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Modern Problem Statement and Framework
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Abstract

The functions of the public switched telephone network (PSTN) are gradually migrating to the Internet. This is generating new requirements for many mechanisms used by the PSTN, including telephone numbers (TNs). TNs no longer serve simply as telephone routing addresses, they are now identifiers which may be used by Internet-based services for a variety of purposes including session establishment, identity verification and service enablement. This problem statement examines how the existing tools for allocating and managing telephone numbers do not align with the needs of the Internet environment and proposes a fraemwork for Internet-based services relying on TNs.

Status of This Memo

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1. Problem Statement

The challenges of utilizing telephone numbers (TNs) on the Internet has been known for some time. Internet telephony provided the main use case for routing telephone numbers on the Internet in a manner similar to how calls are routed in the public switched telephone network (PSTN). As the Internet had no service for discovering the endpoints associated with telephone numbers, ENUM [3] created a DNS-based mechanism for resolving TNs in an IP environment by defining procedures for translating TNs into URIs for use by protocols such as SIP [2]. Originally, it was envisioned that ENUM would be deployed as a global hierarchical service, though in practice it has only been deployed piecemeal by various parties. The DRINKS [4] framework showed ways that authorities might provision information about telephone numbers at an ENUM service or similar Internet-based directory. These technologies have generally tried to preserve the features and architecture familiar from the PSTN numbering environment.

Telephone numbering, however, has long been transitioning away from a provider-centric model towards a user-centric model. Number portability has been implemented in many countries, and the right of a user to choose and change their service provider while retaining their TN is widely acknowledged now. However, TN administration

processes rooted in PSTN technology and policies dictate that this be an exception process fraught with problems and delays. Thanks to the increasing sophistication of consumer mobile devices, users now associate telephone numbers with many applications other than telephony. Ideally the user would have full control of their TN and would drive the porting process on their own rather than rely on complex and time consuming back office processes among multiple service providers.

Most TNs today are assigned to specific geographies, at both an international level and within national numbering plans. This has shaped the way that service providers interconnect, as well as how telephone numbers are routed and administered: the PSTN was carefully designed to delegate switching intelligence geographically. In interexchange carrier routing in North America, for example, calls to a particular TN are often handed off to the terminating service provider close to the geography where that TN is assigned. But the overwhelming success of mobile telephones has increasing eroded the connection between numbers and regions. Furthermore, the topology of IP networks is not anchored to geography in the same way that the telephone network is. In an Internet environment, establishing a network architecture for routing telephone numbers would depend little on geography.

While some properties of ENUM have been successfully deployed, others have not. Most notably, ENUM is mostly used as an internal network function, and is hardly used between service provider networks. The original ENUM concept of a single root, e164.arpa, proved to be politically challenging, and less centralized models have thus flourished. The industry also came to realize that there were limitations in the DNS protocol and it may not be a good fit for a communications protocol that would need more security, richer datasets and more complex query and response capabilities. The TeRQ proposal [12], a framework and information model for "telephone-related queries," proposes a reconsideration of telephone routing and administrative services by focusing on what data needs needs to be shared rather limiting the data to fit within the particular protocols chosen to carry it.

With the PSTN well on its way to becoming an all IP network and TNs showing no signs of sunsetting as a resource, it is time to address the issues of routing, management and administration of TNs in an IP environment. This document will create a common understanding of the problem statement related to TNs in an IP environment and help develop a vision for how to create IP-based mechanisms for TNs. It will be important to acknowledge that there are various international and national policies and processes related to TNs, and any solutions needs to be flexible enough to account for these variations.

2. Actors

The following actors are defined in this document:

Numbering Authority: An entity that manages an inventory of allocated and unallocated telephone numbers. This may be a root authority, such as a national regulator, or any delegate of the root authority that dispenses numbers to other parties.

Communication Service Provider: A provider of communications services to users, where those services can be identifed by telephone numbers. This includes both traditional telephone carriers and service providers with no presence on the PSTN who use telephone numbers. It also encompasses users who operate services on their own behalf.

User: An operator of communications endpoints, either as an individual or an organization; usually a customer of a communication service provider who uses telephone numbers to reach and identify services.

Government Entity: An entity that, due to legal powers resulting from the root of number authority, has privileged access to information about number allocation.

3. Framework

The framework outlined in this document requires three Internet-based mechanisms for managing and resolving telephone numbers (TNs) in an IP environment. These mechanisms will likely reuse existing protocols for sharing structured data; it is unlikely that new protocol development work will be required, though new information models specific to the data itself will be a major focus of framework development. Likely candidates for reuse here include work done in DRINKS and WEIRDS, as well as the TeRQ framework.

These protocol mechanisms are scoped in a way that makes them likely to apply to a broad range of future policies for number administration. It is not the purpose of this framework to dictate number policy, but instead to provide tools that will work with policies as they evolve going forward. These mechanisms therefore do not assume that number administration is centralized, nor that number "ownership" is restricted to any privileged service providers, though these tools must and will work in environments with those propoerties.

The three mechanisms are:

Acquisition: a protocol mechanism to enable users or CSPs to acquire TNs from authorities, including an enrollment process for the individuals and entities that manage TNs.

Management: a protocol mechanism for users to associate data with TNs at a CSP.

Retrieval: a protocol mechanism for service providers, users, and governemnt entities to retrieve data about TNs from either an authority or a CSP.

The acquisition mechanism will enable actors to acquire telephone numbers for use with a communications service. The acquisition mechanism will provide a means for either a user or a CSP to request numbering resources from an authority, either on a number-by-number basis, or as inventory blocks. The authority who grants numbering resources to a user will retain metadata about the assignment, including the responsible organization or individual to whom numbers have been assigned. In the DNS environment, an authority thus might be analagous to either a registrar or a reseller of names, though obvious hierarchical domain names do not have a comparable inventory situation to telephone numbers.

The management mechanism will let actors provision data associated with telephone numbers at CSPs. If a user owns a telephone number, they may select a CSP to provide particular service associated with the number, or a CSP may own a number, and effectively rent these to users. In either case, a user needs a mechanism for provision data associated with the number at a CSP.

The resolution mechanism will enable actors to learn information about telephone numbers, typically by sending a request to a CSP. For some information, an actor may need to send a request to a numbering authority rather than a CSP. Different parties may be authorized to receive different information about telephone numbers.

4. Use Cases

4.1. CSP Acquires Numbers from Authority

TBD.

4.2. User Acquires Numbers from Authority

TBD.

4.3. Accessing Numbering Data

TBD.

4.3.1. Privileged Access for Government Entities

TBD.

4.4. Service Management for Numbers

TBD.

5. Acknowledgments

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6. IANA Considerations

This memo includes no request to IANA.

7. Security Considerations

TBD.

8. Informative References

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