

ENUM: The Internet Numbers Game

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Table of Contents

Introduction	1
What Is the ENUM Protocol?	2
From Telephone Numbers to Internet Domain Names	2
What's Next? Voice Traffic and the Internet	3
The Evolution of ENUM	4
Where Did ENUM Come From?	4
The Input of the International Telecommunication Union	5
ENUM in the United States: The Department of State	6
Public Test Trials of ENUM	7
The Future of ENUM: Public Policy Issues	8
International Issues	9
Domestic Issues	9
Conclusion	11

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Introduction

In today's fast moving, interconnected society, there are seemingly unending ways to ensure constant and real-time communication. People can be contacted through home telephone numbers, business telephone numbers, wireless telephone numbers, one or more e-mail addresses, paging devices, and fax machines, among other ways. While such communication certainly can enhance productivity, it has also created the pressing problem of keeping track of myriad lengthy and ever changing contact information and identifiers. Whether termed "unified messaging" or some other catch phrase, the ability to simplify and enhance the process of remaining in touch has become the Holy Grail of communications for the new millennium.

A recent facet of this quest is the work commenced by a group of engineers to establish a protocol that essentially translates between public switched network telephone numbers and Internet domain names. Called ENUM (short for **E**lectronic **N**UMber or **t**Elephone **N**UMbering and **M**apping), the protocol merges two formerly separate, but related sets of identifiers: the international telephone numbering system and the Internet's domain name system ("DNS") based upon Internet Protocol ("IP") addresses. ENUM could potentially unify otherwise disparate communications media. By enabling parties to control how and when they are contacted, ENUM would facilitate broad communication for callers armed with only one piece of contact data (e.g., sending an e-mail even when the caller has only a

mobile phone number). In short, ENUM could bring us closer to a world where we are never out of touch unless we so choose.

This White Paper provides an overview and explanation of ENUM, its history, and the legal, policy, and regulatory issues that may arise with its implementation.¹ Rather than take a position on any of the highly charged and important matters that remain to be resolved, the focus of this White Paper is to provide readers with sufficient information and encourage thoughtful debate, rather than simplistic rhetoric. We welcome the input of our readers, who may contact us at: info@l-olaw.com or at our office address.

What Is the ENUM Protocol?

From Telephone Numbers to Internet Domain Names

In a nutshell, the ENUM protocol translates ordinary public switched network telephone numbers²—sometimes known as “E.164” numbers—into the language of the Internet's Domain Name System,³ assigning each telephone number a unique IP address. Under the ENUM system, users equipped only with the calling party's phone number would type that number into their browser (or “Internet-ready” telephone) and connect to the called party. More specifically, by using the called party's Naming Authority Pointer (“NAPTR”)⁴ record that includes the called party's selected preferences, the service providers would work “behind the scenes” to deliver communications messages in accordance with the called party's service preferences (e.g., routing calls to the called party's voicemail or sending a voicemail/incoming call as an e-mail file, etc.). NAPTR records allow users to attach as many services to a telephone number as the user desires and provides basic directions and rules for navigating the resources. The NAPTR record is the essence of the ENUM protocol since the NAPTR records list and prioritize the services that are associated with a particular telephone number and are used to reference the various resources such as fax number,

¹ Special acknowledgment and appreciation should be given to Nguyen T. Vu for his enormous efforts and assistance in preparing this White Paper.

² All current telephone numbers comply with the International Telecommunication Union (“ITU”) standard described in the ITU's Telecom Standardization Sector Recommendation E.164 that specifies the format for standard international telephone numbers. See *ITU-T E.164 The International Public Telecommunications Numbering Plan* (rel. May 1997), available at, <http://www.itu.org>.

³ The Domain Name System (“DNS”) is the manner in which Internet domain names are located and translated into Internet Protocol (“IP”) addresses. An IP address is a 32-binary digit number that identifies each sender or receiver of information that is sent in packet across the Internet. A domain name is a meaningful and easy-to-remember “handle” for an IP address, such as www.washingtonpost.com.

⁴ See The Naming Authority Pointer (“NAPTR”) DNS Resource Record, RFC 2915 (September 2000) available at <<http://www.ietf.org/rfc/rfc2915.txt>>.

e-mail address, Global Positioning System coordinates, wireless telephone number, website, etc. associated with that number. As shown in *Figure 1* below, the ENUM protocol automatically converts the number into a DNS address and sends the query to the DNS server.⁵

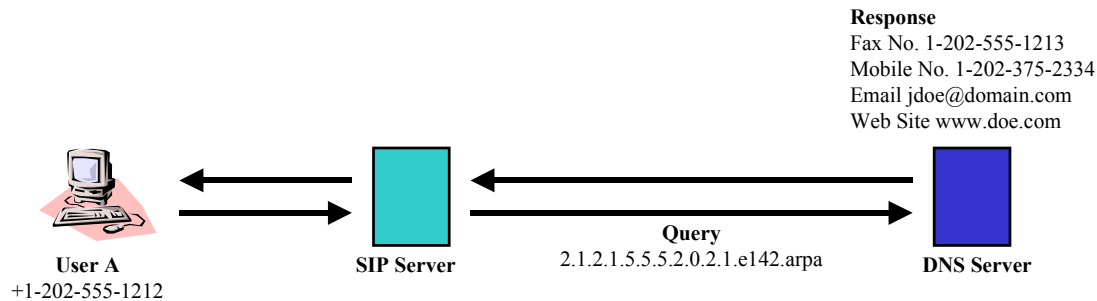


Figure 1

The NAPTR record resulting from an ENUM query delineates the associated services in the called party's order of preference, allowing ENUM subscribers to control better how and when they are contacted. For example, ENUM allows subscribers to specify a preference for voicemail messages over live calls at certain times of the day or to forward calls to a particular number.

What's Next? Voice Traffic and the Internet

While the potential for ENUM is far ranging, one often-discussed application of ENUM is Voice Over Internet Protocol (“VoIP”). Using either an Internet-ready telephone or an ordinary telephone connected to an Internet gateway, a caller could effectively use ENUM so that circuit-switched voice traffic is carried along a packet-switched data network. Under this scenario, a caller would dial the desired telephone number, which would in turn contact the DNS server to determine whether or not the called party is an ENUM subscriber. If the called party is an ENUM subscriber, the call would proceed along the IP network and a two-way connection with the called party would be established. If not, however, the call would be routed back to the public switched telephone network (“PSTN”) and the call would proceed as dialed. While the widespread use of ENUM to allow voice traffic to sidestep the existing circuit-switched telephone network raises numerous policy questions, as a technological matter, its implementation is relatively straightforward (see *Figure 2*).

⁵ Note that the telephone number digits are reversed since Internet addresses are read from right to left. The address includes the ENUM domain e164.arpa.

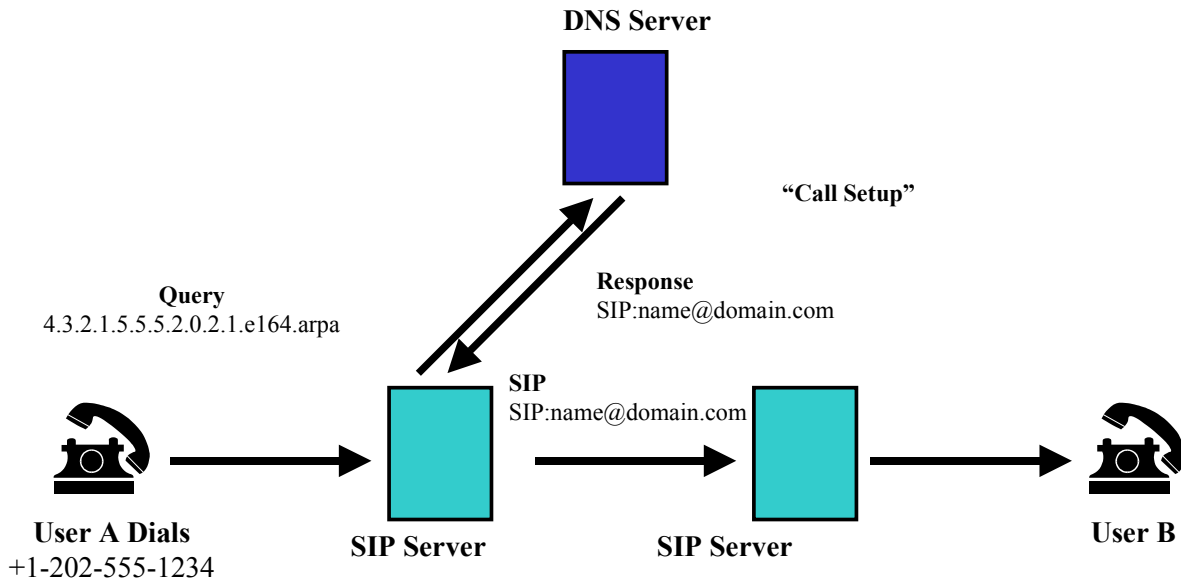


Figure 2

The Evolution of ENUM

Where Did ENUM Come From?

The concept of using telephone numbers as identifiers on the Internet has its roots in a 1993 experiment by Marshall Rose and Carl Malamoud.⁶ The experiment created a new TPC.INT domain that allowed facsimiles to be sent for free to many parts of the world using Internet e-mail.⁷ Designed for people that were users of facsimile but not e-mail, the system relied on volunteer hosts of “fax servers” or “remote printers” throughout the world.⁸ Users would type an Internet e-mail to one of these “remote printers,” which would then transmit a facsimile to the recipient.⁹ Though not widely used, the experiment continues today.

In 1999, a growing interest in Internet-based voice telephony led the Internet Engineering Task Force (“IETF”), the association that creates Internet standards and related documents, to commence work on a protocol that would convert standard E.164 international telephone numbers into Internet addresses using the DNS.¹⁰ The resulting Working Group, called ENUM, recognized that its work would almost certainly be impacted by

⁶ A complete description of this experiment is available at <http://www.tpc.int/faq/history.html>.

⁷ See *id.*

⁸ See Send A FAX By E-mail, available at <http://www.tpc.int/faxbyemail.html>.

⁹ See *id.*

the E.164 international telephone numbering plan. As such, in September 2000, the IETF submitted to the International Telecommunication Union (“ITU”)—the United Nation’s sponsored international group responsible for the coordination and standardization of communications, including telephone numbers—a Request for Comments entitled “E.164 Number and DNS” (or “Request for Comments 2916”), which set forth the basic ENUM protocol.¹¹

The Input of the International Telecommunication Union

In addition to defining the basic ENUM protocol, the Request for Comments 2916 sought input and suggestions for improvement.¹² According to the proposal, the fundamental ENUM infrastructure would reside in the Internet’s DNS, within the top-level domain called “e164.arpa” because the “.arpa” domain was designed specifically for Internet infrastructure purposes. Internet addresses within this top-level domain would be delegated to parties according to the ITU’s Recommendation E.164, which describes the routing and parameters of telephone numbers among ITU Member States. At an October 2000 meeting of the ITU Working Party 1/2 to discuss the Request for Comments 2916¹³, the ITU released a document regarding discussions between the Chairman of Study Group 2, ITU Secretariat staff and the Internet Architecture Board (“IAB”)¹⁴ regarding deployment of ENUM services.¹⁵ Significantly, this document stated that because each E.164 number begins with a country code, national or integrated numbering plan policy-makers at a “country code” level should decide how to handle ENUM services in their corresponding DNS zones.¹⁶

In response to Request for Comments 2916, at its January and September 2001 meetings, the ITU’s Study Group 2 worked on a Supplement (possibly to Recommendation E.164) intended as a tutorial to explain further the

¹⁰ See IETF’s Telephone Number Mapping (enum) Working Group Charter (November 1999) available at <<http://www.ietf.org/html.charters/enum-charter.html>>.

¹¹ See E.164 Number and DNS, Request For Comments 2916 at 5, (September 2000) available at <<http://www.ietf.org/rfc/rfc2916.txt>>.

¹² See *id.*

¹³ ITU-T Study Group 2 has been the primary collaborative standards activity through which ITU Member States have coordinated the interworking of their national public telephone networks and the associated numbering plans. This includes agreements among Member States as to the geographical and Country Codes for International Public Telephone Service. See <http://www.itu.int/infocom/enum/wp1-39_rev1.htm>.

¹⁴ The Internet Architecture Board (“IAB”) is a technical advisory group chartered by the Internet Society. It provides oversight of the process used to create Internet standards, and therefore is the organization responsible for the architecture of the protocols and procedures used by the Internet. A nominating committee drawn from the IETF nominates six of the 13 IAB members each year. One of the main motivations for the foundation of the Internet Society was to provide a legal umbrella for the IAB and for the IETF’s standardization actions.

¹⁵ See Contribution to Study Group 2 on ENUM ITU Strategies and Policy Unit (October 2000) available at <<http://www.itu.int/osg/spu/infocom/enum/wp1-321.html>>.

¹⁶ See *id.* at 6.

ENUM protocol. No consensus was reached on the language of the Supplement and, as explained in an October ITU press release, work continues on both an informational Supplement and a Recommendation which will detail the role of the ITU in the administration of ENUM.¹⁷ These will be discussed at the next meeting of Study Group 2 in May 2002. The earliest date that a Recommendation could be adopted is the November 2002 Study Group 2 meeting, after which all ITU Member States would have to officially adopt the Recommendation. Thus, any “official” implementation of the ENUM protocol using the top-level domain “e164.arpa” remains at least one year away.

ENUM in the United States: The Department of State

In the United States, the Department of State (“State Department”) serves as the official representative to the ITU and, accordingly, eventually will decide whether to support the “e164.arpa” top-level domain approach and the ENUM protocol described in Request for Comments 2916.¹⁸ To advise the State Department on this decision, the Department of Commerce's National Telecommunications and Information Administration (“NTIA”)¹⁹ established an Ad Hoc Group called Study Group A Ad Hoc on ENUM (“Ad Hoc Group”) in late 2000. After meeting several times in the winter and spring of 2001, the Ad Hoc Group, consisting largely of U.S. Internet and telecommunications industry representatives, delivered a report to the State Department on July 6, 2001 (“July Report”).²⁰ While the July Report recognized ENUM implementations using domains other than “e164.arpa” are not precluded and are being deployed, the Report focused on advising the U.S. government on U.S. participation in a single global ENUM DNS domain under “e164.arpa.” Without stating a preference, the July Report identified three options to implement ENUM within the United States: a single ENUM administrator for all E.164 numbers in Country Code 1; two sub-tiers within Country Code 1; or multiple ENUM tiers delegated according to the telephone NPA codes in the United States.²¹

¹⁷ “Progress Achieved Towards Implementing Electronic Numbering “ENUM””, ITU Press Release, (Oct. 1, 2001), available at http://www.itu.int/newsroom/press_releases/2001/18.html.

¹⁸ The State Department's authority to represent the United States at the ITU was granted through Executive Order 12046 (1978) (43 FR 13349, 3 CFR, 1978 Comp. at 158) stating that: “[w]ith respect to telecommunications, the Secretary of State shall exercise primary authority for the conduct of foreign policy, including the determination of United States positions and the conduct of United States participation in negotiations with foreign governments and international bodies. In exercising this responsibility the Secretary of State shall coordinate with other agencies as appropriate, and, in particular, shall give full consideration to the Federal Communications Commission's regulatory and policy responsibility in this area.”

¹⁹ See Public Meeting on the Telephone Number Mapping (ENUM) Protocol available at < <http://www.ntia.doc.gov/ntiahome/ntiageneral/enum120800.htm>>.

²⁰ Report of the Department of State ITAC-T Advisory Committee Study Group A Ad Hoc on ENUM, (July 2001) (“July Report”) available at < http://www.nominum.com/ENUM/2001_07_06-ENUM-Report-Department-of-State-Final.doc>.



On July 31, 2001 and August 15, 2001 the State Department met with the Ad Hoc Group to discuss the July Report and to prepare the U.S. Delegation for the September 2001 Study Group 2 meeting in Geneva. As a result of these meetings, the United States submitted two brief documents at the September 2001 meeting. The first describes the U.S. reservations with the proposed Study Group 2 Supplement, explaining that it is beyond the scope of an informational Supplement and should be revised. The second supports the designation of “e164.arpa” as the top-level domain for a coordinated, global ENUM DNS domain, but urges that such a system neither precludes other deployments of ENUM and similar protocols nor restricts the development of innovative and competing ENUM alternatives.

After advising the State Department on U.S. implementation of “e164.arpa,” several industry members created an ENUM Forum to work on technical and operational issues involved with the deployment of RFC 2916 in the United States in the “e164.arpa” domain.²² The ENUM Forum consists of six Task Groups (Architectural and Infrastructure, Provisioning, Applications, Security and Privacy, Interworking, and Legal Experts) and is scheduled to hold its second meeting in Kansas in late October 2001.

Public Test Trials of ENUM

As the ITU and Member States, including the United States, debate the preferred implementation of ENUM, the private sector forges ahead with public trials. Specifically, at least three different U.S. companies have commenced offering ENUM-like functions under the auspices of company-owned domains.²³ These trials represent an important testing of the technology and the market, allowing the companies to assess market demand for ENUM services and perfect the technical functioning of the service.

VeriSign's ENUM test bed, launched in December 2000 using the “.com” domain (found at www.enumworld.com) involves network vendors and carriers. According to public releases, VeriSign's trial operates with the help of Telcordia Technologies and allows companies to register existing telephone numbers from 10 country codes.²⁴ At the same time, a number of firms have joined NetNumber's ENUM trial using the “.net” domain (www.netnumber.com) since its launch in November 2000.²⁵ As described, NetNumber

²¹ See *id.*

²² More information on the ENUM Forum is available at <http://www.enum-forum.org>.

²³ These include the offerings of VeriSign, NeuStar, and NetNumber.

²⁴ See VeriSign Press Release, VeriSign and Telcordia Announce Opening of the First Public ENUM Trial, December 20, 2000 available at < http://corporate.verisign.com/news/2000/pr_20001220.html >.

²⁵ See NetNumber Global ENUM Services, available at, < <http://www.netnumber.com/index.jsp> >. NetNumber also announced on October 15, 2001, the formation of an Alliance Program bringing together SIP and ENUM technologies to accelerate the market for Voice Over the Internet. “NetNumber “Interconnect With ENUM” Alliance Promotes Service Provider Interconnects Leveraging SIP and ENUM”, NetNumber Press Release (Oct. 15, 2001), available at <http://netnumber.com/news/10-15-2001Alliance.pdf>.

has teamed with six vendors, including IP telephony supplier PingTel and switch supplier NexTone Communications, to provide ENUM support on products.²⁶ Recently, NetNumber and VeriSign also announced that they will jointly promote Internet telephony offerings using NetNumber's ENUM services and VeriSign's DNS operational capabilities.²⁷

Finally, NeuStar—the entity responsible for neutral administration of the North American Numbering Plan and U.S.-mandated local number portability implementation—is also conducting an ENUM trial (www.enum.org). Unlike VeriSign and NetNumber, however, NeuStar will only register trial telephone numbers, not existing telephone numbers.²⁸ As these trials progress, the shape of ENUM to come will likely emerge.

The Future of ENUM: Public Policy Issues

While the U.S. government currently allows private industry to take the lead in ENUM implementation, there remains the specter of government involvement, especially to the extent that controversial public policy issues demand authoritative decisions. While almost no party would argue for heavy-handed regulation of the new protocol and its applications, some issues may demand a certain level of government input. Even today, it is clear that the fundamental transition necessary for ENUM implementation—including the use of the international and national numbering schemes—raises both international and domestic policy issues.

International Issues

If the Recommendation for a global “e164.arpa” ENUM domain is approved at the ITU, Member States must decide whether to adopt that Recommendation. While many countries have been actively involved with the development of ENUM (Sweden and Norway currently have trials underway), others may not be so supportive, especially since the deployment of ENUM could well affect the traditional circuit-switched voice telephony system.

As noted, a significant application of ENUM is likely to be VoIP, implicating the consequent migration of traffic from the PSTN to the IP network. It may well be that countries such as India, Israel, and others, that currently for-

²⁶ “PingTel, NetNumber Partner To Bring First ENUM-Enabled IP Phone To Market”, NetNumber Press Release (Mar. 19, 2001), available at <http://www.netnumber.com/news/3-19-01pingtel.pdf>; “Nex-Tone and NetNumber Partner To Extend Reach of Next-Generation Communications Providers, NetNumber Press Release, (Feb. 27, 2001), available at <http://www.netnumber.com/news/2-27-01nextone.pdf>.

²⁷ “NetNumber Selects VeriSign Registry for Global ENUM Services,” NetNumber Press Release (October 9, 2001), available at <http://netnumber.com/news/10-9-01verisign.pdf>.

²⁸ See NeuStar’s ENUM Public Trial, Trial Information, available at, < <http://www.enum.org/information/trial.cfm>>.



bid IP telephony, (which circumvents the PSTN and dramatically reduces settlement rates of international long-distance calls among other economic results), will be similarly opposed to ENUM.²⁹ These countries may view IP telephony, and therefore ENUM, as a threat to the pricing structure of their telecommunications carriers because it undermines the incumbent carriers' core business, potentially reducing revenues available to extend the domestic network or to meet universal service obligations.³⁰ Significantly, as Member States individually decide whether to adopt ENUM, it is also possible that interoperability issues could develop, prompting the State Department to voice U.S. interests at the ITU.

Domestic Issues

In addition to the broader international issues, as ENUM implementation marries the heavily regulated PSTN to the relatively unregulated Internet DNS, these industries are entering uncharted territory. Regulators have been content thus far to allow private industry to conduct public trials and work out any technical or operational issues as they occur. Yet, it may be as particular issues and disputes arise, parties will undoubtedly seek the assistance of various government agencies.

For example, the intricate task of merging telecommunications numbers with the Internet Domain Name System may create numbering disputes that arguably fall within the jurisdiction of the Federal Communications Commission ("FCC"). While the FCC and State Public Utility Commissions have long handled numbering issues, federal law under the Telecommunications Act of 1996³¹ vests the FCC with exclusive jurisdiction over the portions of the North American Numbering Plan that pertain to the United States. For this reason, some may assert that the FCC can and should readily handle such disputes.³² It should be noted, however, that ENUM services would not consume telephone number resources; rather, ENUM makes use of the telephone number as an identifier, after the telecommunications carrier has assigned the telephone number to the end user.

Similarly, issues regarding "slamming" or the unauthorized change of a customer's preferred services via ENUM would arguably be appropriate for the FCC, especially if the unauthorized change was to the customer's preferred telecommunications service providers. Certainly, the FCC has jurisdiction and expertise on these issues in the long-distance industry.³³ With

²⁹ Report of the Secretary-General on IP Telephony, World Telecommunications Policy Forum (dated Jan. 31, 2001).

³⁰ See *id.*

³¹ Telecommunications Act of 1996, Pub.L.No. 104-104, 110 Stat. 56 (1996).

³² See 47 U.S.C. § 251(e)(1).

³³ *Implementation of the Subscriber Carrier Selection Changes Provisions of the Telecommunications Act of 1996; Policies and Rules Concerning Unauthorized Changes of Consumers' Long Distance Carriers, Second Report and Order*, 14 FCC Rcd 1058 (1998) (subsequent history omitted).

multiple providers accessing ENUM user databases, slamming may be a problem as companies attempt to switch a user's provider without permission. The July Report anticipates such a problem and recommends preventative measures similar to those in place for the telecommunications industry, specifically third-party validation or electronic validation.³⁴ Of course, to the extent that an industry-sponsored process fails to adequately prevent "slamming" via unauthorized changes to the end user's ENUM records, FCC intervention is more likely.

Further, with ENUM databases repositories for so much personal information, privacy issues may arise. There is a concern by some that parties entrusted with an ENUM subscriber's personal information should not provide or use this information for purposes other than ENUM, such as for mass marketing. If privacy issues arise, it may be that the Federal Trade Commission ("FTC"), which has actively asserted its jurisdiction in this area in the last several years, would be called upon to address concerns.³⁵ The FTC's authority stems from the Federal Trade Commission's Act's prohibition of "unfair or deceptive acts or practices in or affecting commerce."³⁶ The FTC's jurisdiction includes the print, television, telephone, radio, and Internet media.

ENUM implementation also raises issues of centralization of ENUM functions and the public policy goal of fostering a competitive market in nascent technologies, which is a key goal of both communications and antitrust laws. While a significant faction of the industry urges as much competition as possible in ENUM's implementation, with multiple, competing, yet effective ENUM databases available, one possibility described in the July Report was a single ENUM administrator of the entire Country Code 1.³⁷ To the extent telecommunications carriers or a single, ENUM database provider exert undue control over ENUM services and do not allow applications service providers access to ENUM users, antitrust issues could arise. The Department of Justice traditionally handles antitrust issues, and in this case, it may be that they would intercede by investigating or threatening to prosecute an anti-competitive claim. Parties may also bring a private action by suing in court, therefore involving the judiciary.

Lastly, with ENUM's intersection of telephone numbers and domain names, it may be that disputes would come under the purview of the Department of Commerce. Although the coordination of the DNS has largely been done by or subject to agreements with agencies of the U.S. government, there is no explicit legislation requiring that the government exercise oversight over the domain name system. According to the Department of Commerce, its authority to support the privatization of the DNS stems from its

³⁴ July Report at § 7.1.

³⁵ For a guide to the FTC's privacy initiatives in the Internet arena, see www.ftc.gov/privacy/index.html.

³⁶ 15 U.S.C. §§ 45(a), 57(a) (1994).

³⁷ July Report at § 5.2.3.1.

broad general authority to foster, promote, and develop foreign and domestic commerce,³⁸ as well as the NTIA's specific authority to coordinate the telecommunications activities of the executive branch.³⁹

Conclusion

Described in an IETF document barely 10 pages in length, ENUM is considered by many to be a seminal Internet protocol. The critical issues concerning ENUM are more political than they are technical; ENUM implementation is not simple because it straddles both the Internet and the telephone worlds. The resolution of these issues may set a significant precedent for the role of governments to shape the convergence of Internet and telephony communications.

³⁸ 15 U.S.C. § 1512 (1981).

³⁹ 47 U.S.C. § 902(b)(2)(H) (2000).