ZHONE

Ethernet over Copper Product Guide

Enabling high bandwidth without the cost of fiber construction

Access for a Converging World

Copper is everywhere...

Ethernet loop bonding delivers high-bandwidth services without the cost of fiber construction. With more than **85%** of all US businesses served by copper today, copper loop bonding is the ideal solution for optimizing OPEX. The business case works—Ethernet access has a quick ROI, with gross margins of **80%** realized by incumbent and alternative carriers alike! Simple to install, fast to deploy… without costly fiber installations or infrastructure additions.*

1999	2002	2003	2005	2006	2007
Net to Net introduces Ethernet over Copper	Net to Net introduces Copper Loop Bonding	Paradyne acquires Net to Net	**Zhone** acquires Paradyne	**Zhone** launches 802.3ah EFM	**Zhone** number one in worldwide EoC port shipments

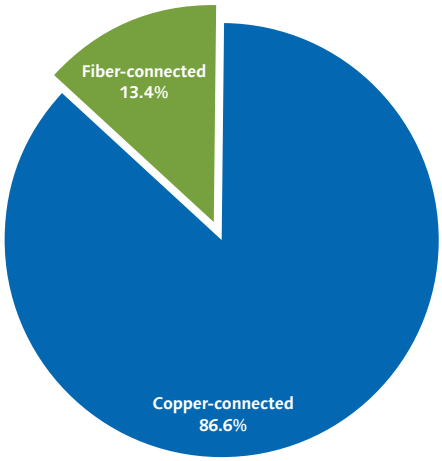
Zhone is the Global Market Leader

- Pioneered development of Ethernet over copper and now shipping 802.3ah-standard Ethernet First Mile (EFM) solutions
- Ranked number one worldwide in Ethernet over Copper (EoC) ports shipped**
- Supporting EoC across multiple access platforms and an extensive line of Ethernet Access Devices (EADs)

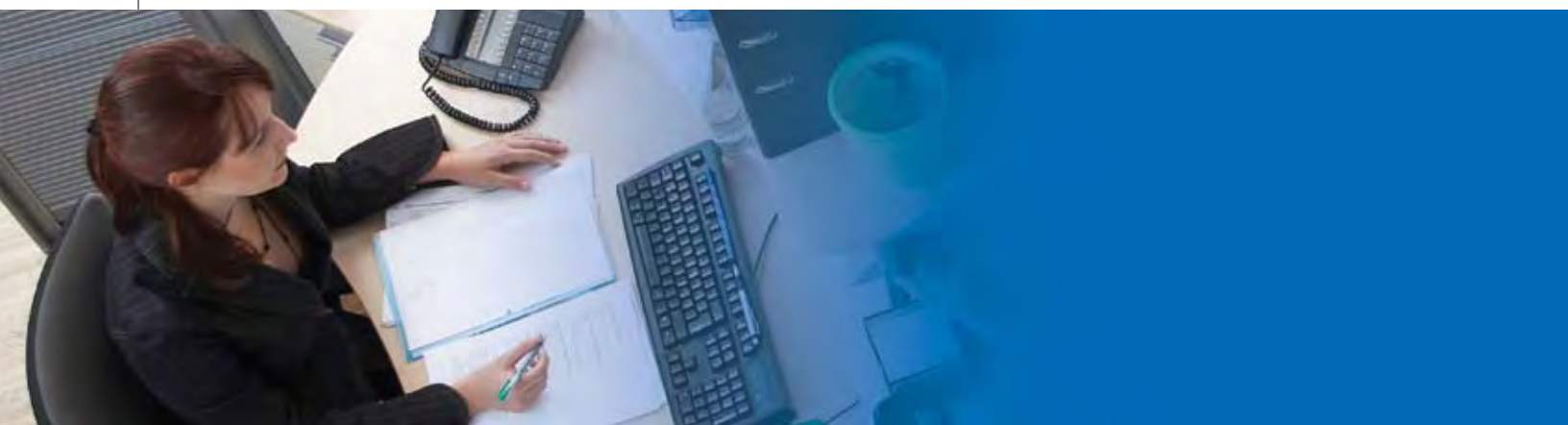
* *Source: Vertical Systems Group*

** *Source: Infonetics*

Business service delivery to US commercial buildings with 20+ employees



Source: Vertical Systems Group



Bonding copper circuits for increased Ethernet bandwidth

The key innovation in EFM is the loop bonding of multiple copper circuits to provide increased bandwidth. By intelligently distributing traffic across multiple circuits, and using very high-efficiency hardware processing, these multiple circuits appear to the network as a single, high-bandwidth link, overcoming the limitations of individual copper circuits.

802.3ah EFM

The IEEE 802.3ah standard for EFM, covering both fiber and copper Ethernet applications, specifies the type of encoding used, bonding methodology for copper, and OAM (Operations, Administration and Maintenance) support. Zhone supports 802.3ah in our Ethernet aggregation line cards and EtherXtend SHDSL.bis EAD products.

N2N Ethernet over Copper Bonding

Pioneered by Net to Net (also known as N2N, acquired by Zhone in 2005) N2N Ethernet over copper loop bonding is the pre-standard benchmark for performance. Deployed worldwide and field proven, Zhone continues its support for N2N bonding along with standards-based EFM. N2N-based bonding provides physical layer (PHY) bonding of T1/E1/DS3 and SHDSL circuits for highly efficient and reliable bandwidth gain.

Ethernet over Copper as Frame Relay replacement

IP SLA adds value

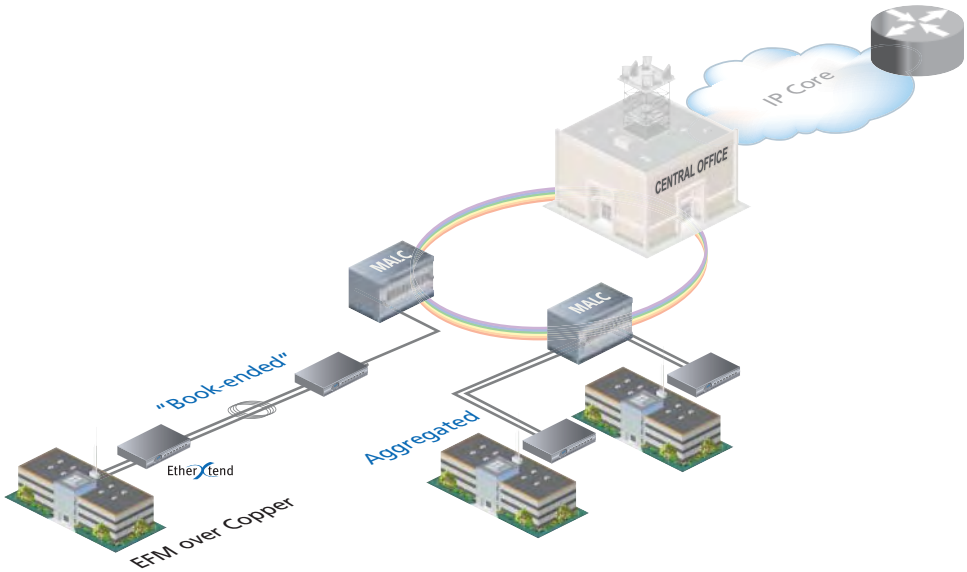
Today's businesses need higher bandwidth and are willing to pay for assured performance. IP Service Level Agreement (IP SLA) enables the business customer to receive reports on round trip performance, link availability, link uptime, latency, jitter, and other statistical data measurements for their service.

The advantage of Transparent LAN Service (TLS)

TLS uses the simplicity and ease of native Ethernet and VLANs to deliver easy-to-provision Layer 2 services. TLS provides seamless LAN-to-WAN connectivity, without costly and complex WAN equipment or the need to encapsulate. Up to 8 pairs of T1/E1 or SHDSL.bis pairs can be bonded, thus providing scalable bandwidth up to 45 Mbps.

Ethernet Private Line services are quick and easy

Creating a point-to-point Ethernet Private Line (E-Line) service using existing copper pairs allows copper bonding to rapidly increase bandwidth by creating T1/E1 or SHDSL.bis Ethernet connections from 1.5 Mbps to as high as 45 Mbps. Using the same copper delivering Fractional or Full T-1 Frame Relay, a secure and higher bandwidth E-Line is created without the need to reconfigure the core network.



EtherXtend ... Easy, Proven, Deployed.

3300 Series EtherXtend EADS

Fully featured, high-capacity loop bonding and multi-standard support all-in-one device using extended rate SHDSL.bis with inband OAM

ETHX 3344: 4-port SHDSL.bis
ETHX 3384: 8-port SHDSL.bis

- Up to 45.6 Mbps bonded capacity
- 802.3ah EFM or N2N selectable bonding
- Bridged or routed on every port
- 4 10/100 Base-T LAN interfaces

3000 Series EtherXtend EADS

Fully managed and intelligent features using 802.3ah EFM standards with inband OAM over bonded extended rate SHDSL.bis

ETHX 3014: 1-port SHDSL.bis
ETHX 3024: 2-port SHDSL.bis
ETHX 3044: 4-port SHDSL.bis

- Up to 22 Mbps bonded capacity
- Simplicity of bridged operation
- 802.3ah EFM bonding
- 1, 2 or 4 WAN port models
- 4 10/100 Base-T LAN interfaces

2200 Series EtherXtend EADS

Delivering Ethernet over Copper Loop Bonding on DS3

ETHX 2214: 1-port DS3
ETHX 2224: 2-port DS3

- Up to 90 Mbps bonded capacity
- Proven N2N bonding
- Support Multimedia Traffic Management (MTM)

2100 Series EtherXtend EADS

The most widely used Ethernet over Copper Loop Bonding technology combined with the high bandwidth of SHDSL.bis

ETHX 2111: 1-port SHDSL.bis/1-LAN port
ETHX 2112: 1-port SHDSL.bis/2-LAN ports
ETHX 2122: 2-port SHDSL.bis/2-LAN ports

- Up to 11.4 Mbps bonded capacity
- Proven N2N bonding
- Either provider or subscriber units
- Simplicity of bridged operation

EtherXtend Ethernet Access Device Product Selection Guide

	3300 Series	3000 Series	2200 Series	2100 Series	TNE	SNE	ENE
WAN Interface	SHDSL.bis 5.7 Mbps	SHDSL.bis 5.7 Mbps	DS3 45 Mbps	SHDSL.bis 5.7 Mbps	T1 1.544 Mbps	SHDSL 2.3 Mbps	E1 2.048 Mbps
WAN Ports	4 or 8	1, 2 or 4	1 or 2	1 or 2	1, 2, 4 or 8	1, 2 or 4	1, 2, 4 or 8
Bandwidth (at max ports)	Up to 45.6 Mbps	Up to 22.8 Mbps	Up to 90 Mbps	Up to 11.4 Mbps	Up to 12 Mbps	Up to 9.2 Mbps	Up to 16 Mbps
Loop Bonding	802.3ah EFM N2N	802.3ah EFM EFM	N2N	N2N	N2N	N2N	N2N
LAN Interfaces 10/100 Base-T	4	4	4	1 or 2	1 (1/2 port) 4 (4/8 port)	1	1 (1/2 port) 4 (4/8 port)
Management	802.3ah inband	CLI, Web, SNMP	CLI, Web, SNMP	CLI, Web, SNMP	CLI, Web, SNMP (4/8 port)	Unmanaged	CLI, Web, SNMP (4/8 port)
QoS	802.1p	802.1p	802.1p	802.1p	802.1p		802.1p
Layer 2 Layer 3	Bridging Routing	Bridging L3 aware	Bridging L3 aware	Bridging L3 aware	Bridging L3 aware	Bridging	Bridging L3 aware

TNE/ENE/SNE Family

T1/E1/SHDSL Network Extenders with proven performance — deployed worldwide

TNE
T1 Network Extenders

TNE 1500
- 1 T1 WAN port, 1 10/100 Ethernet LAN port

TNE 1520 1 or 2 T1 WAN ports
- 1 10/100 Ethernet LAN port

TNE 1544
- 4 T1 WAN ports, 4 10/100 Ethernet LAN ports
- Fully managed

TNE 1584
- 8 T1 WAN ports, 4 10/100 Ethernet LAN ports
- Fully managed

SNE
G.SHDSL Network Extenders

SNE 2000
- 1 SHDSL 2.3 Mbps WAN port, 1 10 Mbps LAN port
- Provider and Subscriber units

SNE 2020
- 2 SHDSL 2.3 Mbps WAN ports, 1 10 Mbps LAN port
- Provider and Subscriber units

SNE 2040
- 4 SHDSL 2.3 Mbps WAN ports, 1 10/100 Ethernet LAN port
- Provider and Subscriber units

ENE
E1 Network Extenders

ENE 2000
- 1 E1 WAN port, 1 10/100 Ethernet LAN port

ENE 2020
- 1 or 2 E1 WAN ports. 1 10/100 Ethernet LAN port

ENE 2044
- 4 E1 WAN ports, 4 10/100 Ethernet LAN ports
- Fully managed

ENE 2084
- 8 E1 WAN ports, 4 10/100 Ethernet LAN ports
- Fully managed

Ethernet Aggregation

MALC-MSAP

MALC-EFM-SHDSL-24
MALC-EFM-T1/E1-24
MALC-EFM-SHDSL-24 NTP
MALC-EFM-SHDSL-24 NTWC

- 802.1ad Q in Q transparent LAN support
- Bridging and routing support on all ports
- 802.3ah (EFM) compliance with 802.3ah OAM
- N2N loop bonding support with 802.3ah
- IP SLA latency/jitter/data-loss measurements
- Layer 2 and 3 functions
- Gigabit Ethernet uplinks
- Card options for network timing and network powering

MALC and Raptor 319, 719, 723

World-class Multi-Service Access Platform (MSAP) supporting Ethernet Aggregation

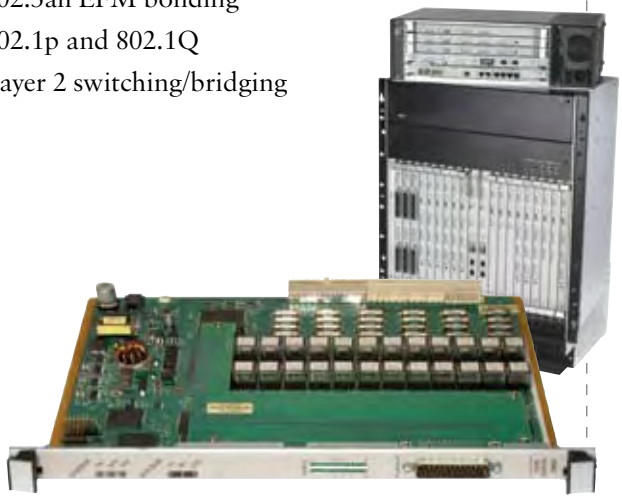
The MALC has the highest-density Ethernet Aggregation of any MSAP today. 24-port SHDSL.bis or T1/E1 line cards enable bonding across all ports.

DSLAM

8820/8620
Core DSLAM functionality with 802.3ah EFM support

Ethernet Aggregation is combined with DSLAM functionality on an ATM and IP Platform

- 24-port SHDSL.bis bonding card
- 802.3ah EFM bonding
- 802.1p and 802.1Q
- Layer 2 switching/bridging

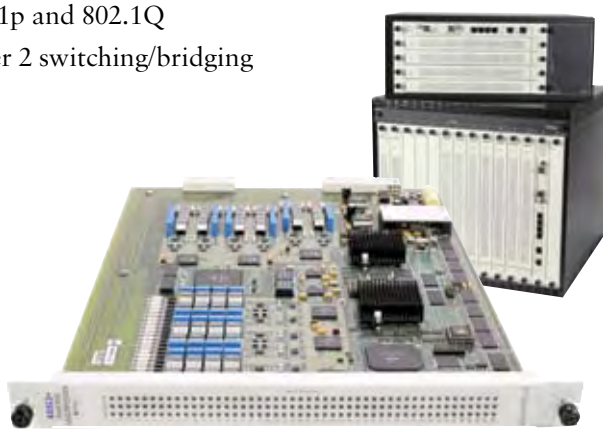


IPD DSLAM

4000/12000
IP DSLAM delivering advanced broadband services

IPD is the world's most widely deployed Ethernet Aggregation platform, pioneering Ethernet over copper with N2N bonding.

- 48-port SHDSL.bis bonding card
- 24-port T1/E1 bonding card
- 802.1p and 802.1Q
- Layer 2 switching/bridging



Aggregation Platforms

	MALC-EFM		8800 /8620 DSLAM	IPD 4000/12000 DSLAM			
Line Card	**MALC-EFM-SHDSL-24**	**MALC-EFM-T1/E1-24**	**8986-B1-000**	**ESIM-5700-48**	**SIM2000-24**	**TIM1500-24**	**EIM2000-24**
Access Interface	SHDSL.bis 5.7 Mbps	T1/E1	SHDSL.bis 5.7Mbps	SHDSL.bis 5.7 Mbps	SHDSL 2.3 Mbps	T1	E1
Loop Bonding	802.3ah, N2N	N2N	802.3ah	N2N	N2N	N2N	N2N
Ports per Card	24	24	24	48	24	24	24
Shelf Capacity (card slots/ports)	319: 8/192 719: 16/384 723: 20/480	319: 7/192 719: 17/384 723: 19/480	8820: 18/432 8620: 3/72	12000: 12/576 4000: 4/192	12000: 12/288 4000: 4/96	12000: 12/288 4000: 4/96	12000: 12/288 4000: 4/96
Management	CLI, Web, SNMP ZMS	CLI, Web, SNMP ZMS	CLI, Web, SNMP	CLI, Web, SNMP	CLI, Web, SNMP	CLI, Web, SNMP	CLI, Web, SNMP
QoS	802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p
Layer 2 Layer 3 Layer 4	Bridging Routing Aware	Bridging Routing Aware	Bridging	Bridging Aware	Bridging Aware	Bridging Aware	Bridging Aware
IP SLA	●	●					
Network Timing Wetting Current	Optional Cards						

EAD to Aggregation Platform Interoperability

	MALC-EFM-SHDSL-bis	MALC-EFM-T1/E1	DSLAM 8986-B1 SHDSL.bis	IPD ESIM-5700 SHDSL.bis	IPD SIM-2000 G.SHDSL	IPD TIM-1500 T1	IPD EIM-2000 E1
EtherXtend 3300 Series	●		●	●	At 2.3 Mbps		
EtherXtend 3000 Series	●		●				
EtherXtend 2100 Series	●			●	At 2.3 Mbps		
Network Extender TNE (T1)		●				●	
EtherXtend SNE Series	At 2.3 Mbps			At 2.3 Mbps	At 2.3 Mbps		
EtherXtend ENE Series		●					●

Serving Customer Needs

NETMEDIA

Zhone Delivers Higher Bandwidth to Netmedia

"Using Zhone's Ethernet over Copper solutions with both E1 and SHDSL lines has enabled delivery of higher bandwidth Ethernet business services in Finland over existing copper lines, thereby creating new and profitable Ethernet business services by re-using existing plant."

Martin Sten, Founder
Netmedia, Finland

Grande COMMUNICATIONS

Grande Communications Makes Carrier Ethernet a Big Success

"The addition of Zhone's Ethernet access technology in combination with Grande's extensive copper and fiber network creates an unparalleled delivery vehicle. The unique ability to offer true 802.1 Q-in-Q Transparent LAN Service with the requisite Layer 2 and 3 controls is an important component of this product offering for Grande."

Lamar Horton, Director
Network Engineering
Grande Communications

Saudi Telecom

Dramatic Improvement in Service Capability

"We believe Zhone's EFM solution will dramatically improve our service capability through copper loop bonding for higher bandwidth along with symmetric data capabilities for our business customers demanding enhanced services. Zhone's EFM standards-based access aggregation ensures our service objectives are met, including simplifying provisioning and management."

Sami Al-Zomaia, Access
Engineering Manager
Saudi Telecom

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