Fusion Embedded™ TCP/IPv4/IPv6

Unicoi's Fusion Embedded™ IPv4/IPv6 TCP/IP dual mode embedded networking stack represents the natural evolution of Unicoi's Fusion TCP/IPv4 stack, the world's most widely deployed embedded networking stack.

This next-generation stack fully supports all of the previous Fusion Embedded IPv4-only stack features including zero-copy, a full BSD Sockets compatible network programming API, and a powerful yet simple device driver interface. By adding full support for the next-generation Internet protocol, IPv6, the Fusion Embedded IPv4/v6 stack brings the benefits of the new standard for the Internet to embedded systems, including full support for IPv6 Neighbor Discovery (the successor to IPv4 ARP), IPv6 Auto-Address Configuration, failed router discovery, superior multicast support, reduced IP header processing overhead including the removal of the redundant IP header checksum found in IPv4, built-in support for traffic flows based on labels, and last but not least, a virtually infinite address space.

And by including IPv4-IPv6 interoperability and transition mechanisms such as IPv6-over-IPv4 tunneling and IPv4-mapped IPv6 addresses, and seamless integration of IPv4 and IPv6, the Fusion Dual stack allows an existing IPv4 application to be converted into a dual IPv4/v6 application by changing only a few lines of code. It isn't even necessary to modify an existing application that uses a single socket for IPv4 to support a second socket for IPv6 - a single socket can be used to communicate with both IPv4 and IPv6 peers. For example, a server can handle both IPv4 and IPv6 clients using only a single socket and without even being aware of which protocol family the client is using.

The impact on performance of the longer IPv6 addresses (16 bytes versus 2 bytes for IPv4) is mitigated through the Fusion stack's use of an efficient internal representation that allows the stack to manipulate IPv6 addresses as four 32-bit words, or even two 64-bit words when using processors or compilers that support a 64-bit unsigned integer type.

The Fusion Embedded TCP/IP dual stack's forwarding database uses hash tables of balanced binary trees to store both IPv4 and IPv6 routes for high-speed lookup. Forwarding performance and RFC compatibility is further enhanced through the use of a high-speed destination cache. And like its IPv4-only predecessor, the Fusion Embedded IPv4/IPv6 stack can be used to construct both hosts and routers (gateways). IPv6 hosts running Fusion can auto-configure IPv6 addresses and default gateways from IPv6 router advertisements, and IPv6 routers running Fusion can enable host auto-configuration by sending IPv6 router advertisements.

For those OEMs who feel that IPv4 is sufficient for their product's needs or whose customers are not yet demanding a solution that includes the next generation Internet protocol, a reduced-cost version of the IPv4/IPv6 stack that supports only IPv4 is still available. And this latest IPv4 stack is even better than the previous generations of the IPv4-only stack owing in part to new features like redundant routing and destination route caching that were outgrowths of the IPv6 development effort. Plus, you will have the security of knowing that should you require IPv6 in the future you will be able to upgrade to the full stack and drop it into your system with virtually no additional porting effort. Keep that in mind before committing to any IPv4-only offering even if you don't require IPv6 today.

General Stack Features

- High performance and scalable architecture
- Highly portable 100% ANSI C code with no dependencies on specific compilers or operating systems for code that is straightforward to port to any processor or RTOS and can even run without an RTOS.
- Rich and robust BSD sockets API with RFC-compliant extensions for IPv6, and Unicoi proprietary extensions for both IPv4 and IPv6 including zero-copy transmit and receive on both UDP and TCP sockets.
- Unicoi proprietary multi-point unicast UDP socket feature for sending UDP packets to multiple unicast

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destinations with no additional data copies.
- Flexible and powerful Unicoi network API for address and route configuration, device driver development, and other crucial "below the socket layer" programming.
- Support for multiple network interfaces whether acting as a host or a router, and support for multiple IPv4 and IPv6 addresses on each interface.
- Device layer supports scatter-gather transmission for efficient use of hardware DMA engines and allows zero-copy transmission using proprietary Socket API extensions or one-copy without any loss of BSD Socket compatibility.

Fusion Embedded TCP/IP is the World's Most Widely Deployed Embedded Networking Stack

- Redundant IPv6 and IPv4 routing with fail-over
- High-performance forwarding database and destination address caches using hash tables of balanced binary trees for fast and efficient IPv4 and IPv6 route lookups.
- Highly efficient internal representation of IPv6 addresses mitigates the performance impact of longer IPv6 representing them in as little as two 64-bit words where supported by the processor/compiler.
- Priority transmit packet queuing for enhanced Quality of Service
- Support for on-demand routing
- Support for IEEE 802.1Q virtual LAN (VLAN) operation including VLAN tunnels.
- A full complement of add-ons to the core stack, including IPsec, IKE, NAT, PPP, RIP, RIPng (RIP for IPv6), PPPoE, and more enable a wide range of OEM products and applications.
- Shipped with example applications that run the Fusion stack on Windows™ and UNIX PCs independently of the native OS stack and provide a basis to allow OEM developers to start writing code even before the target hardware is available.
- Provides an easy migration path to IPv6 for existing Fusion customers of earlier IPv4-only versions of the stack.
- Reduced cost IPv4-only version of the stack is available for customers who do not yet need IPv6.
- Royalty-Free licensing is available

Protocol Features

- Full support for IPv6 stateless address auto-configuration as well as for IPv4 auto-IP with integrated duplicate address detection for both provides for "plug and play" operation.
- Support for auto-configuration of IPv6 global addresses from router advertisements.
- Support for auto-configuration of IPv6 temporary addresses when privacy is a concern.
- Enables development of both hosts and routers for both IPv4 and IPv6.
- Simple changes to application code for configuring IPv6 interface addresses and static routes can convert an IPv4 Fusion port to an IPv6 Fusion port with minimal effort
- Full support for IPv4-mapped IPv6 addresses along with the fnsGetAddrInfo and fnsGetNameInfo DNS resolver library functions allows client and server application to use only IPv6 sockets to transparently communicate with both IPv4 and IPv6 peers. Thus, many IPv4 applications can be converted to IPv4/v6 applications with relative ease
- Full support for IPv6 router advertisements whether functioning as a host or a router.
- Powerful source and destination selection algorithms that support multi-homed IPv6 interfaces and multiple on-link IPv6 prefixes are also provided by Fusion IPv6.
- Host-side support IGMPv1/2 and MLDv1 delivered with the core stack and an available IGMPv3/MLDv3 option.
- IPv4-v6 transition support including IPv6-over-v4 configured tunneling and IPv4-mapped IPv6 addresses.
- High performance IPv4 and IPv6 fragmentation and reassembly including no-copy fragmentation when the network driver supports scatter-gather transmission.

IPv4 Protocols Included with the IPv4-only and Dual Stack

ARP, RARP, IPv4, UDP, TCP, ICMP, BOOTP, TFTP client, IGMPv1/2, IPv4 Auto-IP address configuration, IPv4 over Ethernet, 802.1Q VLAN support including tunneling, ping (echo) client (optional) and responder (built-in).

IPv6 Protocols Included with the Dual Stack

IPv6 core, TCP, UDP, ICMPv6, Neighbor Discovery including Router Advertisements, IPv6 auto-configuration of link-local, global, and private auto-addresses, TFTP client, Ping6 client (optional) and responder (built-in), MLDv1, IPv6-over-IPv4 Tunneling, IPv6 over Ethernet, and 802.1Q VLAN support

RFC Compliance

- RFC 768 UDP User Datagram Protocol
- RFC 791 IP Internet Protocol
- RFC 792 ICMP Internet Control Message Protocol
- RFC 793 TCP Transmission Control Protocol
- RFC 813 Window & Acknowledgement Strategy in TCP
- RFC 826 Ethernet Address Resolution Protocol
- RFC 896 Congestion Control in TCP/IP Internetworks
- RFC 903 Reverse Address Resolution Protocol
- RFC 1058, "Routing Information Protocol" (sold separately)
- RFC 1112 Host Extension for IP Multicast
- RFC 1122 Requirements for Internet Hosts - Communications layers
- RFC 1256 ICMP Router Discovery Messages
- RFC 1323 TCP Extensions for High Performance
- RFC 1349 TOS Bit Type of service In Internet Protocol
- RFC 1388, "RIP Version 2" (included with RIP product sold separately)
- RFC 1886 DNS Extensions to Support IPv6 (built into Fusion DNS resolver product)
- RFC 1981 Path MTU Discovery for IPv6
- RFC 2001 TCP Slow start congestion avoidance
- RFC 2018 TCP Selective Acknowledge Options
- RFC 2080, "RIPng for IPv6" (sold separately)
- RFC 2375 IPv6 Multicast Address Assignments
- RFC 2460 Internet Protocol Version 6
- RFC 2461/4861 Neighbor Discovery for IPv6
- RFC 2462/4862 IPv6 Stateless Address Auto-configuration
- RFC 2463/4443 IPv6 Internet Control Message Protocol (ICMPv6) for IPv6
- RFC 2464 Transmission of IPv6 Packets over Ethernet Networks
- RFC 2474 Definition of the Differentiated Services Files (DSField) in the IPv4 & IPv6 Headers
- RFC 2710 Multicast Listener Discovery (MLD) for IPv6 (host-side only)
- RFC 2711 IPv6 Router Alert Option (DSField) in the IPv4 & IPv6 Headers
- RFC 2893/4213 Transition Mechanisms for IPv6 Hosts and Routers (Configured Tunneling IPv6 over IPv4 and IPv4-mapped IPv6 addresses)
- RFC 3041 Privacy Extensions for Stateless Address Auto-configuration in IPv6
- RFC 3484 Default Address Selection for IPv6
- RFC 3487 IPv6 Global Unicast Address Format
- RFC 3493 Basic Socket Interface Extension for IPv6
- RFC 3513/4291 IPv6 Addressing Architecture
- RFC 3587 IPv6 Aggregatable Global Unicast Address Format
- RFC 3590 Source Address Selection for the Multicast Listener Discovery Protocol
- RFC 3810 Multicast Listener Discovery Version 2 (MLDv2) for IPv6 (available separately)
- RFC 4007 IPv6 Scoped Address Architecture
- RFC 4193 Unique Local IPv6 Unicast Addresses
- RFC 5095 Deprecation of Type 0 Routing Headers in IPv6
- RFC 6106 IPv6 Router Advertisement Options for DNS Configuration

Available IPv4 Add-ons for both versions of the Fusion Embedded Stack[1]

DHCPv4 client, RIPv1/2, PPPv4, PPPoE, NAT, IGMPv3, IPsec, IKEv1/v2 (IPv6 supported only by IKEv2).

Available IPv6 add-ons for the Fusion Embedded IPv4/IPv6 Stack[1]

PPP with IPCPv6, DHCPv6, MLDv2, RIPng (RIP next-generation for IPv6)

Other Protocols available for Fusion Embedded and 3rd Party TCP/UDP/IPv4 and Dual stacks[2]

CIFS, DNS Resolver, DHCP Server (DHCPv6 sold separately), FTP (client and server), HTTP Client, HTTP Server, SSL option for HTTP Client and Server (sold separately), POP3, RTP, RTSP, SAP, SDP, SIP, SMTP, SNMPv1/v2/v3 (v3 option sold separately), SNTP, SRTP, STUN (IPv4 only), Telnet Server, TFTP (included at no additional cost with the Fusion stack)

[1]Compatible only with Unicoi's Fusion TCP/UDP/IPv4/v6 stacks, not with 3rd party TCP/UDP/IP stacks.
[2]These products are compatible with Fusion and 3rd Party TCP/UDP/IPv4/v6 stacks that have a BSD-like Sockets API. The base products include support for both IPv4 and IPv6 unless otherwise noted.

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