

IPv6 Operations Working Group

Internet Draft

Document: [draft-ietf-v6ops-ent-scenarios-00.txt](#)

Obsoletes: [draft-pouffary-v6ops-ent-v6net-03.txt](#)

Expires: April 2004

Jim Bound (Editor)

Hewlett Packard

## IPv6 Enterprise Network Scenarios

[<draft-ietf-v6ops-ent-scenarios-00.txt>](#)

### Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of [Section 10 of RFC2026](#).

This document is a submission by the Internet Protocol IPv6 Working Group of the Internet Engineering Task Force (IETF). Comments should be submitted to the [ipng@sunroof.eng.sun.com](mailto:ipng@sunroof.eng.sun.com) mailing list.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/ietf/1id-abstracts.txt>

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>.

### Abstract

This document describes the scenarios for IPv6 deployment within Enterprise networks. It will focus upon an Enterprise set of network base scenarios with assumptions, coexistence with legacy IPv4 nodes, networks, and applications, and network infrastructure requirements. These requirements will be used to provide analysis to determine a set of Enterprise solutions in a later document.

Internet Draft

IPv6 Enterprise Network Scenarios

October 2003

Table of Contents:

<a href="#">1.</a>	<a href="#">Introduction.....</a>	<a href="#">3</a>
<a href="#">2.</a>	<a href="#">Terminology.....</a>	<a href="#">5</a>
<a href="#">3.</a>	<a href="#">Base Scenarios.....</a>	<a href="#">6</a>
<a href="#">3.1</a>	<a href="#">Base Scenarios Defined.....</a>	<a href="#">6</a>
<a href="#">3.2</a>	<a href="#">Scenarios Characteristics.....</a>	<a href="#">6</a>
<a href="#">3.3</a>	<a href="#">Base Scenario Examples.....</a>	<a href="#">8</a>
<a href="#">4.</a>	<a href="#">Support for Legacy IPv4 Nodes and Applications.....</a>	<a href="#">9</a>
<a href="#">4.1</a>	<a href="#">IPv4 Tunnels to Encapsulate IPv6.....</a>	<a href="#">9</a>
<a href="#">4.2</a>	<a href="#">IPv6 Tunnels to Encapsulate IPv4.....</a>	<a href="#">10</a>
<a href="#">4.3</a>	<a href="#">IPv6 communicating with IPv4.....</a>	<a href="#">10</a>
<a href="#">5.</a>	<a href="#">Network Infrastructure Requirements.....</a>	<a href="#">10</a>
<a href="#">5.1</a>	<a href="#">DNS.....</a>	<a href="#">10</a>
<a href="#">5.2</a>	<a href="#">Routing.....</a>	<a href="#">10</a>
<a href="#">5.3</a>	<a href="#">Autoconfiguration.....</a>	<a href="#">11</a>
<a href="#">5.4</a>	<a href="#">Security.....</a>	<a href="#">11</a>
<a href="#">5.5</a>	<a href="#">Applications.....</a>	<a href="#">11</a>
<a href="#">5.6</a>	<a href="#">Network Management.....</a>	<a href="#">11</a>
<a href="#">5.7</a>	<a href="#">Address Planning.....</a>	<a href="#">11</a>
<a href="#">6.</a>	<a href="#">Security Considerations.....</a>	<a href="#">12</a>
<a href="#">7.</a>	<a href="#">References.....</a>	<a href="#">12</a>
<a href="#">7.1</a>	<a href="#">Normative References.....</a>	<a href="#">12</a>
<a href="#">7.2</a>	<a href="#">Non-Normative References.....</a>	<a href="#">12</a>
	<a href="#">Document Acknowledgments.....</a>	<a href="#">12</a>
	<a href="#">Authors-Design Team Contact Information.....</a>	<a href="#">13</a>
	<a href="#">Intellectual Property Statement.....</a>	<a href="#">14</a>
	<a href="#">Full Copyright Statement.....</a>	<a href="#">14</a>
	<a href="#">Acknowledgement.....</a>	<a href="#">15</a>

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

## 1. Introduction

This document describes the scenarios for IPv6 deployment within Enterprise networks. It will focus upon an Enterprise set of network base scenarios with assumptions, coexistence with legacy IPv4 nodes, networks, and applications, and network infrastructure requirements. These requirements will be used to provide analysis to determine a set of Enterprise solutions in a later document.

The audience for this document is the enterprise network team considering deployment of IPv6. The document will be useful for Enterprise teams that will have to determine the IPv6 transition strategy for their enterprise. It is expected those teams include members from management, network operations, and engineering. The scenarios presented provide an example set of cases the Enterprise can use to build an IPv6 network scenario.

To frame the discussion, the document will describe a set of scenarios and characteristics for each scenario. It is impossible to define every possible Enterprise scenario that will apply to IPv6 adoption and transition.

Each enterprise will select the transition that best supports their business requirements. Any attempt to define a default or one-size-fits-all transition scenario, will simply not work. This document does not try to depict the drivers for adoption of IPv6 by an Enterprise.

While it is difficult to quantify all the potential motivations for enterprise network teams to move to IPv6, there are some cases where an abstract description is possible. The document presents three example motivations as a general use case. This model can be used to define additional abstractions, for the Enterprise to define scenarios to fit their requirements.

The first scenario assumes the Enterprise decides to deploy IPv6 in parallel with IPv4. The second scenario assumes the Enterprise decides to deploy IPv6 because of a specific set of applications the Enterprise wants to use over an IPv6 network. The third scenario assumes an Enterprise is building a new network or re-structuring an existing network and decides to deploy IPv6. The document then defines a set of characteristics that must be analyzed. The document then provides several scenario examples using the characteristics to depict the requirements. These are common Enterprise deployment cases to depict the challenges for the Enterprise to transition a network to IPv6.

The document then discusses the issues of supporting Legacy functions on the network, while the transition is in process, and the network infrastructure components required to be analyzed by the Enterprise. The interoperation with legacy functions within the Enterprise will be required for all transition except possibly by a new network that will be IPv6 from inception. The network infrastructure components will inform the Enterprise of key points of transition in their networks that require consideration for IPv6 deployment and transition.

Using the scenarios, characteristics, and examples in the document an

[draft-ietf-v6ops-ent-scenarios-00.txt](#) Expires April 2004 [Page 3]

---

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

Enterprise can define a scenario. Understanding the legacy functions and network infrastructure components required, the Enterprise can determine the network operations required to deploy IPv6. The tools and mechanisms to support IPv6 deployment operations will require Enterprise analysis. The analysis to determine the tools and mechanisms to support the scenarios is the next document for the Enterprise network.

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

## 2. Terminology

- |                    |  |
|--------------------|--|
| Enterprise Network | - An Enterprise Network is a network that has multiple links, a router connection to a Provider, and is actively managed by a network operations entity. |
| Provider           | - A Provider is an entity that provides services and connectivity to the Internet or other private external networks for the Enterprise Network.         |
| IPv6/IPv4          | - A node or network capable of supporting both IPv6 and IPv4.  |

- |           |  |
|-----------|--|
| IPv4 only | - A node or network capable of supporting only IPv4. |
| IPv6 only | - A node or network capable of supporting only IPv6. |

### 3. Base Scenarios

Three base scenarios are defined to capture the essential abstraction set for the Enterprise. Each scenario has assumptions and

requirements. This is not an exhaustive set of scenarios, but a base set of general cases.

### 3.1 Base Scenarios Defined

Scenario 1: Enterprise with an existing IPv4 network wants to deploy IPv6 in parallel with their IPv4 network.

**\*\*Note To V6ops WG:** Would a network topology map be useful here?

Assumptions: The IPv4 characteristics have an equivalent in IPv6.

Requirements: Don't break IPv4 network characteristics assumptions with IPv6. IPv6 should be equivalent or "better" than the ones in IPv4, however, it is understood that IPv6 is not required to solve every single problem.

Scenario 2: Enterprise with an existing IPv4 network wants to deploy a set of particular IPv6 "applications" (application is voluntarily loosely defined here, e.g. peer to peer). The IPv6 deployment is limited to the minimum required to operate this set of applications.

**\*\*Note To V6ops WG:** Would a network topology map be useful here?

Assumptions: IPv6 software/hardware components for the application are available.

Requirements: Don't break IPv4 network operations.

Scenario 3: Enterprise deploying a new network or re-structuring an existing network, decides IPv6 is the basis for network communication.

**\*\*Note To V6ops WG:** Would a network topology map be useful here?

Assumptions: Required IPv6 network components are available, or available over some defined timeline.

Requirements: Interoperation and Coexistence with IPv4 network operations and applications are required for communications.

### 3.2 Scenarios Characteristics

This section defines the characteristics that exist for the above Enterprise scenarios. This is not an exhaustive set of characteristics, but a base list that can be expanded by the

Enterprise. The characteristics components are presented as questions that the Enterprise must determine as part of defining the scenario. The answers to these questions will identify actions that are required to deploy IPv6.

Characteristic 1 - Providers for External Network Operation

- Is external connectivity required?
- One site vs. multiple sites?
- Leased lines or VPN?
- IPv4 existing address ownership (Provider based addresses vs. Provider independent addresses)?
- Multi-homing?
- Do ISPs offer IPv6 service?
- Is there an external data-center?

Characteristic 2 - Enterprise Application Analysis

- List of applications in use?
- Can the application be upgraded to IPv6?
- Can the application support both IPv4 and IPv6?

Characteristic 3 - Enterprise IT Department Operations Analysis

- Who "owns"/"operate" the network: in house, outsourced?
- Is a Tele-commuter work force supported?
- Is inter-site communications required?
- Is network mobility used?
- IPv4 addressing plan?
- IPv4 addressing assignment procedure (DHCP vs. manual)?
- Internal IPv4 routing protocols used?
- External IPv4 routing protocols used?
- IPv4 Network Management policy/procedure?
- IPv4 QoS policy/procedure?
- IPv4 Security policy/procedure?
- List of "network operation" software that may be impacted by IPv6?
  - DNS
  - Management (SNMP & ad-hoc tools)
  - Enterprise Network Servers
  - Mail Servers
  - High Availability Software for Nodes
  - Directory Services
- Are all these software functions upgradeable to IPv6?
- If not upgradeable, then what are the workarounds?
- Do any of the software functions store IP addresses?
- List of "network operation" hardware that may be impacted by IPv6
  - Routers/switches
  - Firewalls
  - Load balancers
  - VPN Points of Entry/Exit
  - Security Servers
  - Printers
  - Network Interconnect for Platforms
  - Intelligent Network Interface Cards
  - Network Storage Devices



- Are all these hardware functions upgradeable to IPv6?
- If not, what are the workarounds?
- Do any of the hardware functions store IP addresses?

#### Characteristics 4 - Enterprise Network Management System

- Performance Management Required?

- Network Management Applications Required?
- Configuration Management Required?
- Policy Management and Enforcement Required?
- Security Management Required?
- Management of Transition Tools and Mechanisms?
- What new considerations does IPv6 create for Network Management?

### 3.3 Base Scenario Examples

This section presents a set of Base Scenario Examples and is not an exhaustive list of examples. These examples were selected to provide further clarity of Base Scenarios within an Enterprise of a less abstract nature.

#### Example Network A:

A distributed network across a number of geographically separated campuses.

- External network operation.
- External connectivity required.
- Multiple sites connected by leased lines.
- Provider independent IPv4 addresses.
- ISP does not offer IPv6 service.
- Private Leased Lines no Service Provider Used

#### Applications run by the enterprise:

- Internal Web/Mail.
- File servers.
- Java applications.
- Collaborative development tools.
- Enterprise Resource Applications.
- Multimedia Applications.
- Financial Enterprise Applications.
- Data Warehousing Applications.

#### Internal network operation:

- In house operation of the network.
- DHCP (v4) is used for all desktops, servers use static address

configuration.

- The DHCP server to update naming records for dynamic desktops uses dynamic DNS.
- A web based tool is used to enter name to address mappings for statically addressed servers.
- Network management is done using SNMP.
- All routers and switches are upgradeable to IPv6.
- Existing firewalls can be upgraded to support IPv6 rules.
- Load balancers do not support IPv6, upgrade path unclear.
- Peer-2-Peer Application and Security supported.

#### Example Network B:

A bank running a large ATM network supporting an order of magnitude number of transactions per second, with access to a central database on an external network from the ATM network:

- External connectivity not required.
- Multiple sites connected by VPN.
- Multiple sites connected by Native IP protocol.

Applications in the enterprise:

- ATM transaction application.
- ATM management application.
- Financial Software and Database.

Internal Network Operation:

- Existing firewalls can be upgraded to support IPv6 rules.
- Load balancers do not support IPv6, upgrade path unclear.

#### Example Network C:

A Security Defense Network Operation:

- External network required at secure specific points.
- Network is its own Internet.
- Network must be able absorb ad-hoc creation of sub-Networks.
- Entire parts of the Network are completely mobile.
- All nodes on the network can be mobile (including routers)
- Network True High-Availability is mandatory.
- Network must be able to be managed from ad-hoc location.
- All nodes must be able to be configured from stateless mode.

Applications run by the Enterprise:

- Multimedia streaming of audio, video, and data for all nodes.
- Data computation and analysis on stored and created data.
- Transfer of data coordinate points to sensor devices.
- Data and Intelligence gathering applications from all nodes.

#### Internal Network Operations:

- All packets must be secured end-2-end with encryption.
- Intrusion Detection exists on all network entry points.
- Network must be able to bolt on to the Internet to share bandwidth as required from Providers.
- VPNs can be used but NAT can never be used.
- Nodes must be able to access IPv4 legacy applications over IPv6 network.

## 4. Support for Legacy IPv4 Nodes and Applications

The Enterprise network will have to support the coexistence of IPv6 and IPv4, to support legacy IPv4 applications and nodes. The Enterprise user has the following choices for that coexistence to consider today.

### 4.1 IPv4 Tunnels to Encapsulate IPv6

IPv6/IPv4 nodes want to communicate using IPv6, but an IPv4 Internal router is between them. These nodes could also be Mobile nodes on a visited network.

[draft-ietf-v6ops-ent-scenarios-00.txt](#) Expires April 2004 [Page 9]

---

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

### 4.2 IPv6 Tunnels to Encapsulate IPv4

An IPv4/IPv6 node wants to communicate with a legacy IPv4 node and is on an IPv6 only link and routing domain.

### 4.3 IPv6 communicating with IPv4

An IPv6 only node wants to communicate with an IPv4 only node.

In cases where the IPv6 host cannot be a dual stack, in order to continue support of communications with IPv4 nodes an IPv4/v6 translator is required. Introduction of such translator will prevent usage of end-to-end security and application carrying embedded IP addressing information.

**\*\*Note to V6ops WG:** Should we discuss porting of applications too in the legacy section?

## 5. Network Infrastructure Requirements

The Enterprise will need to determine what network infrastructure components require enhancements or to be added for deployment of IPv6. This infrastructure will need to be analyzed and understood as a critical resource to manage.

### 5.1 DNS

DNS will now have to support both IPv4 and IPv6 DNS records and the Enterprise will need to determine how the DNS is to be managed and accessed, and secured.

**\*\*Note to V6ops WG:** Should we get into other DNS issues?

### 5.2 Routing

Interior and Exterior routing will be required to support both IPv4 and IPv6 routing protocols, and the coexistence of IPv4 and IPv6 over the enterprise network. The enterprise will need to define the routing topology, and any ingress and egress points to provider networks. The enterprise will also need to define points of transition mechanism to use within that routing topology.

IPv6/IPv4 routers should be monitored to ensure the router has sufficient storage for both IPv6 and IPv4 route tables. Existing network design principles to limit the number of routes in the network, such as prefix aggregation, become more critical with the addition of IPv6 to an existing IPv4 network.

**\*\*Note to V6ops WG:** Above is example of additional text we could add

[draft-ietf-v6ops-ent-scenarios-00.txt](#) Expires April 2004 [Page 10]

---

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

to each component we list here. Are there other Routing issues?

### 5.3 Autoconfiguration

IPv6 introduces the concept of stateless autoconfiguration in addition to statefull autoconfiguration. The enterprise will have to determine the best method of autoconfiguration, for their network.

**\*\*Note to V6ops WG:** Should we get into other autoconfiguration

issues?

#### [5.4](#) Security

Current existing mechanisms used for IPv4 to provide security need to be supported for IPv6 within the Enterprise. IPv6 should create no new security concerns for IPv4.

\*\*Note to V6ops WG: Should we get into other security issues?

#### [5.5](#) Applications

Existing applications will need to be ported to support both IPv4 and IPv6.

\*\*Note to V6ops WG: Should we get into other application issues?

#### [5.6](#) Network Management

The addition of IPv6 and points of transition will need to be managed by the Enterprise network operations center. This will affect many components of the network and software required on nodes.

\*\*Note to V6ops WG: Should we get into other Management issues?

#### [5.7](#) Address Planning

The address space within the Enterprise will need to be defined and coordinated with the routing topology of the Enterprise network.

\*\*Note to V6ops WG: Should we get into other Address Planning issues?

\*\*Note to V6ops WG: What other components are we missing?

## [6.](#) Security Considerations

This document lists scenarios for the deployment of IPv6 in enterprise networks, and there are no security considerations associated with making such a list.

There will security considerations for the deployment of IPv6 in each of these scenarios, but they will be addressed in the document that includes the analysis of each scenario.

## [7.](#) References

### [7.1](#) Normative References

None at this time.

### [7.2](#) Non-Normative References

None at this time.

## Document Acknowledgments

The Authors would like to acknowledge contributions from the following: IETF v6ops Working Group, Alan Beard, Brian Carpenter, Alain Durand, and Bob Hinden.

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

#### Authors-Design Team Contact Information

Send email to [ent-v6net@viagenie.qc.ca](mailto:ent-v6net@viagenie.qc.ca) to contact the design team and send comments.

Yanick Pouffary (Chair of Design Team)  
HP Competency Center  
950, Route des Colles, BP027,  
06901 Sophia Antipolis CEDEX  
FRANCE  
Phone: + 33492956285  
Email: [Yanick.pouffary@hp.com](mailto:Yanick.pouffary@hp.com)

Jim Bound (Editor)  
Hewlett Packard  
110 Spitbrook Road  
Nashua, NH 03062  
USA  
Phone: 603.884.0062  
Email: [jim.bound@hp.co](mailto:jim.bound@hp.co)

Marc Blanchet

Tony Hain

Paul Gilbert  
Cisco Systems  
1 Penn Plaza, 5th floor,  
NY, NY 10119  
USA  
Phone: 212.714.4334  
Email: [pgilbert@cisco.com](mailto:pgilbert@cisco.com)

Margaret Wasserman  
Wind River  
10 Tara Blvd, Suite 330  
Nashua, NH 03062 USA  
USA  
Phone: 603.897.2067  
Email: [mrw@windriver.com](mailto:mrw@windriver.com)

Jason Goldschmidt  
Sun Microsystems  
M/S UMPK17-103  
17 Network Circle  
Menlo Park, CA 94025  
USA  
Phone: (650)-786-3502  
Fax: (650)-786-8250  
Email: [jason.goldschmidt@sun.com](mailto:jason.goldschmidt@sun.com)

Aldrin Isaac  
Bloomberg L.P.  
499 Park Avenue  
New York, NY 10022  
USA  
Phone: 212.940.1812  
Email: aisaac@bloomberg.com

[draft-ietf-v6ops-ent-scenarios-00.txt](#) Expires April 2004 [Page 13]

---

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

Tim Chown

Jordi Palet Martinez  
Consulintel  
San Jose Artesano, 1  
Madrid, SPAIN  
Phone: +34 91 151 81 99  
Fax: +34 91 151 81 98  
Email: jordi.palet@consulintel.es

Fred Templin  
Nokia  
313 Fairchild Drive  
Mountain View, CA 94043  
USA  
Phone: 650.625.2331  
Email: ftemplin@iprg.nokia.com

Roy Brabson  
IBM  
PO BOX 12195  
3039 Cornwallis Road  
Research Triangle Park, NC 27709  
USA  
Phone: +1 919 254 7332  
Email: rbrabson@us.ibm.com

## Intellectual Property Statement

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in [BCP-11](#). Copies of claims of rights made available for publication and any assurances of



licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

## Full Copyright Statement

Copyright (C) The Internet Society (2002). All Rights Reserved.

[draft-ietf-v6ops-ent-scenarios-00.txt](#) Expires April 2004 [Page 14]

---

Internet Draft      IPv6 Enterprise Network Scenarios      October 2003

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works. However, this document itself may not be modified in any way, such as by removing the copyright notice or references to the Internet Society or other Internet organizations, except as needed for the purpose of developing Internet standards in which case the procedures for copyrights defined in the Internet Standards process must be followed, or as required to translate it into languages other than English.

The limited permissions granted above are perpetual and will not be revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an "AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

## Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

