

ZebOS™

**Advanced Routing Suite:
IPv4 and IPv6 Testing &
Interoperability**

ipinfusion™

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Introduction

IP Infusion's ZebOS™ Advanced Routing Suite (ARS) is a platform-independent software package that supports IPv4 and IPv6 based routing protocols for BGP, OSPF, and RIP. In addition, ZebOS ARS supports multiprotocol label switching (MPLS) through the label distribution protocol (LDP), which provides a crucial platform for BGP-VPN. Please refer to the separate document for "MPLS Testing and Interoperability".

Because ZebOS™ software is a critical component in routing and switching platforms, IP Infusion devotes a substantial amount of time and resources to the testing cycle of each development release, including full functional testing and extensive combinatorial testing in Multiple Instance environments and Virtual Router operation. This paper discusses IP Infusion's IPv4 and IPv6 testing methodology and outlines in detail each phase of our test cycle.

Our aim is to provide the most complete performance, stress, interoperability, and reliability testing in the market. We welcome feedback and comments on this paper and encourage our customers to work with us to provide additional testing and performance metrics.

Please also refer to our family of Performance White Papers on BGP and OSPF, especially relating to Memory Usage, Scalability Parameters, and Benchmarking. The full Performance Test Methodology for these crucial performance issues are presented and summarized.

All the results for tests described herein and for product performance are available from IP Infusion. Contact your local sales representative for instructions on how to obtain these test results.

Testing Methodology

IP Infusion has defined a testing methodology to ensure the high quality and reliability of our ZebOS Advanced Routing Suite. This testing methodology starts from the moment we begin producing each new release, until it is finally shipped to market. The four testing regimes are:

- Internal Testing
- Interoperability Lab Testing
- 6-Bone (57 country) Deployment for IPv6
- Adoption of the Network Processing Forum Testing and Benchmarking Initiatives

(Please also refer to our separate testing suite on MPLS –VPN and MPLS-TE)

Our internal tests validate that the product design and functionality meet our specifications and pass a set of rigorous tests that prepare us to ship the product to private interoperability lab testing facilities. These labs make certain that each of the protocols passes a detailed list of interoperability tests. IP Infusion ensures compliance with these tests before we go into our beta test cycle.

Advanced-concepts test sites are those special worldwide configurations that certify the rapid growing advanced features of the Internet. The 6-Bone test site for IPv6 has been in-place worldwide for 20 months with many ZebOS-based operational routers. ZebOS will be in full compliance with the Testing and Benchmarking of the Network Processing Forum (NPF). Currently, IP Infusion chairs the Software Working Group and holds the Software Working Group Secretary position of the NPF.

ZebOS originated from the open source community, having passed hours and hours of live testing in hundreds of sites. These real-world installations have been a crucial kick-off for the platform of reliable operations upon which all ZebOS feature sets are based.

Internal Testing

Our internal test suites are designed at the same time we develop the initial product specifications for each ZebOS release. This process certifies that testing is an integral part of the design of our product. While we implement the initial design, we continually perform a set of unit tests to ensure the reliability and functionality of the software. When the unit tests are complete, we go into a set of protocol module and routing services module tests to validate the performance, functionality, and reliability of each module in our routing suite.

Of extreme importance to the testing cycle is the adoption of the Software Engineering Best Practices concepts embedded within the *Rational Test RealTime* testing and evaluation suites. This filtering process scans through and compiles the raw source code and scans for errors, redundancies, and in-efficiencies.

After the module tests are complete, we run a set of system tests to determine the functionality of the entire system. This includes the routing services module and the protocol modules for OSPF, BGP, and RIP (both IPv4 and IPv6) as well as our newest MPLS-LDP Switching Module, ZebOS Network Services Module (NSM), and BGP with VPN extensions. This process validates the communication, configuration, and functionality for each of the protocol modules and the routing services module. This includes route conversion, command line interface functionality, management, logging, and event handling.

In order to validate the functionality and performance of ZebOS we use the following tools:

- Rational Test RealTime
- Empirix ANVL
- Ixia performance tool

Additionally, we test the software on a variety of platforms, including: Linux, Solaris™, FreeBSD, OpenBSD, NetBSD, VxWorks®, OSE, OS-9®, and QNX.

The *Rational Test RealTime* software suite provides key elements to ensure source code integrity for IP Infusion's Linux code and VxWorks® Tornado code. The code is subjected to various levels of analysis throughout its compilation and link stages. Code under execution is scrutinized for possible memory leaks and a variety of erroneous operating conditions.

Empirix ANVL testing begins with the authoring of an array of test suites to specifically test a rich variety of router functionalities. Each release is subjected to this extensive session of testing.

Given all the platforms and the various ANVL test suites, a total of 33 full-test runs comprise every ZebOS release. Those ANVL test suites are:

RIP Testing (54 Tests)

- | | |
|-----------------------------------|----------------------------------|
| 1. Messages, 520 Updates | 28. Ignore or Update Metric |
| 2. Messages, Unsolicited | 29. Non-existent infinite metric |
| 3. Messages, Responses | 30. Update routes with metric 16 |
| 4. Packets, 25 times | 31. Ignore already as good route |
| 5. Valid Packets | 32. Response only sent to one |
| 6. Trace Packets | 33. Trigger update on changes |
| 7. Packet Skipping | 34. Update Delays |
| 8. Packet Metrics | 35. Horizon w/poisoned reverse |
| 9. Maximum datagram | 36. Disallow/Allow lists |
| 10. Checking packet format | 37. Version 2 fields |
| 11. Host Route Dropping | 38. Version 2 tuples |
| 12. Checking Bad Values | 39. 0xffff Authentications |
| 13. Subnet Restrictions | 40. Authentication verification |
| 14. Gateways w/ address 0.0.0.0 | 41. Authentication validation |
| 15. Ignoring 0.0.0.0 entries | 42. Reachable Address |
| 16. Router/Garbage Timers | 43. Next Hop Reachability |
| 17. Garbage Collection Reset | 44. Multicast Addressing |
| 18. Ignoring Version 0 datagrams | 45. Multicast receive capability |
| 19. Checking "must be zero" | 46. Multicast Receive Capability |
| 20. Responses to Valid Requests | 47. Compatibility Switch |
| 21. Sending the Full Route Table | 48. Receive Control Switch-1 |
| 22. Checking Replies to Request | 49. Receive Control Switch-2 |
| 23. Split Horizon and Hiding | 50. Receive Control Updates |
| 24. Ignoring responses | 51. Ignore Receive Switch |
| 25. IP valid neighbor | 52. Router List Feature |
| 26. Ignore own address response | 53. Receive Version Switch |
| 27. Ignore unused octets not-zero | 54. Route Table Overflow |

OSPF Testing in 62 Categories (non-extended, 307 tests)

- | | |
|--------------------------------|--------------------------------|
| 1. OSPF Set-up, Hello, Advert. | 32. LS Sequence Numbers |
| 2. OSPF Flooding | 33. Type-3 LSAs |
| 3. Routing Table Look-ups | 34. LS Sequence Numbers |
| 4. Testing route table changes | 35. Type-1 LSAs |
| 5. Intra-Area SPF | 36. Initial LS Sequence Number |
| 6. Inter-Area SPF | 37. Type-3 LS Sequence Num. |
| 7. AS Route Calculation | 38. Type-4 LSAs |
| 8. Functional Summaries | 39. Type-1 LSAs |
| 9. Routing Protocol Packets | 40. Type-3 LSAs |
| 10. Hello Protocol | 41. Link State Header |
| 11. DataBase Synchronization | 42. LSA Checksum |
| 12. Designated Router | 43. LSA deletion |
| 13. Backup Designated Router | 44. LSA Database |
| 14. Send Protocol Packets | 45. LSA Details (type-1 to 5) |
| 15. Receive Protocol Packets | 46. Originating LSAs |
| 16. Send Hello Packets | 47. Router LSAs |

- | | |
|--------------------------------|-------------------------------|
| 17. Interface Data Structure | 48. Network LSAs |
| 18. Interface States | 49. Summary LSAs |
| 19. DR election | 50. AS-External LSAs, |
| 20. Send Hello packets | 51. Flooding Procedures |
| 21. Neighbor Data Structure | 52. Sending Protocol Packets |
| 22. Neighbor States (machine) | 53. Receiving Self-Orig. LSAs |
| 23. Receive Hello Packet | 54. Sending LSA Packets |
| 24. Receive Data Descriptors | 55. Receiving LSA Packets |
| 25. Receive LS Request Packets | 56. Virtual Links |
| 26. Send Data Descriptors | 57. Calculating Inter-Areas |
| 27. Send LS Request Packets | 58. Encapsulation |
| 28. Link State Age | 59. Hello Packets |
| 29. Options | 60. LSA Ack. Packets |
| 30. Link State Types | 61. Router/Summary LSAs |
| 31. Link State Types | 62. Architectural Constraints |

Extended OSPF Testing (46 tests)

- | | |
|---------------------------------|--------------------------------|
| 1. OSPF NSSA Hello N-Bit | 24. NSSA subsumed addresses |
| 2. NSSA non-type-5 LSA | 25. NSSA subsumed ranges |
| 3. NSSA, Type-7s, Internal only | 26. NSSA Highest path type |
| 4. NSSA, Type 7s no external | 27. NSSA DoNotAdvertise |
| 5. NSSA Summary imports | 28. NSSA Type-7s not in range |
| 6. N-bit On, E-bit off | 29. NSSA Type-7 Advertise |
| 7. NSSA no type 5 LSAs | 30. NSSA ABR Advertise |
| 8. NSSA translations | 31. NSSA ABR/Path Advertise |
| 9. NSSA ABRs set the E-bit | 32. NSSA ABR/FWD Advertise |
| 10. NSSA Summary imports | 33. NSSA Ranges Advertise |
| 11. NSSA rules to skip Type-7s | 34. NSSA Drop LSA w/Limits |
| 12. NSSA Identical Type-7 paths | 35. Overflow State AS Accept. |
| 13. NSSA Type-5s and Type-7s | 36. Opaque Type-9 not flooded |
| 14. NSSA Type-7 AS Ext Routes | 37. Opaque Type-10 flooding |
| 15. NSSA Type-5 tie-breaker | 38. Opaque Type-10 flooding |
| 16. NSSA P-bit priority | 39. Opaque Type-11 AS-transit |
| 17. NSSA High ID Translator | 40. Opaque Type-11 non-stubs |
| 18. NSSA Type-7 Ranges | 41. Opaque Stub Rejection |
| 19. NSSA Type-5 Origination | 42. Opaque Type-9 Restrictions |
| 20. NSSA Type 7/5 Translation | 43. Opaque Type-10 Restriction |
| 21. NSSA Type-5 Origination | 44. Opaque O-Bit |
| 22. NSSA Type-5 Origination | 45. Opaque Handshakes |
| 23. NSSA Type-5 Rules | 46. Opaque Virtual Neighbors |

BGP Testing (48 tests)

- | | |
|---------------------------------|-----------------------------------|
| 1. Establish BGP-4 Session | 25. Internal Peer Exclusion |
| 2. Establish two Sessions | 26. Internal Peer Exclusion |
| 3. Router Adds Updates | 27. Internal Peer Preference |
| 4. Router Forwards Updates | 28. Internal Peer tie-breaking |
| 5. BGP Next Hop Advertising | 29. Internal Peer ID tie-breaking |
| 6. Never Install Itself | 30. Internal Peer w/same NLRI |
| 7. Next Hop Modifying | 31. Internal Peer Unfeasible |
| 8. Next Hop Aggregation | 32. External Peer new routes |
| 9. State Machine Open Message | 33. Own AS updates |
| 10. Update Messages, Withdraw | 34. MinRouteAdvertiseinterval |
| 11. Feasible and Unfeasible msg | 35. Withdrawal Exclusion |
| 12. Update Message Replacmnt | 36. Next Hop non- Aggregation |

- | | |
|-----------------------------------|--------------------------------|
| 13. Update Decision Process | 37. Next Hop Aggregation |
| 14. Update NLRI | 38. Aggregation AS_Path |
| 15. Update Route Overlapping | 39. Aggregation Tuples |
| 16. Route Selection Preferences | 40. Aggregation AS_SET tuples |
| 17. Route Selection Policy | 41. Aggregation X precedes Y |
| 18. Route Selection, Exclusion | 42. Aggregation same value |
| 19. Route Selection Feasibilities | 43. Update Packets Stress Test |
| 20. Route Selection Sets | 44. BigNet Sessions |
| 21. Route Selection Removal | 45. BigNet Updates |
| 22. Route Selection Lowest ID | 46. BigNet Updates, Forwarding |
| 23. Route Selection Priorities | 47. BigNet Route Flapping |
| 24. Route Selection, Internal | 48. BigNet Link Flapping |

LDP Testing (58 tests; For detailed information, refer to MPLS Testing and Interoperability Paper)

- | | |
|---------------------------------|----------------------------------|
| 1. Periodic LDP Hello | 30. Loop Detection Notification |
| 2. Proper LDP Version | 31. No Label Resource notify |
| 3. Hello upstream / downstream | 32. Retransmit Label Request |
| 4. Targeted Hello upstream | 33. Unmatched Prefix Response |
| 5. TCP connection from TLV | 34. Hop Count exceeded max |
| 6. TCP connection well known | 35. Label Request out of range |
| 7. LDP passive Init / Keepalive | 36. Label Request downstream |
| 8. Closes TCP upon error | 37. Mapping for FEC from FIB |
| 9. Delayed Session after error | 38. Mapping DOD label adv |
| 10. Hold Timer Expiration | 39. Mapping on new FEC N-Hop |
| 11. (Session rejected) | 40. Using Label from Neighbor |
| 12. Keepalive before expiration | 41. Upstream Label w/no map |
| 13. Loop Detection, Label Req | 42. Upstream Label w/Indep. |
| 14. Upstream to Downstream Req | 43. Upstream Label w/egress |
| 15. Label Map to Upstream LSR | 44. Ordered control mode |
| 16. Hop Count Increment | 45. Upstream Label w/loop det. |
| 17. Independent Control Mode | 46. Label Map with own LSR ID |
| 18. Unknown Hop Count Msg | 47. Upstream Label w/ord. Ctrl |
| 19. Path Vector Downstream | 48. Upstream Label w/ord. Ctrl |
| 20. Self Path vector | 49. Downstream Label, new FEC |
| 21. Ordered Control Self Path | 50. Label Req Abort Notification |
| 22. Independent Control path | 51. Ignoring Label Abort Msg |
| 23. Path Vector upstream | 52. Label Withdraw Messages |
| 24. Appending self to Path | 53. Fwd Label Withdraw Msg |
| 25. Notification w/ F-bit | 54. Response to Label Release |
| 26. Notification Rejection | 55. Transmit Label Release Msg |
| 27. Upstream Advertisement | 56. Label Release not Next Hop |
| 28. Label Request Downstream | 57. Response, Label Withdraw |
| 29. Retransmit Downstream | 58. Interface Status |

Advanced internal testing continues with several combinations of testing: OSPF/BGP Multiple Instances, BGP/MPLS/VPN over Ethernet, IPv6, full SNMP-API, full Command Line Interface-API, and Virtual Router Operation. At this point many configurations are tested for memory usage and scalability parameters. For further details, please refer to our separate Test Methodology White Papers.

Significant Performance Evaluation statistics are gathered using the *IXIA traffic generator*. Some tests have exceeded 1,000,000 installed routes, and the testing focuses on building a data base of Benchmarks, Memory Footprints, and Scalability.

These tests are especially tailored to generate massive router traffic deployed with an extensive variety of parameters.

Finally, we run a set of interoperability tests to validate that the ZebOS Advanced Routing Suite, which runs on a variety of processors and operating systems, can interoperate with popular routers, such as Cisco Systems, as well as firewalls and other Internet devices.

It is important to note that as the Advanced Routing Suite is ported and integrated into various customer configurations it is subjected to yet another level of rigorous testing and validation. These customer-run verifications of the product become an important ingredient to overall reliability of IP Infusion's products.

Interoperability Lab Testing

After completing internal tests, we send the software to private entities that perform very detailed protocol functionality, reliability, stress, and interoperability testing. One of the key interoperability labs is the [University of New Hampshire Interoperability Laboratory \(UNH IOL\)](#), which performs multiple tests for all of the protocols (OSPF, BGP, and RIP), and IPv6 for RIP. The UNH IOL has a large list of [consortium members](#) that use their extensive testing services

The service that UNH IOL provides to IP Infusion and to our customers is invaluable. They test each protocol in detail and provide well-documented feedback indicating if a protocol has not met certain specifications. At that time, we then return to our internal development and test cycles until we believe that we have substantially addressed each one of the issues in the UNH IOL test results.

The sections below outline the specific tests run for each of the protocols that we support: RIP, OSPF, and BGP, as well as IPv6.

RIP Testing

The UNH IOL RIP testing for RIP v1 and v2 is a complete set of RIP protocol tests that include: Processing Tests, Validation Tests, and Forwarding Tests. The lists below show the specific tests run in each of the categories. Each of the tests in a specific category can include multiple subtests.

Processing Tests

Basic Response	Next Hop
Subnet Mask	Default Route
Metric Processing	Host Route
Version Number	Family Identifier
Route Tags	Triggered Response
Route Timeout	Number of Entries
v1 Compatibility	Full Table Request
Simple Authentication	

Validation Tests

Subnet Mask	Network Validation
Metric Validation	Must Be Zero Fields
Command Number	Number of Entries
Source Address	Next Hop

Forwarding Tests

Basic Forwarding	Priority Forwarding
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OSPF Testing

The extremely detailed OSPF tests are broken into five main test categories: Hello Protocol tests, Flooding & Adjacency tests, Link State Advertisement tests, Route Calculation tests, and Configuration & Formatting tests. In each category multiple tests validate that the protocol is functioning as required by the IETF RFC's and in an interoperable fashion.

Hello Protocol

Hello Addressing	Hello Waiting
Event Backup	No Waiting
Accept Existing	Dr Collision
Bdr Become Dr	Dr Other Become
Hello Mismatch	Remote Hello
Hello E Bit	

Flooding & Adjacency

Multi-Access Adj.	Database Desc mtu set
Database Desc mtu match	Master Negotiation
Self Orig LSA Rcpt	Old LSA Rcpt
NBR State Too Low	DD Retransmit
Event Seq. Num Mismatch	Flooding
Flooding ASE	LS Ack
LSA Retransmission	LSA Flood guarantee
LSA Multicast Flood	LSA Retransmit
	Unicast
LSA Request Retransmit	Event Bad LS Req
LSA Maxage Flood	LSA Refresh Flood
Remove LSA from retrans	Remove LSA from retrans

Link State Advertisements

Router LSA transit	Router LSA DR change
Router LSA stub	Net LSA DR Change

Net LSA Attached Router	Summary Asbr LSA Intra Area
Sum Net LSA Intra Area	Inter Area Become Inter Area
Sum Area Range RFC 1583	Sum Area Range RFC 2328
Sum Area Range Common	Sum Area Range No Transit
Virtual Link LSA	ASE static
ASE RIP	Remove Redundant
Default Summary Origination	Default Summary Use
Host Bits ASE	LE Sequence

Route Calculation

Prefer Intra Area Route	Inter Area Through Transit
ASE Forwarding Addr	Asbr Intra Area Route
Prefer Internal Route	ASE Type 1 and 2
Multiple Asbr Intra enabled	Multiple Asbr Intra disabled
Multiple Asbr Inter enabled	Multiple Asbr Inter disabled

Configuration & Formatting

Area Parameters Config	Interface Parameters
Router LSA Bits	Precedence TOS IP Header
No Virtual Link In Stub	Authentication RFC 1583
Authentication RFC 2328	Authentication MD5
Checksum	Number Advertisements
Packet Length Field	LSA Header Length
Router LSA #Links	Router LSA #TOS
Bad LSA Age	

BGP Testing

As with OSPF and RIP, the BGP protocol test suite is broken down into the following categories: Basic Processing, BGP Finite State Machine, Error Handling, and Extensions. The specific tests in each category are listed below:

Basic Processing

TCP port connection direct	TCP port connection remote
Routing table matching	Hold Time Negotiation
Keep Alive	Close
Internal Update	External Update
Attribute Order	Origin Attribute
AS Path Attribute	Next Hop Attribute
Multi Exit Disc Attribute	Local Pref Attribute
Atomic Aggregate Attribute	Aggregation Path Attributes
Optional Attributes	Route Selection

BGP Finite State Machine

Idle FSM	Connect FSM
Active FSM	Opensent FSM
Openconfirm FSM	Established FSM

Error Handling

Header Error	Open Error
Update Error	Hold Timer
Connection Collision	
Detect	

Extensions

Confederations Propagate	Confederations Orig
Confederations Changes	Route Reflector
Route Reflector To	Communities
Nonclient	
Capabilities Negotiation	Multiprotocol
Label Info	

Internet Protocol Version 6 (IPv6)

To fully evaluate the ZebOS Advanced Routing Suite, the interoperability tests begin with the full base of TCP/IP testing for IPv6 in conformance with RFC 2460 (Basic IPv6 Packet Operation) and RFC 2461 (IPv6 Neighbor Discovery). Once the base is tested, the UNH IOL lab proceeds with Router Testing. The UNH IOL suite includes the following fundamental IPv6 operations:

Basic IPv6 Packet Operation

Unknown Header Error	Packet Reassembly Error Recovery
Recovery	
Valid Zero Payload Length	Fragment Flag Error Recovery
Zero Next Header Error	Proper response to oversized packet
Recovery	
Proper Header Processing	Proper Offset Zero Fragment
	Handling
Unknown Options Processing	Two Fragments More Error Recovery
Options, Order of Occurrence	Proper Fragment Reassembly
Routing Header Processing	Next Header Value 59 Handling
Routing Header Error Recovery	
Packet Fragment Parsing	

IPv6 Neighbor Discovery

Destination on-link	Reachable State Handling
Packet Queuing	ICMP Redirect Message
Router Solicitation Processing	Non Neighbor ICMP rejection
Neighbor Cache Updating	Redirect Message Limitations
Neighbor Solicitation Handling	Redirect Message Handling
Neighbor Solicitation Actions	Packet-Too-Big Handling
Neighbor Solicitation to Cache	Packet-Too-Big Generation
Neighbor Advertisement Discarding	Reduction in Path MTU Handling
Incomplete State Handling	Lower PMTU handling
Stale State Handling	PMTU low value Handling
Delay State Handling	PMTU greater than Estimate
	Handling
Probe State Handling	

RIPng Testing

The UNH IOL RIPng testing for IPv6 Operation is a complete set of RIP protocol tests that certify complete compliance with RFC 2080.

Basic RIPng, IPv6 Packet Operation

Add Routes from valid RIPng response	Route Entry Validations
RIPng Zero-Message Handling	Multiple Next Hop Handling
Handling of Must-Be-Zero in Next hop Default Route Handling	Off-Link Global Address Handling
Multiple Route Selections	Ignoring self Route Updates
Route Expiration and Garbage collection	Next Hop Half-Spent Handling
Empty Request Message Handling	Triggered Responses Waiting
Full Table Request Handling	Triggered Response Contents
Invalid UDP port Handling	Multiple Response Generation
Hop Count non-255 handling	New Version Packet Processing

By successfully completing these extensive and detailed tests performed by UNH IOL, we believe that our products have achieved a rather significant level of functionality, quality, reliability, and performance.

6-Bone (57 country) Deployment for IPv6

The 6-bone test bed deployment of IPv6 is a massive site representing over 57 countries engaged in the IPv6 phase-in. It is an outgrowth of the IETF Ipng project that created the IPv6 protocols. It is operated with oversight from the “NGtrans” (IPv6 Transition) Working Group of the IETF. The test bed started as a virtual network, using IPv6 over IPv4 tunneling/encapsulation, which operates over the IPv4-based Internet to support IPv6 transport; it is slowly migrating to native links for IPv6 transport.

ZebOS IPv6 features are well represented by several countries, and especially in Japan by DML Networks and its affiliates. The world’s transition to IPv6 is proceeding quickly; therefore, ZebOS is tested for the following IPv6 functions:

- Expanded Addressing
- Simplified Header Format
- Improved Extension and Option Support
- Flow Labeling
- Improved Authentication and Privacy
- Tunneling

IP Infusion is committed to the growth and use of IPv6 protocols. The ZebOS™ Advanced Routing Suite is one of the most widely deployed testing software used on the 6Bone (IPv6 test bed). The management of IP Infusion is also active in a number of international organizations such as the IETF (Internet Engineering Task Force), JANOG (Japan Network Operators Group) and the Global IPv6 Summit¹. IP Infusion will

¹ Please see <http://www.jp.ipv6forum.com/slides/J3-3.ppt> for a presentation given at the last Global IPv6 Summit by Kunihiro Ishiguro, C.T.O. of IP Infusion.

continue its participation in the standards bodies while fully supporting the latest developments in IPv6 protocols and testing.

The 6bone operates under the IPv6 Testing Address Allocation (see [RFC 2471](#)). Information can be found at www.6bone.net and by selecting “About various IPv6 Implementations”.

Adoption of NPF Testing and Benchmarking Initiatives

The Network Processing Forum (NPF) is devoted to the advanced definition of the Data Plane and Control Plane operations that ensure high-speed hardware solutions on the Internet. Their goal is to focus on Standards, Testing, Benchmarking, and Education, so that effective high-performance hardware solutions are properly defined.

Additionally, IP Infusion is working with its strategic partners in helping to define, standardize, and test the NPF Software API. The ZebOS High Level API (Classification, IPv4) uses both a Unicast ARP and Unicast Forwarding interface to the High Level API of the Forwarding Plane (data plane). The Low Level API provides interconnect to cPCI, Switch Fabric, Ethernet, etc.

As we continue to demo products in 2002, the NPF components are tested under worldwide partnership agreements and commonly viewed in operation at various worldwide industry conferences and seminars.

Conclusions & Futures

As a result of using in-house tools and processes, external testing organizations, advanced-concepts test-sites, and the open source community, IP Infusion offers a complete testing program that focuses on the delivery of high-quality, reliable, and high-performance routing software to the router/switch, network processor, wireless, and embedded device communities. Our mission is to become the industry standard, platform-independent, routing protocol vendor. IP Infusion’s focus on next generation Internet standards such as IPv6, MPLS, network processors, our rich feature set, and our complete testing program together positions the company well to achieve our mission.

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