

Cisco Any Transport over Multiprotocol Label Switching

General

Q. What is Cisco Any Transport over Multiprotocol Label Switching?

A. Any Transport over Multiprotocol Label Switching (AToM) is the Cisco solution for transporting Layer 2 packets over a Multiprotocol Label Switching (MPLS) backbone. AToM extends the usability of IP networks by enabling the transport of Layer 2 frames over an MPLS backbone. AToM is required for supporting legacy services over MPLS infrastructures and for supporting several new connectivity options, including Layer 2 Virtual Private Networks (VPNs) and Layer 2 virtual leased lines.

Q. What is a Layer 2 VPN with MPLS?

A. A Layer 2 VPN with MPLS builds VPN connectivity with a set or group of point-to-point Layer 2 AToM circuits. Either a Network Management System (NMS) application or router-based signaling can be used to build the circuits.

For more information on L2 VPNs please visit:

<http://www.cisco.com/go/mpls/>

Q. How does AToM work?

A. AToM uses a directed Label Distribution Protocol (LDP) session between edge routers for setting up and maintaining connections. Forwarding occurs through the use of two level labels, switching between the edge routers. The external label (tunnel label), routes the

packet over the MPLS backbone to the egress Provider Edge (PE) at the ingress PE. The VC label determines the egress interface, and it binds the Layer 2 egress interface to the tunnel label.

Q. On what standards/draft standards is AToM based?

A. Cisco pioneered the development and marketing of AToM in 1999, and worked with the author of draft martini to standardize the technology. It is being standardized as a part of the Pseudo Wire Emulation Edge to Edge (PWE3) working group in the IETF. Following are key documents, which the working group is in the process of standardizing:

Signaling for Transport of Layer 2 Frames over MPLS. LDP is used to signal the transport of Layer 2 frames over an MPLS network. The LDP procedures are specified in draft-ietf-pwe3-control-protocol Encapsulation Methods for Transport of Layer 2 Frames Over MPLS. These documents describe methods for encapsulating the Protocol Data Units of layer 2 protocols such as Frame Relay, ATM AAL5, or Ethernet for transport across an MPLS network. They can be accessed at <http://www.ietf.org/html.charters/pwe3-charter.html>:

- *Frame Relay*: draft-ietf-pwe3-frame-relay
- *ATM*: draft-ietf-pwe3-atm-encap
- *Ethernet*: draft-ietf-pwe3-atm-encap



Q. What is the advantage of a L2VPN versus a L3VPN?

A. Cisco AToM enables connectivity for L2VPNs that complement the widely deployed Cisco Layer 3 MPLS VPN capabilities:

- Layer 2 VPNs appeal to subscribers who run their own Layer 3 networks over the wide area and require Layer 2 connectivity from Service Providers. In this case, the subscriber manages their own routing information.
- Layer 3 VPNs, or the traditional RFC2547, appeal to subscribers who prefer to outsource their routing to service providers. The Service Provider manages routing for the customer's sites.

Ethernet over MPLS

Q. What is Ethernet over MPLS?

A. Ethernet over MPLS (EoMPLS) is the transport of Ethernet frames across an MPLS core. It transports all frames received on a particular Ethernet or virtual LAN (VLAN) segment, regardless of the destination Media Access Control (MAC) information. It does not perform MAC learning or MAC look up for forwarding packets from the Ethernet interface.

Q. Which QoS mechanisms are supported with EoMPLS?

A. At the edge, Ethernet frames can be prioritized and bandwidth can be allocated between classes in order to implement sophisticated Service Level Agreements (SLAs). At the core, packets are treated according to their MPLS EXP marking, and the QoS policies implemented in the core of the network. EoMPLS supports 802.1p mapping to MPLS EXP bits.

It is also possible to assign an EXP value and to disregard the 802.1p value from the incoming interface. As a whole, the QoS mechanisms supported allow Service Providers to implement sophisticated SLAs for Ethernet subscribers while maintaining a scalable core design.

Q. Can an EoMPLS connection be traffic shaped?

A. Yes, traffic shaping can be applied to an EoMPLS connection. It is performed on a per-interface and on a per-VLAN basis to the MPLS domain.

Q. Where can I find more information about EoMPLS?

- Ethernet over MPLS Technology Brief:

http://www.cisco.com/warp/public/cc/pd/rt/7600osr/prodlit/emp76_tc.htm

- Cisco 7600 Series Router Q&A

http://www.cisco.com/en/US/products/hw/routers/ps368/products_qanda_item09186a008017a32b.shtml

ATM over MPLS

Q. What types of ATM over MPLS transport mechanisms are available?

A. There are two types of transport mechanisms for ATM over MPLS:

- AAL5-over-MPLS mode: ATM interface assembles the AAL5 PDU with either AAL5SNAP or AAL5MUX encapsulation at the boundary and transports it across the network as a single MPLS packet.
- Cell-relay mode: ATM interface receives cells and transports them across the MPLS core. Cell relay with cell packing is used to send multiple cells in one MPLS frame, improving the efficiency of cell transport.



Q. Which draft describes the AAL5-over-MPLS mode?

A. The first release of AAL5 over MPLS is with Cisco IOS Software Release 12.0(10)ST and is based on the older Martini Version 2. In Phase 1 of AToM, the AAL5 over MPLS will support Version 0 of the draft-ietf-pwe3-atm-encap draft.

Q. How are the ATM Operations, Administration and Maintenance and Interim Local Management Interface functions handled with AAL5 over MPLS?

A. The ATM signaling is terminated at the ATM interface on the PE router. The values for virtual path identifier (VPI) and virtual channel identifier (VCI) for the ATM permanent virtual circuit (PVC) are pre-determined in the configuration. Each PVC is configured individually.

Q. How is the ATM signaling handled with cell relay over MPLS?

A. In cell-relay mode, the signaling is transparently passed through the MPLS cloud, rather than terminated at the PE.

Q. What QoS mechanisms are supported with AAL5 over MPLS?

A. AAL5 over MPLS sets the EXP bits in the MPLS header based on a static value or based on traffic policing (RFC 2697 / RFC 2698). Cell-Loss-Priority (CLP) marking is possible in the egress port where traffic is delivered to the subscriber. However, ingress EXP bit setting based on the cell-loss-priority (CLP) value in the cell header will be supported in Phase 2.

Q. Where is ATM over MPLS information available?

A. http://www.cisco.com/en/US/tech/tk436/tk798/tech_protocol_family_home.html

Frame Relay over MPLS

Q. How does Frame Relay over MPLS work?

A. Traffic is encapsulated in MPLS packets and forwarded across the MPLS network. When encapsulating Frame Relay over MPLS, the Frame Relay header and the frame check sequence (FCS) are stripped from the packet. The bits for Backward Explicit Congestion Notification (BECN), Forward Explicit Congestion Notification (FECN), Discard Eligibility (DE) and Command/Response (C/R) are carried across the MPLS network in the "Control Word" header.

Q. What are the main applications of Frame Relay over AToM?

A.

- Frame Relay Trunking enables users to tunnel all Frame Relay data and across an IP core to a remote destination. It is used for interconnecting and transporting a Frame Relay point of presence (POP) across an IP core network.
- Per-DLCI tunneling allows for the tunneling of individual frame Relay PVCs. This method offers granularity of controlling which of the traffic is tunneled to a given destination.

Q. How are Local Management Interface messages handled in Trunking (port) Mode?

A. In port mode Local Management Interface (LMI) messages are passed transparently transported across the network. This allow for trunking applications to be implemented.

Q. How are LMI messages handled in Per-DLCI Tunneling Mode?

A. LMI messages are not transported across the network; rather, they are terminated at the PE. The advantage of terminating LMI messages is that when a PVC disappears, the PE initiates a label-withdraw request, informing the remote end that the PVC is not available. Another mechanism bundles a set of PVCs into one group ID. Therefore, when a link goes down, the router can quickly withdraw all labels associated with the group ID.

Feature Support and Roadmap

Q. What features are currently supported in AToM?

A. AToM was released with Cisco IOS Software Release 12.0(21)ST in February 2002.

- Cisco IOS Software Release 12.1(9)E supports Ethernet over MPLS. It provides support for the Cisco 7600 Optical Services Router System, including the Supervisor engine 2 with

Multilayer Switch Feature Card (MSFC2)/Policy Feature Card (FC2), and a four-port Gigabit Ethernet OSM as the system uplink.

- Cisco IOS Software Release 12.0(23)S provided Ethernet-over-MPLS support on the Cisco 7200 and 7500 Series Routers, and Cisco 12000 Series Internet Routers with the Trident Gigabit Ethernet line card.
- ATM over MPLS is available on the Cisco 7200 and 7500 Series Routers, and Cisco 12000 Series Internet Routers. VC, VP, Port Cell Packing, AAL5w/OAM Emulation are all available in Cisco IOS Software Release 12.0(25)S.
- Frame Relay over MPLS, PPP over MPLS, and HDLC over MPLS are available with restrictions in Cisco IOS Software Release 12.0(22)ST for the Cisco 7200 and 7500 Series and the Cisco 12000 Series Internet Routers.



Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: 31 0 20 357 1000
Fax: 31 0 20 357 1100

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
Capital Tower
168 Robinson Road
#22-01 to #29-01
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

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