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Identity Representation for RSVP

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Abstract

This document describes the representation of identity information in POLICY_DATA object [POL-EXT] for supporting policy based admission control in RSVP. The goal of identity representation is to allow a process on a system to securely identify the owner and the application of the communicating process (e.g. user id) and convey this information in RSVP messages (PATH or RESV) in a secure manner. We describe the encoding of identities as RSVP policy element. We describe the processing rules to generate identity policy elements for multicast merged flows. Subsequently, we describe representations of user identities for Kerberos and Public Key based user authentication mechanisms. In summary we describe the use of this identity information in an operational setting.

1. Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC-2119].

2. Introduction

RSVP [RFC 2205] is a resource reservation setup protocol designed for an integrated services Internet [RFC 1633]. RSVP is used by a host to request specific quality of service (QoS) from the network for particular application data streams or flows. RSVP is also used by routers to deliver QoS requests to all nodes along the path(s) of the flows and to establish and maintain state to provide the requested service. RSVP requests will generally result in resources being reserved in each node along the data path. RSVP allows particular users to obtain preferential access to network resources, under the control of an admission control mechanism. Permission to make a reservation is based both upon the availability of the requested resources along the path of the data and upon satisfaction of policy rules. Providing policy based admission control mechanism based on user identity or application is one of the prime requirements.

In order to solve these problems and implement identity based policy control it is required to identify the user and/or application making a RSVP request.

This document proposes a mechanism for sending identification information in the RSVP messages and enables authorization decisions based on policy and identity.

We describe the authentication policy element (AUTH_DATA) contained in the POLICY_DATA object. User process can generate an AUTH_DATA policy element and gives it to RSVP process (service) on the originating host. RSVP service inserts AUTH_DATA into the RSVP message to identify the owner (user and/or application) making the request for network resources. Network elements, such as routers, authenticate request using the credentials presented in the AUTH_DATA and admit the RSVP message based on admission policy. After a request has been authenticated, first hop router installs the RSVP state and forwards the new policy element returned by the Policy Decision Point (PDP) [POL-FRAME].

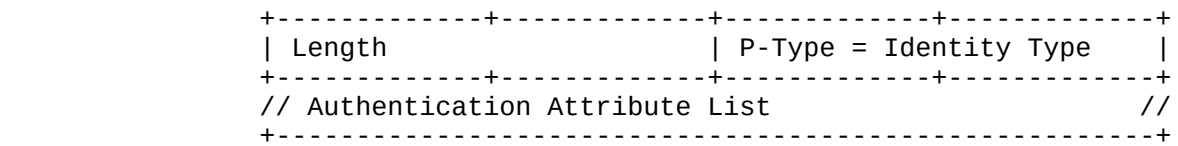
3. Policy Element for Authentication Data

3.1 Policy Data Object Format

POLICY_DATA objects contain policy information and are carried by RSVP messages. A detail description of the format of POLICY_DATA object can be found in "RSVP Extensions for Policy Control" [POL-EXT].

3.2 Authentication Data Policy Element

In this section, we describe a policy element (PE) called authentication data (AUTH_DATA). AUTH_DATA policy element contains a list of authentication attributes.



Length
The length of the policy element (including the Length and P-Type) is in number of octets (MUST be a multiple of 4) and indicates the end of the authentication attribute list.

P-Type (Identity Type)
Type of identity information contained in this Policy Element supplied as the Policy element type (P-type). The Internet Assigned Numbers Authority (IANA) acts as a registry for policy element types for identity as described in the [POL-EXT]. Initially, the registry contains the following P-Types for identity:

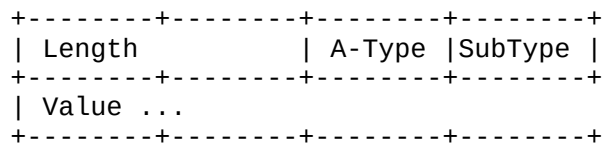
1	AUTH_USER	Authentication scheme to identify users
2	AUTH_APP	Authentication scheme to identify applications

Authentication Attribute List

Authentication attributes contain information specific to authentication method and type of AUTH_DATA. The policy element provides the mechanism for grouping a collection of authentication attributes.

3.3 Authentication Attributes

Authentication attributes MUST be encoded as a multiple of 4 octets, attributes that are not a multiple of 4 octets long MUST be padded to a 4-octet boundary.



Length
The length field is two octets and indicates the actual length of the attribute (including the Length and A-Type fields) in number of octets. The length does not include any bytes padding to the value field to make the attribute multiple of 4 octets long.

A-Type
Authentication attribute type (A-Type) field is one octet. IANA acts as a registry for A-Types as described in the section 9, IANA Considerations. Initially, the registry contains the following A-Types:

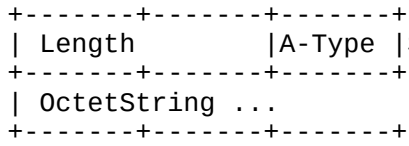
1	POLICY_LOCATOR	Unique string for locating the admission policy (such as X.500 DN described in [RFC 1779]).
2	CREDENTIAL	User credential such as Kerberos ticket, or digital certificate. Application credential such as application ID.
3	DIGITAL_SIGNATURE	Digital signature of the authentication data policy element.
4	POLICY_ERROR_OBJECT	Detailed information on policy failures.

SubType
Authentication attribute sub-type field is one octet. Value of SubType depends on A-type.

Value:
The value field contains the attribute specific information.

3.3.1 Policy Locator

POLICY_LOCATOR is used to locate the admission policy for the user or application. Distinguished Name (DN) is unique for each User or application hence a DN is used as policy locator.



Length
Length of the attribute, which MUST be >= 4.

A-Type
POLICY_LOCATOR

SubType
Following sub types for POLICY_LOCATOR are defined. IANA acts as a registry for POLICY_LOCATOR sub types as described in the section 9, IANA Considerations. Initially, the registry contains the following sub types for POLICY_LOCATOR:

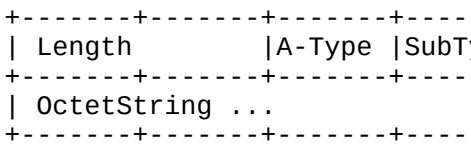
1	ASCII_DN	OctetString contains the X.500 DN as described in the RFC 1779 as an ASCII string.
2	UNICODE_DN	OctetString contains the X.500 DN described in the RFC 1779 as an UNICODE string.
3	ASCII_DN_ENCRYPT	OctetString contains the encrypted X.500 DN. The Kerberos session key or digital certificate private key is used for encryption. For Kerberos encryption the format is the same as returned from gss_seal [RFC 1509].
4	UNICODE_DN_ENCRYPT	OctetString contains the encrypted UNICODE X.500 DN. The Kerberos session key or digital certificate private key is used for encryption. For Kerberos encryption the format is the same as returned from gss_seal [RFC 1509].

OctetString
The OctetString field contains the DN.

3.3.2 Credential

CREDENTIAL indicates the credential of the user or application to be authenticated. For Kerberos authentication method the CREDENTIAL object contains the Kerberos session ticket. For public key based authentication this field contains a digital certificate.

A summary of the CREDENTIAL attribute format is shown below. The fields are transmitted from left to right.



Length
Length of the attribute, which MUST be >= 4.

A-Type
CREDENTIAL

SubType
IANA acts as a registry for CREDENTIAL sub types as described in the section 9, IANA Considerations. Initially, the registry contains the following sub types for CREDENTIAL:

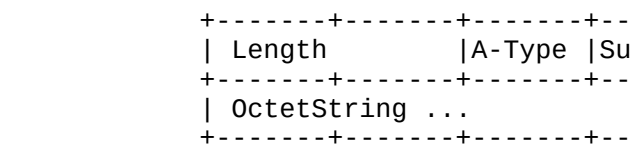
1	ASCII_ID	OctetString contains user or application identification in plain ASCII text string.
2	UNICODE_ID	OctetString contains user or application identification in plain UNICODE text string.
3	KERBEROS_TKT	OctetString contains Kerberos ticket.
4	X509_V3_CERT	OctetString contains X.509 V3 digital certificate [X.509].
5	PGP_CERT	OctetString contains PGP digital certificate.

OctetString
The OctetString contains the user or application credential.

3.3.3 Digital Signature

The DIGITAL_SIGNATURE attribute MUST be the last attribute in the attribute list and contains the digital signature of the AUTH_DATA policy element. The digital signature signs all data in the AUTH_DATA policy element up to the DIGITAL_SIGNATURE. The algorithm used to compute the digital signature depends on the authentication method specified by the CREDENTIAL SubType field.

A summary of DIGITAL_SIGNATURE attribute format is described below.



Length
Length of the attribute, which MUST be >= 4.

ti3 A-Type
DIGITAL_SIGNATURE

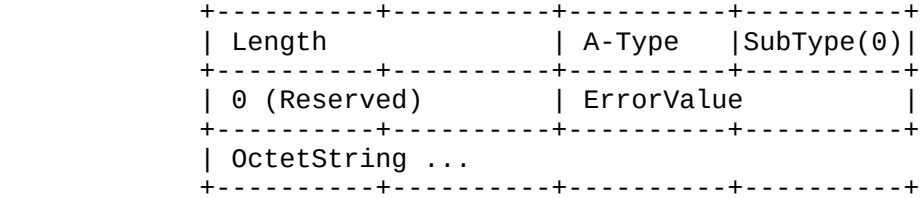
SubType
No sub types for DIGITAL_SIGNATURE are currently defined. This field MUST be set to 0.

OctetString
OctetString contains the digital signature of the AUTH_DATA.

3.3.4 Policy Error Object

This attribute is used to carry any specific policy control errors generated by a node when processing/validating an Authentication Data Policy Element. When a RSVP policy node (local policy decision point or remote PDP) encounters a request that fails policy control due to its Authentication Policy Element, it SHOULD add a POLICY_ERROR_CODE containing additional information about the reason the failure occurred into the policy element. This will then cause an appropriate PATH_ERROR or RESV_ERROR message to be generated with the policy element and appropriate RSVP error code in the message, which is returned to the request's source.

The AUTH_DATA policy element in the PATH or RSVP message SHOULD not contain the POLICY_ERROR_OBJECT attribute. These are only inserted into PATH_ERROR and RESV_ERROR messages when generated by policy aware intermediate nodes.



Length
Length of the attribute, which MUST be >= 8.

A-Type
POLICY_ERROR_CODE

ErrorValue
A 32-bit bit code containing the reason that the policy decision point failed to process the policy element. Following values have been defined.

1	ERROR_NO_MORE_INFO	No information is available.
2	UNSUPPORTED_CREDENTIAL_TYPE	This type of credentials is not supported.
3	INSUFFICIENT_PRIVILEGES	The credentials do not have sufficient privilege.
4	EXPIRED_CREDENTIAL	The credential has expired.
5	IDENTITY_CHANGED	Identity has changed.

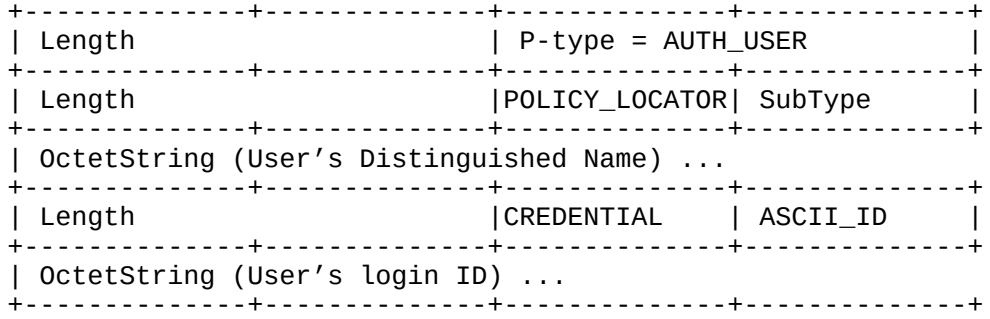
OctetString
The OctetString field contains information from the policy decision point that MAY contain additional information about the policy failure. For example, it may include a human-readable message in the ASCII text.

4. Authentication Data Formats

Authentication attributes are grouped in a policy element to represent the identity credentials.

4.1 Simple User Authentication

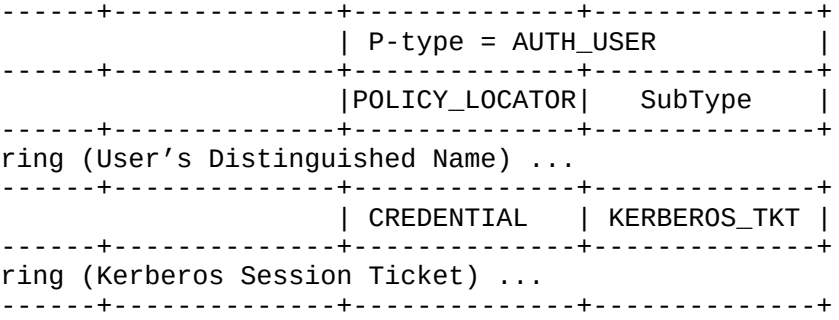
In simple user authentication method the user login ID (in plain ASCII or UNICODE text) is encoded as CREDENTIAL attribute. A summary of the simple user AUTH_DATA policy element is shown below.



4.2 Kerberos User Authentication

Kerberos [RFC 1510] authentication uses a trusted third party (the Kerberos Distribution Center - KDC) to provide for authentication of the user to a network server. It is assumed that a KDC is present and both host and verifier of authentication information (router or PDP) implement Kerberos authentication.

A summary of the Kerberos AUTH_DATA policy element is shown below.

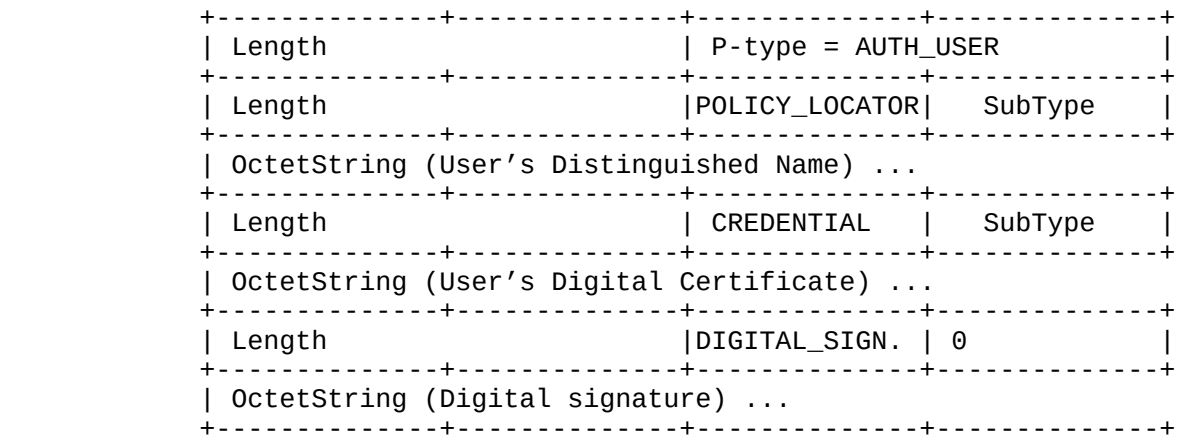


4.2.1. Operational Setting using Kerberos Identities

An RSVP enabled host is configured to construct and insert AUTH_DATA policy element into RSVP messages that designate use of the Kerberos authentication method (KERBEROS_TKT). Upon RSVP session initialization, the user application contacts the KDC to obtain a Kerberos ticket for the next network node or its PDP. A router when generating a RSVP message contacts the KDC to obtain a Kerberos ticket for the next hop network node or its PDP. The identity of the PDP or next network hop can be statically configured, learned via DHCP or maintained in a directory service. The Kerberos ticket is sent to the next network node (which may be a router or host) in a RSVP message. The KDC is used to validate the ticket and authentication the user sending RSVP message.

4.3 Public Key based User Authentication

In public key based user authentication method digital certificate is encoded as user credentials. The digital signature is used for authenticating the user. A summary of the public key user AUTH_DATA policy element is shown below.



4.3.1. Operational Setting for public key based authentication

Public key based authentication assumes following:

- RSVP service requestors have a pair of keys (private key and public key).

- Private key is secured with the user.

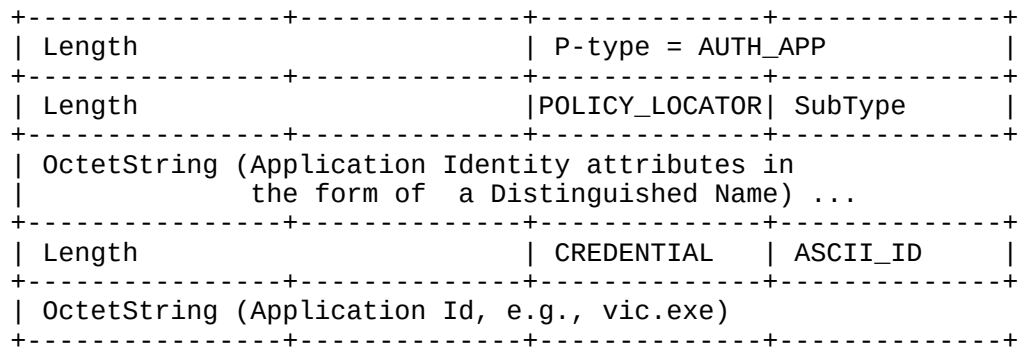
- Public keys are stored in digital certificates and a trusted party, certificate authority (CA) issues these digital certificates.

- The verifier (PDP or router) has the ability to verify the digital certificate.

RSVP requestor uses its private key to generate DIGITAL_SIGNATURE. User Authenticators (router, PDP) use the user's public key (stored in the digital certificate) to verify the signature and authenticate the user.

4.4 Simple Application Authentication

The application authentication method encodes the application identification such as an executable filename as plain ASCII or UNICODE text.



5. Operation

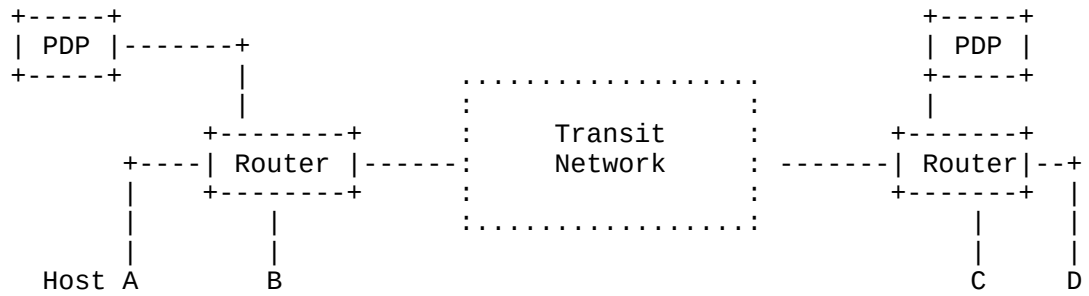


Figure 1: User and Application Authentication using AUTH_DATA PE

Network nodes (hosts/routers) generate AUTH_DATA policy elements, contents of which are depend on the identity type used and the authentication method used. These generally contain authentication credentials (Kerberos ticket or digital certificate) and policy locators (which can be the X.500 Distinguished Name of the user or network node or application names). Network nodes generate AUTH_DATA policy element containing the authentication identity when making the RSVP request or forwarding a RSVP message.

Network nodes generate user AUTH_DATA policy element using the following rules

1. For unicast sessions the user policy locator is copied from the previous hop. The authentication credentials are for the current network node identity.

2. For multicast messages the user policy locator is for the current network node identity. The authentication credentials are for the current network node.

Network nodes generate application AUTH_DATA policy element using the following rules:

1. For unicast sessions the application AUTH_DATA is copied from the previous hop.

2. For multicast messages the application AUTH_DATA is either the first application AUTH_DATA in the message or chosen by the PDP.

6. Message Processing Rules

6.1 Message Generation (RSVP Host)

An RSVP message is created as specified in [RFC2205] with following modifications.

1. RSVP message MAY contain multiple AUTH_DATA policy elements.

2. Authentication policy element (AUTH_DATA) is created and the IdentityType field is set to indicate the identity type in the policy element.

   - DN is inserted as POLICY_LOCATOR attribute.

   - Credentials such as Kerberos ticket or digital certificate are inserted as the CREDENTIAL attribute.

3. POLICY_DATA object (containing the AUTH_DATA policy element) is inserted in the RSVP message in appropriate place. If INTEGRITY object is not computed for the RSVP message then an INTEGRITY object SHOULD be computed for this POLICY_DATA object, as described in the [POL_EXT], and SHOULD be inserted as a Policy Data option.

6.2 Message Reception (Router)

RSVP message is processed as specified in [RFC2205] with following modifications.

1. If router is not policy aware then it SHOULD send the RSVP message to the PDP and wait for response. If the router is policy unaware then it ignores the policy data objects and continues processing the RSVP message.

2. Reject the message if the response from the PDP is negative.

3. Continue processing the RSVP message.

6.3 Authentication (Router/PDP)

1. Retrieve the AUTH_DATA policy element. Check the PE type field and return an error if the identity type is not supported.

2. Verify user credential

   - Simple authentication: e.g. Get user ID and validate it, or get executable name and validate it.

   - Kerberos: Send the Kerberos ticket to the KDC to obtain the session key. Using the session key authenticate the user.

   - Public Key: Validate the certificate that it was issued by a trusted Certificate Authority (CA) and authenticate the user or application by verifying the digital signature.

7. Error Signaling

If PDP fails to verify the AUTH_DATA policy element then it MUST return policy control failure (Error Code = 02) to the PEP. The error values are described in [RFC 2205] and [POL-EXT]. Also PDP SHOULD supply a policy data object containing an AUTH_DATA Policy Element with A-Type=POLICY_ERROR_CODE containing more details on the Policy Control failure (see section 3.3.4). The PEP will include this Policy Data object in the outgoing RSVP Error message.

8. IANA Considerations

Following the policies outlined in [IANA-CONSIDERATIONS], authentication attribute types (A-Type)in the range 0-127 are allocated through an IETF Consensus action, A-Type values between 128-255 are reserved for Private Use and are not assigned by IANA.

Following the policies outlined in [IANA-CONSIDERATIONS], POLICY_LOCATOR SubType values in the range 0-127 are allocated through an IETF Consensus action, POLICY_LOCATOR SubType values between 128-255 are reserved for Private Use and are not assigned by IANA.

Following the policies outlined in [IANA-CONSIDERATIONS], CREDENTIAL SubType values in the range 0-127 are allocated through an IETF Consensus action, CREDENTIAL SubType values between 128-255 are reserved for Private Use and are not assigned by IANA.

9. Security Considerations

The purpose of this memo is to describe a mechanism to authenticate RSVP requests based on user identity in a secure manner. RSVP INTEGRITY object is used to protect the policy object containing user identity information from security (replay) attacks. Combining the AUTH_DATA policy element and the INTEGRITY object results in a secure access control that enforces authentication based on both the identity of the user and the identity of the originating node.

Simple authentication does not contain credential that can be securely authenticated and is inherently less secured.

The Kerberos authentication mechanism is reasonably well secured.

User authentication using a public key certificate is known to provide the strongest security.

10. Acknowledgments

We would like to thank Andrew Smith, Bob Lindell and many others for their valuable comments on this memo.

11. References

[ASCII] Coded Character Set -- 7-Bit American Standard Code for Information Interchange, ANSI X3.4-1986.

[IANA-CONSIDERATIONS] Alvestrand, H. and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.

[POL-EXT] Herzog, S., "RSVP Extensions for Policy Control", RFC 2750, January 2000.

[POL-FRAME] Yavatkar, R., Pendarakis, D. and R. Guerin, "A Framework for Policy-based Admission Control RSVP", RFC 2753, January 2000.

[RFC 1510] Kohl, J. and C. Neuman, "The Kerberos Network Authentication Service (V5)", RFC 1510, September 1993.

[RFC 1704] Haller, N. and R. Atkinson, "On Internet Authentication", RFC 1704, October 1994.

[RFC 1779] Killie, S., "A String Representation of Distinguished Names", RFC 1779, March 1995.

[RFC 2205] Braden, R., Zhang, L., Berson, S., Herzog, S. and S. Jamin, "Resource ReSerVation Protocol (RSVP) - Version 1 Functional Specification", RFC 2205, September 1997.

[RFC 2209] Braden, R. and L. Zhang, "Resource ReSerVation Protocol (RSVP) - Version 1 Message Processing Rules", RFC 2209, September 1997.

[UNICODE] The Unicode Consortium, "The Unicode Standard, Version 2.0", Addison-Wesley, Reading, MA, 1996.

[X.509] Housley, R., Ford, W., Polk, W. and D. Solo, "Internet X.509 Public Key Infrastructure Certificate and CRL Profile", RFC 2459, January 1999.

[X.509-ITU] ITU-T (formerly CCITT) Information technology - Open Systems Interconnection - The Directory: Authentication Framework Recommendation X.509 ISO/IEC 9594-8

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