ZHONE

EFM PRODUCT GUIDE

Copper-Based Ethernet in the First Mile

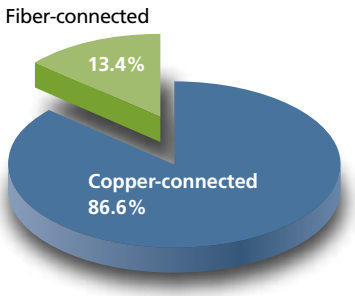
Ethernet Everywhere

Need high-bandwidth Ethernet service over existing copper?

Zhone's EFM Solutions make it easy and cost-effective.

Ethernet loop bonding delivers high-bandwidth services without the cost of fiber construction.

Business service delivery to US commercial buildings with 20+ employees



Source: Vertical Systems Group

With more than 85% of all US businesses served by copper today, Ethernet in the First Mile (EFM) loop bonding has seen a 65% CAGR, the highest growth rate in telecommunications. It's no surprise, given the ease of deployment and the scalability of bandwidth, without costly fiber builds or network re-designs.

Key applications for EFM include:

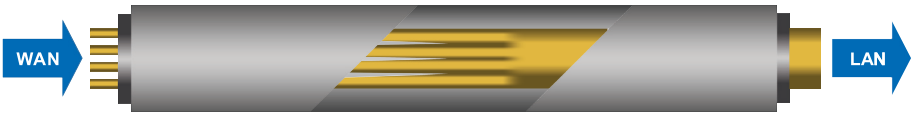
- Symmetrical enterprise data services
- VLAN, E-Line, E-LAN services
- T1 / E1 and Frame Relay replacement services
- Mobile backhaul
- Traffic lights and traffic control monitoring
- Security and surveillance monitoring
- Utility operations and control networks

Zhone's broad portfolio of access aggregation platforms supporting EFM and Ethernet Access Devices (EADs) are designed for flexibility to meet every need. When ease of installation, rapid provisioning and deployment options are important, Zhone is your best choice for EFM.

Zhone is the Global Market Leader in EFM

- Deploying Ethernet over copper for 8 years
- Delivering Loop Bonding for more than 6 years
- More than 100,000 Ethernet Access devices in service
- In use around the world

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, 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.

Two methods of hardware-based bonding are in widespread use, as described below. Zhone offers both forms of bonding to provide maximum flexibility and cost-effectiveness.

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 EAD products.

HDLC-based Ethernet over Copper Bonding

HDLC-based bonding provides physical layer (PHY) bonding of DS1 / E1 / DS3 and SHDSL circuits for highly efficient and reliable bandwidth gain. Widely deployed and field proven, HDLC-based bonding is ideally suited for point-to-point and aggregation applications where simplicity and reliability are critical. Zhone supports HDLC-based Ethernet over copper bonding technology in all of our EADs and aggregation line cards.

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

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

Ethernet Access Devices (EADs)

EtherXtend | **Easy, Proven, Deployed**

World's most proven line of EADs

4 or 8 SHDSL.bis 5.7 Mbps WAN ports and 4 Ethernet LAN ports

EtherXtend

EtherXtend is a high capacity EAD capable of bonding up to 8 SHDSL.bis copper lines for up to 45.6 Mbps of bandwidth. EtherXtend supports both 802.3ah EFM interface and OAM standards, as well as existing HDLC-based Ethernet over copper bonding. It is an intelligent Demarc device, being fully managed with bridging or Layer 3 routing options supported.

1 or 2 SHDSL.bis 5.7 Mbps WAN ports and up to 2 Ethernet LAN ports

EtherXtend LT

EtherXtend LT is a value featured EAD that offers the advantages of 5.7 Mbps SHDSL.bis in 1 or 2 port WANS and up to 1 or 2 Ethernet LAN ports. EtherXtend LT uses proven HDLC-based encoding for Ethernet loop bonding, supported on both MALC and IPD product lines. Features configuration-free, plug-and-play operation.

1 or 2 DS3 WAN ports and 4 Ethernet LAN ports

EtherXtend LT-DS3

EtherXtend LT DS3 is a value featured EAD supporting up to 90 Mbps with bonded DS3. It supports SNMP, CLI or web-based management and Layer 2 bridging. It supports 802.1Q and 802.1p, along with DHCP.

EtherXtend LT uses proven HDLC-based encoding for Ethernet loop bonding, supported on both MALC and IPD product lines.

T1 / E1 / SHDSL Network Extenders with proven performance

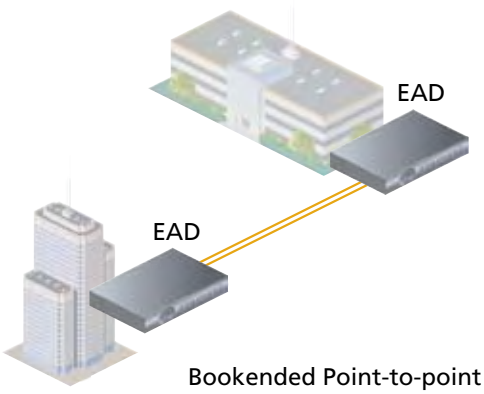
TNE / ENE / SNE

Zhone's line of Network Extenders have been serving carrier's needs for years, delivering highly reliable and proven Ethernet over copper services and loop bonding. A large selection of models offers a selection of WAN and LAN options to suit a particular service need. They can be used bookended or integrated with MALC or IPD Ethernet aggregation compatible line cards. All Network Extenders use time tested HDLC-based Ethernet loop bonding.

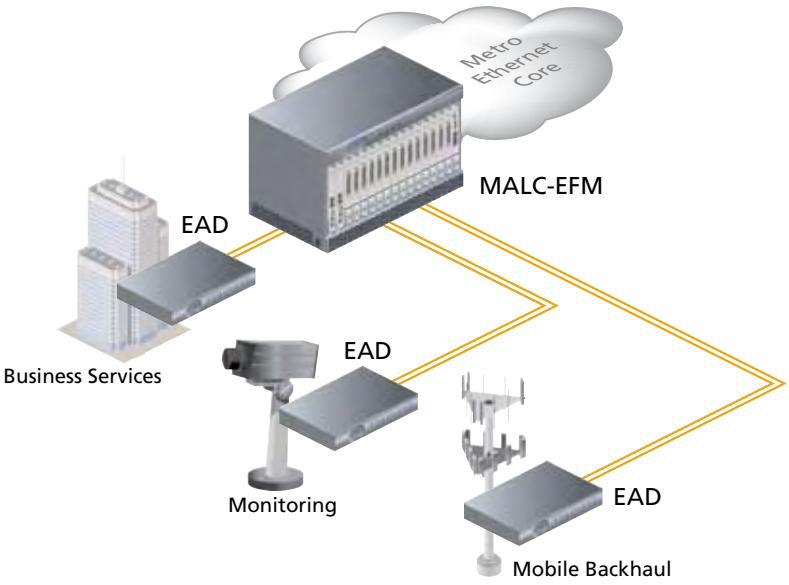
Ethernet Access Device Selection Guide

	EtherXtend Family			Network Extenders		
	EtherXtend	EtherXtend LT	EtherXtend LT DS3	TNE	ENE	SNE
WAN Interface	SHDSL.bis 5.7 Mbps	SHDSL.bis 5.7 Mbps	DS3 45 Mbps	T1 1.544 Mbps	E1 2.048 Mbps	SHDSL 2.3 Mbps
WAN Ports	4 or 8	1 or 2	1 or 2	1, 2, 4 or 8	1, 2, 4 or 8	1, 2 or 4
Bandwidth (at max ports)	Up to 45 Mbps	Up to 11.4 Mbps	Up to 90 Mbps	Up to 12 Mbps	Up to 16 Mbps	Up to 9.2 Mbps
Loop Bonding	802.3ah EFM / HDLC	HDLC	HDLC	HDLC	HDLC	HDLC
LAN Interfaces 10 / 100 Base T	4	1 or 2	4	1 (1 / 2 port) 4 (4 / 8 port)	1 (1 / 2 port) 4 (4 / 8 port)	1
OAM	802.3ah inband	Unmanaged	CLI, Web, SNMP	CLI, Web, SNMP (4 / 8 port)	CLI, Web, SNMP (4 / 8 port)	Unmanaged
QoS	802.1Q 802.1p		802.1Q 802.1p	802.1Q 802.1p	802.1Q 802.1p	
Layer 2 Layer 3	Bridging Routing	Bridging	Bridging Layer 3 aware	Bridging Layer 3 aware	Bridging Layer 3 aware	Bridging

Deployment Options for Ethernet Access Devices



Bookended Point-to-point EFM



Ethernet Aggregation

EFM Aggregation

Versatile multi-service access and aggregation over copper and fiber

MALC-EFM
319, 719, 723

The MALC is a full featured Layer 2 and 3 multi-service access platform. Using a common chassis, uplink and commons, MALC-EFM serves as an Ethernet aggregation access platform supporting SHDSL.bis (5.7 Mbps) or T1 / E1 bonding from 24-port line cards. Network timing and networking powering line card options are also available. MALC-EFM is backwards compatible with HDLC based Ethernet Access Devices (EADs), as well as compliant with 802.3ah EFM standards EADs. EFM services can also be mixed with any other services and line cards. The MALC supports multi-service applications, including POTS, ADSL2+, VDSL2, Active Ethernet, and GPON. The MALC offers maximum flexibility coupled with economic scalability for a carrier's service needs.

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

- 802.1 Q in Q transparent LAN support
- Bridge / Router interface support on all ports
- 802.3ah (EFM) compliance
- 802.3ah OAM
- Original HDLC loop bonding support
- IP SLA latency / jitter / data -loss measurements
- Rate limiting by service
- MTM–rate limiting by service
- SLA support via ICMP
- Card options for network timing and network powering

Core DSLAM functionality with 802.3ah EFM support

8800 DSLAM
8820 / 8620

Recognized as a workhorse in carrier networks for years, the 8820 / 8620 DSLAM family serves as a proven and reliable DSLAM for broadband Internet data services including Ethernet over copper. As an advanced DSLAM, 8820 and 8620 supports both ATM and IP services with QoS support for both.

- Layer 2 switching
- Advanced MTM (Multimedia Traffic Management) features
- Both ATM and IP uplinks
- Supports 802.3ah EFM SHDSL.bis loop bonding aggregation

IP DSLAM delivering advanced broadband services

IPD DSLAM
4000 / 12000

IPD is a proven, carrier-class IP access system providing a high-capacity platform for Ethernet multi-service aggregation. Using a 48-port SHDSL line card or 24-port T1 or E1 Ethernet line cards, IPD delivers highly reliable Ethernet-over-copper with over 6 years of field-proven experience worldwide. IPD can also support ADSL, ADSL2+, SHDSL services as a complete IP services platform along with Ethernet over copper.

- World's most widely used Ethernet over copper aggregation platform
- Field-proven performance and reliability
- Layer 2 switching, layer 3 aware
- VLAN support
- Supports extended-rate SHDSL.bis with a 48-port line card

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, HDLC	EFM, HDLC	802.3ah	HDLC	HDLC	HDLC	HDLC
Ports per Card	24	24	24	48	24	24	24
Shelf Capacity (card slots / ports)	319: 7 / 168 719: 15 / 360 723: 17 / 408	319: 7 / 168 719: 15 / 360 723: 17 / 408	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
OAM	CLI, Web, SNMP	CLI, Web	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

*Other card options available:
MALC-EFM-SHDSL-24 NT (adds network timing)
MALC-EFM-SHDSL-24 NTP (adds network timing and powering)

EAD to Aggregation Platform Interoperability

	MALC-EFM		8800 / 8620 DSLAM	IPD 4000 / 12000 DSLAM			
EAD Model	**MALC-EFM-SHDSL-24***	**MALC-EFM-T1 / E1-24**	**8986-B1-000**	**ESIM-5700-48**	**SIM2000-24**	**TIM1500-24**	**EIM2000-24**
EtherXtend SHDSL.bis 5.7 Mbps	●		●	●	● (at 2.3 Mbps)		
EtherXtend LT SHDSL.bis 5.7 Mbps	●			●	● (at 2.3 Mbps)		
Network Extender SNE (SHDSL) 2.3 Mbps	●			●	●		
Network Extender TNE (T1)		●				●	
Network Extender ENE (E1)		●					●

Access for a Converging World

North America

Corporate Headquarters
Zhone Technologies
@ Zhone Way
7001 Oakport Street
Oakland, CA USA 94621
+1 510 777 7000 Tel.

Canada
Zhone Technologies Canada
30 Winners Circle
Toronto, Canada M4L 3Z7
+1 416 543 4627 Tel.

Europe, Middle East and Africa (EMEA)

Regional Headquarters
Zhone Technologies S.r.l.
Segrate (Milan), Italy
+39 02 75399201 Tel.

United Kingdom
Zhone Technologies Ltd. UK
London, England
+44 01962 734555 Tel.

United Arab Emirates
Zhone Technologies Intl.
Dubai, UAE
+971 4 331 4295 Tel.

Germany
Zhone Technologies GMBH
Stuttgart, Germany
+49 711 806 092 10 Tel.

Egypt
Zhone Technologies Intl. Inc
Cairo, Egypt
+2 02 418 7273 x 329 Tel.

Caribbean and Latin America

Regional Headquarters
Zhone Technologies
Miami, USA 33131
+1 305 789 6680 Tel.

México
Zhone Technologies S. de R.L. de C.V.
México D.F.
+52 55 9171 1480 Tel.

Puerto Rico
Zhone Technologies, Inc.
San Juan, Puerto Rico
+787 723 3217 Tel.

Brazil
Zhone Technologies do Brasil LTDA
São Paulo, Brazil
+55 11 3048 4195 Tel.

Colombia
Zhone Technologies de Colombia LTDA
Bogotá, Colombia
+571 638 6186 Tel.

Asia / Pacific

Regional Headquarters
Zhone Technologies Pte.Ltd.
Singapore
+65 6823 1526 Tel.

Hong Kong
Zhone Technologies Ltd.
Hong Kong
+852 3120 7228 Tel.

China
Zhone Technologies Ltd.
Beijing, China PRC
+86 10 6500 6467 Tel.

ZHONE®

For more information about Zhone and its products, please visit the Zhone Web site at www.zhone.com or e-mail info@zhone.com

ZTI-EFM PG-0607