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A. Begen
Cisco
C. Perkins
University of Glasgow
D. Wing
Cisco
E. Rescorla
RTFM, Inc.

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Guidelines for Choosing RTP Control Protocol (RTCP) Canonical Names (CNAMEs) draft-ietf-avtcore-6222bis-06

Abstract

The RTP Control Protocol (RTCP) Canonical Name (CNAME) is a persistent transport-level identifier for an RTP endpoint. While the Synchronization Source (SSRC) identifier of an RTP endpoint may change if a collision is detected or when the RTP application is restarted, its RTCP CNAME is meant to stay unchanged, so that RTP endpoints can be uniquely identified and associated with their RTP media streams.

For proper functionality, RTCP CNAMEs should be unique within the participants of an RTP session. However, the existing guidelines for choosing the RTCP CNAME provided in the RTP standard are insufficient to achieve this uniqueness. RFC 6222 was published to update those guidelines to allow endpoints to choose unique RTCP CNAMEs. Unfortunately, later investigations showed that some parts of the new algorithms were unnecessarily complicated and/or ineffective. This document addresses these concerns and replaces RFC 6222.

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1. Introduction

In Section 6.5.1 of [RFC3550], there are a number of recommendations for choosing a unique RTCP CNAME for an RTP endpoint. However, in practice, some of these methods are not guaranteed to produce a unique RTCP CNAME. [RFC6222] updated the guidelines for choosing RTCP CNAMEs, superseding those presented in Section 6.5.1 of [RFC3550]. Unfortunately, some parts of the new algorithms are rather complicated and also produce RTCP CNAMEs which in some cases are potentially linkable over multiple RTCP sessions even if a new RTCP CNAME is generated for each session. This document specifies a replacement for the algorithm in Section 5 of [RFC6222], which does not have this limitation and is also simpler to implement.

For a discussion on the linkability of RTCP CNAMES produced by [RFC6222], refer to [I-D.rescorla-avtcore-random-cname].

2. Requirements Notation

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 [RFC2119].

3. Deficiencies with Earlier Guidelines for Choosing an RTCP CNAME

The recommendation in [RFC3550] is to generate an RTCP CNAME of the form "user@host" for multiuser systems, or "host" if the username is not available. The "host" part is specified to be the fully qualified domain name (FQDN) of the host from which the real-time data originates. While this guidance was appropriate at the time [RFC3550] was written, FQDNs are no longer necessarily unique and can sometimes be common across several endpoints in large service provider networks. This document replaces the use of FQDN as an RTCP CNAME by alternative mechanisms.

IPv4 addresses are also suggested for use in RTCP CNAMEs in [RFC3550], where the "host" part of the RTCP CNAME is the numeric representation of the IPv4 address of the interface from which the RTP data originates. As noted in [RFC3550], the use of private network address space [RFC1918] can result in hosts having network addresses that are not globally unique. Additionally, this shared use of the same IPv4 address can also occur with public IPv4 addresses if multiple hosts are assigned the same public IPv4 address and connected to a Network Address Translation (NAT) device [RFC3022]. When multiple hosts share the same IPv4 address, whether private or public, using the IPv4 address as the RTCP CNAME leads to RTCP CNAMEs that are not necessarily unique.

It is also noted in [RFC3550] that if hosts with private addresses and no direct IP connectivity to the public Internet have their RTP packets forwarded to the public Internet through an RTP-level translator, they could end up having non-unique RTCP CNAMEs. The suggestion in [RFC3550] is that such applications provide a configuration option to allow the user to choose a unique RTCP CNAME; this technique puts the burden on the translator to translate RTCP CNAMEs from private addresses to public addresses if necessary to keep private addresses from being exposed. Experience has shown that this does not work well in practice.

4. Choosing an RTCP CNAME

It is difficult, and in some cases impossible, for a host to determine if there is a NAT between itself and its RTP peer. Furthermore, even some public IPv4 addresses can be shared by multiple hosts in the Internet. Using the numeric representation of the IPv4 address as the "host" part of the RTCP CNAME is NOT RECOMMENDED.

4.1. Persistent RTCP CNAMEs versus Per-Session RTCP CNAMEs

The RTCP CNAME can be either persistent across different RTP sessions for an RTP endpoint or unique per session, meaning that an RTP endpoint chooses a different RTCP CNAME for each RTP session.

An RTP endpoint that is emitting multiple related RTP streams that require synchronization at the other endpoint(s) MUST use the same RTCP CNAME for all streams that are to be synchronized. This requires a short-term persistent RTCP CNAME that is common across several RTP streams, and potentially across several related RTP sessions. A common example of such use occurs when lip-syncing audio and video streams in a multimedia session, where a single participant has to use the same RTCP CNAME for its audio RTP session and for its video RTP session. Another example might be to synchronize the layers of a layered audio codec, where the same RTCP CNAME has to be used for each layer.

If the multiple RTP streams in an RTP session are not related, thus do not require synchronization, an RTP endpoint can use different RTCP CNAMEs for these streams.

A longer-term persistent RTCP CNAME is sometimes useful to facilitate third-party monitoring, consistent with [RFC3550]. One such use might be to allow network management tools to correlate the ongoing quality of service for a participant across multiple RTP sessions for fault diagnosis, and to understand long-term network performance statistics. An application developer that wishes to discourage this

type of third-party monitoring can choose to generate a unique RTCP CNAME for each RTP session, or group of related RTP sessions, that the application will join. Such a per-session RTCP CNAME cannot be used for traffic analysis, and so provides some limited form of privacy. Note that there are non-RTP means that can be used by a third party to correlate RTP sessions, so the use of per-session RTCP CNAMEs will not prevent a determined traffic analyst from monitoring such sessions.

This memo defines several different ways by which an implementation can choose an RTCP CNAME. It is possible, and legitimate, for independent implementations to make different choices of RTCP CNAME when running on the same host. This can hinder third-party monitoring, unless some external means is provided to configure a persistent choice of RTCP CNAME for those implementations.

Note that there is no backwards compatibility issue (with [RFC3550]-compatible implementations) introduced in this memo, since the RTCP CNAMEs are opaque strings to remote peers.

4.2. Requirements

RTP endpoints will choose to generate RTCP CNAMEs that are persistent or per-session. An RTP endpoint that wishes to generate a persistent RTCP CNAME MUST use one of the following two methods:

- To produce a long-term persistent RTCP CNAME, an RTP endpoint MUST generate and store a Universally Unique IDentifier (UUID) [RFC4122] for use as the "host" part of its RTCP CNAME. The UUID MUST be version 1, 2, or 4, as described in [RFC4122], with the "urn:uuid:" stripped, resulting in a 36-octet printable string representation.

- To produce a short-term persistent RTCP CNAME, an RTP endpoint MUST generate and use an identifier by following the procedure described in Section 5. That procedure is performed at least once per initialization of the software. After obtaining an identifier, minimally the least significant 96 bits SHOULD be converted to ASCII using Base64 encoding [RFC4648] (to compromise between packet size and uniqueness - refer to Section 6.1). If 96 bits are used, the resulting string will be 16 octets. Note the Base64 encoded value cannot exceed the maximum RTCP CNAME length of 255 octets [RFC3550].

In the two cases above, the "user@" part of the RTCP CNAME MAY be omitted on single-user systems and MAY be replaced by an opaque token on multi-user systems, to preserve privacy.

An RTP endpoint that wishes to generate a per-session RTCP CNAME MUST use the following method:

- For every new RTP session, a new RTCP CNAME is generated following the procedure described in Section 5. After performing that procedure, minimally the least significant 96 bits SHOULD be converted to ASCII using Base64 encoding [RFC4648]. The RTCP CNAME cannot change over the life of an RTP session [RFC3550]. The "user@" part of the RTCP CNAME is omitted when generating per-session RTCP CNAMEs.

It is believed that obtaining uniqueness (with a high probability) is an important property that requires careful evaluation of the method. This document provides a number of methods, at least one of which would be suitable for all deployment scenarios. This document therefore does not provide for the implementor to define and select an alternative method.

A future specification might define an alternative method for generating RTCP CNAMEs, as long as the proposed method has appropriate uniqueness and there is consistency between the methods used for multiple RTP sessions that are to be correlated. However, such a specification needs to be reviewed and approved before deployment.

The mechanisms described in this document are to be used to generate RTCP CNAMEs, and they are not to be used for generating general-purpose unique identifiers.

5. Procedure to Generate a Unique Identifier

To locally produce a unique identifier, one simply generates a cryptographically pseudorandom value as described in [RFC4086]. This value MUST be at least 96 bits.

The biggest bottleneck to implementation of this algorithm is the availability of an appropriate cryptographically secure pseudorandom number generator (CSPRNG). In any setting which already has a secure PRNG, this algorithm described is far simpler than the algorithm described in Section 5 of [RFC6222]. SIP stacks [RFC3261] are required to use cryptographically random numbers to generate To and From tags (Section 19.3). RTCWEB implementations [I-D.ietf-rtcweb-security-arch] will need to have secure PRNGs to implement ICE [RFC5245] and DTLS-SRTP [RFC5764]. And, of course, essentially every Web browser already supports TLS, which requires a secure PRNG.

6. Security Considerations

The security considerations of [RFC3550] apply to this memo.

6.1. Considerations on Uniqueness of RTCP CNAMEs

The considerations in this section apply to random RTCP CNAMEs.

The recommendations given in this document for RTCP CNAME generation ensure that a set of cooperating participants in an RTP session will, with very high probability, have unique RTCP CNAMEs. However, neither [RFC3550] nor this document provides any way to ensure that participants will choose RTCP CNAMEs appropriately, and thus implementations MUST NOT rely on the uniqueness of RTCP CNAMEs for any essential security services. This is consistent with [RFC3550], which does not require that RTCP CNAMEs are unique within a session but instead says that condition SHOULD hold. As described in the Security Considerations section of [RFC3550], because each participant in a session is free to choose its own RTCP CNAME, they can do so in such a way as to impersonate another participant. That is, participants are trusted to not impersonate each other. No recommendation for generating RTCP CNAMEs can prevent this impersonation, because an attacker can neglect the stipulation. Secure RTP (SRTP) [RFC3711] keeps unauthorized entities out of an RTP session, but it does not aim to prevent impersonation attacks from authorized entities.

Because of the properties of the PRNG, there is no significant privacy/linkability difference between long and short RTCP CNAMEs. However, the requirement to generate unique RTCP CNAMEs implies a certain minimum length. A length of 96 bits allows on the order of 2^{40} RTCP CNAMEs globally before there is a large chance of collision (there is about a 50% chance of one collision after 2^{48} RTCP CNAMEs).

6.2. Session Correlation Based on RTCP CNAMEs

Earlier recommendations for RTCP CNAME generation allowed a fixed RTCP CNAME value, which allows an attacker to easily link separate RTP sessions, eliminating the obfuscation provided by IPv6 privacy addresses [RFC4941] or IPv4 Network Address Port Translation (NAPT) [RFC3022].

This specification no longer describes a procedure to generate fixed RTCP CNAME values, so RTCP CNAME values no longer provide such linkage between RTP sessions. This was necessary to eliminate such linking by an attacker, but of course complicates linking by traffic analysis devices (e.g., devices that are looking for dropped or delayed packets).

7. IANA Considerations

No IANA actions are required.

8. Acknowledgments

Thanks to Marc Petit-Huguenin, who suggested using UUIDs in generating RTCP CNAMEs. Also, thanks to David McGrew for providing text for the Security Considerations section in RFC 6222.

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Authors' Addresses

Ali Begen
Cisco
181 Bay Street
Toronto, ON M5J 2T3
CANADA

EMail: abegen@cisco.com

Colin Perkins
University of Glasgow
School of Computing Science
Glasgow G12 8QQ
UK

EMail: csp@csperkins.org

Dan Wing
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134
USA

EMail: dwing@cisco.com

Eric Rescorla
RTFM, Inc.
2064 Edgewood Drive
Palo Alto, CA 94303
USA

Phone: +1 650 678 2350
EMail: ekr@rtfm.com