

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JUNIPER NETWORKS, INC.,

Petitioner

v.

MONARCH NETWORKING SOLUTIONS LLC,

Patent Owner

Patent No. 8,451,844

Inter Partes Review No.
IPR2024-00485

DECLARATION OF SYLVIA HALL-ELLIS, PH.D.

I. INTRODUCTION

1. My name is Sylvia D. Hall-Ellis. I have been retained as an expert on behalf of Juniper Networks, Inc. (“Petitioner”).

2. I have written this report on behalf of Petitioner to provide my expert opinion regarding the authenticity and public availability of three publications. My report sets forth my opinions in detail and provides the basis for my opinions regarding the public availability of these publications.

3. I reserve the right to supplement or amend my opinions, and bases for them, in response to any additional evidence, testimony, discovery, argument, and/or other additional information that may be provided to me after the date of this report.

4. I am being compensated for my time spent working on this matter at my normal consulting rate of \$350 per hour, plus reimbursement for any additional reasonable expenses. My compensation is not in any way tied to the content of this report, the substance of my opinions, or the outcome of this litigation. I have no other interests in this proceeding or with any of the parties.

5. All of the materials that I considered are discussed explicitly in this declaration.

II. QUALIFICATIONS

6. I am currently an Adjunct Professor in the School of Information at San José State University. I obtained a Master of Library Science from the University of North Texas in 1972 and a Ph.D. in Library Science from the University of Pittsburgh in 1985. Over the last 50-plus years, I have held various positions in the field of library and information resources. I was first employed as a librarian in 1966 and have been involved in the field of library sciences since, holding numerous positions.

7. I am a member of the American Library Association (ALA) and its Association for Library Collections & Technical Services (ALCTS) Division, and I served on the Committee on Cataloging: Resource and Description (which wrote the new cataloging rules) and as the chair of the Committee for Education and Training of Catalogers and the Competencies and Education for a Career in Cataloging Interest Group. I also served as the Chair of the ALCTS Division's Task Force on Competencies and Education for a Career in Cataloging. Additionally, I have served as the Chair for the ALA Office of Diversity's Committee on Diversity, as a member of the REFORMA National Board of Directors, as a member of the Editorial Board for the ALCTS premier cataloging journal, *Library Resources and Technical Services*, as a Co-Chair of the Library

Research Round Table (LRRT) for the American Library Association, and as a member of the LRRT Nominating Committee.

8. I have also given over one hundred presentations in the field, including several on library cataloging systems and Machine-Readable Cataloging (“MARC”) standards. My current research interests include library cataloging systems, metadata, and organization of electronic resources.

9. My full curriculum vitae is attached hereto as Exhibit 1006.

III. PRELIMINARIES

10. *Scope of this declaration.* I am not an attorney and will not offer opinions on the law. I am, however, rendering my expert opinion on the authenticity of the documents referenced herein and on when and how each of these documents was disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, could have located the documents before on or around the listed dates of their respective publications below.

11. I am informed by counsel that a printed publication qualifies as publicly accessible as of the date it was disseminated or otherwise made available such that a person interested in and ordinarily skilled in the relevant subject matter could locate it through the exercise of ordinary diligence.

12. While I understand that the determination of public accessibility under the foregoing standard rests on a case-by-case analysis of the facts particular to an individual publication, I also understand that a printed publication is rendered “publicly accessible” if it is cataloged and indexed by a library such that a person interested in the relevant subject matter could locate it (*i.e.*, I understand that cataloging and indexing by a library is sufficient, though there are other ways that a printed publication may qualify as publicly accessible). One manner of sufficient indexing is indexing according to subject matter category. I understand that the cataloging and indexing by a single library of a single instance of a particular printed publication is sufficient, even if the single library is in a foreign country. I understand that, even if access to a library is restricted, a printed publication that has been cataloged and indexed therein is publicly accessible so long as a presumption is raised that the portion of the public concerned with the relevant subject matter would know of the printed publication. I also understand that the cataloging and indexing of information that would guide a person interested in the relevant subject matter to the printed publication, such as the cataloging and indexing of an abstract for the printed publication, is sufficient to render the printed publication publicly accessible.

13. I understand that routine business practices, such as general library cataloging and indexing practices, can be used to establish an approximate date on which a printed publication became publicly accessible.

14. *Persons of ordinary skill in the art.* I am told by counsel that the subject matter of this proceeding generally relates to routing data packets over a computer network.

15. I have been informed by counsel that a “person of ordinary skill in the art at the time of the inventions” is a hypothetical person who is presumed to be familiar with the relevant field and its literature at the time of the inventions. This hypothetical person is also a person of ordinary creativity, capable of understanding the scientific principles applicable to the pertinent field.

16. I am told by counsel that persons of ordinary skill in this subject matter or art would have had a Bachelor of Science degree in electrical engineering, computer engineering, computer science, or a related subject, and three years of work experience in computer networking, including experience with the IPv4 and IPv6 protocols, or a related field, and that lack of professional experience can be remedied by additional education, and vice versa

17. It is my opinion that such a person would have been engaged in research, learning thorough study and practice in the field and possibly through formal instruction the bibliographic resources relevant to his or her research. In

the 2008 timeframe, such a person would have had access to a vast array of long-established print resources in the area of computer networks.

IV. LIBRARY CATALOGING PRACTICES

A. MARC RECORDS AND THE ONLINE LIBRARY CATALOG

18. I am fully familiar with the library cataloging standard known as the MARC standard, which is an industry-wide standard method of storing and organizing library catalog information.¹ MARC was first developed in the 1960s by the Library of Congress. A MARC-compatible library is one that has a catalog consisting of individual MARC records for each of its items. Today, MARC is the primary communications protocol for the transfer and storage of bibliographic metadata in libraries.

19. MARC is a framework into which descriptive bibliographic data are transcribed to interact with the software in online library catalogs to provide access to books, journals, and other resources in the collection. Bibliographic data provide points of access and can be searched by a person of ordinary skill in the art at the time of the invention (“POSITA,” see paragraphs 14-17 above) to identify and obtain resources in the library collection. An information seeker (or POSITA) can search a local online library catalog or the holdings of a group of libraries in a state

¹ The full text of the standard is available from the Library of Congress at <http://www.loc.gov/marc/bibliographic/> (last visited January 8, 2024).

or region or in the global catalog WorldCat.

20. MARC records are not designed for public viewing. Although a significant number of libraries provide access to the MARC version of a bibliographic record, the public display is designed to show information in a succinct manner that is quickly understood and useful to the information seeker. Libraries determine the default search for the online catalog to make the entry of search terms efficient and result in a successful search. Information seekers can enter a keyword, title, author, or standard number for the item. Libraries may also provide a search capability called “Summon” that allows the information seeker to enter known information about the item to conduct a search.

21. Since at least the early 1970s and continuing to the present day, MARC has been the primary communications protocol for the transfer and storage of bibliographic metadata in libraries.² As explained by the Library of Congress:

You could devise your own method of organizing the bibliographic information, but you would be isolating your library, limiting its options, and creating much more work for yourself. Using

² A complete history of the development of MARC can be found in *MARC: Its History and Implications* by Henrietta D. Avram (Washington, DC: Library of Congress, 1975) and available online from the Hathi Trust (<https://babel.hathitrust.org/cgi/pt?id=mdp.39015034388556;view=1up;seq=1>; last visited January 8, 2024).

the MARC standard prevents duplication of work and allows libraries to better share bibliographic resources. Choosing to use MARC enables libraries to acquire cataloging data that is predictable and reliable. If a library were to develop a “home-grown” system that did not use MARC records, it would not be taking advantage of an industry-wide standard whose primary purpose is to foster communication of information.

Using the MARC standard also enables libraries to make use of commercially available library automation systems to manage library operations. Many systems are available for libraries of all sizes and are designed to work with the MARC format. Systems are maintained and improved by the vendor so that libraries can benefit from the latest advances in computer technology. The MARC standard also allows libraries to replace one system with another with the assurance that their data will still be compatible.

Why Is a MARC Record Necessary? LIBRARY OF CONGRESS.³

22. Thus, almost every major library in the world is MARC-compatible.

See, e.g., MARC Frequently Asked Questions (FAQ), LIBRARY OF CONGRESS.⁴

³ <http://www.loc.gov/marc/umb/um01to06.html#part2>

⁴ <https://www.loc.gov/marc/faq.html>

(“MARC is the acronym for MACHine-Readable Cataloging. It defines a data format that emerged from a Library of Congress-led initiative that began fifty years ago. It provides the mechanism by which computers exchange, use, and interpret bibliographic information, and its data elements make up the foundation of most library catalogs used today.”). MARC is the ANSI/NISO Z39.2-1994 standard (reaffirmed in 2016) for Information Interchange Format. The full text of the standard is available from the Library of Congress.⁵

23. Examining the MARC records for a specific item reveals the comprehensive data transcribed about a particular item at the time that cataloging and classification occurred. In addition to the creator, title, subjects, and standard numbers, additional information may provide additional and relevant data depending on the type of resource. Understanding the full extent of bibliographic data for an item and the points of access associated with it provides essential information that can be used to determine the indexing and public availability for documents described in this declaration.

B. MARC RECORDS

24. A MARC record comprises several fields, each of which contains specific data about the work. Each field is identified by a standardized, unique, three-digit code corresponding to the type of data that follow. For example, a

⁵ <http://www.loc.gov/marc/bibliographic/>

work's title is recorded in Field 245; the primary author of the work is transcribed in Field 100; an item's International Standard Book Number ("ISBN") consisting of ten or thirteen digits is transcribed in Field 020; an item's International Standard Serial Number ("ISSN") is transcribed in Field 022; the Library of Congress classification notation is recorded in Field 050; and the publication date is recorded in Field 260 under the subfield "c." If a work is a periodical, then its publication frequency is recorded in Field 310, and the publication dates (e.g., the first and last publication) are recorded in Field 362, which is also referred to as the enumeration/chronology field.⁶

25. The library that created the record is recorded in Field 040 in subfield "a" with a unique library code. When viewing the MARC record online via Online Computer Library Center's ("OCLC") bibliographic database, hovering over this code with the mouse reveals the full name of the library. I used this method of "mousing over" the library codes in the OCLC database to identify the originating library for the MARC records discussed in this Declaration. Where this "mouse over" option was not available, I consulted the Directory of OCLC Libraries to identify the institution that created the MARC record.⁷

26. MARC records also include several fields that include subject matter

⁶ <http://www.loc.gov/marc/bibliographic/bd3xx.html>

⁷ <https://www.oclc.org/en/contacts/libraries.html>

classification information. An overview of MARC record fields is available through the Library of Congress.⁸ For example, 6XX fields are termed “Subject Access Fields.”⁹ Among these, for example, is the 650 field; this is the “Subject Added Entry – Topical Term” field.¹⁰ The 650 field is a “[s]ubject added entry in which the entry element is a topical term.” These entries “are assigned to a bibliographic record to provide access according to generally accepted thesaurus-building rules (e.g., *Library of Congress Subject Headings* (LCSH), *Medical Subject Headings* (MeSH)).” *Id.* Further, MARC records include call numbers, which themselves include a classification number. For example, the 050 field is the “Library of Congress Call Number.”¹¹ A defined portion of the Library of Congress Call (LCC) Number is the classification number, and “source of the classification number is *Library of Congress Classification* and the *LC Classification-Additions and Changes*.” Thus, included in the 050 field is a subject matter classification. Further, the 082 field is the “Dewey Decimal Call Number.”¹² A defined portion of the Dewey Decimal Call (DDC) Number is the classification number, and “source of the classification number is the *Dewey Decimal*

⁸ <http://www.loc.gov/marc/bibliographic/>

⁹ <http://www.loc.gov/marc/bibliographic/bd6xx.html>

¹⁰ <http://www.loc.gov/marc/bibliographic/bd650.html>

¹¹ <http://www.loc.gov/marc/bibliographic/bd050.html>

¹² <http://www.loc.gov/marc/bibliographic/bd082.html>

Classification and Relative Index.” Thus, included in the 082 field is a subject matter classification. Each item in a library has a single classification number. A library selects a classification scheme (e.g., the Library of Congress classification scheme just described or a similar scheme such as the Dewey Decimal classification scheme) and uses it consistently. When the Library of Congress assigns the LCC classification number, it appears as part of the 050 field. When the Library of Congress assigns the DDC classification number, it appears as part of the 082 field. If a local library assigns the classification number, it appears in a 090 field. In either scenario, the MARC record includes a classification number that represents a subject matter classification.

C. OCLC

27. The OCLC was created “to establish, maintain and operate a computerized library network and to promote the evolution of library use, of libraries themselves, and of librarianship, and to provide processes and products for the benefit of library users and libraries, including such objectives as increasing availability of library resources to individual library patrons and reducing the rate of rise of library per-unit costs, all for the fundamental public purpose of furthering ease of access to and use of the ever-expanding body of worldwide scientific,

literary and educational knowledge and information.”¹³ Among other services, OCLC and its members are responsible for maintaining the WorldCat database (<http://www.worldcat.org/>), used by independent and institutional libraries throughout the world.

28. OCLC also provides its members online access to MARC records through its OCLC bibliographic database. When an OCLC member institution acquires a work, it creates a MARC record for this work in its computer catalog system in the ordinary course of its business. MARC records created at the Library of Congress are tape-loaded into the OCLC database through a subscription to MARC Distribution Services daily or weekly. Once the MARC record is created by a cataloger at an OCLC member institution or is tape-loaded from the Library of Congress, the MARC record is then made available to any other OCLC members online, and therefore made available to the public. Accordingly, once the MARC record is created by a cataloger at an OCLC member institution or is tape-loaded from the Library of Congress or another library anywhere in the world, any publication corresponding to the MARC record has been cataloged and indexed according to its subject matter such that a person interested in that subject matter

¹³ Third Article, Amended Articles of Incorporation of OCLC Online Computer Library Center, Incorporated (available at <https://www.oclc.org/content/dam/oclc/membership/articles-of-incorporation.pdf>).

could, with reasonable diligence, locate and access the publication through any library with access to the OCLC bibliographic database or through the Library of Congress.

29. When an OCLC member institution creates a new MARC record, OCLC automatically supplies the date of creation for that record. The date of creation for the MARC record appears in the fixed Field (008), characters 00 through 05. The MARC record creation date reflects the date on which, or shortly after which, the item was first acquired or cataloged. Initially, Field 005 of the MARC record is automatically populated with the date the MARC record was created in year, month, day format (YYYYMMDD) (some of the newer library catalog systems also include hour, minute, second (HHMMSS)). Thereafter, the library's computer system may automatically update the date in Field 005 every time the library updates the MARC record (*e.g.*, to reflect that an item has been moved to a different shelving location within the library). Field 005 is visible when viewing a MARC record via an appropriate computerized interface, but when a MARC record is printed to hardcopy, no "005" label appears. The initial Field 005 date (*i.e.*, the date the MARC record was created) does appear, however, next to the label "Entered."¹⁴ The date upon which the most recent update to Field 005

¹⁴ Field 005 is visible when viewing a MARC record via an appropriate computerized interface. But when a MARC record is printed directly to hardcopy

occurred also appears, next to the label “Replaced.” Thus, when an item’s MARC record has been printed to hardcopy—as is the case with the MARC attachments to this Declaration—the date reflected next to the label “Entered” is necessarily on or after the date the library first cataloged and indexed the underlying item.

30. Once one library has cataloged and indexed a publication by creating a MARC record for that publication, other libraries that receive the publication do not create additional MARC records—the other libraries instead rely on the original MARC record. They may update or revise the MARC record to ensure accuracy, but they do not replace or duplicate it. This practice does more than save libraries from duplicating labor. It also enhances the accuracy of MARC records. Further, it allows librarians around the world to know that a particular MARC record is authoritative (in contrast, a hypothetical system wherein duplicative records were created would result in confusion as to which record is authoritative).

31. Catalogers can create MARC records for all types of print, online, and digital resources. The date of creation of the MARC record by a cataloger at an OCLC member institution reflects when the underlying item is accessible to the public. Upwards of two-thirds to three-quarters of book sales and magazine subscriptions to libraries come from a jobber or wholesaler for online and print

from the OCLC database, the “005” label is not shown. The date in the 005 field instead appears next to the label “Replaced.”

resources. These resellers make it their business to provide items to their customers as fast as possible, often providing turnaround times of only a single day after publication. Libraries purchase a significant portion of the balance of their books and journals directly from publishers themselves, which provide delivery on a similarly expedited schedule. In general, libraries make these purchases throughout the year and shelve the newly received items as soon thereafter as possible to make them available to their patrons.

32. *Journals.* Catalogers can create MARC records for all types of print, online, and digital resources. For example, MARC records cover serial publications, including both serially-published monographs and journals. OCLC hosts MARC records for more than 320 million serial publications. Serial publications are those publications that have the same collective title but are intended to be continued indefinitely with enumeration such as a volume or issue number (*e.g.*, magazines, journals, etc.). In the OCLC bibliographic database, the first issue of the serial publication is typically cataloged (*i.e.*, a corresponding MARC record is created), but the date is left open-ended with the use of a punctuation mark such as a dash. OCLC serial publication MARC records represent the entire run of the serial title. With knowledge of the first issue published, future issues can be predicted based on the information provided in the MARC record, for example in field 362. In my extensive professional experience,

it is highly unusual for a library to stop collecting and shelving a serial publication prior to the end of its publication run. If a subscription to a serial publication ends its run or is cancelled before the end of its run, the library will denote that it has stopped receiving new volumes by filling in the end date in the MARC record.

33. The handling of printed journal subscriptions is shown on the cover or the first few pages of individual issues. As was the best practice among libraries, issues arrived at a central facility and were immediately received, verified as part of a subscription, checked in, and stamped or labeled with the institution's name and date. Determining that the issue was part of the library subscription ensured that the entire set of publications for the year had been received so that they could be professionally bound and retained. This process also verified that all of the published issues arrived so that the library staff did not have to request or claim an issue that did not arrive as expected. In large public libraries with branches and multi-campus libraries within academic institutions, the journals were sorted and delivered to the subscribing unit. The new issue was placed in the public area; the older issue was stored so that it remained available.

34. The foregoing process has been standard library practice longer than I have been working in the profession. I first learned the steps in the process in the late 1970s and later supervised it. Although the checking in process has become automated and now links electronically to holdings records for the MARC record

for each serial title, the manual placement of a stamp or label and placing the issue in a public area has not changed for 50 years. Unless I note otherwise below in reference to a specific serial publication, it is my expert opinion that this standard protocol was followed for all of the serial publications discussed below.

35. In preparing this report, I used authoritative databases, such as the OCLC bibliographic database and the Library of Congress Online Catalog, to confirm citation details of the various publications discussed.

36. *Indexing.* A researcher may discover material relevant to his or her topic in a variety of ways. One common means of discovery is to search for relevant information in an index of periodical and other publications. Having found relevant material, the researcher will then normally obtain it online, look for it in libraries, or purchase it from a publisher, a bookstore, a document delivery service, or other provider. Sometimes, the date of a document's public accessibility will involve both indexing and library date information. However, date information for indexing entries is often unavailable. This is especially true for online indices.

37. Indexing services use a wide variety of controlled vocabularies to provide subject access and other means of discovering the content of documents. The formats in which these access terms are presented vary from service to service.

38. Online indexing services commonly provide bibliographic

information, abstracts, and full-text copies of the indexed publications, along with a list of the documents cited in the indexed publication. These services also often provide lists of publications that cite a given document. A citation of a document is evidence that the document was publicly available and in use by researchers no later than the publication date of the citing document.

39. Before the widespread development of online databases to index articles in journals, magazines, conference papers, and technical reports, libraries purchased printed volumes of indices. Graduate library school education mandated that students learn about the bibliographic control of disciplines, the prominent indexing volumes, and searching strategies required to use them effectively and efficiently. Half of the courses that I studied in library school were focused on the bibliography and resources in academic disciplines.

40. Librarians consulted with information seekers to verify citations, check availability in union catalogs, printed books catalogs, the OCLC database, and make formal requests for materials (e.g., books, conference proceedings, journal articles). Requests were transmitted using Telex machines, rudimentary email systems, and the United States Postal Service. During my career, I have performed and supervised staff who handled these resource sharing tasks.

41. A major firm known for the breadth of subjects and comprehensive treatment in the preparation of index volumes, the H. W. Wilson Company offered

these reference resources since the firm was founded in 1898. The *Reader's Guide to Periodical Literature* is one of the best-known titles available from H. W. Wilson. Each volume includes a comprehensive index for 300 of the most popular and important periodicals published in the United States and Canada. Information seekers have subject access expressed in plain language terminology, author access, and cross references to find the desired results from their searches. The family of index titles included *Science & Technology Index*, *Business Periodicals*, *Applied Science & Technology Index*, *Humanities Index*, *Biological & Agricultural Index*, and *Industrial Arts Index*. These printed indices have been superseded by digital database offerings available to information seekers through Ebsco.

42. Online indexing services such as *Google Scholar*¹⁵ or *ScienceDirect*¹⁶ commonly provide bibliographic information, abstracts, and full-text copies of the indexed publications, along with a list of the documents cited in the indexed publication. These services also often provide lists of publications that cite a given document.

43. A citation of a document by another is evidence that the document was publicly available and in use no later than the publication date of the citing document.

¹⁵ <https://scholar.google.com/>

¹⁶ <https://www.sciencedirect.com/>

V. DOCUMENT 1: EXHIBIT 1037 (“LI”)

44. Exhibit 1037 is a copy of a conference paper published in the electronic volume titled *2006 IEEE/IFIP Network Operations and Management Symposium* found in the King Library at San José State University (San José, California). The conference paper titled “Forwarding IPv4 Traffics in Pure IPv6 Backbone with Stateless Address Mapping” by Xing Li, Maoke Chen, Ang Li, and Yong Cui (hereafter “Li”) appears beginning on page 260. The 2006 IEEE/IFIP Network Operations and Management Symposium was held on April 3-7, 2006, in Vancouver, British Columbia, Canada. Exhibit 1037 is a true and correct copy of the Li conference paper (pages 260-270). I obtained this copy of the conference paper from the *IEEE Xplore* database in the King Library at San José State University.¹⁷ The *IEEE Xplore* database indicates that the Li conference paper was added on October 23, 2006. Specifically, the text of the Li conference paper is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible alterations to the document. Exhibit 1037 was found within the custody of a library – a place where, if authentic, a copy of this electronic conference proceedings volume would likely be. Exhibit 1037 is a true and correct copy in a condition that creates no suspicion about authenticity.

¹⁷ <https://ieeexplore.ieee.org/document/1687557>

45. The Li conference paper is also available in the digital repositories *ResearchGate*¹⁸ and *Semantic Scholar*.¹⁹

46. Attached hereto as Attachment 1A is a true and correct copy of the MARC record for the electronic volume titled *2006 IEEE/IFIP Network Operations and Management Symposium* obtained from the OCLC bibliographic database. I personally identified and retrieved the MARC record that is Attachment 1A. As previously noted, the library that created the record is recorded in field 040 with a unique library code. For Attachment 1A, that library code is “WAU,” which means that the MARC record for this electronic conference proceedings volume was cataloged at the University of Washington Libraries (Seattle, Washington). As can be seen in the “Entered” field in the MARC record for this exhibit, a cataloger at the University of Washington Libraries created OCLC record number 80110201 on January 25, 2007, as shown in the “Entered” field (“20070125”). The library continues to update the MARC record to meet current cataloging rules. The most recent enhancement to the MARC record occurred on June 28, 2022, as shown in the “Replaced” field (“20220628”).

47. Attachment 1A further includes an entry in field 050 (“TK5105.5 \$b

¹⁸ https://www.researchgate.net/publication/224645592_Forwarding_IPv4_Traffics_in_Pure_IPv6_Backbone_with_Stateless_Address_Mapping

¹⁹ <https://www.semanticscholar.org/paper/Forwarding-IPv4-Traffics-in-Pure-IPv6-Backbone-with-Chen-Li/988a0b75366cbd3c914cbf7bd48b7d1fb2507040>

.I147 2006”)—as described above, a subject matter classification number consistent with the Library of Congress classification system (analogous to the Dewey Decimal classification system). Attachment 1A also shows that Exhibit 1037 was catalogued with three descriptor terms reading “Computer networks \$x Management \$v Congresses” (see Attachment 1B, Library of Congress subject heading sh2008101494), “Telecommunication systems \$x Management \$v Congresses” (Attachment 1C, Library of Congress subject heading sh2010115960) and “Computer architecture \$v Congresses” (see Attachment 1D, Library of Congress subject heading sh2008101468) in the 650 fields. Thus, as of its cataloging, the publication corresponding to the MARC record attached hereto as Attachment 1A was indexed according to its subject matter by virtue of at least two independently sufficient classifications: the field 050 entry and the field 650 entries. Further, as of January 25, 2007, the MARC record attached hereto as Attachment 1A was accessible through any library with access to the OCLC bibliographic database or the online catalog at a library that acquired the electronic conference proceedings volume, which means that the corresponding publication was publicly available on or before that same date through any library with access to the OCLC bibliographic database or through an individual library.

48. Attachment 1A indicates that the electronic version of the conference proceedings volume titled *2006 IEEE/IFIP Network Operations and Management*

Symposium as cataloged at the University of Washington Libraries is currently available from 24 libraries. In view of the above, the electronic version of the conference proceedings volume titled *2006 IEEE/IFIP Network Operations and Management Symposium* was publicly available on or shortly after January 25, 2007, because by that date it had been received, cataloged, and indexed at the University of Washington Libraries and made part of the OCLC bibliographic database. The Li conference paper was available in the *IEEE Xplore* database on October 23, 2006. For these reasons, it is my opinion that Exhibit 1037 was published and publicly accessible on or shortly after October 23, 2006.

VI. DOCUMENT 2: EXHIBIT 1027 (“IVI MEMO”)

49. Exhibit 1027 is a copy of the Internet draft of a technical standards document, *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition*, prepared by Xing Li, Maoke Chen, Congxiao Bao, Hong Zhang, and Jianping Wu issued by the Network Working Group of the Internet Engineering Task Force²⁰ (hereafter “IVI Memo”). The IVI Memo is designated as a part of the “Standards Track” category with a July 6, 2008, date. Exhibit 1027 is a true and correct copy of the document titled *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition* that I understand is being submitted as an exhibit in this proceeding. I downloaded this

²⁰ <https://datatracker.ietf.org/doc/html/draft-xli-behave-ivi-00>

copy of the IVI Memo from the IETF data tracker website. Specifically, the text of the document is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible alterations to the document. Exhibit 1027 was found within the custody of the issuing organization – a place where an authentic copy of this document would likely be. Exhibit 1027 is a true and correct copy in a condition that creates no suspicion about its authenticity.

50. Further, I understand that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence could have located the IETF website using the common search terms (e.g., address allocation for private internets) and/or reasonable diligence.

51. The Wayback Machine captured the IVI Memo from the IETF website numerous times during the period 2018-2022. Attached as Attachment 2A is the copy of the IVI Memo captured by the Wayback Machine on December 26, 2018.²¹ It is my opinion that the IVI Memo was publicly accessible digitally on the IETF.com website at least by July 6, 2008.

52. Therefore, the document titled *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition* was publicly accessible

²¹ <https://web.archive.org/web/20181226042302/https://datatracker.ietf.org/doc/html/draft-xli-behave-ivi-00>

digitally as early as July 6, 2008, on the IETF.com website. For these reasons, it is my opinion that Exhibit 1027 was published and accessible to the public digitally by July 6, 2008.

VII. DOCUMENT 3: EXHIBIT 1028 (“IVI PRESENTATION”)

53. Exhibit 1028 is a copy of a presentation from the Internet Engineering Task Force 1972 meeting titled *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition* by Xing Li, Maoke Chen, Congxiao Bao, Hong Zhang, and Jianping Wu (hereafter “IVI Presentation”). The IVI Presentation was presented at the Internet Engineering Task Force which was held on July 27-August 1, 2008, in Dublin, Ireland (see Attachment 3A). The IVI Presentation was on July 29, 2008, as part of the second afternoon session. Exhibit 1028 is a true and correct copy of presentation titled *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition* that I understand is being submitted as an exhibit in this proceeding. I downloaded this copy of the IVI Presentation from the IETF data tracker website.²² Specifically, the text of the document is complete; no pages are missing, and the text on each page appears to flow seamlessly from one page to the next; further, there are no visible alterations to the document. Exhibit 1028 was found within the custody of the issuing organization – a place where an authentic copy of this document would likely be.

²² <https://www.ietf.org/proceedings/72/slides/behave-5.pdf>

Exhibit 1028 is a true and correct copy in a condition that creates no suspicion about its authenticity.

54. Further, I understand that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence could have located the IETF website using the common search terms (e.g., address allocation for private internets) and/or reasonable diligence.

55. The Wayback Machine captured the IVI Presentation from the IETF website numerous times during the period 2018-2022. Attached as Attachment 3B is the copy of the IVI Presentation captured by the Wayback Machine on January 11, 2019.²³ It is my opinion that the IVI Presentation was publicly accessible digitally on the IETF.com website at least by July 29, 2008.

56. Therefore, the document titled *Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition* was publicly accessible digitally as early as July 29, 2008, on the IETF.com website. For these reasons, it is my opinion that Exhibit 1028 was published and accessible to the public digitally by July 29, 2008.

VIII. SUMMARY OF OPINIONS

57. In view of the foregoing, it is my opinion that the publication

²³ <https://web.archive.org/web/20190111024747/https://www.ietf.org/proceedings/72/slides/behave-5.pdf>

described above was publicly available no later than the corresponding date listed in the table below:

Exhibit	Publication	Publicly Available No Later Than
1037	Chen, Maoke, Xing Li, Ang Li, and Yong Cui. "Forwarding IPv4 Traffics in Pure IPv6 Backbone with Stateless Address Mapping." <i>2006 IEEE/IFIP Network Operations and Management Symposium</i> (pp. 260-270). NOMS 2006. Piscataway, NJ: Institute of Electrical and Electronics Engineers, 2006.	October 23, 2006
1027	Li, Xing, Maoke Chen, Congxiao Bao, Hong Zhang, and Jianping Wu. <i>Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition</i> . Internet Draft, July 6, 2008. Reston, VA: Internet Engineering Task Force, 2008.	July 6, 2008
1028	Li, Xing, Maoke Chen, Congxiao Bao, Hong Zhang, and Jianping Wu. <i>Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition</i> . IETF-72, Dublin, behave, 29 July 2008.	July 29, 2008

58. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

59. I hereby declare that all statements made herein of my own

knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1034 of Title 18 of the United States Code.

DATED: January 23, 2024

By: /s/ Sylvia D. Hall-Ellis
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111 2 IEEE/IFIP Network Operations and Management Symposium \$n (10th : \$d 2006 : \$c Vancouver, B.C.)

245 10 10th IEEE/IFIP Network Operations & Management Symposium : \$b NOMS 2006 : management of integrated end-to-end communications and services : April 3-7, 2006, Vancouver, Canada.

246 30 Management of integrated end-to-end communications and services

246 30 NOMS 2006

260 Piscataway, NJ : \$b IEEE, \$c ©2006.

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504 Includes bibliographical references and author index.

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655 7 Conference papers and proceedings. \$2 fast \$0 (OCoLC)fst01423772

710 2 Institute of Electrical and Electronics Engineers.

710 2 IEEE Communications Society.

710 2 International Federation for Information Processing.

740 0 Network Operations and Management Symposium, 2006, NOMS 2006, 10th IEEE/IFIP.

856 40 \$3 IEEE Xplore \$u <http://ieeexplore.ieee.org/servlet/opac?punumber=11101>

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Attachment 2A

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Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: January 7, 2009

X. Li
M. Chen
C. Bao
H. Zhang
J. Wu

CERNET Center/Tsinghua University
July 6, 2008

**Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6
Coexistence and Transition
draft-xli-behave-ivi-00.txt**

Status of this Memo

By submitting this Internet-Draft, each author represents that any applicable patent or other IPR claims of which he or she is aware have been or will be disclosed, and any of which he or she becomes aware will be disclosed, in accordance with Section 6 of BCP 79.

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.

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This Internet-Draft will expire on January 7, 2009.

Li, et al.

Expires January 7, 2009

[Page 1]

Abstract

This document presents the concept and practice of the prefix-specific and stateless address mapping mechanism (IVI) for IPv4/IPv6 coexistence and transition. In this scheme, subsets of the IPv4 addresses are embedded in prefix-specific IPv6 addresses and these IPv6 addresses can therefore communicate with the global IPv6 networks directly and can communicate with the global IPv4 networks via stateless (or almost stateless) gateways. The IVI scheme supports the end-to-end address transparency, incremental deployment and performance optimization in multi-homed environment. This document is a comprehensive report on the IVI design and its deployment in large scale public networks. Based on the IVI scenario, the corresponding address allocation and assignment policies are also proposed.

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1. Introduction

This document presents the concept and practice of the prefix-specific and stateless address mapping mechanism (IVI) for IPv4/IPv6 coexistence and transition.

The experiences for the IPv6 deployment in the past 10 years strongly indicate that for a successful transition, the IPv6 hosts need to communicate with the global IPv4 networks [JJI07]. However, the current transition methods do not fully support this requirement [RFC4213]. For example, dual-stack hosts can communicate with both the IPv4 and IPv6 hosts, but the IPv4 address depletion problem makes the dual-stack approach inapplicable [COUNT]. The tunneled architectures can link the IPv6 islands cross IPv4 networks, but they cannot help the communication between two address families [RFC3056] [RFC5214] [RFC4380]. The translation architectures can relay the communications for the hosts located in IPv4 and IPv6 networks, but the current implementation of this kind of architecture is not scalable and it cannot maintain the end-to-end address transparency [RFC2766] [RFC3142] [RFC4966] [RFC2775].

However, since IPv4 and IPv6 are different protocols with different addressing structure, the translation mechanism is still necessary for the communication between the two address families. There are several ways to implement the translation. One is the stateless IP/ICMP translation algorithm (SIIT), which provides a mechanism for the translation between IPv4 and IPv6 packet headers (including ICMP headers) without requiring any per-connection state. But, SIIT does not specify the address assignment and routing scheme [RFC2766]. For example, when SIIT is used for the IPv4 mapped IPv6 addresses [::FFFF:ipv4-addr/96] and IPv4 compatible IPv6 addresses [::ipv4-address/96]), these addresses violate the aggregation nature of the IPv6 routing [RFC4291]. The other translation mechanism is NAT-PT, which has serious technical and operational difficulties and IETF has reclassified it from proposed standard to historic status. But in the same document, it suggested that a revised, possibly restricted version of NAT-PT can be a suitable solution for the communication between IPv4 and IPv6 hosts [RFC4966]. Recently, several mechanisms are proposed in this direction, for example NAT64 translates the IPv4 server address by adding or removing a /96 prefix, and translates the IPv6 client address by installing mappings in the normal NAT manner [I-D.bagnulo-behave-nat64].

In this document, we follow the basic specification of SIIT, but we define the address assignment and routing scheme (IVI). Our IVI mechanism is related to the NAT-PT and NAT64, but differs from them significantly. First, it is stateless (or almost stateless) in both the IPv4-to-IPv6 mapping direction, as well as in the IPv6-to-IPv4

mapping direction. Secondly, it supports address transparency. Thirdly, it supports both client-server applications and the peer-to-peer applications cross IPv4 and IPv6 address families without using NAT-traversal techniques. Finally, it can satisfy most of the basic and advanced requirements for the IPv4 to IPv4 transition as specified by the Internet Drafts [I-D.v6ops-nat64-pb-statement-req].

2. Terms and Abbreviations

The following terms and abbreviations are used in this document:

IVI: IV means 4 and VI means 6 in Roman representation, so IVI means mapping and translation between IPv4 and IPv6.

ISP(i): A specific Internet service provider "i".

IPG4: An address set containing all IPv4 addresses, the addresses in this set are mainly used by IPv4 hosts at the current stage.

IPS4(i): A subset of IPG4 allocated to ISP(i).

IVI4(i): A subset of IPS4(i), the addresses in this set will be mapped to IPv6 via IVI rule and physically used by IPv6 hosts of ISP(i).

IPG6: An address set containing all IPv6 addresses.

IPS6(i): A subset of IPG6 allocated to ISP(i).

IVIG46(i): A subset of IPS6(i), an image of IPG4 in IPv6 address family via IVI mapping rule.

IVI6(i): A subset of IVIG46(i), an image of IVI4(i) in IPv6 address family via IVI mapping rule.

IVI gateway: The mapping and translation gateway between IPv4 and IPv6 based on IVI scheme.

IVI DNS: Providing IVI Domain Name Service (DNS).

The key words MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL, when they appear in this document, are to be interpreted as described in [RFC2119].

3. The Overview of the IVI Mechanism

The IVI is a prefix-specific and stateless address mapping scheme which can be carried out by individual ISPs.

IVI mapping and translation mechanism is implemented in an IVI gateway which connects to both IPv4 and IPv6 networks. The SIIT stateless translation is implemented in the IVI gateway [RFC2765].

A unique, prefix-specific and stateless mapping scheme is defined between IPv4 addresses and subsets of IPv6 addresses, so each provider-independent IPv6 address block (usually a /32) will have a small portion of IPv6 addresses, which is the image of the totality of the global IPv4 addresses.

Each provider can borrow a portion of its IPv4 addresses and maps them into IPv6 based on the above mapping rule. These special IPv6 addresses will be physically used by IPv6 hosts. The original IPv4 form of the borrowed addresses is the image of these special IPv6 addresses.

The packets generated from the global IPv4 addresses and sent to the special IPv6 addresses are routed to the IPv4 interface of the IVI gateway via the IPv4 routing protocol and the packets generated from the special IPv6 addresses and sent to the global IPv4 addresses are routed to the IPv6 interface of the IVI gateway via the IPv6 routing protocol. The processes in both directions are symmetric. In addition, the special IPv6 addresses can communicate with the global IPv6 networks.

The IVI scheme related issues, for example the IVI DNS support, the multiplexing of the public IPv4 addresses, the IVI multicast support, etc. can be solved without involving any major change in the current Internet protocol.

3.1. Address Mapping

The IVI address mapping is defined based on individual ISP's prefix as shown in the following figure.

IVI Address Mapping

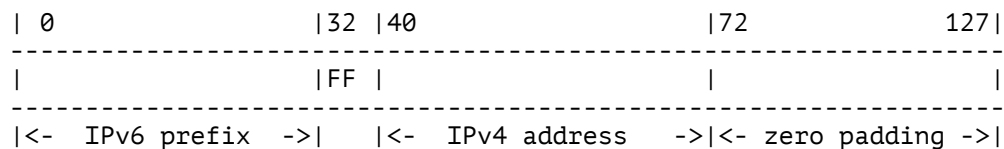


Figure 1

where bit 0 to bit 31 are the prefix of ISP(i)'s /32 (e.g. IPS6=2001:DB8::/32), bit 32 to bit 39 are all one's as the identifier of IVI, bit 40 to bit 71 are embedded global IPv4 space (IPG4) presented in hexadecimal format. (e.g. 2001:DB8:ff00::/40). Because this mapping is 1-to-1 defined by the IVI mapping rule, it is stateless and it has feature of end-to-end address transparency.

(1) The ISP(i) uses a subset of ISP4(i) defined as IVI4(i), and maps it into IPv6 as IVI6(i). The IVI6(i) is physically used by IPv6 hosts inside ISP(i)'s IPv6 network and the IVI4(i) cannot be used by IPv4 hosts. Therefore, IVI6(i) is the special IPv6 address block which can communicate with both address families.

(2) Based on the above mapping rule, the ISP(i) uses a subset of ISP6(i) defined as IVIG46(i), and maps it into IPv4 as IPG4. The IVIG46(i) is virtually used by global IPv4 hosts and it cannot be used by IPv6 hosts, except the portion of IVI6(i).

The mapping of the different address sets and the relations are shown in the following figure.

IVI Address Mapping Relation

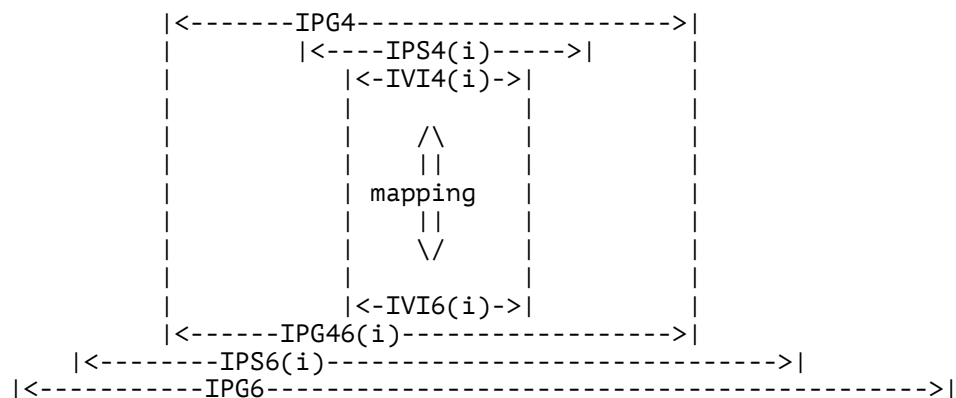


Figure 2

where IVI4(i) and IVI6(i) are representing the same entities in IPv4 and IPv6 address families, respectively. Similarly, IPG4 and IPG46(i) are representing the same entities in IPv4 and IPv6 address families, respectively. In addition, IVI4(i) is a subset of IPG4 and IVI6(i) is a subset of IPG46(i).

3.2. Routing and Forwarding

Based on the IVI address mapping rule, the routing is straightforward, as shown in the following figure.

IVI Routing

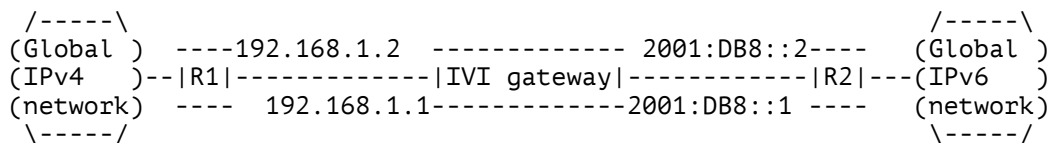


Figure 3

where

(1) Router R1 has IPv4 route of IVI4(i)/k (k is the prefix length of

IVI4(i)) with next-hop equals to 192.168.1.1 and this route is distributed to global IPv4 networks with proper aggregation.

(2) Router R2 has IPv6 route of IVIG46(i)/40 with next-hop equals to 2001:DB8::1 and this route is distributed to global IPv6 networks with proper aggregation.

(3) IVI gateway has IPv6 route of IVI6(i)/(40+k) with next hop equals to 2001:DB8::2. IVI gateway also has IPv4 default route 0.0.0.0/0 with next hop equals to 192.168.1.2 .

Note that the routes described above can be learned/inserted by dynamic routing protocols in the IVI gateway neighboring (IGP) or peering (BGP) with R1 and R2.

The address reachability matrix of the IPv4, IVI and IPv6 is shown in the following figure.

IVI reachability Matrix

		IPG4	IVI	IPG6

IPG4		OK	OK	NO
IVI		OK	OK	OK
IPG6		NO	OK	OK

Figure 4

Since both IVI4(i) and IVI6(i) are aggregated to IPS4(i) and IPS6(i) in ISP(i)'s border routers respectively, there will be no affect to the global IPv4 and IPv6 routing tables [RFC4632].

If IVI4(i) and IVI6(i) has 1-to-1 mapping relationship, then IVI is stateless and it can support multi-homing.

Since IVI can be implemented independently in each ISP's network, it can be incrementally deployed.

3.3. IVI Communication Scenarios

Scenario 1:

Assume that there are IPv4 address A and ISP(1) IVI-mapped IPv6 address A', an arbitrary IPv4 address B and ISP(1) IVI-mapped IPv6 address B', as well as an arbitrary IPv6 address C'. If ISP(1)

deploys IVI, then A' is a physical IPv6 host and B is a physical IPv4 host. A' can communicate with B via the IVI gateway. Note that in this scenario A' is actually communicating with B', an image of B, and B is actually communicating with A, an image of A'. Since A' is an IPv6 address inside ISP6(1), it can also communicate with arbitrary IPv6 host C'. This can form an early stage of IPv4/IPv6 coexistence and transition.

IVI Communication Scenario 1

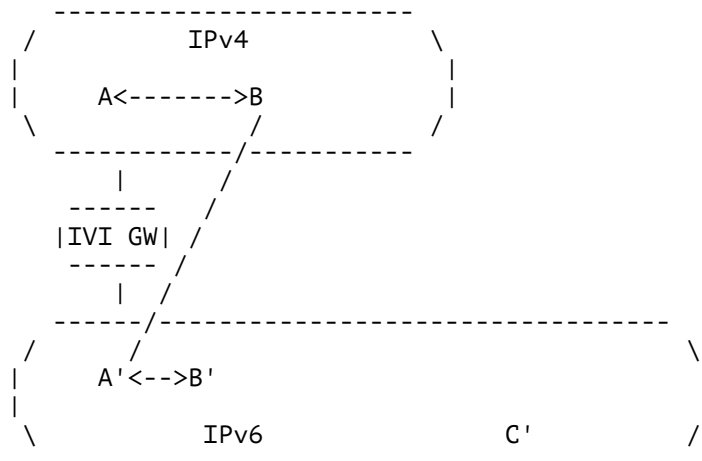


Figure 5

Scenario 2:

Assume that there are IPv4 address A, ISP(1) IVI-mapped IPv6 address A' and ISP(2) IVI-mapped IPv6 address A''. Similarly, assume that there are IPv4 address B, ISP(1) IVI-mapped IPv6 address B' and ISP(2) IVI-mapped IPv6 address B''. If both ISP(1) and ISP(2) deploy IVI, then A' and B' are physical IPv6 hosts. In addition, if ISP(1) and ISP(2) do not know the IVI deployment on the other end, then A' can still communicate with B'' through A and B via two IVI gateways. Note that in this scenario A' is actually communicating with B', an ISP(1)'s version image of B, and B'' is actually communicating with A'', an ISP(2)'s version image of A. Since there are two IVI gateways involved, the routing is not optimal.

IVI Communication Scenario 2

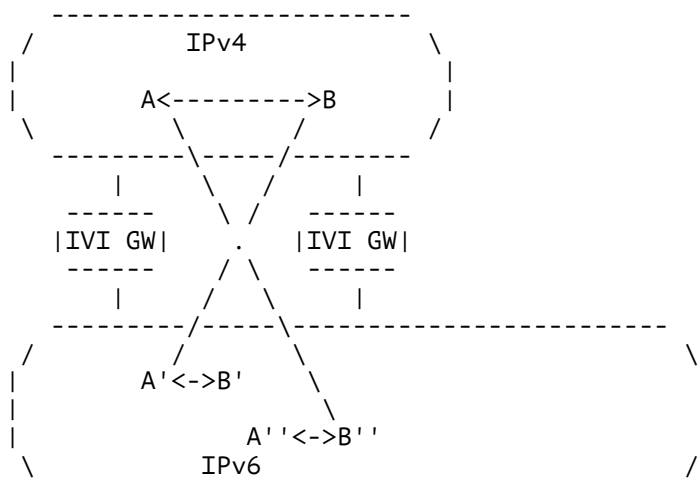


Figure 6

Scenario 3:

Assume that there are IPv4 address A and ISP(1) IVI-mapped IPv6 address A'. Similarly, assume that there are IPv4 address B and ISP(2) IVI-mapped IPv6 address B''. If both ISP(1) and ISP(2) deploy IVI, then A' and B'' are physical IPv6 hosts. In addition, if ISP(1) and ISP(2) by contrast know the IVI deployment on the other end, then A' can communicate with B'' directly. Since it is the communication in IPv6, the routing is optimal. This can form a later stage of the transition.

IVI Communication Scenario 3

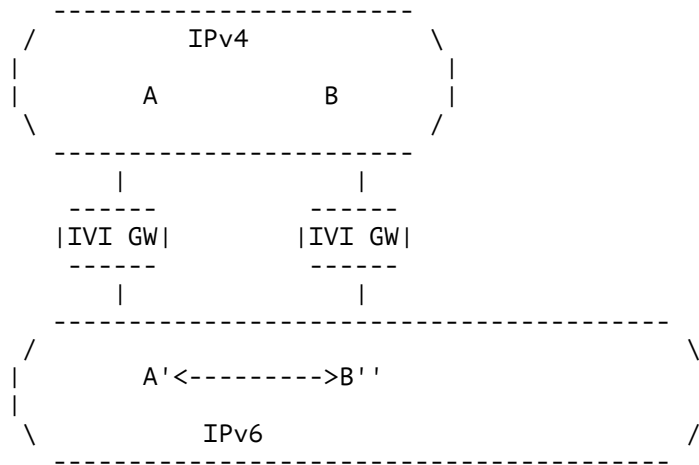


Figure 7

4. Design Considerations

The components of the IVI scheme include: address mapping, network-layer header translation, transport-layer header translation, fragmentation/MTU handling, ICMP handling, application layer gateway, IPv6 source address selection and IPv4 over IPv6 support.

4.1. Address Mapping

The address mapping rule is defined in Section 3.1.

In addition, depending on the implementation scope of the IVI gateway, IVIG46(i) block can also be defined as 2001:DB8:FFFF::/48, 2001:DB8:ABCD:FF00::/56 or 2001:DB8:ABCD:FFFF::/64, etc. A special case is to define IVIG46(i)=2001:DB8:XXXX:XXXX:XXXX:XXXX::/96, then the mapping rule is similar to the method of translating the IPv4 server address proposed in [I-D.bagnulo-behave-nat64].

4.2. Network-layer Header Translation

IPv4 [RFC791] [RFC791] and IPv6 [RFC2460] are different protocols with different network layer header format, the translation of the IPv4 and IPv6 headers must be performed [MVB98] [RFC2765] as shown in the following figures.

IPv4 to IPv6 Header translation based on IVI scheme

IPv4 Field	Translated to IPv6
Version (0x4)	Version (0x6)
IHL	discarded
Type of Service	discarded
Total Length	Payload Length = Total Length -IHL * 4
Identification	discarded
Flags	discarded
Offset	discarded
Time to Live	Hop Limit
Protocol	Next Header
Header Checksum	discarded
Source Address	IVI address mapping
Destination Address	IVI address mapping
Options	discarded

Figure 8

IPv6 to IPv4 Header translation based on IVI scheme

IPv6 Field	Translated to IPv4 Header
Version (0x6)	Version (0x4)
Traffic Class	discarded
Flow Label	discarded
Payload Length	Total Length = Payload Length + 20
Next Header	Protocol
Hop Limit	TTL
Source Address	IVI address mapping
Destination Address	IVI address mapping
-	IHL = 5
-	Header Checksum recalculated

Figure 9

4.3. Transport-layer Header Translation

Since the TCP and UDP headers [RFC793] [RFC768] consist of check sums which include the IP header, the recalculation and updating of the transport-layer headers must be performed [RFC2765].

4.4. Fragmentation and MTU Handling

When the packet is translated by the IVI gateway, due to the different sizes of the IPv4 and IPv6 headers, the IVI6 packets will be at least 20 bytes larger than the IVI4 packets, which may exceed the MTU of the next link in the IPv6 network. Therefore, the MTU handling and translation between IPv6 fragmentation headers and fragmentation field in the IPv4 headers are necessary, which is performed in the IVI gateway according to SIIT [RFC2765].

4.5. ICMP Handling

For ICMP message translation between IPv4 and IPv6, IVI follows the ICMP/ICMPv6 message correspondence as defined in SIIT [RFC2765]. Note that the ICMP message may be generated by an intermediate router whose IPv6 address does not belong to IVIG46(i). Since ICMP translation is important to the path MTU discovery, the inverse mapping for unmapped addresses is defined in this document. In the current prototype, a pseudo IPv4 address is generated in such a way that the first 16 bits are the IPv4 address of the IVI gateway, and the last 16 bits are the AS number of the current domain. This prevents translated ICMP messages from being discarded due to unknown

or private IP source. A small IPv4 address block should be reserved to identify the non-IVI mapped IPv6 addresses.

4.6. Application Layer Gateway

Due to the features of 1-to-1 address mapping and stateless, IVI can support most of the existing applications, such as HTTP, SSH, Telnet and Microsoft Remote Desktop Protocol. However, some applications are designed such that IP addresses are used to identify application-layer entities (e.g. FTP). In these cases, application layer gateway (ALG) is unavoidable, but it can be integrated into the IVI gateway. A list of applications which support the IVI scheme will be given in a later version of this document.

4.7. IPv6 Source Address Selection

Since each IPv6 host may have multiple addresses, it is important for the host to use an IVI6(i) address to reach the global IPv4 networks. The short-term work around is to use IVI6(i) as the default IPv6 address of the host. The long-term solution requires that the application be able to select the source addresses for different services.

4.8. IPv4 over IPv6 Support

The IVI scheme can support the IPv4 over IPv6 service (NAT64), i.e. a stub IPv4 network can be connected to an IVI gateway to reach the IPv6 network and via another IVI gateway to reach the global IPv4 network [RFC4925]

A more interesting scenario is to integrate the functions of the first IVI gateway into the end-system. In this case, the application softwares are IPv4-based and there is no need to have ALG support in the IVI gateway when it is communicating with IPv4 hosts.

5. DNS Configuration and Mapping

The DNS [RFC1035] service is important for the IVI scheme.

5.1. DNS Configuration for the IVI6(i) Addresses

For providing authoritative DNS service for IVI4(i) and IVI6(i), each host name will both have an A record and an AAAA record pointing to IVI4(i) and IVI6(i), respectively. Note that the same name always points to a unique host, which is an IVI6(i) host and it has IVI4(i) representation via the IVI gateway.

5.2. DNS Mapping for the IVIG46(i) Addresses

For resolving the IVI IPv6-mapped global IPv4 space (IVIG46(i)), each ISP must provide customized IVI DNS service for the IVI6(i) hosts. The IVI DNS server is in dual stack environment. When the IVI6(i) host queries an AAAA record for an IPv4 only domain name, the IVI DNS server will query the A record and map it to IVIG46(i) with ISP's IPv6 prefix and return an AAAA record to the IVI6(i) host.

6. Multiplexing of the Global IPv4 Addresses

Since public-IPv4 address is a scarce resource, the effective use of the IPv4 address is important for the IVI scheme. The multiplexing techniques are temporal multiplexing, port multiplexing, spatial multiplexing and multiplexing using IPv4 NAT-PT techniques.

6.1. Temporal Multiplexing

The IVI6 can be temporally multiplexed inside the ISP(i)'s /32. This is to say that the ISP can dynamically assign IVI6(i) to an end system when it requests the IPv4 communication service and release the IVI6(i) when the communication is finished. For temporal multiplexing, the features of stateless and end-to-end address transparency are maintained.

6.2. Port Multiplexing

To further increase the utilization ratio of the public IPv4 addresses, the port multiplexing inside the ISP(i)'s /32 can be deployed [RFC2766] [RFC4966]. This is to say that a single IPv4 address (IVI4(i)) can be used for multiple IVI6(i) addresses. The mapping scheme is to use the least significant bits in the IVI6(i) to define the multiple mapping and combine the transport-layer port number to perform uniquely the mapping from IVI4(i) to IVI6(i).

IVI Address Mapping for Port Multiplexing

Ratio	IVI6(i) range
1-to-1	2001:DB8:ffxx:xxxx:xx00:: - 2001:DB8:ffxx:xxxx:xx00::
1-to-2 ¹	2001:DB8:ffxx:xxxx:xx00:: - 2001:DB8:ffxx:xxxx:xx00::1
.....	
1-to-2 ⁴	2001:DB8:ffxx:xxxx:xx00:: - 2001:DB8:ffxx:xxxx:xx00::15

Figure 10

Based on this method, the mapping gain can be adjusted incrementally depending on the requirements. For example, zero bit means 1-to-1 mapping, and it is stateless. One bit means 1-to-1 mapping, and it has two states. Four bits means 1-to-16 mapping, etc. In the case of one-to-many mapping, when two IVI6(i)s have the same port number, the IVI gateway will map one of the port number to an unused port number and maintain the mapping table (IVI4(i) plus port number). Since the one-to-many mapping loses the feature of being stateless

and may lose the end-to-end address transparency, the proper use of the one-to-many mapping is the balancing of tradeoffs [RFC4966].

The tradeoffs are: (1) the number of the port number (2^{16}); (2) the gain of the IPv4 address utilization; (3) half association (3-tuple: source IP address, source port, transport protocol) or full association (5-tuple: source IP address, source port, destination IP address, destination port, transport protocol); (4) the number of states in the IVI gateway; (5) the average concurrent port used in an IPv6 host and; (6) the collision ratio of the port number.

6.3. Spatial Multiplexing

The spatial multiplexing means that for different operation modes of server and client, the different port multiplexing ratios can be applied. There are basically three cases.

(1) Server: we suggest having 1-to-1 mapping between IVI4(i) and IVI6(i), because it has the advantages of end-to-end address transparency, being stateless, having multi-homing support and providing services via well-known ports.

(2) Client with self-initiated connection: we suggest having 1-to- 2^N mapping between IVI4(i) and IVI6(i) (N is a positive integer greater than 1), i.e. one IVI4(i) can support several IVI6(i) users to access the IPv4 network. By adjusting N, The number of states can be controlled. In this case, the port number is randomly generated by the client operating system. The IVI gateway maintains the port mapping table to avoid collision. There is no need to modify the client operating system and/or client application.

(3) Client with peer initiated connection: we suggest having 1-to- 2^M mapping between IVI4(i) and IVI6(i) (M is a positive integer greater than 1 and may be smaller than N), i.e. one IVI4(i) can support several IVI6(i) users as the peer-to-peer hosts for the IPv4 network. By adjusting M, The number of states can be controlled. In this case, we can define "pseudo-well-known port number", which is unique for IVI4(i) and known to the peers. However, modification of the client operating system and/or client application may be necessary. By combining address and pseudo-well-known port number, the feature of end-to-end address transparency can still be maintained.

6.4. Multiplexing using IPv4 NAT-PT

If the private IPv4 address (e.g. 10.0.0.0/8) is used as the IPv4 address under the IVI scheme, combining conventional NAT-PT and NAT-traversing techniques, the public IPv4 addresses can also be multiplexed. The advantage of this method is that IPv4 NAT-PT

equipments are widely available and can be deployed immediately. Moreover, the mapped prefix-specific IPv6 addresses (IVI6(i)) are no longer behind the NAT box in IPv6 and can be accessed by any IPv6 hosts.

7. IVI Multicast Support

The IVI scheme can support IPv4/IPv6 communication of the protocol-independent specific-source sparse-mode multicast (PIM SSM) [RFC3171] [RFC3569] [RFC4607].

(1) The IVI group address mapping rule: There will be 2^{24} group addresses for IPv4 SSM. The corresponding IPv6 SSM group addresses can be defined as shown in the following figure.

IVI Multicast Group Address Mapping

IPv4 Group Address	IPv6 Group Address
232.0.0.0/8	ff3e:0:0:0:0:f000:0000/96
232.255.255.255/8	ff3e:0:0:0:0:f0ff:ffff/96

Figure 11

(2) The IVI multicast source address selection: The source address in IPv6 has to be IVI6(i) in order to perform reverse path forwarding (RPF) as required by PIM-SM.

(3) The multicast protocol: The inter operation of PIM-SM for address families IPv4 and IPv6 can either be implemented via the application layer gateway or via the static join based on IGMPv3 and MLDv2 in IPv4 and IPv6, respectively.

The Any Source Multicast (ASM) cannot be supported in the cross address-family environment, since IPv6 does not support the MSDP [RFC4611], and IPv4 does not support the embedded RP [RFC3956].

8. IVI Implementation and Preliminary Testing Results

The IVI scheme presented in this document is implemented in the Linux OS and the source code can be downloaded [LINUX]. The example of the configuration is shown in Appendix A.

The IVI gateway based on the Linux implementation has been deployed between CERNET (IPv4 and partially dual-stack) [CERNET] and CNGI-CERNET2 (pure IPv6) [CERNET2] since March 2006. The pure IPv6 web servers using IPv6 addresses (IVI) behind IVI gateway can be accessed by the IPv4 hosts [IVI4], and also by the global IPv6 hosts [IVI6].

In addition, two traceroute results are presented in Appendix B to show the address mapping of the IVI scheme.

9. Features of IVI

The basic features of the IVI scheme are:

- (1) Special IPv6 addresses can communicate with the global IPv6 network directly and can communicate with the global IPv4 network via IVI gateways.
- (2) When the mapping is 1-to-1, the IVI gateway is stateless and can support multi-homing. When mapping is 1-to-2^N (N!=0), the IVI gateway is stateful, but the number of state can be controlled.
- (3) When the mapping is 1-to-1, the IVI scheme has the advantages of end-to-end address transparency. When mapping is 1-to-2^M, by introducing pseudo-well-known ports, the feature of end-to-end address transparency can also be maintained.
- (4) The IVI addresses are globally routable.
- (5) The IVI scheme is incrementally deployable.
- (6) Based on the multiplexing techniques, the global IPv4 addresses can be effectively used.

The IVI scheme can satisfy most of the basic and advanced requirements for the IPv4 to IPv4 transition as specified by the Internet Drafts [I-D.v6ops-nat64-pb-statement-req].

For the basic requirements (MUST):

- (1) No need to change the end system (IPv4 and IPv6).
- (2) Support v4-initiated and v6-initiated short-lived local handle.
- (3) Support interaction with dual-stack hosts.
- (4) The standard IPv4 NAT can easily be integrated into the system.
- (5) Do not violate standard DNS semantics.
- (6) No affect to IPv6 routing.
- (7) Support TCP, UDP, ICMP.
- (8) Can handle fragmentation.

For the advanced requirements (SHOULD):

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- (1) Support multicast (SSM).
- (2) Support operational flexibility.
- (3) Support central Management.

Other requirements specified by the IETF RFC or the IETF drafts will be studied in a later version of this document.

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10. Address Policy and IVI Address Evolution

Based on the IVI scheme, we propose to modify IPv4 address-allocation and IPv6 address-assignment policies [RFC1744] [RFC2008] for IPv4/IPv6 coexistence and transition as follows.

10.1. IPv6 Address Assignment Policy

- (1) Reserve 2001:DB8:ff00::/40 for each 2001:DB8::/32 (2001:DB8::/32 is the documentation address, which represents all /32s [RFC4291]).
- (2) Encourage ISPs to deploy their IPv6 networks and to install their IVI gateways.
- (3) Encourage ISPs to use a subset (i.e. IVI4(i)) of their own IPv4 address blocks and map it into IPv6 via the IVI scheme (i.e. IVI6(i)) for their initial deployment of IPv6. For servers using the 1-to-1 mapping, and for clients using the 1-to-2^N mapping. In this way, the scarce IPv4 addresses can be effectively used. This special IPv6 block can communicate with the global IPv6 networks directly and communicate with the global IPv4 networks via IVI gateways.
- (4) Encourage ISPs to increase the size of IVI4(i). When IVI4(i)=IPS4(i), the IPv4 to IPv6 transition for ISP(i) will be accomplished.

10.2. IPv4 Address Allocation Policy

- (1) The remaining IPv4 address should be dedicated for the IVI transition use, i.e. using these blocks for the IVI6(i) deployment. The users using IVI6(i) can access the IPv6 networks directly and the IPv4 networks via the IVI gateways.
- (2) Based on multiplexing techniques, the global IPv4 addresses can be used effectively. For example, with a reasonable port multiplexing ratio (say 16), one /8 can support 268M hosts. If 10 /8s can be allocated for the IVI use, it will be 2.6 billion addresses, possibly enough even for the unwired population in the world. The 43.0.0.0/8 could be a good candidate for the initial trial [APNIC].

10.3. Evolution of the IVI Addresses and Services

The IVI scheme is an effective method for transparent IPv4/IPv6 coexistence and smooth IPv4/IPv6 transition. Unlike the existing transition techniques which treat the IPv6 addresses equally [JSG2008], the IVI scheme suggests dividing the current IPv6 addresses into IVI6 addresses and non-IVI6 addresses. The IVI6

addresses, due to their nature as images of IVI4, can communicate with the global IPv4 networks via IVI gateways and they can also communicate with the global IPv6 networks directly. Therefore, the ISPs should use the IVI6 addresses for the initial deployment of their IPv6 infrastructure and this should be the IPv4/IPv6 coexistence stage. When $IVI4(i)=IPS4(i)$ for most of $ISP(i)$, the rest of the IPv6 addresses (non IVI6(i)) can be used for the further development of the global Internet, as shown in the following figure.

IPv4/IPv6 Address Coexistence and Evolution

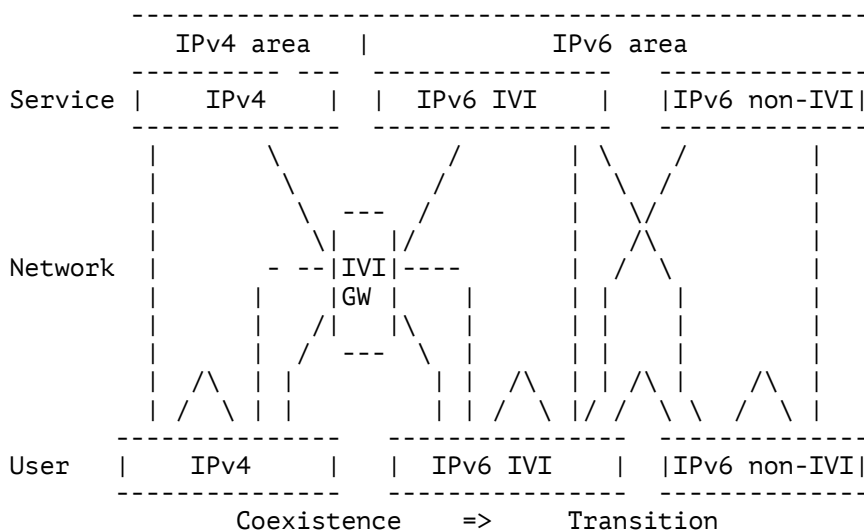


Figure 12

11. Security Considerations

This document presents the prefix-specific and stateless address mapping scheme (IVI) for the IPv4/IPv6 coexistence and transition. The IPv4 security and IPv6 security issues should be addressed by related documents of each address family and are not included in this document.

However, the specific security issues for the IVI gateway implementation should be studied and addressed during the development of the IVI mechanisms.

12. IANA Considerations

The address allocation and assignment policies discussed in this document may have impact to IANA operation.

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13. Principal Authors

Xing Li

Maoke Chen

Congxiao Bao

Hong Zhang

Jianping Wu

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14. Contributors

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16. Appendix A. The IVI gateway configuration example

IVI Configuration Example

```
#!/bin/bash
# open forwarding
echo 1 > /proc/sys/net/ipv6/conf/all/forwarding
echo 1 > /proc/sys/net/ipv4/conf/all/forwarding

# config route for IVI6 = 2001:da8:ffca:2661:cc00::/70,
#                      IVI4 = 202.38.97.204/30

# configure IPv6 route
route add -A inet6 2001:da8:ffca:2661:cc00::/70 \
gw 2001:da8:aaae::206 dev eth0

# config mapping for      source-PF = 2001:da8::/32
# config mapping for destination-PF = 2001:da8::/32

# for each mapping, a unique pseudo-address (10.0.0.x/8)
# should be configured.
# ip addr add 10.0.0.1/8 dev eth0

# IPv4-to-IPv6 mapping, multiple mappings can be done via multiple
# commands.
# mroute IVI4-network IVI4-mask pseudo-address interface \
# source-PF destination-PF
/root/mroute 202.38.97.204 255.255.255.252 10.0.0.1 \
eth0 2001:da8:: 2001:da8::

# IPv6-to-IPv4 mapping
# mroute6 destination-PF destination-PF-pref-len
/root/mroute6 2001:da8:ff00:: 40
```

Figure 13

17. Appendix B. The traceroute results

```
ivitraceroute
```

```
ivitraceroute 202.38.108.2
```

```
1 202.112.0.65 6 ms 2 ms 1 ms
2 202.112.53.73 4 ms 6 ms 12 ms
3 202.112.53.178 1 ms 1 ms 1 ms
4 202.112.61.242 1 ms 1 ms 1 ms
5 202.38.17.186 1 ms 1 ms 1 ms
  202.38 AS4538
6 202.38.17.186 1 ms 1 ms 1 ms
  202.38 AS4538
7 202.38.17.186 2 ms 2 ms 2 ms
  202.38 AS4538
8 202.38.17.186 2 ms 2 ms 2 ms
  202.38 AS4538
9 202.38.17.186 4 ms 4 ms 3 ms
  202.38 AS4538
10 202.38.108.2 2 ms 3 ms 3 ms
```

Figure 14

Note that the non-IVI IPv6 addresses are mapped to 202.38.17.186, which is defined in this document (the first two sections are the IPv4 prefix of /16 of the IVI gateway interface and the last two sections are the autonomous system number 4538).

```
ivitraceroute6
```

```
ivitraceroute6 www.mit.edu
```

```
src_ivi4=202.38.97.205 src_ivi6=2001:da8:ffca:2661:cd00::
dst_host=www.mit.edu
dst_ip4=18.7.22.83 dst_ivi6=2001:da8:ff12:716:5300::
```

```
traceroute to 2001:da8:ff12:716:5300:: (2001:da8:ff12:716:5300::),
30 hops max, 40 byte packets to not_ivi
```

```
1 2001:da8:ff0a:0:100::      0.304 ms 0.262 ms 0.190 ms
  10.0.0.1
2 2001:da8:ffca:7023:fe00::  0.589 ms * *
  202.112.35.254
3 2001:da8:ffca:7035:4900::  1.660 ms 1.538 ms 1.905 ms
  202.112.53.73
4 2001:da8:ffca:703d:9e00::  0.371 ms 0.530 ms 0.459 ms
  202.112.61.158
5 2001:da8:ffca:7035:1200::  0.776 ms 0.704 ms 0.690 ms
  202.112.53.18
6 2001:da8:ffcb:b5c2:7d00::  89.382 ms 89.076 ms 89.240 ms
  203.181.194.125
7 2001:da8:ffc0:cb74:9100::  204.623 ms 204.685 ms 204.494 ms
  192.203.116.145
8 2001:da8:ffcf:e7f0:8300::  249.842 ms 249.945 ms 250.329 ms
  207.231.240.131
9 2001:da8:ff40:391c:2d00::  249.891 ms 249.936 ms 250.090 ms
  64.57.28.45
10 2001:da8:ff40:391c:2a00::  259.030 ms 259.110 ms 259.086 ms
  64.57.28.42
11 2001:da8:ff40:391c:700::  264.247 ms 264.399 ms 264.364 ms
  64.57.28.7
12 2001:da8:ff40:391c:a00::  271.014 ms 269.572 ms 269.692 ms
  64.57.28.10
13 2001:da8:ffc0:559:dd00::  274.300 ms 274.483 ms 274.316 ms
  192.5.89.221
14 2001:da8:ffc0:559:ed00::  274.534 ms 274.367 ms 274.517 ms
  192.5.89.237
15 * * *
16 2001:da8:ff12:a800:1900::  276.032 ms 275.876 ms 276.090 ms
  18.168.0.25
17 2001:da8:ff12:716:5300::  276.285 ms 276.370 ms 276.214 ms
  18.7.22.83
```

Figure 15

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Note that all of the IPv4 addresses can be mapped to prefix-specific IPv6 addresses (for example 18.7.22.83 is mapped to 2001:da8:ff12:716:5300::).

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July 2008

Authors' Addresses

Xing Li
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing 100084
CN

Phone: +86 62785983
Email: xing@cernet.edu.cn

Maoke Chen
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing 100084
CN

Phone: +86 62785983
Email: mk@cernet.edu.cn

Congxiao Bao
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing 100084
CN

Phone: +86 62785983
Email: congxiao@cernet.edu.cn

Hong Zhang
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing 100084
CN

Phone: +86 62785983
Email: neilzh@gmail.com

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July 2008

Jianping Wu
CERNET Center/Tsinghua University
Room 225, Main Building, Tsinghua University
Beijing 100084
CN

Phone: +86 62785983
Email: jianping@cernet.edu.cn

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Attachment 3A



Datatracker

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Meeting Agenda

Dublin, July 27 - August 1, 2008

[Agenda](#)
[Floor plan](#)
[Plaintext](#)

Schedule

[Meeting](#)
[Local](#)
[UTC](#)
[Europe - Dublin](#)

Time	Location		Event		
Sunday, July 27, 2008					
10:00 - 12:00	Ballroom 1		IEPG Meeting		
11:30 - 13:00			 Continental Breakfast		
12:00 - 19:00			IETF Registration		
13:00 - 14:45	Ballroom 2		Introduction to xml2rfc		
13:00 - 14:45	Convention 3		Newcomer's Training		
13:00 - 14:45	Ballroom 1		Routing, Bridging and Switching Tutorial		
15:00 - 16:45	Convention 3		Document Lifecycle		
17:00 - 19:00	Kingswood Suite		Welcome Reception		
Monday, July 28, 2008					
08:00 - 09:00			 Continental Breakfast		
08:00 - 18:00			IETF Registration		
09:00 - 11:30	Monday Morning Session I				
—	Ballroom 2	 apparea	Applications Area Open Meeting	   	
—	Rathcoole	 pana	Protocol for carrying Authentication for Network Access	   	
—	Convention 2	 softwire	Softwires	  	



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—	Convention 1	RAI	sipping	Session Initiation Proposal Investigation	
—	Convention 3	RTG	mpls	Multiprotocol Label Switching	
—	Ballroom 1	SEC	ipsecme	IP Security Maintenance and Extensions	
—	Conservatory	TSV	nfsv4	Network File System Version 4	
11:30 - 13:00		<i>Continental Breakfast</i>			
13:00 - 15:00		Monday Afternoon Session I			
—	Ballroom 2	SEC	dkim	Domain Keys Identified Mail	
—	Convention 3	INT	csi	Cga & Send maintenance	
—	Conservatory	INT	mip4	Mobility for IPv4	
—	Rathcoole	IRTF	hiprg	Host Identity Protocol	
—	Ballroom 1	OPS	dime	Diameter Maintenance and Extensions	
—	Convention 2	RAI	speermint	Session PEERing for Multimedia INTERconnect	
—	Convention 1	RTG	l3vpn	Layer 3 Virtual Private Networks	
—	Newcastle	TSV	dccp	Datagram Congestion Control Protocol	
15:00 - 15:20		<i>Continental Breakfast</i>			
15:20 - 17:20		Monday Afternoon Session II			
—	Rathcoole	APP	idnabis	Internationalized Domain Names in Applications, Revised	
—	Convention 1	INT	mext	Mobility EXTensions for IPv6	
—	Conservatory	OPS	bmwg	Benchmarking Methodology	
—	Ballroom 2	RAI	bliss	Basic Level of Interoperability for SIP Services	
—	Newcastle	RTG	forces	Forwarding and Control Element Separation	
—	Convention 3	RTG	l2vpn	Layer 2 Virtual Private Networks	
—	Ballroom 1	SEC	tls	Transport Layer Security	



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17:20 - 17:40		📅 <i>Continental Breakfast</i>	
17:40 - 19:50		Monday Afternoon Session III	
—	Newcastle	APP eai	Email Address Internationalization 📅 📄 📄 🗨
—	Conservatory	INT ntp	Network Time Protocol 📅 📄 📄 🗨
—	Ballroom 1	INT savi	Source Address Validation Improvements 📅 📄 📄 🗨
—	Rathcoole	OPS ipfix	IP Flow Information Export 📅 📄 📄 🗨
—	Convention 1	RAI avt	Audio/Video Transport 📅 📄 📄 🗨
—	Convention 3	RTG ccamp	Common Control and Measurement Plane 📅 📄 📄 🗨
—	Convention 2	RTG sidr	Secure Inter-Domain Routing 📅 📄 📄 🗨
—	Ballroom 2	TSV tcpm	TCP Maintenance and Minor Extensions 📅 📄 📄 🗨
Tuesday, July 29, 2008			
08:00 - 09:00		📅 <i>Continental Breakfast</i>	
08:00 - 18:00		IETF Registration	
09:00 - 11:30		Tuesday Morning Session I	
—	Conservatory	APP httpbis	Hypertext Transfer Protocol Bis 📅 📄 📄 🗨
—	Ballroom 2	INT 6lowpan	IPv6 over Low power WPAN 📅 📄 📄 🗨
—	Ballroom 1	INT dhc	Dynamic Host Configuration 📅 📄 📄 🗨
—	Convention 1	OPS opsarea	Operations & Management Area Open Meeting 📅 📄 📄 🗨
—	Convention 2	RTG rtgwg	Routing Area Working Group 📅 📄 📄 🗨
—	Newcastle	SEC hokey	Handover Keying 📅 📄 📄 🗨
—	Convention 3	TSV alto	Application-Layer Traffic Optimization 📅 📄 📄 🗨
—	Rathcoole	TSV rmt	Reliable Multicast Transport 📅 📄 📄 🗨
11:30 - 13:00		📅 <i>Continental Breakfast</i>	
13:00 - 15:00		Tuesday Afternoon Session I	



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—	Rathcoole	INT	tictoc	Timing over IP Connection and Transfer of Clock	   
—	Ballroom 1	OPS	dnsop	Domain Name System Operations	   
—	Convention 3	RAI	sip	Session Initiation Protocol	   
—	Newcastle	RTG	roll	Routing Over Low power and Lossy networks	   
—	Conservatory	SEC	krb-wg	Kerberos	   
—	Convention 1	TSV	tsvarea	Transport Area Open Meeting	   
15:00 - 15:20					 <i>Continental Breakfast</i>
15:20 - 17:20		Tuesday Afternoon Session II			
—	Convention 3	RAI	ecrit	Emergency Context Resolution with Internet Technologies	   
—	Rathcoole	APP	idnabis	Internationalized Domain Names in Applications, Revised	   
—	Ballroom 1	INT	mipshop	Mobility for IP: Performance, Signaling and Handoff Optimization ↳ Room Change	   
—	Newcastle	OPS	pmol	Performance Metrics for Other Layers	   
—	Ballroom 2	RTG	pim	Protocol Independent Multicast	   
—	Convention 1	RTG	pwe3	Pseudowire Emulation Edge to Edge	   
—	Conservatory	SEC	sasl	Simple Authentication and Security Layer	   
—	Convention 2	TSV	behave	Behavior Engineering for Hindrance Avoidance ↳ Room Change	   
17:20 - 17:40					 <i>Continental Breakfast</i>
17:40 - 18:40		Tuesday Afternoon Session III			
—	Rathcoole	APP	ipdvb	IP over DVB	   
—	Ballroom 1	OPS	capwap	Control And Provisioning of Wireless Access Points	   



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—	Ballroom 2	RTG	idr	Inter-Domain Routing	
—	Convention 1	RTG	manet	Mobile Ad-hoc Networks	
—	Conservatory	SEC	kitten	Common Authentication Technology Next Generation	
—	Newcastle	TSV	nsis	Next Steps in Signaling	
18:50 - 19:50		Tuesday Afternoon Session IV			
—	Conservatory	OPS	netconf	Network Configuration	
—	Ballroom 1	RAI	avt	Audio/Video Transport	
—	Convention 3	RAI	enum	Telephone Number Mapping	
—	Ballroom 2	RTG	idr	Inter-Domain Routing	
—	Convention 1	RTG	manet	Mobile Ad-hoc Networks	
—	Convention 2	TSV	behave	Behavior Engineering for Hindrance Avoidance ↳ Room Change	
Wednesday, July 30, 2008					
08:00 - 09:00		Continental Breakfast			
08:00 - 17:00		IETF Registration			
09:00 - 11:30		Wednesday Morning Session I			
—	Convention 3	RAI	p2psip	Peer-to-Peer Session Initiation Protocol	
—	Ballroom 2	APP	morg	Message Organization	
—	Ballroom 1	INT	6man	IPv6 Maintenance	
—	Convention 2	INT	explisp	Experimentation in LISP	
—	Rathcoole	IRTF	moboopts	IP Mobility Optimizations Research Group	
—	Convention 1	RTG	mpls	Multiprotocol Label Switching	
—	Conservatory	OPS	radext	RADIUS EXTensions	
—	Newcastle	TSV	ippmxx	IP Performance Metrics, Next Steps	



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13:00 - 15:00		Wednesday Afternoon Session I			
—	Newcastle	INT	ancp	Access Node Control Protocol	   
—	Convention 2	INT	netlmm	Network-based Localized Mobility Management	   
—	Convention 1	OPS	opsawg	Operations and Management Area Working Group	   
—	Ballroom 2	RAI	mediactrl	Media Server Control	   
—	Convention 3	RTG	rtgarea	Routing Area Open Meeting	   
—	Ballroom 1	SEC	pkix	Public-Key Infrastructure (X.509)	   
—	Conservatory	TSV	fecframe	FEC Framework	   
—	Rathcoole	TSV	ippm	IP Performance Metrics	   
15:10 - 16:10		Wednesday Afternoon Session II			
—	Convention 3	INT	16ng	IP over IEEE 802.16 Networks	   
—	Rathcoole	IRTF	asrg	Anti-Spam Research Group	   
—	Conservatory	OPS	opsec	Operational Security Capabilities for IP Network Infrastructure	   
—	Ballroom 1	RAI	simple	SIP for Instant Messaging and Presence Leveraging Extensions	   
—	Ballroom 2	RTG	isis	IS-IS for IP Internets	   
—	Newcastle	SEC	keyprov	Provisioning of Symmetric Keys	   
16:10 - 17:00		🍽️ Continental Breakfast			
16:10 - 17:00		Conservatory		PGP Session 	
17:00 - 19:30		Convention 1 and 2		🌐 Technical Plenary    	
Thursday, July 31, 2008					
08:00 - 09:00		🍽️ Continental Breakfast			
08:00 - 17:00		IETF Registration			
09:00 - 11:30		Thursday Morning Session I			



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—	Convention 2	INT	intarea	Internet Area Working Group	
—	Convention 3	OPS	mboned	MBONE Deployment	
—	Newcastle	OPS	netmod	NETCONF Data Modeling Language	
—	Ballroom 2	RAI	geopriv	Geographic Location/Privacy	
—	Ballroom 1	RTG	pce	Path Computation Element	
—	Conservatory	SEC	nea	Network Endpoint Assessment	
—	Rathcoole	TSV	pcn	Congestion and Pre-Congestion Notification	
11:30 - 13:00					<i>Continental Breakfast</i>
13:00 - 15:00		Thursday Afternoon Session I			
—	Conservatory	APP	sieve	Sieve Mail Filtering Language	
—	Rathcoole	GEN	ipr	Intellectual Property Rights	
—	Ballroom 1	INT	dnsext	DNS Extensions	
—	Ballroom 2	OPS	v6ops	IPv6 Operations	
—	Convention 3	RTG	ccamp	Common Control and Measurement Plane	
—	Convention 2	SEC	saag	Security Area Open Meeting	
—	Convention 1	TSV	tana	Techniques for Advanced Networking Applications	
15:10 - 16:10		Thursday Afternoon Session II			
—	Ballroom 2	RAI	drinks	Data for Reachability of Inter/tra-Network SIP	
—	Conservatory	APP	isms	Integrated Security Model for SNMP	
—	Ballroom 1	INT	dna	Detecting Network Attachment	
—	Rathcoole	INT	hip	Host Identity Protocol	
—	Newcastle	OPS	grow	Global Routing Operations	
—	Convention 3	RAI	sip	Session Initiation Protocol	
16:10 - 17:00					<i>Continental Breakfast</i>

	Datatracker		<div>Sign in</div>	<div></div>
17:00	18:00	CONVENTION 1 and 2	Administration Plenary	<div></div> <div></div> <div></div> <div></div>
Friday, August 1, 2008				
08:00 - 09:00			<div></div> Continental Breakfast	
09:00 - 11:30	Friday Morning Session I			

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	CONVENTION 1	netmod	Until 5:00pm	<div></div> <div></div> <div></div> <div></div>
—	Convention 1	OPS netmod	NETCONF Data Modeling Language	<div></div> <div></div> <div></div> <div></div>
—	Rathcoole	SEC emu	EAP Method Update	<div></div> <div></div> <div></div> <div></div>

Attachment 3B



Microsoft PowerPoint...

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1

Outline

- Introduction
- IVI scheme
- Design considerations
- Testing result
- Transition
- Address Policy
- Conclusions

2

Introduction

- The experiences for the IPv6 deployment in the past 10 years strongly indicate that the IPv6 hosts need to communicate with the global IPv4 networks.
- In this document, we follow the basic specification of [51], but we define the address assignment and routing scheme (IVI).
- It is suitable for general networks in both the IPv4-to-IPv6 mapping direction, as well as in the IPv6-to-IPv4 mapping direction.
- It supports address transparency.
- It supports both IPv4 related communication and the IPv4 related communication without using NAT/translation techniques.

3

IVI Scheme

- The IVI is a prefix-specific and explicit bidirectional address mapping scheme.
- Global global IPv4 addresses are a subset of each IPv6 address block.
- Based on the mapping rule, each IPv6 can become a portion of its IPv4 address and vice versa.
- The NAT address translation is implemented in the NAT gateway.
- The IPv6 multiplexing technique can be used.
- IPv4.

4

Terms and Abbreviations of IVI

- General
 - IPv4
- IPv6
 - IPv6: An address not containing all IPv4 addresses. The address in this scheme is not used in IPv4-to-IPv6 mapping.
 - IPv6: A subset of IPv6, the address in this scheme will be mapped to IPv4 via address translation, using the IPv4-to-IPv6 mapping.
- IPv4
 - IPv4: An address not containing all IPv6 addresses.
 - IPv4: A subset of IPv4, the address in this scheme will be mapped to IPv6 via address translation, using the IPv6-to-IPv4 mapping.
- Mapping
 - Mapping: A subset of IPv6, the address in this scheme will be mapped to IPv4 via address translation, using the IPv4-to-IPv6 mapping.
 - Mapping: A subset of IPv4, the address in this scheme will be mapped to IPv6 via address translation, using the IPv6-to-IPv4 mapping.
- Compatibility
 - IPv4
 - IPv6

5

Address Mapping (1)



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