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Messaging Use Cases and Extensions for STIR
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Abstract

Secure Telephone Identity Revisited (STIR) provides a means of attesting the identity of a telephone caller via a signed token in order to prevent impersonation of a calling party number, which is a key enabler for illegal robocalling. Similar impersonation is sometimes leveraged by bad actors in the text and multimedia messaging space. This document explores the applicability of STIR's Personal Assertion Token (PASSporT) and certificate issuance framework to text and multimedia messaging use cases, including support both for messages carried as a payload in SIP requests and for messages sent in sessions negotiated by SIP.

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STIR Messaging

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[1.](#) Introduction

The STIR problem statement [[RFC7340](#)] describes widespread problems enabled by impersonation in the telephone network, including illegal robocalling, voicemail hacking, and swatting. As telephone services are increasingly migrating onto the Internet and using Voice over IP (VoIP) protocols such as SIP [[RFC3261](#)], it is necessary for these protocols to support stronger identity mechanisms to prevent impersonation. [[RFC8224](#)] defines a SIP Identity header capable of carrying PASSporT [[RFC8225](#)] objects in SIP as a means to cryptographically attest that the originator of a telephone call is authorized to use the calling party number (or, for native SIP cases, SIP URI) associated with the originator of the call.

The problem of bulk, unsolicited commercial communications is not, however, limited to telephone calls. Spammers and fraudsters are increasingly turning to messaging applications to deliver undesired

content to consumers. In some respects, mitigating these unwanted messages resembles the email spam problem: textual analysis of the message contents can be used to fingerprint content that is generated by spammers, for example. However, encrypted messaging is becoming more common, and analysis of message contents may no longer be a

reliable way to mitigate messaging spam in the future. And as STIR sees further deployment in the telephone network, the governance structures put in place for securing telephone network resources with STIR could be repurposed to help secure the messaging ecosystem.

One of the more sensitive applications for message security is emergency services. As next-generation emergency services increasingly incorporate messaging as a mode of communication with public safety personnel (see [\[RFC8876\]](#)), providing an identity assurance could help to mitigate denial-of-service attacks, as well as ultimately helping to identify the source of emergency communications in general (including swatting attacks, see [\[RFC7340\]](#)).

This specification therefore explores how the PASSport mechanism defined for STIR could be applied to providing protection for textual and multimedia messaging, but focuses particularly on those messages that use telephone numbers as the identity of the sender. It moreover considers the reuse of existing STIR certificates, which are beginning to see widespread deployment, for signing PASSports that protect messages. For that purpose it defines a new PASSport type and an element that protects message integrity.

[2.](#) Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [\[RFC2119\]](#) [\[RFC8174\]](#) when, and only when, they appear in all capitals, as shown here.

[3.](#) Applicability to Messaging Systems

At a high level, baseline PASSport [\[RFC8225\]](#) claims provide similar value to number-based messaging as they do to traditional telephone calls. A signature over the calling and called party numbers, along

with a timestamp, could already help to prevent impersonation in the mobile messaging ecosystem. When it comes to protecting message contents, broadly, there are a few ways that the PASSporT mechanism of STIR could apply to messaging: first, a PASSporT could be used to securely negotiate a session over which messages will be exchanged; and second, in sessionless scenarios, a PASSporT could be generated on a per-message basis with its own built-in message security.

3.1. Message Sessions

For the first case, where SIP negotiates a session where the media will be text messages or MIME content, as, for example, with the Message Session Relay Protocol (MSRP) [[RFC4975](#)], the usage of STIR would deviate little from [[RFC8224](#)]. An INVITE request sent with an Identity header containing a PASSporT with the proper calling and called party numbers would then negotiate an MSRP session the same way that an INVITE for a telephone call would negotiate an audio session. This could be applicable to MSRP sessions negotiated for RCS [[RCC.07](#)]. Note that if TLS is used to secure MSRP (per RCS [[RCC.15](#)]), fingerprints of those TLS keys could be secured via the "mky" claim of PASSporT using the [[RFC8862](#)] framework. Similar practices would apply to sessions that negotiate real-time text over RTP ([[RFC4103](#)], [[RFC5194](#)]); any that can operate over DTLS/SRTP should work with the "mky" PASSporT claim. For the most basic use cases, STIR for messaging should not require any further protocol enhancements.

Current usage of baseline [[RFC8224](#)] Identity is largely confined to INVITE requests that initiate telephone calls. RCS-style applications would require PASSporTs for all conversation participants, which could become complex in multi-party conversations. Any solution in this space would likely require the implementation of STIR connected identity [[I-D.peterson-stir-rfc4916-update](#)], but the specification of PASSporT-signed session conferencing is outside the scope of this document.

Also note that the assurance offered by [\[RFC8862\]](#) is "end-to-end" in the sense that it offers assurance between an authentication service and verification service. If those are not implemented by the endpoints themselves, there are still potential opportunities for tampering before messages are signed and after they are verified. For the most part, STIR does not intend to protect against man-in-the-middle attacks so much as spoofed origination, however, so the protection offered may be sufficient to mitigate nuisance messaging.

[3.2.](#) PASSporTs and Individual Messages

In the second case, SIP also has a method for sending messages in the body of a SIP request: the MESSAGE [\[RFC3428\]](#) method. MESSAGE is used for example in some North American emergency services use cases. The interaction of STIR with MESSAGE is not as straightforward as the potential use case with MSRP. An Identity header could be added to any SIP MESSAGE request, but without some extension to the PASSporT claims, the PASSporT would offer no protection to the message content, and potentially be reusable for cut-and-paste attacks. As

the bodies of SIP requests are MIME encoded, S/MIME [\[RFC8591\]](#) has been proposed as a means of providing integrity for MESSAGE (and some MSRP cases as well). The use of CPIM [\[RFC3862\]](#) as a MIME body allows the integrity of messages to withstand interworking with non-SIP protocols. The interaction of [\[RFC8226\]](#) STIR certificates with S/MIME for messaging applications requires some further explication; and additionally, PASSporT can provide its own integrity check for message contents through a new claim defined to provide a hash over message contents.

In order to differentiate a PASSporT for an individual message from a PASSporT used to secure a telephone call or message stream, this document defines a new "msg" PASSporT Type. "msg" PASSporTs may carry a new optional JWT [\[RFC7519\]](#) claim "msgi" which provides a digest over a MIME body that contains a text or multimedia message. Authentication services MUST NOT include "msgi" elements in PASSporT types other than "msg", but "msgi" is OPTIONAL in "msg" PASSporTs, as integrity for messages may be provided by some other service (e.g. [\[RFC8591\]](#)). Verification services MUST ignore the presence of "msgi" in non-"msg" PASSporT types. Implementations of "msgi" MUST support following hash algorithms: "SHA256", "SHA384", or "SHA512", which are defined as part of the SHA-2 set of cryptographic hash functions by

the NIST. [[SHA2](#)]

A "msgi" message digest is computed over the entire MIME body of a SIP message, which per [[RFC3428](#)] may be any sort of MIME body, including a multipart body in some cases, especially when multimedia content is involved. Those MIME bodies contain encrypted content or not as the sender desires. The digest becomes the value of the JWT "msgi" claim, as per this example:

```
"msgi" :  
"sha256-H8BRh8j4809oYatfu5AZzq6A9RINQZngK7T62em8MUt1FLm52t+eX6x0"
```

Note that in some CPIM environments, intermediaries may add or consume CPIM headers used for metadata in messages. MIME-layer integrity protection of "msgi" would be broken by a modification along these lines. Any such environment would require a profile of this specification that reduces the scope of protection only to the CPIM payload, as discussed in [[RFC8946](#)] [Section 9.1](#).

Finally, note that messages may be subject to store-and-forward treatment that differs from traditional delivery expectations of SIP transactions. In such cases, the expiry timers recommended by [[RFC8224](#)] may be too strict, as routine behavior might dictate the delivery of a MESSAGE minutes or hours after it was sent. The potential for replay attacks can, however, be largely mitigated by the timestamp in PASSporTs; duplicate messages are easily detected,

and the timestamp can order messages displayed to the user inbox in a way that precludes showing stale messages as fresh. Relaxing the expiry timer would require support for such features on the receiving side of the message.

[3.2.1](#). PASSporT Conveyance with Messaging

If the message is being conveyed in SIP, via the MESSAGE method, then the PASSporT could be conveyed in an Identity header in that request. The authentication and verification service procedures for populating that PASSporT would follow [[RFC8224](#)], with the addition of the "msgi" claim defined in [Section 3.2](#).

In text messaging today, multimedia message system (MMS) messages are often conveyed with SMTP. There are thus a suite of additional email

security tools available in this environment for sender authentication, such as DMARC [RFC7489]. The interaction of these mechanisms with STIR certificates and/or PASSporTs would require further study and is outside the scope of this document.

For other cases where messages are conveyed by some protocol other than SIP, that protocol might itself have some way of conveying PASSporTs. But there will surely be cases where legacy transmission of messages will not permit an accompanying PASSporT, in which case something like out-of-band [RFC8816] conveyance would be the only way to deliver the PASSporT. This may be necessary to support cases where legacy SMPP systems cannot be upgraded, for example.

A MESSAGE request can be sent to multiple destinations in order to support multiparty messaging. In those cases, the "dest" field of the PASSporT can accommodate the multiple targets of a MESSAGE without the need to generate a PASSporT for each target of the message. If however the request is forked to multiple targets by an intermediary later in the call flow, and the list of targets is not available to the authentication service, then that forking intermediary would need to use diversion [RFC8946] PASSporTs to sign for its target set.

4. Certificates and Messaging

The [RFC8226] STIR certificate profiles defines a way to issue certificates that sign PASSporTs, which attest through their TNAuthList a Service Provider Code (SPC) and/or a set of one or more telephone numbers. This specification proposes that the semantics of these certificates should suffice for signing for messages from a telephone number without further modification.

Note that the certificate referenced by the "x5u" of a PASSporT can change over time, due to certificate expiry/rollover; in particular the use of short-lived certificates can entail rollover on a daily basis, or even more frequently. Thus any store-and-forward messaging system relying on PASSporTs must take into account the possibility that the certificate that signed the PASSporT, though valid at the time the PASSporT was generated, could expire before a user reads the message. This might require storing some indicator of the validity

of the signature and certificate at the time the message was received, or securely storing the certificate along with the PASSporT, so that the "iat" field can be compared the expiry window of the certificate prior to validation.

As the "orig" and "dest" field of PASSporTs may contain URIs containing SIP URIs without telephone numbers, the STIR for messaging mechanism contained in this specification is not inherently restricted to the use of telephone numbers. This specification offers no guidance on certification authorities who are appropriate to sign for non-telephone number "orig" values.

[5.](#) Acknowledgments

We would like to thank Christer Holmberg, Brian Rosen, Ben Campbell, Russ Housley, and Alex Bobotek for their contributions to this specification.

[6.](#) IANA Considerations

[6.1.](#) JSON Web Token Claims Registration

This specification requests that the IANA add one new claim to the JSON Web Token Claims registry as defined in [[RFC7519](#)].

Claim Name: "msgi"

Claim Description: Message Integrity Information

Change Controller: IESG

Specification Document(s): [[RFCThis](#)]

[6.2.](#) PASSporT Type Registration

This specification defines one new PASSporT type for the PASSport Extensions Registry defined in [[RFC8225](#)], which resides at <https://www.iana.org/assignments/passport/passport.xhtml#passport-extensions>.

Reference: [RFCThis] [Section 3.2](#)

[7.](#) Privacy Considerations

Signing messages or message sessions with STIR has little direct bearing on the privacy of messaging for SIP as described in [[RFC3428](#)] or [[RFC4975](#)]. An authentication service signing a MESSAGE method may compute the "msgi" hash over the message contents; if the message is in cleartext, that will reveal its contents to the authentication service, which might not otherwise be in the call path.

The implications for anonymity of STIR are discussed in [[RFC8224](#)], and those considerations would apply equally here for anonymous messaging. Creating a "msg" PASSporT does not add any additional privacy protections to the original message content.

[8.](#) Security Considerations

This specification inherits the security considerations of [[RFC8224](#)]. The carriage of messages within SIP per [Section 3.2](#) has a number of security and privacy implications as documented in [[RFC3428](#)], which are expanded in [[RFC8591](#)]; these considerations apply here well. The guidance about store-and-forward messaging and replay protection in [Section 3.2](#) should also be recognized by implementers.

Note that a variety of non-SIP protocols, both those integrated into the traditional telephone network and those based on over-the-top applications, are responsible for most of the messaging that is sent to and from telephone numbers today. Introducing this capability for SIP-based messaging will help to mitigate spoofing and nuisance messaging for SIP-based platforms only.

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