX	Two 8-10 µm SMF, 1310 nm	F	8B/10B	NRZ	416	5 km	
	1000BASE-ZX	Two 8-10 µm SMF, 1310 nm	F	8B/10B	NRZ	416	80 km	
	10GBASE-SR	Two 50 µm MMF, 850 nm	F	64B/66B	NRZ	N/A	2 ~ 300 m	
	10GBASE-SW	Two 62.5 µm MMF, 850 nm	F	64B/66B	NRZ	N/A	2 ~ 33 m	
	10GBASE-LX4	Two 50 µm MMF, 4 x DWDM signal	F	8B/10B	NRZ	N/A	300 m	
10GEthernet IEEE 802.3ae (clause 48-53) XGMII	10GBASE-LX4	Two 62.5 µm MMF, 4 x DWDM signal	F	8B/10B	NRZ	N/A	300 m	
	10GBASE-LX4	Two 8 ~ 10 µm SMF, 1310 nm, 4 x DWDM signal	F	8B/10B	NRZ	N/A	10 km	
	10GBASE-LR	Two 8 ~ 10 µm SMF, 1310 nm	F	64B/66B	NRZ	N/A	10 km	
	10GBASE-LW	Two 8 ~ 10 µm SMF, 1310 nm	F	64B/66B	NRZ	N/A	10 km	
	10GBASE-ER	Two 8 ~ 10 µm SMF, 1550 nm	F	64B/66B	NRZ	N/A	2 ~ 40 km	
	10GBASE-EW	Two 8 ~ 10 µm SMF, 1550 nm	F	64B/66B	NRZ	N/A	2 ~ 40 km	

Figure 2 Ethernet layers, 802.3 model compared with OSI. MII and Autonegotiation are optional.

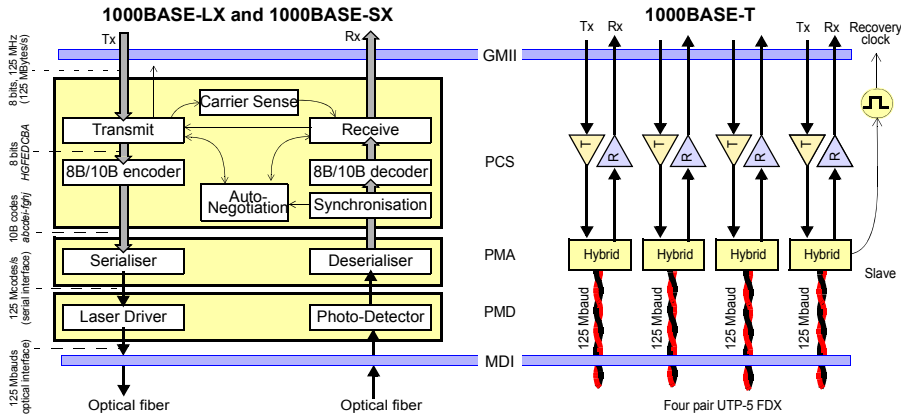
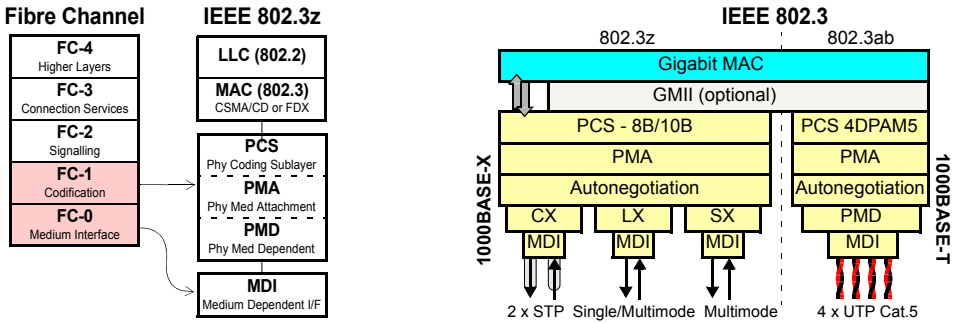


Figure 3 Gigabit Ethernet defines several transmission media: 802.3z (1000BASE-X) based on the existing Fibre Channel technology, and 802.3ab (1000BASE-T) which uses UTP.

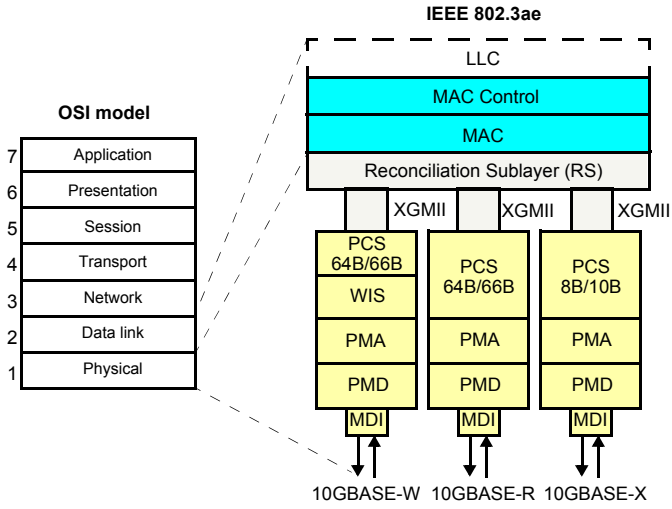


Figure 4 Layered model of IEEE 802.3ae 10 Gigabit Ethernet.

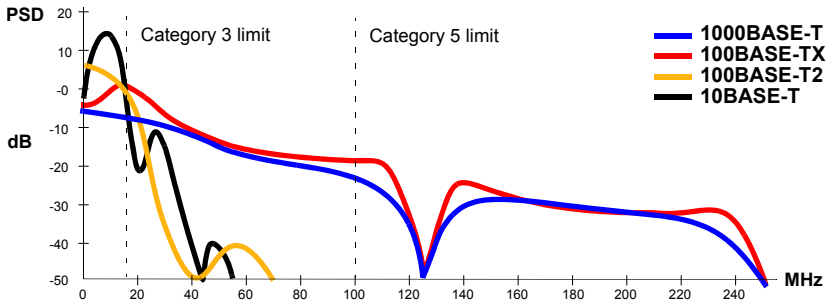


Figure 5 Power Spectrum Density (PSD).

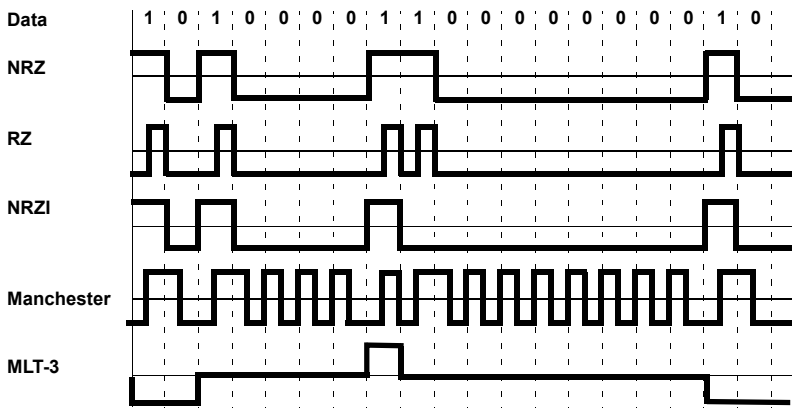


Figure 6 Symbol encoding schemes used in Ethernet.

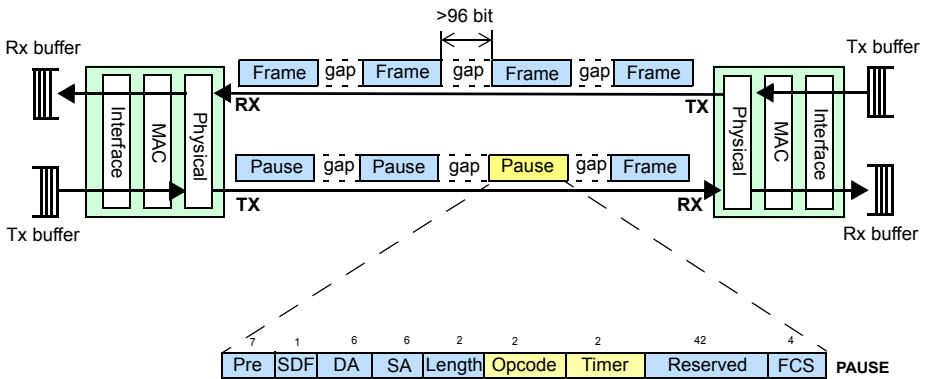
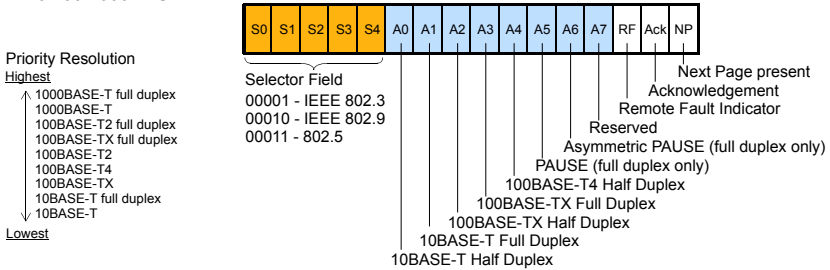
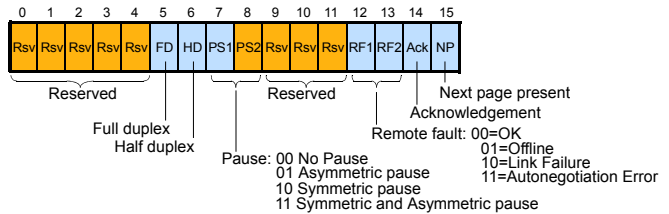


Figure 7 FDX operation enables two-way transmission simultaneously without contention, collisions, extension bits or retransmissions. The only restriction is that a gap must be allowed between two consecutive frames. FDX also requests flow control, which is transmitted by the receiver to request that the transmitter temporarily stops transmitting.

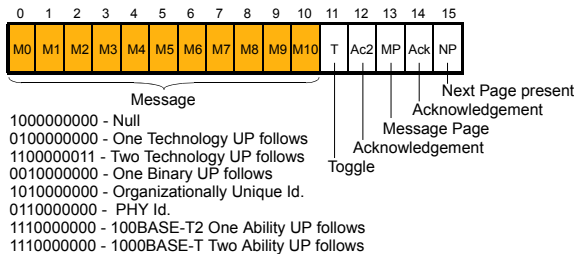
**Autonegotiation Base Page
10/100/1000BASE-T**



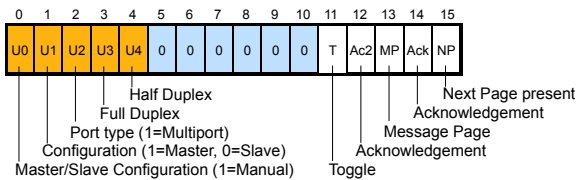
**Autonegotiation Base Page
1000BASE-X**



Message Next Page



**Unformatted Page 1
1000BASE-T**



**Unformatted Page 2
1000BASE-T**

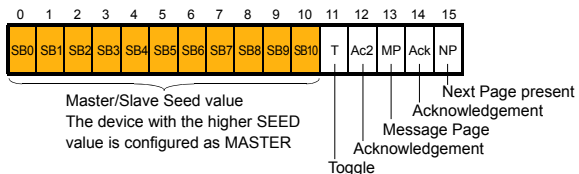
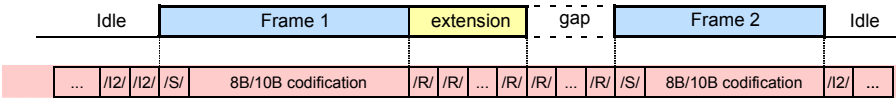


Figure 8

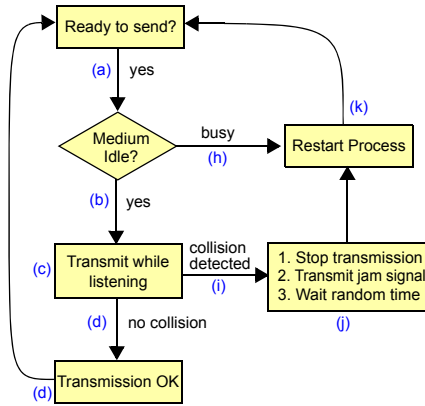
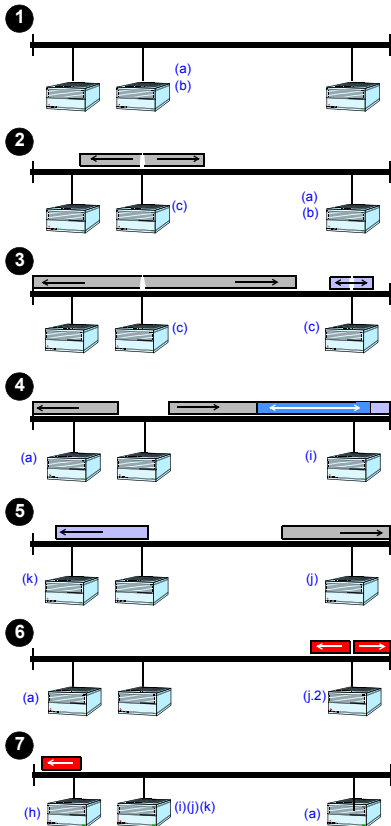
Autonegotiation messages. On link initialization, the two stations send 16 bits page messages to their partners. The interchange can consist of many pages in addition to the base page.
Scope:
10/100BASE-T autonegotiation: only systems 10/1000 Mbit/s using UTP and RJ-45.
1000BASE-X autonegotiation: media equivalent systems at 1000 Mbit/s
1000BASE-T autonegotiation: negotiable 10/100/1000 Mbit/s using UTP and RJ-45.



Code	Description	Encoding	Comment
/C1/	Configuration	/K28.5/D21.5/Msg	Alternating C1 and C2.
/C2/	Configuration	/K28.5/D2.2/Msg	Autonegotiation
/I1/	Idle	/K28.5/D5.6/	Interframe gaps. /I1/
/I2/	Idle	/K28.5/D16.2/	Correcting, /I2/ preserving
/R/	Carrier Extend	/K23.7/	Also interframe gaps
/S/	Start of Frame	/K27.7/	Delimiter
/T/	End of Frame	/K29.7/	Delimiter
/V/	Error	/K30.7/	Error notification

Data	8B value HGF-EDCBA	Name	10B code abcdei fghj	10B code + abcdei fghj
D7	110 10111	/D23.6/	111010 0110	000101 0110
/I2/	Idle	/K28.5/ D16.2/	001111 1010 011011 0101	110000 0101 100100 0101
/R/	Carrier Extend	/K23.7/	111010 1000	000101 0111
/S/	Start of Frame	/K27.7/	111010 1000	000101 0111
/T/	End of Frame	/K29.7/	101110 1000	010001 0111
/V/	Error	/K30.7/	011110 1000	100001 0111

Figure 9 At the Line Coding for 1000BASE-X. The use of code words to encapsulate the frame is made to unambiguously distinguish data from control information.



Half Duplex Operation limits

Bit rate	Type	Diameter	With repeaters
1000 Mbit/s	1000BASE-T	100 m	200 m
1000 Mbit/s	Fiber	316 m	200 m
100 Mbit/s	UTP	100 m	205 m
100 Mbit/s	Fiber	412 m	205 m
10 Mbit/s	UTP	100 m	2500 m

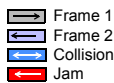
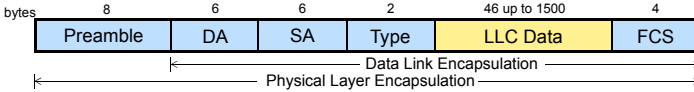
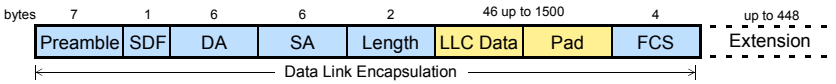


Figure 10 Half-duplex operation. CSMA/CD flow chart. The jamming signal ensures that all the stations know that there has been a collision. The amount of random time waited depends on the back-off strategy.

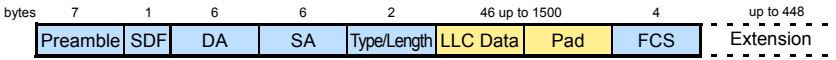
DIX frame (1970)



IEEE 802.3x frame (1983)



IEEE 802.3x frame (1997)



Preamble: Synchronization pattern

SDF: Start Frame Delimiter (10101011)

DA: Destination Address

SA: Source Address

Type: Nature of the client protocol *IP, IPX, AppleTalk, etc

Length: Number of bytes of the LLC data

LLC data: Information supplied by LLC layer

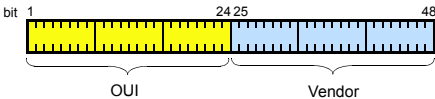
Pad: Bytes added to ensure a minimum frame size of 46 bytes

Extension: Only for Gigabit, ensures a minimum frame size (520 or 416 bytes depending on the version)

FCS: Frame Check Sequence CRC code based on all the fields except Preamble and SDF

Figure 11 The basic IEEE 802.3 MAC frame format.

MAC address coding



OUI: Organizationally Unique Identifier, IEEE administrated code

Vendor: Code administrated by the manufacturer

IP into MAC multicast address mapping

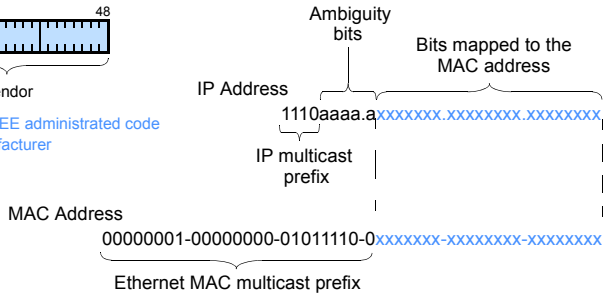


Figure 12 The 48-bit Ethernet MAC address is composed by a 24-bit word administered by the IEEE, and a second 24-bit word administered by NIC vendors. Multicast IP addresses can be directly mapped into multicast addresses with a special multicast prefix.

Virtual LAN

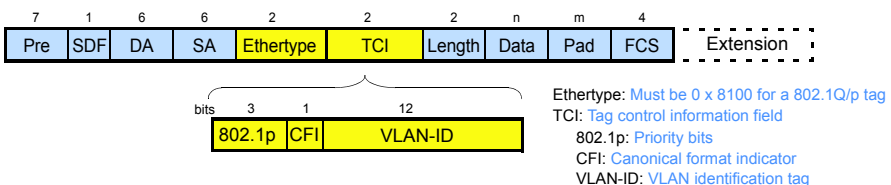


Figure 13 Ethernet frame with 802.1Q/p VLAN field structure.

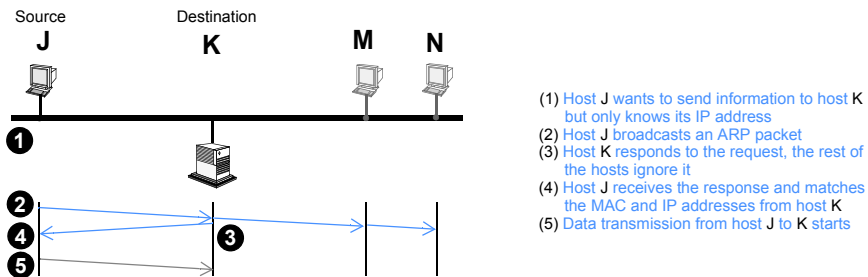


Figure 14 ARP operation when source and destination hosts are both in the same Ethernet network.

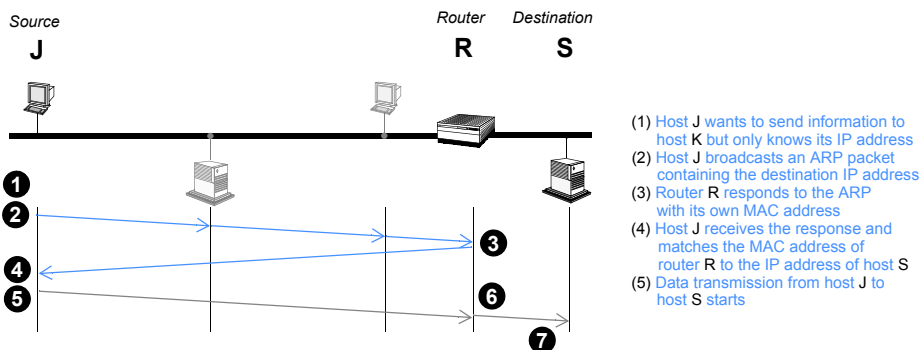


Figure 15 ARP operation when source and destination hosts are in different Ethernet networks and the information is forwarded between them by a router.

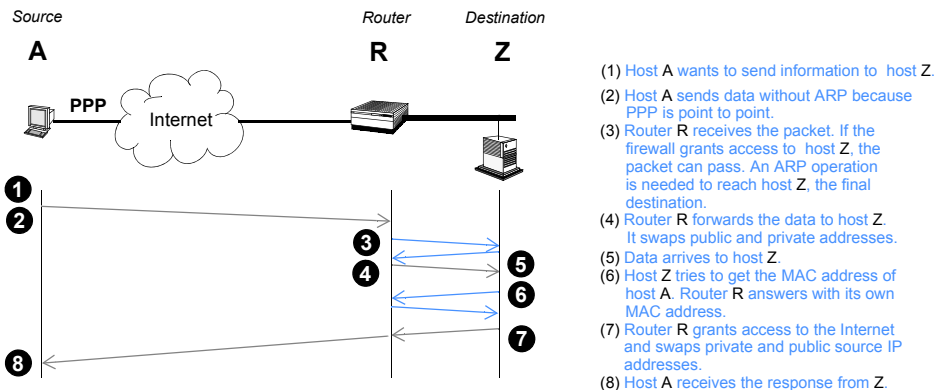
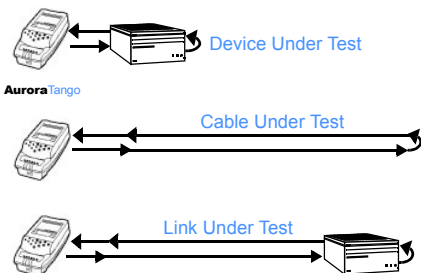
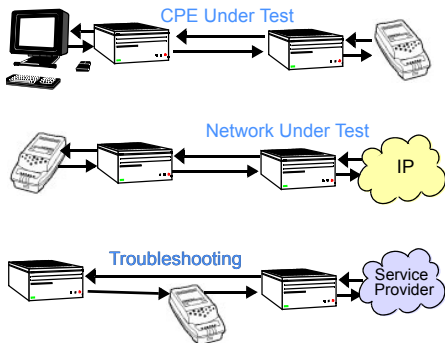


Figure 16 Access to a remote host placed behind a NAT firewall with a PPP connection to the Internet.

Gigabit Ethernet Testing



AuroraTango

Acronyms

ARP	Address Resolution Protocol	NAT	Network Address Translation
CPE	Customer Premises Equipment	NIC	Network Interface Card
CSMA/CD	Carrier-Sense Multiple Access Collision Detect	NRZ	Non-Return to Zero
DIX	Digital Intel and Xerox	OSI	Open Systems Interconnection
DUT	Device Under Test	PAM	Pulse Amplitude Modulation
FDX	Full-Duplex Capacity	PCS	Physical Code Sublayer
GMII	Gigabit Media-Independent Interface	PHY	PHYsical layer
IEEE	Institute of Electrical and Electronics Engineers	PMA	Physical Medium Attachment
IP	Internet Protocol	PMD	Physical Media Dependent
LAN	Local Area Network	PPP	Point to Point Protocol
LLC	Logical Link Control	RZ	Return to Zero
MAC	Media Access Control	RZI	Return to Zero Inverted
MDI	Media-Dependent Interface	SMF	Single-Mode Fibre
MFS	Minimum Frame Size	STP	Shielded Twisted Pair
MII	Media-Independent Interface	UP	Unformatted Page
MLT3	Multi-Level Threshold	UTP	Unshielded Twisted Pair
MMF	Multi-Mode Fibre	VLAN	Virtual Local Area Network



Trend Communications Ltd.
Whitebrook Park,
Lower Cookham Road,
Maidenhead,
Berkshire, SL6 8XY, UK



More information in:
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TrendCommunications

International: +44 (0)1628 503500
China: +86 1085183141
Deutschland: +49 (0)8932300930
España: +34 933003313
France: +33 169355470
India: +91 2228521059
UK: +44 (0)1628503500
US: +1 2564610790
Email: infoline@trendcomms.com
Web: www.trendcomms.com