



Internet Protocol Version 4 (IPv4)

EION Open IP Environment IPv4 is a portable software module that implements IP forwarding and route generation per industry standard(s). This module includes IP, ICMP, UDP, TCP and other IETF protocols.

Overview

EION Open IP Environment is a portable real-time software suite that IP-enables new and traditional network elements providing high performance interoperability across multiple platforms and products. Open IP Environment is based on a single, open, modular and scalable framework that allows system integrators and developers to incorporate services such as routing, Quality of Service (QoS), security, IP accounting and policy management into any type of device. Open IP Environment is platform and real-time operating system (RTOS) independent and can work on any type of device ranging from high end optical core switches to personal digital assistants (PDAs).

Framework Overview

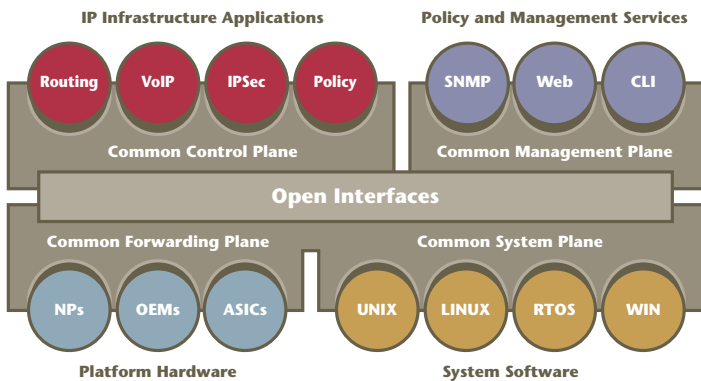
EION Open IP Environment framework consists of four planes: Common Control Plane, Common System Plane, Common Forwarding Plane and Common Management Plane. Each of these planes contains a set of components that are built to use well-defined interfaces.

Open IP Environment IPv4 module resides within the Common Control Plane to deliver high performance and interoperable routing. The control plane supports the Open IP Environment Internet Protocol (IP) infrastructure protocols and enables a mix and match approach for adding support for networking protocols and/or services. The control plane holds together the Routing Protocol Applications (RPAs) that interface with the control plane and deliver network functionality for providing interchangeable access for all IP-based modules such as BGP, RIP and OSPF.

The Route Table Manager (RTM) is an Open IP Environment component that maintains the unicast routing table and is responsible for the process of redistributing routes to the various RPAs. The RTM receives information from the Open IP Environment IPv4 module and sends the "best" routes to the forwarding engine located within the forwarding plane.

IPv4 Overview

EION Open IP Environment IPv4 module is used in interconnected systems of packet-switched computer communication networks. IPv4 is a 32-bit addressing scheme whereby an IP address is represented by four fields, each containing 8-bit numbers. The Open IP Environment IPv4 provides TCP/IP stack, Internet Control Message Protocol (ICMP) and Circuit Mapper.



IPv4 Interactions

EION Open IP Environment IPv4 module has been specifically designed to deliver time to market advantages through the built-in control-plane interaction with other Open IP Environment modules, such as the RTM and RPAs. Furthermore, the modularity and portability of the Open IP Environment IPv4 module permits interaction with third party RPAs through well-defined application programming interfaces (APIs).

IPv4 and RPAs

Open IP Environment IPv4 module provides the TCP/IP stack that is used by the Open IP Environment and third party routing protocol applications (RPAs) such as OSPF, BGP and RIP to send and receive protocol data units (PDUs) from other OSPF peers.

IPv4 and Planes

Within the Open IP Environment, the IPv4 module can be configured to use the Open IP Environment's Common System Plane functions such as timers, message queues, memory manager and thread manager libraries. This module also uses the services

of the Common Management Plane by developing appropriate management code in order to integrate with management services such as SNMP, EION Command Line Interface and/or web-based management.

IPv4 and Others

Finally, the IPv4 module seamlessly integrates with the Open IP Environment or third party forwarding engine through a Forwarding Plane Interface to forward Protocol Data Units (PDUs). The PDUs are forwarded through a network interface based on a forwarding table that provides the best route to the packet destination.

For more details about other Open IP Environment modules and planes, please refer to the relevant product briefs.

IPv4 Features

EION Open IP Environment IPv4 module demonstrates the following key features:

- Window and Acknowledgement
- TCP Maximum Segment Size
- Congestion Control in TCP/IP
- Internetworks
- Broadcasting Internet Datagrams in the Presence of Subnets
- ISSP (Internet Standard Subnetting Procedure)
- Host Extensions for IP
- ICMP Router Discovery Messages
- MD-5 Message -Digest Algorithm
- TCP Extensions for High Performance
- Type of Service in the Internet
- Protocol Suite
- CIDR
- Assigned Numbers
- Requirements for IPv4 Routers
- TCP Selective Acknowledgment Options
- Path MTU Discovery

For a complete listing of the Open IP Environment IPv4 RFC support, please refer to the last page of this product brief.

IPv4 Management Support

The module implements management via SNMP as specified in RFC 1213 and RFC 2096. All objects are defined in a high-level description file to allow easy integration with Open IP Environment and third party SNMP Agents.

In addition, IPv4 implements management via EION Command Line Interface (CLI). EION CLI is packaged with industry standard commands which can be easily integrated into the customer's specific device. Please refer to the EION Command Line Interface Product Brief for more information.

IPv4 Module Implementation

EION Open IP Environment IPv4 module is implemented in the "C" programming language and runs as a single thread. The module has been configured to periodically relinquish control. This permits utilizing of the CPU for other activities in the system.

Through the publication of APIs, the Open IP Environment IPv4 module has been designed for ease of portability and modularity. Open IP Environment provides an architecture to allow you to implement IPv4 within the Open IP Environment framework, or alternatively to adapt the IPv4 module to your specific environment.

Ease of Portability

EION Open IP Environment provides a set of interoperable modules that are available for use in both established and "greenfield" products. The customer has the choice to pick and choose Open IP Environment modules to incorporate into the customer's established products, preserving the investment in prior development. The customer also has the option to use modules

within the Open IP Environment framework to develop a new software base to address going-forward opportunities. It is also possible to compile the software for a variety of target processors. Therefore, protocol composition can be statically changed by modifying the configuration to suit your needs.

Established products typically have a well-developed architecture and an existing suite of applications, and these products will be looking to Open IP Environment for additional capabilities. The portable and modular Open IP Environment components can be integrated into an existing execution environment to work within an existing code base, with minimal modifications to the customer's environment.

Greenfield products typically require a full suite of applications plus the Open IP Environment framework to provide an appropriate execution environment. The Open IP Environment framework and modules are well-positioned to address such greenfield opportunities.

Benefits

In a market that demands ever-increasing IP support, it is difficult to maintain sufficient in-house expertise in every area. EION Open IP Environment framework and IPv4 module solve this problem by:

- Allowing OEMs to focus on their real value added solutions, not underlying infrastructure
- Reducing the length of time to market via ease of integration of key components such as IPv4
- Enabling the freedom to choose among different software and hardware platforms
- Enabling ease of portability to traditional and new network enabled devices
- Enabling accelerated development of highly customized IP-enabled products via well documented APIs
- Enabling a pick and choose approach to Open IP Environment modules via a flexible open framework addressing various devices and applications from PDAs to carrier grade optical switches
- Delivering components of the framework that are scalable, modular, and portable that consistently demonstrate high performance attributes
- Delivering standards-based interfaces and common programming languages such as C, C++ and Java to developers, enhancing overall productivity with a small learning curve.
- Delivering configured and managed modules that use one or several of the following management capabilities:
 - EION Command Line Interface
 - Simple Network Management Protocol (SNMP)
 - Web-based management.

EION Open IP Environment IPv4 Feature Summary

RFC and Draft Support

- | | | | |
|------------|--|------------|--|
| • RFC 768 | UDP | • RFC 1256 | ICMP Router Discovery Messages |
| • RFC 791 | IP | • RFC 1321 | MD-5 Message - Digest Algorithm |
| • RFC 792 | ICMP | • RFC 1323 | TCP Extensions for High Performance |
| • RFC 793 | TCP | • RFC 1349 | Type of Service in the Internet Protocol Suite |
| • RFC 813 | Window and Acknowledgement | • RFC 1519 | CIDR |
| • RFC 879 | TCP Maximum Segment Size | • RFC 1700 | Assigned Numbers |
| • RFC 896 | Congestion Control in TCP/IP Internetworks | • RFC 1812 | Compliant (Requirements for IPv4 Routers) |
| • RFC 922 | Broadcasting Internet Datagrams in the Presence of subnets | • RFC 2018 | TCP Selective Acknowledgement Options |
| • RFC 950 | ISSP | • RFC 2096 | IP Forwarding Table MIB |
| • RFC 1213 | MIB-II | • RFC 2385 | Protection of BGP Session via TCP MD5 Signature Option |

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