

Network Working Group  
Internet-Draft  
Intended status: Standards Track  
Expires: August 18, 2014

J. Peterson  
NeuStar  
S. Turner  
IECA  
February 14, 2014

**Secure Telephone Identity Credentials: Certificates**  
**draft-peterson-stir-certificates-00.txt**

Abstract

In order to provide a means of proving ownership of telephone numbers on the Internet, some kind of public structure needs to exist that binds cryptographic keys to authority over telephone numbers. This document describes a certificate-based credential system for telephone numbers, which could be used as a part of a broader architecture for managing telephone numbers as identities in protocols like SIP.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <http://datatracker.ietf.org/drafts/current/>.

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

This Internet-Draft will expire on August 18, 2014.

Copyright Notice

Copyright (c) 2014 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must

include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

- [1. Introduction](#) . . . . . [2](#)
- [2. Terminology](#) . . . . . [3](#)
- [3. Enrollment and Authorization](#) . . . . . [3](#)
  - [3.1. Certificate Scope and Structure](#) . . . . . [4](#)
  - [3.2. Provisioning Private Keying Material](#) . . . . . [5](#)
- [4. Acquiring Credentials to Verify Signatures](#) . . . . . [5](#)
  - [4.1. Verifying Certificate Scope](#) . . . . . [6](#)
  - [4.2. Certificate Freshness and Revocation](#) . . . . . [8](#)
- [5. Acknowledgments](#) . . . . . [8](#)
- [6. IANA Considerations](#) . . . . . [8](#)
- [7. Security Considerations](#) . . . . . [8](#)
- [8. Informative References](#) . . . . . [8](#)
- Authors' Addresses . . . . . [10](#)

**[1. Introduction](#)**

As is discussed in the STIR problem statement [[13](#)], the primary enabler of robocalling, vishing, swatting and related attacks is the capability to impersonate a calling party number. The starkest examples of these attacks are cases where automated callees on the PSTN rely on the calling number as a security measure, for example to access a voicemail system. Robocallers use impersonation as a means of obscuring identity; while robocallers can, in the ordinary PSTN, block (that is, withhold) their caller identity, callees are less likely to pick up calls from blocked identities, and therefore appearing to calling from some number, any number, is preferable. Robocallers however prefer not to call from a number that can trace back to the robocaller, and therefore they impersonate numbers that are not assigned to them.

One of the most important components of a system to prevent impersonation is an authority responsible for issuing credentials to parties who control telephone numbers. With these credentials, parties can prove that they are in fact authorized to use telephony numbers, and thus distinguish themselves from impersonators unable to present credentials. This document describes a credential system for telephone numbers based on X.509 version 3 certificates in accordance with [[7](#)]. While telephone numbers have long been a part of the X.509 standard, the certificates described in this document may contain telephone number blocks or ranges, and accordingly it uses an alternate syntax.



In the STIR in-band architecture, two basic types of entities need access to these credentials: authentication services, and verification services (or verifiers); see [15]. An authentication service must be operated by an entity enrolled with the certificate authority (see [Section 3](#)), whereas a verifier need only trust the root certificate of the authority, and have a means to acquire and validate certificates.

The STIR out-of-band architecture is not considered in this document. [TBD]

## 2. Terminology

In this document, the key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in [RFC 2119](#) [1] and [RFC 6919](#) [2].

## 3. Enrollment and Authorization

This document assumes a threefold model for certificate enrollment.

The first enrollment model is one where the certificate authority acts in concert with national numbering authorities to issue credentials to those parties to whom numbers are assigned. In the United States, for example, telephone number blocks are assigned to Local Exchange Carriers (LECs) by the North American Numbering Plan Administrator (NANPA), who is in turn directed by the national regulator. LECs may also receive numbers in smaller allocations, through number pooling, or via an individual assignment through number portability. LECs assign numbers to customers, who may be private individuals or organizations - and organizations take responsibility for assigning numbers within their own enterprise.

The second enrollment model is one where a certificate authority requires that an entity prove control by means of some sort of test. For example, an authority might send a text message to a telephone number containing a URL (which might be deferred by the recipient) as a means of verifying that a user has control of terminal corresponding to that number. Checks of this form are frequently used in commercial systems today to validate telephone numbers provided by users. This is comparable to existing enrollment systems used by some certificate authorities for issuing S/MIME credentials for email by verifying that the party applying for a credential receives mail at the email address in question.

The third enrollment model is delegation: that is, the holder of a certificate (assigned by either of the two methods above) may



delegate some or all of their authority to another party. In some cases, multiple levels of delegation could occur: a LEC, for example, might delegate authority to customer organization for a block of 100 numbers, and the organization might in turn delegate authority for a particular number to an individual employee. This is analogous to delegation of organizational identities in traditional hierarchical PKIs who use the name constraints extension [3]; the root CA delegates names in sales to the sales department CA, names in development to the development CA, etc. As lengthy certificate delegation chains are brittle, however, and can cause delays in the verification process, this document considers optimizations to reduce the complexity of verification.

[TBD] Future versions of this specification will also discuss methods of partial delegation, where certificate holders delegate only part of their authority. For example, an individual assignee may want to delegate authority to an entity for text messages associated with their telephone number, but not for other functions.

### **3.1. Certificate Scope and Structure**

The subjects of telephone number certificates are the administrative entities to whom numbers are assigned or delegated. For example, a LEC might hold a certificate for a range of telephone numbers.

This specification places no limits on the number of telephone numbers that can be associated with any given certificate. Some service providers may be assigned millions of numbers, and may wish to have a single certificate that is capable of signing for any one of those numbers. Others may wish to compartmentalize authority over subsets of the numbers they control.

Moreover, service providers may wish to have multiple certificates with the same scope of authority. For example, a service provider with several regional gateway systems may want each system to be capable of signing for each of their numbers, but not want to have each system share the same private key.

The set of telephone numbers for which a particular certificate is valid is expressed in the certificate through a certificate extension; the certificate's extensibility mechanism is defined in [RFC 5280](#) but the telephone number authorization extension is defined in this document.



### **[3.2.](#) Provisioning Private Keying Material**

In order for authentication services to sign calls via the procedures described in [\[15\]](#), they must possess a private key corresponding to a certificate with authority over the calling number. This specification does not require that any particular entity sign requests, only that it be an entity with an appropriate private key; the authentication service role may be instantiated by any entity in a SIP network. For a certificate granting authority only over a particular number which has been issued to an end user, for example, an end user device might hold the private key and generate the signature. In the case of a service provider with authority over large blocks of numbers, an intermediary might hold the private key and sign calls.

The specification recommends distribution of private keys through PKCS#8 objects signed by a trusted entity, for example through the CMS package specified in [\[8\]](#).

## **[4.](#) Acquiring Credentials to Verify Signatures**

This specification documents multiple ways that a verifier can gain access to the credentials needed to verify a request. As the validity of certificates does not depend on the circumstances of their acquisition, there is no need to standardize any single mechanism for this purpose. All entities that comply with [\[15\]](#) necessarily support SIP, and consequently SIP itself can serve as a way to acquire certificates. This specification does allow delivery through alternate means as well.

The simplest way for a verifier to acquire the certificate needed to verify a signature is for the certificate to be conveyed along with the signature itself. In SIP, for example, a certificate could be carried in a multipart MIME body [\[9\]](#), and the URI in the Identity-Info header could specify that body with a CID URI [\[10\]](#). However, in many environments this is not feasible due to message size restrictions or lack of necessary support for multipart MIME.

Alternatively, the Identity-Info header of a SIP request may contain a URI that the verifier dereferences with a network call. Implementations of this specification are required to support the use of SIP for this function (via the SUBSCRIBE/NOTIFY mechanism), as well as HTTP, via the Enrollment over Secure Transport mechanisms described in [RFC 7030](#) [\[11\]](#).

A verifier can however have access to a service that grants access to certificates for a particular telephone number. Note however that there may be multiple valid certificates that can sign a call setup





request for a telephone number, and that as a consequence, there needs to be some discriminator that the signer uses to identify their credentials. The Identity-Info header itself can serve just such a discriminator.

#### **4.1. Verifying Certificate Scope**

The subjects of these certificates are the administrative entities to whom numbers are assigned or delegated. When a verifier is validating a caller's identity, local policy always determines the circumstances under which any particular subject may be trusted, but for the purpose of validating a caller's identity, this certificate extension establishes whether or not a signer is authorized to sign for a particular number.

The TN Authorization List certificate extension is identified by the following object identifier:

```
id-ce-TNAuthList OBJECT IDENTIFIER ::= { TBD }
```

The TN Authorization List certificate extension has the following syntax:



```
TNAuthorizationList ::= SEQUENCE SIZE (1..MAX) OF TNAuthorization
```

```
TNAuthorization ::= SEQUENCE SIZE (1..MAX) OF TNEEntry
```

```
TNEEntry ::= CHOICE {  
    spid ServiceProviderIdentifierList,  
    range TelephoneNumberRange,  
    one E164Number }
```

```
ServiceProviderIdentifierList ::= SEQUENCE SIZE (1..3) OF
```

```
    OCTET STRING
```

```
-- When all three are present: SPID, Alt SPID, and Last Alt SPID
```

```
TelephoneNumberRange ::= SEQUENCE {
```

```
    start E164Number,
```

```
    count INTEGER }
```

```
E164Number ::= IA5String (SIZE (1..15)) (FROM ("0123456789"))
```

[TBD- do we really need to do IA5String? The alternative would be UTF8String, e.g.: UTF8String (SIZE (1..15)) (FROM ("0123456789")) ]

The TN Authorization List certificate extension indicates the authorized phone numbers for the call setup signer. It indicates one or more blocks of telephone number entries that have been authorized for use by the call setup signer. There are three ways to identify the block: 1) a Service Provider Identifier (SPID) can be used to indirectly name all of the telephone numbers associated with that service provider, 2) telephone numbers can be listed in a range, and 3) a single telephone number can be listed.

Note that because large-scale service providers may want to associate many numbers, possibly millions of numbers, with a particular certificate, optimizations are required for those cases to prevent certificate size from becoming unmanageable. In these cases, the TN



Authorization List may be given by reference rather than by value, through the presence of a separate certificate extension that permits verifiers to either securely download the list of numbers associated with a certificate, or to verify that a single number is under the authority of this certificate. This optimization will be detailed in future version of this specification.

#### **4.2. Certificate Freshness and Revocation**

The problem of certificate freshness gains a new wrinkle in the telephone number context, because verifiers must establish not only that a certificate remains valid, but also that the certificate's scope contains the telephone number that the verifier is validating. Dynamic changes to number assignments can occur due to number portability, for example. So even if a verifier has a valid cached certificate for a telephone number (or a range containing the number), the verifier must determine that the entity that the signer is still a proper authority for that number.

This document therefore recommends the use of OCSP in high-volume environments for validating the freshness of certificates, per [12]. [TBD - depending on our algorithm choices this profile may need to be further profiled.]

#### **5. Acknowledgments**

Russ Housley, Brian Rosen, Cullen Jennings and Eric Rescorla provided key input to the discussions leading to this document.

#### **6. IANA Considerations**

This memo includes no request to IANA.

#### **7. Security Considerations**

This document is entirely about security. For further information on certificate security and practices, see [RFC 3280](#) [5], in particular its Security Considerations.

#### **8. Informative References**

- [1] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [2] Barnes, R., Kent, S., and E. Rescorla, "Further Key Words for Use in RFCs to Indicate Requirement Levels", [RFC 6919](#), April 1 2013.



- [3] Rosenberg, J., Schulzrinne, H., Camarillo, G., Johnston, A., Peterson, J., Sparks, R., Handley, M., and E. Schooler, "SIP: Session Initiation Protocol", [RFC 3261](#), June 2002.
- [4] Rosenberg, J. and H. Schulzrinne, "Session Initiation Protocol (SIP): Locating SIP Servers", [RFC 3263](#), June 2002.
- [5] Housley, R., Polk, W., Ford, W., and D. Solo, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", [RFC 3280](#), April 2002.
- [6] Rescorla, E., "HTTP Over TLS", [RFC 2818](#), May 2000.
- [7] Cooper, D., Santesson, S., Farrell, S., Boeyen, S., Housley, R., and W. Polk, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", [RFC 5280](#), May 2008.
- [8] Turner, S., "Asymmetric Key Packages", [RFC 5958](#), August 2010.
- [9] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", [RFC 2046](#), November 1996.
- [10] Levinson, E., "Content-ID and Message-ID Uniform Resource Locators", [RFC 2392](#), August 1998.
- [11] Pritikin, M., Yee, P., and D. Harkins, "Enrollment over Secure Transport", [RFC 7030](#), October 2013.
- [12] Deacon, A. and R. Hurst, "The Lightweight Online Certificate Status Protocol (OCSP) Profile for High-Volume Environments", [RFC 5019](#), September 2007.
- [13] Peterson, J., Schulzrinne, H., and H. Tschofenig, "Secure Telephone Identity Problem Statement", [draft-ietf-stir-problem-statement-03](#) (work in progress), January 2014.
- [14] Peterson, J., "Retargeting and Security in SIP: A Framework and Requirements", [draft-peterson-sipping-retarget-00](#) (work in progress), February 2005.





- [15] Peterson, J., Jennings, C., and E. Rescorla,  
"Authenticated Identity Management in the Session  
Initiation Protocol (SIP)", [draft-jennings-stir-  
rfc4474bis-00](#) (work in progress), October 2013.

Authors' Addresses

Jon Peterson  
Neustar, Inc.  
1800 Sutter St Suite 570  
Concord, CA 94520  
US

Email: [jon.peterson@neustar.biz](mailto:jon.peterson@neustar.biz)

Sean Turner  
IECA, Inc.  
3057 Nutley Street, Suite 106  
Fairfax, VA 22031  
US

Email: [turners@ieca.com](mailto:turners@ieca.com)

