

[MS-RNAP]: Vendor-Specific RADIUS Attributes for Network Access Protection (NAP) Data Structure

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1 Introduction

The Remote Access Dial In User Service (RADIUS) Protocol (as specified in [RFC2865](#)) provides authentication, authorization, and accounting (AAA) of **endpoints** in scenarios such as wireless networking, dial-up networking, and virtual private networking (VPN).

RADIUS is an extensible protocol that allows vendors to provide specialized behavior through the use of **vendor-specific attributes (VSAs)** ([RFC2865](#) section 5.26).

1.1 Glossary

The following terms are defined in [\[MS-GLOS\]](#):

Active Directory Domain Services (AD DS)
Coordinated Universal Time (UTC)
Dynamic Host Configuration Protocol (DHCP) scope
Dynamic Host Configuration Protocol (DHCP) server
endpoint
Extensible Authentication Protocol (EAP)
filter
globally unique identifier (GUID)
health registration authority (HRA)
Internet Protocol security (IPsec)
little-endian
Network Access Policy
Network Access Protection (NAP)
network access server (NAS)
RADIUS attribute
RADIUS client
RADIUS server
Remote Access Service (RAS) server
security identifier (SID)
statement of health (SoH)
statement of health response (SoHR)
Unicode

The following terms are specific to this document:

Remote Desktop Gateway (RDG) server: A gateway that enables authorized users to connect to remote computers on a corporate network from any computer with an Internet connection.

Routing and Remote Access Service (RRAS): A **RADIUS client** that provisions routing and remote access service capabilities of a Windows operating system.

RNAP: Represents the collection of **vendor-specific attributes (VSAs)** that are defined or described in this document. This term is used, for example, in discussions about whether a network entity is capable of processing the **VSAs** defined in this document, as in "an RNAP-aware DHCP server".

RNAP client: A **RADIUS client** that is capable of processing Microsoft-specific **vendor-specific attributes (VSAs)**.

RNAP server: A **RADIUS server** that is capable of processing Microsoft-specific **vendor-specific attributes (VSAs)**.

vendor-specific attribute (VSA): A **RADIUS attribute** (as specified in [RFC2865](#) section 5.26) whose **Value** field contains a vendor identifier, the vendor-attribute type, a length, and a vendor-defined value.

MAY, SHOULD, MUST, SHOULD NOT, MUST NOT: These terms (in all caps) are used as described in [RFC2119](#). All statements of optional behavior use either MAY, SHOULD, or SHOULD NOT.

1.2 References

References to Microsoft Open Specification documents do not include a publishing year because links are to the latest version of the documents, which are updated frequently. References to other documents include a publishing year when one is available.

1.2.1 Normative References

We conduct frequent surveys of the normative references to assure their continued availability. If you have any issue with finding a normative reference, please contact dochelp@microsoft.com. We will assist you in finding the relevant information. Please check the archive site, <http://msdn2.microsoft.com/en-us/library/E4BD6494-06AD-4aed-9823-445E921C9624>, as an additional source.

[CM-HCAP] Cisco Systems and Microsoft Corporation, "Cisco Network Admission Control and Microsoft Network Access Protection Interoperability Architecture", http://www.cisco.com/en/US/solutions/collateral/ns340/ns394/ns171/ns466/ns617/net_implementation_white_paper0900aecd8051fc24.pdf

[IANA-ENT] Internet Assigned Numbers Authority, "Private Enterprise Numbers", January 2007, <http://www.iana.org/assignments/enterprise-numbers>

[IANA-PROTO-NUM] Internet Assigned Numbers Authority, "Protocol Numbers", February 2007, <http://www.iana.org/assignments/protocol-numbers>

[MS-DTYP] Microsoft Corporation, "[Windows Data Types](#)".

[MS-HCEP] Microsoft Corporation, "[Health Certificate Enrollment Protocol Specification](#)".

[MS-MSRP] Microsoft Corporation, "[Messenger Service Remote Protocol Specification](#)".

[MS-NAPSO] Microsoft Corporation, "[Network Policy and Access Services System Overview](#)".

[MS-SOH] Microsoft Corporation, "[Statement of Health for Network Access Protection \(NAP\) Protocol Specification](#)".

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/rfc/rfc2119.txt>

[RFC2548] Zorn, G., "Microsoft Vendor-Specific RADIUS Attributes", RFC 2548, March 1999, <http://www.ietf.org/rfc/rfc2548.txt>

[RFC2865] Rigney, C., Willens, S., Rubens, A., and Simpson, W., "Remote Authentication Dial In User Service (RADIUS)", RFC 2865, June 2000, <http://www.ietf.org/rfc/rfc2865.txt>

[RFC2868] Zorn, G., Leifer, D., Rubens, A., et al., "RADIUS Attributes for Tunnel Protocol Support", RFC 2868, June 2000, <http://www.ietf.org/rfc/rfc2868.txt>

[RFC3004] Stump, G., Droms, R., Gu, Y., et al., "The User Class Option for DHCP", RFC 3004, June 2000, <http://www.ietf.org/rfc/rfc3004.txt>

[RFC3162] Aboba, B., Zorn, G., and Mitton, D., "RADIUS and IPv6", RFC 3162, August 2001, <http://www.ietf.org/rfc/rfc3162.txt>

[RFC5080] Nelson, D., and DeKoK, A., "Common Remote Authentication Dial In User Service (RADIUS) Implementation Issues and Suggested Fixes", RFC 5080, December 2007, <http://www.ietf.org/rfc/rfc5080.txt>

1.2.2 Informative References

[IEEE802.1X] Institute of Electrical and Electronics Engineers, "IEEE Standard for Local and Metropolitan Area Networks - Port-Based Network Access Control", December 2004, <http://ieeexplore.ieee.org/iel5/9828/30983/01438730.pdf>

[MS-GLOS] Microsoft Corporation, "[Windows Protocols Master Glossary](#)".

[MSDN-ANSI-CODEPAGE] Microsoft Corporation, "WideCharToMultiByte", 2006, <http://msdn.microsoft.com/en-us/library/aa450989.aspx>

[MSDN-MS-SSTP] Microsoft Corporation, "Secure Socket Tunneling Protocol (SSTP) Specification", <http://msdn.microsoft.com/en-us/library/cc247338.aspx>

[MSFT-NAQC] Microsoft Corporation, "Network Access Quarantine Control in Windows Server 2003", 2004, <http://technet.microsoft.com/en-us/library/bb726973.aspx>

[RFC1661] Simpson, W., Ed., "The Point-to-Point Protocol (PPP)", STD 51, RFC 1661, July 1994, <http://www.ietf.org/rfc/rfc1661.txt>

[RFC2882] Mitton, D., Nortel Networks, "Network Access Servers Requirements: Extended RADIUS Practices", RFC 2882, July 2000, <http://www.ietf.org/rfc/rfc2882.txt>

[RFC3579] Aboba, B., and Calhoun, P., "RADIUS (Remote Authentication Dial In User Service) Support For Extensible Authentication Protocol (EAP)", RFC 3579, September 2003, <http://www.ietf.org/rfc/rfc3579.txt>

1.3 Overview

The Remote Authentication Dial-In User Service (RADIUS) Protocol, as specified in [\[RFC2865\]](#), provides authentication, authorization, and accounting (AAA) of endpoints in scenarios such as wireless networking, dial-up networking, and virtual private networking (VPN). This document specifies the Microsoft vendor-specific attributes (VSAs) that are passed over RADIUS between the **network access server (NAS)** and the **RADIUS server** to authenticate and authorize connection requests, as well as to configure the level of network access provided by the NAS, and account for usage.

The following figure shows a common deployment model for the RADIUS Protocol.

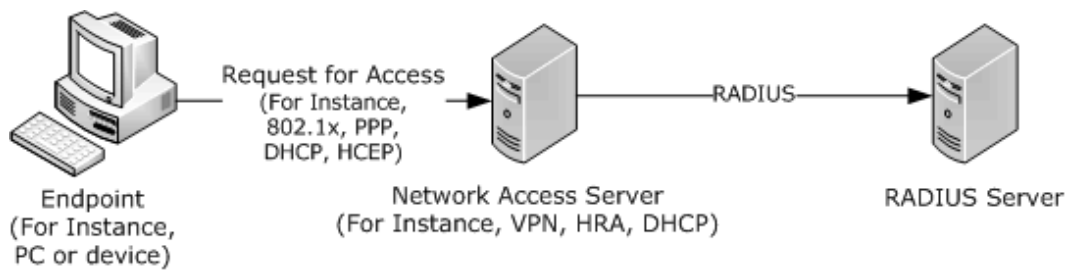


Figure 1: Common RADIUS deployment model

A NAS provides network access to endpoints (for example, a client PC or device). A NAS can be a network infrastructure device, such as a switch or a wireless access point, or it can be a server, such as a VPN gateway or dial-up server.

Endpoints initiate communication with a NAS to establish connectivity with a network. A variety of protocols can be used to establish connectivity with a network, such as 802.1x (as specified in [\[IEEE802.1X\]](#)) or Point-to-Point Protocol (PPP) (as specified in [\[RFC1661\]](#)). The NAS then exchanges RADIUS messages with a RADIUS server to authenticate and authorize the endpoint's connectivity to the network. The RADIUS server is configured with policy to accept or reject the endpoint's connectivity request and to instruct the NAS regarding the network restrictions to enforce on the endpoint, if appropriate.

The RADIUS Protocol includes an extensibility mechanism that enables NAS vendors and RADIUS server vendors to expose features that are specific to their products through the use of vendor-specific attributes (VSAs), as specified in [\[RFC2865\]](#) section 5.26.

This document defines or otherwise describes the VSAs that are specific to Microsoft.

1.4 Relationship to Other Protocols

The VSAs specified in this document rely on and are transported within the [RADIUS Protocol](#).

Protocols between the client and the **Network Access Protection (NAP)** server (for example, PPP [\[RFC1661\]](#), 802.1x [\[IEEE802.1X\]](#), and Health Certificate Enrollment [\[MS-HCEP\]](#)) relate to the Microsoft VSAs in the following ways:

- Unless otherwise noted, **RADIUS attributes** are sent only between a **RADIUS client** and a RADIUS server. However, some Microsoft RADIUS VSAs may be transported over the protocols between the endpoint and the NAS in addition to being transported over RADIUS. For example, the Health Certificate Enrollment Protocol transports the MS-AFW-Zone attribute, as specified in [\[MS-HCEP\]](#) section 2.2.2.2.
- The Microsoft RADIUS VSAs may affect the operation of the protocols between the endpoint and the NAS. For example, the [MS-Quarantine-Grace-Time](#) attribute sets a limit on the time that a client can remain connected through a particular NAS, regardless of the protocol between the client and the NAS.

1.5 Prerequisites/Preconditions

For the Microsoft VSAs to be used, the [RADIUS Protocol](#) and a set of **Network Access Policies** are configured for use between a NAS and a RADIUS server; specifically, an administrator is required to configure a RADIUS shared secret between a NAS and a RADIUS server.

1.6 Applicability Statement

The use of RADIUS VSAs is applicable in those environments where the [RADIUS Protocol](#) is used to authenticate and authorize network access requests.

1.7 Versioning and Capability Negotiation

None of the Microsoft RADIUS VSAs described in this document affects the versioning or capability negotiation of the protocols they are transported over. Some of the Microsoft RADIUS VSAs described in this document may not be recognized by a particular type or model of NAS - the behavior of a RADIUS client encountering unknown attributes is described in [\[RFC5080\]](#) section 2.5.

See the individual VSAs documented in section [2.2](#) for information about version fields, if any, that are used in each VSA.

1.8 Vendor-Extensible Fields

The Microsoft VSAs themselves do not define any additional vendor-extensible fields.

1.9 Standards Assignments

Parameter	Value	Reference
RADIUS VSA type	0x1A	[RFC2865] , section 5.26
SMI Network Management Private Enterprise Code for the Vendor ID field	0x00000137	[IANA-ENT]

2 Messages

This protocol references commonly used data types as defined in [\[MS-DTYP\]](#).

2.1 Transport

The RADIUS Protocol, specified in [\[RFC2865\]](#), defines the transport of RADIUS and associated attributes over UDP.

2.2 Message Syntax

The following sections contain information about the VSAs that are defined in this document. These VSAs are used in RADIUS Access-Request and Access-Accept messages [\[RFC2865\]](#) in the manner specified in sections [3.1.5.2](#), [3.2.5](#), and [3.3.5](#).

2.2.1 Microsoft Vendor-Specific Attributes (VSAs)

The RADIUS Protocol specification [\[RFC2865\]](#) defines attribute type 0x1A as a VSA. This type was defined to allow vendors to extend the RADIUS attribute set. For reference, the format of the standard RADIUS attribute is provided below.

When representing a VSA, the fields **MUST** be set as follows (for more details, see [\[RFC2865\]](#)).

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Type									Length							Value (variable)															
...																															

Type (1 byte): An 8-bit unsigned integer that **MUST** be 0x1A, which indicates the type of the **Value** field as vendor-specific.

Length (1 byte): An 8-bit unsigned integer that **MUST** specify the sum of the lengths of an attribute's **Type**, **Length**, and **Value** fields, in bytes. For vendor-specific RADIUS attributes, the value **MUST** be at least 9 to account for the **Type**, **Length**, and **Value** fields. The RADIUS client **SHOULD** ignore the attribute if the value is less than 9.

Value (variable): For Microsoft vendor-specific RADIUS attributes, the value **MUST** be formatted as described in [\[RFC2865\]](#) section 5.26. For reference, the format is as follows.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Vendor-ID																															
Vendor-Type									Vendor-Length									Attribute-Specific Value (variable)													
...																															

Vendor-ID (4 bytes): A 32-bit unsigned integer in network byte order, the most significant 8 bits MUST be set to 0 and the remaining 24 bits MUST be set to the SMI code of the vendor taken from [\[IANA-ENT\]](#). Microsoft VSAs MUST have the **Vendor-ID** field set to 311 (0x00000137).

Vendor-Type (1 byte): An 8-bit unsigned integer that MUST specify the VSA type contained in the **Attribute-Specific Value** field. Microsoft VSA vendor types MUST be set as specified in [\[RFC2548\]](#) and in sections [2.2.1.1](#) through [2.2.1.27](#) of this specification.

Vendor-Length (1 byte): An 8-bit unsigned integer that MUST be set to 2 plus the length of **Attribute-Specific Value**. The RADIUS client SHOULD ignore the attribute if Vendor-Length is less than 3.

Attribute-Specific Value (variable): The value of the VSA specified in the **Vendor-Type** field. The format of the **Attribute-Specific Value** field for a given **Vendor-Type** MUST be set as specified in [\[RFC2548\]](#) and in sections [2.2.1.1](#) through [2.2.1.27](#) of this specification.

The attribute definitions in the following sections specify the specific parameters relevant to that extension.

2.2.1.1 MS-RAS-Client-Name

MS-RAS-Client-Name is a VSA, as specified in section [2.2.1](#). It is used to specify the name of the endpoint generating a request.

The fields of the **MS-RAS-Client-Name**VSA MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x22 for **MS-RAS-Client-Name**.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 added to the length of the **Attribute-Specific Value** field. Its value MUST be at least 3 and less than 36.

Attribute-Specific Value: This field MUST be the machine name of the endpoint that requests network access, sent in ASCII format, and MUST be null terminated. A valid character set includes the symbols ! @ # \$ % ^ & ' (. - _ { } ~ in addition to letters and numbers.[<1>](#)

For more details about MS-RAS-Client-Name, see sections [3.2.5.1.1](#) and [3.3.5.1.1](#).

2.2.1.2 MS-RAS-Client-Version

MS-RAS-Client-Version is a VSA, as specified in section [2.2.1](#). It is used to specify the version of the endpoint generating a request.

The fields of the MS-RAS-Client-Version vendor-specific attribute MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x23 for MS-RAS-Client-Version.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 added to the length of the **Attribute-Specific Value** field. Its value MUST be at least 3.

Attribute-Specific Value: This field MUST be the ASCII version string of a remote access client; this string MUST be in network byte order.[<2>](#)

For more details about MS-RAS-Client-Version, see sections [3.2.5.1.2](#) and [3.3.5.1.2](#).

2.2.1.3 MS-Quarantine-IPFilter

MS-Quarantine-IPFilter is a VSA, as specified in section [2.2.1](#). It is used to specify the set of IP filters to be provisioned for the endpoint associated with a RADIUS Access-Request (as specified in [\[RFC2865\]](#)).

This attribute may be sent by a RADIUS server to define the network-access scope of the endpoint. It is used only for IPv4 addresses. This attribute defines traffic filters to a NAS for restricting access for a specific network-access connection. If multiple MS-Quarantine-IPFilter attributes are contained within a packet, they MUST be in order and they MUST be consecutive attributes in the packet. For the late bound field, this is used to allow a NAS to change a field in the filter after the connection with the endpoint is complete.

The fields of MS-Quarantine-IPFilter MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x24 for MS-Quarantine-IPFilter.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 74 to specify at least 1 **filter**. The total length will depend on the number of filter sets and filters in each set.

Attribute-Specific Value: A list of IPv4 filter sets, defined as follows:

The usage of this attribute within Access-Request, Access-Accept, Access-Reject, Access-Challenge and Accounting-Request packets is defined in section [3.1.5.2](#). If multiple MS-Quarantine-IPFilter VSAs occur in a single RADIUS packet, the **Attribute-Specific Value** field from each MUST be concatenated in the order received to form the full MS-Quarantine-IPFilter value.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Version																															
Size																															
FilterSetEntryCount																															
FilterSetEntryList (variable)																															
...																															
FilterSetList (variable)																															
...																															

Version (4 bytes): A 32-bit unsigned integer in **little-endian** byte order that MUST be set to 0x00000001. No other versions are defined. See section [3.1.5.3](#) for processing details.

Size (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the size of the VSA field for this VSA, including the version, size, and subsequent filter set data. The size MUST be at least 72, so as to specify at least 1 filter. The total size will depend on the number of filter sets and filters in each set.

FilterSetEntryCount (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the number of filter set entries. Its value MUST be greater than 0.

FilterSetEntryList (variable): A consecutive list of filter set entries, **FilterSetEntryCount** in number, each of which MUST be formatted as defined below.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
InfoType																															
InfoSize																															
FilterSetCount																															
Offset																															

InfoType (4 bytes): A 32-bit unsigned integer in little-endian order specifying the type of filters that are contained in the filter set list. The value MUST be one of the following.

Value	Meaning
0xffff0001	Input filter: The filter MUST be applied to IP packets sent from the endpoint to the Network Access Server (NAS).
0xffff0002	Output filter: The filter MUST be applied to IP packets sent from the NAS to the endpoint.
0xffff0009	Site-to-site connection: IP traffic that matches this filter indicates to the NAS that a site-to-site connection MUST be connected and all IP packets matching this filter MUST be routed into the connection.

InfoSize (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the overall size, in bytes, of the list of filtersets specified by this filter set entry.

FilterSetCount (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the number of filter sets in this entry. Its value MUST be greater than 0.

Offset (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the offset of the start of the first filter set of this filter set entry within the **Attribute-Specific Value** of this VSA. Offset values are always multiples of 8 (in other words, a filter set MUST begin at an 8-octet aligned offset within the **Attribute-Specific Value**). To meet this requirement, any unused octets (holes) within the **Attribute-Specific Value** before or after a filter set MUST be set to 0 (in other words, padded), as necessary.

FilterSetList (variable): A consecutive list of filter sets equal in number to the value of **FilterSetCount**, each of which MUST be formatted as defined below.

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
FilterVersion																															
FilterCount																															
ForwardAction																															
FilterList (variable)																															
...																															

FilterVersion (4 bytes): A 32-bit unsigned integer in little-endian byte order that **MUST** be set to 0x00000001. No other versions are defined. For processing details, see section [3.1.5.3](#).

FilterCount (4 bytes): A 32-bit unsigned integer in little-endian byte order that **MUST** specify the number of filters. Its value **MUST** be greater than 0.

ForwardAction (4 bytes): A 32-bit unsigned integer in little-endian byte order that **MUST** specify the action for the filter. Its value **MUST** be one of the following.

Value	Meaning
0x00000000	Forward
0x00000001	Drop

FilterList (variable): A consecutive list of filters, equal in number to the value of **FilterCount**, each of which **MUST** be formatted as defined below:

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Source Address																															
Source Mask																															
Destination Address																															
Destination Mask																															
Protocol																															
Late Bound																															
Source Port																Destination Port															

Source Address (4 bytes): A 32-bit unsigned integer in network byte order specifying the IPv4 source address for which the filter applies. A value of 0x00000000 in this field denotes ANY.

Source Mask (4 bytes): A 32-bit unsigned integer in network byte order specifying the subnet mask for the source address.

Destination Address (4 bytes): A 32-bit unsigned integer in network byte order specifying the IPv4 destination address for the filter. A value of 0x00000000 in this field denotes ANY.

Destination Mask (4 bytes): A 32-bit unsigned integer in network byte order specifying the subnet mask for the destination address in network byte order.

Protocol (4 bytes): A 32-bit unsigned integer in little-endian byte order specifying the protocol number (such as TCP or UDP) for the filter. Possible values include the following.

Name	Value
ANY	0x00000000
ICMP	0x00000001
TCP	0x00000006
UDP	0x00000011

The complete list is specified in [\[IANA-PROTO-NUM\]](#).

Late Bound (4 bytes): A 32-bit unsigned integer in little-endian byte order specifying whether the fields in the filter is dynamically replaced by a NAS with values for specific endpoints. Its value MUST be at least one of the following or a bit-wise OR result of two or more such values.

Value	Meaning
0x00000000	No Source or Destination Address or Mask Replacement
0x00000001	Source Address replaceable with a new address
0x00000004	Destination Address replaceable with a new address
0x00000010	Source Address Mask replaceable with a new Mask
0x00000020	Destination Address Mask replaceable with a new Mask

Source Port (2 bytes): If the Protocol is TCP or UDP, this MUST be a 16-bit unsigned integer in network byte order that specifies a port number for the corresponding protocol. If the Protocol is ICMP or ICMPv6, this MUST be a 16-bit unsigned integer in little-endian byte order that specifies a corresponding type indicator for ICMP or ICMPv6. For all other protocol values, this MUST be set to 0 (byte order does not matter).

Destination Port (2 bytes): If the Protocol is TCP or UDP, this MUST be a 16-bit unsigned integer in network byte order that specifies a port number for the corresponding protocol. If the Protocol is ICMP or ICMPv6, this MUST be a 16-bit unsigned integer in little-endian byte order that specifies a corresponding code indicator for ICMP or ICMPv6. For all other protocol values, this MUST be set to 0 (byte order does not matter).

For more details about MS-Quarantine-IPFilter, see sections [3.2.5.2.1](#) and [3.3.5.2.1](#).

2.2.1.4 MS-Quarantine-Session-Timeout

MS-Quarantine-Session-Timeout is a VSA, as specified in [2.2.1](#). It is used to specify a timeout value used by a **Routing and Remote Access Service (RRAS)** server.

The fields of MS-Quarantine-Session-Timeout MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x25.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST contain the time in seconds that a restricted VPN connection can remain in a restricted state before being disconnected.

For more details about MS-Quarantine-Session-Timeout, see sections [3.2.5.2.2](#) and [3.3.5.2.2](#).

2.2.1.5 MS-User-Security-Identity

MS-User-Security-Identity is a VSA, as specified in section [2.2.1](#). It is used to specify the **security-identifier (SID)**, as defined in [\[MS-DTYP\]](#) section 2.4.2, of the user requesting access.

The fields of MS-User-Security-Identity MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x28 for MS-User-Security-Identity.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 plus the length of the **Attribute-Specific Value** field. Its value MUST be at least 3.

Attribute-Specific Value: This field MUST contain the account SID of the user requesting access in the format of a binary SID used to authenticate a remote access client.

2.2.1.6 MS-Identity-Type

MS-Identity-Type is a VSA, as specified in section [2.2.1](#). It is used to specify that the RADIUS server MUST process access authorization based on a machine health-check only.

The fields of MS-Identity-Type MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x29.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST contain the following value.

Value	Meaning
0x00000001	Indicates to the RADIUS server that this access request message is for a machine health check only and not for authentication.

For more details about MS-Identity-Type, see sections [3.2.5.1.4](#) and [3.3.5.1.4](#).

2.2.1.7 MS-Service-Class

MS-Service-Class is a VSA, as specified in section [2.2.1](#). It is used to specify which group of **Dynamic Host Configuration Protocol (DHCP) scopes** should supply an IP address to the endpoint requesting access.

The fields of MS-Service-Class MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x2A.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 plus the length of the **Attribute-Specific Value** field. Its value MUST be at least 3.

Attribute-Specific Value: The name of a group of DHCP scopes that correspond to the endpoint requesting access. This name string MUST be sent as characters using the code page of the current system (see [\[MSDN-ANSI-CODEPAGE\]](#)). This field MUST only be used when the RADIUS client is a **Dynamic Host Configuration Protocol (DHCP) server**.

For more details about MS-Service-Class, see sections [3.2.5.1.5](#) and [3.3.5.1.5](#).

2.2.1.8 MS-Quarantine-User-Class

MS-Quarantine-User-Class is a VSA, as specified in section [2.2.1](#). It is used to carry the name of a special DHCP user class, as specified in [\[RFC3004\]](#), called NAP user class.

The fields of MS-Quarantine-User-Class MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x2C.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 plus the length of the **Attribute-Specific Value** field. RADIUS client SHOULD ignore the attribute if Vendor-Length is less than 3.

Attribute-Specific Value: This field MUST contain the name of the DHCP user class to be assigned to the endpoint that is requesting access from a DHCP server. The name MUST be sent in ASCII characters with the code page to be the current system Microsoft Windows® ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format (that is, the string is sent with ANSI code page). For more details about the DHCP option for user class, see [\[RFC3004\]](#).

For more details about MS-Quarantine-User-Class, see sections [3.2.5.2.3](#) and [3.3.5.2.3](#).

2.2.1.9 MS-Quarantine-State

MS-Quarantine-State is a VSA, as specified in section [2.2.1](#). It is used to specify the target restrictive state of the endpoint.

The fields of MS-Quarantine-State MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x2D.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST specify the network access level that the RADIUS server authorizes for the endpoint. It MUST be one for the following values.

Value	Meaning
0x00000000	Full access: The endpoint is given full access to the network.
0x00000001	Restricted: The endpoint is given limited access to the network.
0x00000002	On probation: The endpoint is given full access within a limited time period.

For more details about MS-Quarantine-State, see sections [3.2.5.2.4](#) and [3.3.5.2.4](#).

2.2.1.10 MS-Quarantine-Grace-Time

MS-Quarantine-Grace-Time is a VSA, as specified in section [2.2.1](#). It is used to specify the amount of time a host has to conform to network policy.

The fields of MS-Quarantine-Grace-Time MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x2E.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST specify the number of seconds since January 1, 1970 **Coordinated Universal Time (UTC)** that the RADIUS server authorizes the endpoint to have full network access. After this time, the endpoint is expected to be authorized to have only restricted access.

For more details about MS-Quarantine-Grace-Time, see sections [3.2.5.2.5](#) and [3.3.5.2.5](#).

2.2.1.11 MS-Network-Access-Server-Type

MS-Network-Access-Server-Type is a VSA, as specified in section [2.2.1](#). It is used to specify the type of the network access server making the request.

The fields of MS-Network-Access-Server-Type MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x2F.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST indicate the type of the NAS. The value MUST be interpreted in accordance with the following table:

Value	Meaning
0x00000000	Unspecified
0x00000001	Terminal Server Gateway
0x00000002	Remote Access Service (RAS) server (VPN or dial-in)
0x00000003	DHCP server
0x00000005	Health Registration Authority (HRA)
0x00000006	Host Credential Authorization Protocol (HCAP) server
All Other Values	A tag value used to identify applicable network access policies on the RADIUS server.

For more details about MS-Network-Access-Server-Type, see sections [3.2.5.1.6](#) and [3.3.5.1.6](#).

2.2.1.12 MS-AFW-Zone

MS-AFW-Zone is a VSA, as specified in section [2.2.1](#). When a network access server (NAS) that understands this attribute receives it, it SHOULD provide it to the endpoint that is requesting access (for example, secure zone, boundary zone, or quarantine zone), to be used as a hint for dynamic selection of a preconfigured **Internet Protocol security (IPsec)** policy by the endpoint.

The fields of MS-AFW-Zone MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x30.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST indicate the protection level that the RADIUS server authorizes for the endpoint. It MUST be set to one of the following values.

Value	Meaning
0x00000001	Indicates that the endpoint SHOULD apply an IPsec policy that can require encryption (a boundary policy).
0x00000002	Indicates that the endpoint SHOULD apply an IPsec policy that does not require encryption (an unprotected policy).
0x00000003	Indicates that the endpoint SHOULD apply an IPsec policy that does require encryption (a protected policy).

For more details about MS-AFW-Zone, see sections [3.2.5.2.6](#) and [3.3.5.2.6](#).

2.2.1.13 MS-AFW-Protection-Level

MS-AFW-Protection-Level is a VSA, as specified in section [2.2.1](#). It is used as a hint for dynamic selection of a preconfigured IPsec policy by the endpoint requesting access.

The fields of MS-AFW-Protection-Level MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x31.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST indicate the protection level that the RADIUS server authorizes for the endpoint. It MUST be set to one of the following values.

Value	Meaning
0x00000001	Indicates that the certificate payload in the Health Certificate Enrollment Protocol (HCEP) response can be used for signing data.
0x00000002	Indicates that the certificate payload in the HCEP response can be used for signing and encrypting data.

For more details about MS-AFW-Protection-Level, see sections [3.2.5.2.7](#) and [3.3.5.2.7](#).

2.2.1.14 MS-Machine-Name

MS-Machine-Name is a VSA, as specified in section [2.2.1](#). It is used to communicate the machine name of the endpoint requesting network access.

The fields of MS-Machine-Name MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x32.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 3.

Attribute-Specific Value: An octet string containing characters from Windows ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format and MUST specify the machine name of the endpoint requesting access.

For more details about MS-Machine-Name, see sections [3.2.5.1.7](#) and [3.3.5.1.7](#).

2.2.1.15 MS-IPv6-Filter

MS-IPv6-Filter is a VSA, as specified in section [2.2.1](#). It is used to limit the inbound and/or outbound access of the endpoint.

This attribute may be sent by a RADIUS server to define the network access scope of the endpoint. It is used only for IPv6 addresses and MS-Filter; [\[RFC2548\]](#) VSA is the corresponding attribute for IPv4 addresses. The structure of MS-Filter is identical to the structure of [MS-Quarantine-IPFilter](#), as specified in section [2.2.1.3](#). [<3>](#) This attribute defines traffic filters to a NAS for restricting access for a specific network access connection. If multiple MS-IPv6-Filter attributes are contained within a packet, they MUST be in order and they MUST be consecutive attributes in the packet.

The fields of MS-IPv6-Filter MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x33.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 98, to specify a minimum of 1 filter. The total length will depend on the number of filter sets and filters in each set.

Attribute-Specific Value: A list of IPv6 filter sets, defined as follows.

The usage of this attribute within Access-Request, Access-Accept, Access-Reject, Access-Challenge and Accounting-Request packets is defined in section [3.1.5.2](#). If multiple MS-IPv6-Filter attributes occur in a single RADIUS packet, the **Attribute-Specific Value** field from each MUST be concatenated in the order received to form the full MS-IPv6-Filter value.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Version																															
Size																															
FilterSetEntryCount																															

FilterSetEntryList (variable)
...
FilterSetList (variable)
...

Version (4 bytes): A 32-bit unsigned integer in network byte order that MUST be set to 0x00000001. No other versions are defined. For processing details, see section [3.1.5.3](#).

Size (4 bytes): A 32-bit unsigned integer in network byte order that MUST specify the size of the **Attribute-Specific Value** field for this VSA, including the version, size, and subsequent filter set data. The size MUST be at least 96, so as to specify at least one filter. The total size depends on the number of filter sets and filters in each set.

FilterSetEntryCount (4 bytes): A 32-bit unsigned integer in network byte order that MUST specify the number of filter set entries. Its value MUST be greater than 0.

FilterSetEntryList (variable): A list of consecutive filter set entries, equal in number to the value of **FilterSetEntryCount**, each of which MUST be formatted as defined below.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
InfoType																															
InfoSize																															
FilterSetCount																															
Offset																															

InfoType (4 bytes): A 32-bit unsigned integer in network byte order specifying the type of filters that are contained in the filter set list. The value MUST be one of the following.

Value	Meaning
0xffff0011	Input filter – The filterNAS MUST be applied to IP packets sent from the endpoint to the NAS.
0xffff0012	Output filter – The filter MUST be applied to IP packets sent from the NAS to the endpoint.

InfoSize (4 bytes): A 32-bit unsigned integer in network byte order specifying the overall size, in bytes, of the list of filter sets specified by this filter set entry.

FilterSetCount (4 bytes): A 32-bit unsigned integer in network byte order specifying the overall size, in bytes, of the list of filter sets specified by this filter set entry.

Offset (4 bytes): A 32-bit unsigned integer in network byte order specifying the offset of start of the first filter set of this filter set entry within the **Attribute-Specific Value** of this VSA. Offset values are always multiples of 8, and a filter set MUST therefore begin at an 8-octet aligned offset within the **Attribute-Specific Value**. To meet this requirement, any unused octets (holes) within the **Attribute-Specific Value** before or after a filter set MUST be set to 0 (padded) as necessary.

FilterSetList (variable): A list of consecutive filter sets, equal in number to the value of **FilterSetCount**, each of which MUST be formatted as defined below.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
FilterVersion																															
FilterCount																															
ForwardAction																															
FilterList (variable)																															
...																															

FilterVersion (4 bytes): A 32-bit unsigned integer in network byte order that MUST be set to 0x00000001. No other versions are defined. For processing details, see section [3.1.5.3](#).

FilterCount (4 bytes): A 32-bit unsigned integer in network byte order specifying the number of filters. Its value MUST be greater than 0.

ForwardAction (4 bytes): A 32-bit unsigned integer in network byte order specifying the action for the filter. Its value MUST be one of the following.

Value	Meaning
0x00000000	Forward
0x00000001	Drop

FilterList (variable): A list of consecutive filters, equal in number to the value of **FilterCount**, each of which MUST be formatted as defined below.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Source Address																															
...																															
...																															

...	
Source Prefix Length	
Destination Address	
...	
...	
...	
Destination Prefix Length	
Protocol	
Late Bound	
Source Port	Destination Port

Source Address (16 bytes): A 128-bit unsigned integer in network byte order specifying the IPv6 source address for which the filter applies. A value of 0x00000000 in this field MUST denotes ANY.

Source Prefix Length (4 bytes): A 32-bit unsigned integer in network byte order specifying the prefix length for the source address. If this value is set to zero, the NAS MUST use ANY as a source address.

Destination Address (16 bytes): A 128-bit unsigned integer in network byte order that specifies the IPv6 destination address for the filter. A value of zero in this field denotes ANY.

Destination Prefix Length (4 bytes): A 32-bit unsigned integer in network byte order that specifies the Prefix Length for the destination address. If this value is set to zero, the NAS MUST use ANY as a Destination address.

Protocol (4 bytes): A 32-bit unsigned integer in network byte order specifying the protocol number (such as TCP or UDP) for the filter. Possible values include the following.

Name	Value
ANY	0x00000000
ICMP	0x00000001
ICMPv6	0x0000003A
TCP	0x00000006
UDP	0x00000011

Late Bound (4 bytes): A 32-bit unsigned integer in network byte order that indicates if the fields in the filter MAY be dynamically replaced by the NAS with values for specific endpoints. Its value MUST be at least one of the following or a bit-wise OR of two or more such values.

Value	Meaning
0x00000000	No source or destination address or mask replacement
0x00000001	Source address replaceable with a new address
0x00000004	Destination address replaceable with a new address
0x00000010	Source address mask replaceable with a new mask
0x00000020	Destination address mask replaceable with a new mask

Source Port (2 bytes): If the Protocol is TCP or UDP, this MUST be a 16-bit unsigned integer in network byte order that specifies a port number for the corresponding protocol. If the Protocol is ICMP or ICMPv6, this MUST be a 16-bit unsigned integer in network byte order that specifies a corresponding type indicator for ICMP or ICMPv6. For all other protocol values, this MUST be set to 0 (byte order does not matter).

Destination Port (2 bytes): If the Protocol is TCP or UDP, this MUST be a 16-bit unsigned integer in network byte order that specifies a port number for the corresponding protocol. If the Protocol is ICMP or ICMPv6, this MUST be a 16-bit unsigned integer in network byte order that specifies a corresponding code indicator for ICMP or ICMPv6. For all other protocol values, this MUST be set to 0 (byte order does not matter).

For more details about MS-IPv6-Filter, see sections [3.2.5.2.8](#) and [3.3.5.2.8](#).

2.2.1.16 MS-IPv4-Remediation-Servers

MS-IPv4-Remediation-Servers is a VSA, as specified in section [2.2.1](#). This value is used to specify a list of servers that should be reachable by an endpoint with restricted access so that it may remediate itself.

The fields of MS-IPv4-Remediation-Servers MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x34.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Only values greater than 6 whose value modulo 4 equals 3 are valid.

Attribute-Specific Value: An 8-bit unsigned integer, which is reserved and which MUST be set to 0 by the RADIUS server, followed by a list of IPv4 addresses that the RADIUS server authorizes a restricted endpoint to access. The list MUST be formatted as a sequential series of 4-octet values. Each of the four-octet values MUST be an IPv4 address in network byte order.

For more details about MS-IPv4-Remediation-Servers, see sections [3.2.5.2.9](#) and [3.3.5.2.9](#).

2.2.1.17 MS-IPv6-Remediation-Servers

MS-IPv6-Remediation-Servers is a VSA, as specified in section [2.2.1](#). This value is used to specify a list of servers that should be reachable by an endpoint with restricted access so that it may remediate itself.

The fields of MS-IPv6-Remediation-Servers MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x35.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 plus the length of the **Attribute-Specific Value** field. Only values greater than 18 whose value modulo 16 equals 3 are valid.

Attribute-Specific Value: An 8-bit unsigned integer, which is reserved and which MUST be set to 0 by the RADIUS server, followed by a list of IPv6 addresses that the RADIUS server authorizes a restricted endpoint to access. The list MUST be formatted as a sequential series of 16-octet values. Each of the 16-octet values MUST be an IPv6 address in network byte order.

For more details about MS-IPv6-Remediation-Servers, see sections [3.2.5.2.10](#) and [3.3.5.2.10](#).

2.2.1.18 Not-Quarantine-Capable

Not-Quarantine-Capable is a VSA used by a RADIUS client to specify whether an endpoint sent a **statement of health (SoH)**, as specified in section [2.2.1](#).

The fields of Not-Quarantine-Capable MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x36.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST indicate whether the endpoint is capable of reporting its state to the NAS. It MUST be one of the following values.

Value	Meaning
0x00000001	The endpoint sent an SoH.
0x00000000	The endpoint did not send an SoH.

For more details about Not-Quarantine-Capable, see sections [3.2.5.2.11](#) and [3.3.5.2.11](#).

2.2.1.19 MS-Quarantine-SoH

MS-Quarantine-SoH is a VSA, as specified in section [2.2.1](#). It is used to carry Statement of Health information (as specified in [\[MS-SOH\]](#)).

The fields of MS-Quarantine-SoH MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x37.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 2 plus the length of the **Attribute-Specific Value** field. Its value MUST be at least 12.

Attribute-Specific Value: This field MUST be formatted as an SoH, as specified in [\[MS-SOH\]](#) section 2.2.5.

For more details about MS-Quarantine-SoH, see sections [3.2.5.1.8](#), [3.2.5.2.12](#), [3.3.5.1.8](#), and [3.3.5.2.12](#).

2.2.1.20 MS-RAS-Correlation-ID

The MS-RAS-Correlation-ID is a VSA, as specified in section [2.2.1](#). It is used by the NAS to send an identifier, which is used for the correlation of log events, to the RADIUS server.

The fields of MS-RAS-Correlation-ID MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x38.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **globally unique identifier (GUID)** string in the **Attribute-Specific Value** plus 2.

Attribute-Specific Value: A 128-bit unsigned integer that SHOULD specify a GUID and be represented using a curly braced GUID string, as defined in [MS-DTYP](#) (section [2.3.2](#)).

2.2.1.21 MS-Extended-Quarantine-State

The MS-Extended-Quarantine-State VSA is used to specify additional information about a restricted access decision by a RADIUS server, as specified in section [2.2.1](#).

The fields of MS-Extended-Quarantine-State MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x39.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network-byte order that MUST contain one of the following values.

Value	Meaning
0x00000000	No data
0x00000001	Transition
0x00000002	Infected
0x00000003	Unknown

2.2.1.22 HCAP-User-Groups

HCAP-User-Groups is a VSA used to specify user groups information received over an HCAP interface [\[CM-HCAP\]](#) by a RADIUS client, as specified in section [2.2.1](#).

The fields of HCAP-User-Groups MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3A.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 3.

Attribute-Specific Value: An octet string that contains characters from Windows ANSI code page (for more information, see [\[MSDN-ANSI-CODEPAGE\]](#)) and MUST specify the group name to which an HCAP user belongs (as specified in [\[MS-HCEP\]](#)).

2.2.1.23 HCAP-Location-Group-Name

HCAP-Location-Group-Name is a VSA used to specify location group information received over a HCAP interface [\[CM-HCAP\]](#) by a RADIUS client, as specified in section [2.2.1](#).

The fields of HCAP-Location-Group-Name MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3B.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 3.

Attribute-Specific Value: An octet string that contains characters from Windows ANSI code page (for more information, see [\[MSDN-ANSI-CODEPAGE\]](#)) and MUST specify the location group name for the HCAP entity (as specified in [\[CM-HCAP\]](#)).

2.2.1.24 HCAP-User-Name

HCAP-User-Name is a VSA used to indicate user identity information received over a HCAP interface [\[CM-HCAP\]](#) by a RADIUS client, as specified in section [2.2.1](#).

The fields of HCAP-User-Name MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3C.

Vendor-Length: An 8-bit unsigned integer that MUST be set to the length of the **Attribute-Specific Value** field plus 2. Its value MUST be at least 3.

Attribute-Specific Value: An octet string that contains characters from Windows ANSI code page (for more information, see [\[MSDN-ANSI-CODEPAGE\]](#)) and MUST specify the name for the HCAP user (as specified in [\[CM-HCAP\]](#)).

2.2.1.25 MS-User-IPv4-Address

MS-User-IPv4-Address is a VSA used to specify the IPv4 address of the endpoint as known to the RADIUS client, as specified in section [2.2.1](#).

The fields of MS-User-IPv4-Address MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3D.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network byte order that MUST specify the IPv4 address of the machine of the user requesting network access.

2.2.1.26 MS-User-IPv6-Address

MS-User-IPv6-Address is a VSA used to specify the IPv6 address of the endpoint as known to the RADIUS client, as specified in section [2.2.1](#).

The fields of MS-User-IPv6-Address MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3E.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 18.

Attribute-Specific Value: A 128-bit unsigned integer in network byte order that MUST specify the IPv6 address of the machine of the user requesting network access.

2.2.1.27 MS-RDG-Device-Redirection

MS-RDG-Device-Redirection is a VSA specifying filters used by a **Remote Desktop Gateway (RDG) server**, as specified in section [2.2.1](#).

The fields of MS-RDG-Device-Redirection MUST be set as follows:

Vendor-Type: An 8-bit unsigned integer that MUST be set to 0x3F.

Vendor-Length: An 8-bit unsigned integer that MUST be set to 6.

Attribute-Specific Value: A 32-bit unsigned integer in network-byte order (bit 0 is the least significant bit) in which the bits MUST have following meaning.

Bit	Meaning
0	Drives redirection (0: enabled, 1: disabled)
1	Printers redirection (0: enabled, 1: disabled)
2	Serial ports redirection (0: enabled, 1: disabled)
3	Clipboard redirection (0: enabled, 1: disabled)
4	Plug and play devices redirection (0: enabled, 1: disabled)
5-28	<Reserved for additional devices>
29	1: Disable redirection for all devices 0: Device redirection is controlled by bits 0..4
30	1: Enable redirection for all devices 0: Device redirection is controlled, first, by bit 29 and then by bits 0..4
31	<Unused>

When either bit 29 or bit 30 is set to 1, the values for bits 0..4 are ignored.

2.2.2 Microsoft Vendor-Specific Values for RADIUS Attributes

2.2.2.1 Vendor-Specific Value for the Tunnel-Type RADIUS Attribute

In addition to the values specified in [\[RFC2868\]](#), the standard RADIUS attribute Tunnel-Type [\[RFC2868\]](#) is extended to include a value for the Secure Socket Tunneling Protocol (as specified in [\[MS-SSTP\]](#)) of 0x013701 in network-byte order. This value was determined using the technique specified in [\[RFC2882\]](#), in which "Vendor-Specific Values" are encoded by concatenating the private enterprise ID [\[IANA-ENT\]](#) with an 8-bit unsigned integer value. In this case, a tunnel tag of zero is always used, along with the Microsoft private enterprise ID (0x0137) and an 8-bit unsigned integer value 0x01. As a result, the 4 octet value of the attribute (including the tag) is encoded as 0x00013701.[<4>](#)

3 Protocol Details

3.1 Common Details

3.1.1 Abstract Data Model

There are no common abstract data model elements.

3.1.2 Timers

There are no common timers.

3.1.3 Initialization

There is no common initialization.

3.1.4 Higher-Layer Triggered Events

There are no common higher-level events.

3.1.5 Message Processing Events and Sequencing Rules

3.1.5.1 Windows Implementation of RADIUS Attributes

Section [3.1.5.2](#) specifies the Microsoft Windows® implementation of RADIUS VSA attributes. [<5>](#)

RADIUS/NAS attributes get used in parallel to the use of RNAP on the server. This table explains the mapping from Active Directory to RADIUS attributes and these RADIUS attributes follow the standard RADIUS architecture [\[RFC2865\]](#) and [\[RFC3162\]](#).

Active Directory Attribute	Description
msNPCallingStationID [MS-ADA2] (section 2.418) msNPSavedCallingStationID [MS-ADA2] (section 2.419)	[RFC2865] section 5.31
msRADIUSCallbackNumber [MS-ADA2] (section 2.443) msRASSavedCallbackNumber [MS-ADA2] (section 2.453)	[RFC2865] section 5.19
msRADIUSServiceType [MS-ADA2] (section 2.452)	[RFC2865] section 5.6
msRADIUSFramedRoute [MS-ADA2] (section 2.448) msRASSavedFramedRoute [MS-ADA2] (section 2.455)	[RFC2865] section 5.22
msRADIUSFramedIPAddress [MS-ADA2] (section 2.445) msRASSavedFramedIPAddress [MS-ADA2] (section 2.454)	[RFC2865] section 5.8

Active Directory Attribute	Description
msRADIUS-FramedInterfaceID [MS-ADA2] (section 2.444) msRADIUS-SavedFramedInterfaceID [MS-ADA2] (section 2.449)	[RFC3162] section 3.2
msRADIUS-FramedIpv6Prefix [MS-ADA2] (section 2.446) msRADIUS-SavedFramedIpv6Prefix [MS-ADA2] (section 2.450)	[RFC3162] section 2.3
msRADIUS-FramedIpv6Route [MS-ADA2] (section 2.447) msRADIUS-FramedIpv6Route [MS-ADA2] (section 2.451)	[RFC3162] section 2.5
msNPAllowDialin [MS-ADA2] (section 2.416)	This attribute is present in values of TRUE or FALSE, which indicate that a given Machine Account will or will not be given network access. If the value is FALSE, the Machine Account will receive an access_reject response specified in [RFC2865] .

3.1.5.2 Microsoft VSA Support of RADIUS Messages

The RADIUS Protocol standard (as specified in [\[RFC2865\]](#) section 4) defines the messages sent between a RADIUS client and a RADIUS server. Each Microsoft VSA is valid only in certain messages as defined in the second table.

The following table defines the meaning of the entries in the second table.

Value	Meaning
0	This attribute MUST NOT be present in packet.
0+	Zero or more instances of this attribute MUST be present in the packet.
0-1	Zero or one instance of this attribute MUST be present in the packet.

Microsoft vendor-specific attribute	Request	Accept	Reject	Challenge	Accounting-Request
MS-RAS-Client-Name	0-1	0	0	0	0-1
MS-RAS-Client-Version	0-1	0	0	0	0-1
MS-Quarantine-IPFilter	0	0+	0	0	0+
MS-Quarantine-Session-Timeout	0	0-1	0	0	0-1
MS-User-Security-Identity	0-1	0	0	0	0-1
MS-Identity-Type	0-1	0	0	0	0
MS-Service-Class	0-1	0	0	0	0

Microsoft vendor-specific attribute	Request	Accept	Reject	Challenge	Accounting-Request
MS-Quarantine-User-Class	0	0-1	0	0	0
MS-Quarantine-State	0	0-1	0	0	0
MS-Quarantine-Grace-Time	0	0-1	0	0	0
MS-Network-Access-Server-Type	0-1	0	0	0	0
MS-AFW-Zone	0	0-1	0	0	0
MS-AFW-Protection-Level	0	0-1	0	0	0
MS-Machine-Name	0-1	0	0	0	0-1
MS-IPv6-Filter	0	0+	0	0	0+
MS-IPv4-Remediation-Servers	0	0-1	0	0	0
MS-IPv6-Remediation-Servers	0	0-1	0	0	0
Not-Quarantine-Capable	0	0-1	0	0	0
MS-Quarantine-SoH	0-1	0-1	0	0	0
MS-RAS-Correlation-ID	0-1	0	0	0	0-1
MS-Extended-Quarantine-State	0	0-1	0	0	0
HCAP-User-Groups	0-1	0	0	0	0
HCAP-Location-Group-Name	0-1	0	0	0	0
HCAP-User-Name	0-1	0	0	0	0
MS-User-IPv4-Address	0-1	0	0	0	0
MS-User-IPv6-Address	0-1	0	0	0	0
MS-RDG-Device-Redirection	0	0-1	0	0	0

3.1.5.3 Processing RADIUS Attributes

As specified in [\[RFC2865\]](#) section 5, RADIUS clients and RADIUS servers SHOULD [≤6>](#) ignore VSAs with unknown types.

3.1.6 Timer Events

None.

3.1.7 Other Local Events

None.

3.2 Server Details

3.2.1 Abstract Data Model

The RADIUS Protocol is a stateless protocol, as specified in [\[RFC2865\]](#) section 2.5.

A RADIUS Access-Request is generated by a RADIUS client based on a user request to a NAS. The RADIUS server generates a response containing RADIUS attributes based on the policy settings on the RADIUS server.

ClientNapCompatibility Mapping: The server SHOULD maintain a mapping that establishes the correspondence between a client, identified by an IP address, and NAP compatibility of that client. The mapping is a list of (IpAddress, Boolean) pairs. For initialization information about this ADM element, see section [3.2.3](#).

PolicyConfiguration structure: A structure that contains the policy that has been configured by the network administrator. The fields of the structure are as follows:

- **RASClientName:** A list of NULL-terminated strings that is used to restrict the allowed computer names of the endpoint that is requesting access.
- **ServiceClass:** A list of NULL-terminated strings that is used to restrict the allowed names of the groups of DHCP scopes that the endpoint requesting access MUST correspond to.
- **NetworkAccessServerType:** A list of 32-bit unsigned integers in network byte order. The list is used to restrict the allowed types of the NAS that is sending RADIUS Access-Request messages. Possible values for list items are specified in section [2.2.1.11](#).
- **MachineName:** A list of octet strings containing characters from the Microsoft Windows® ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format. The list is used to restrict the allowed machine names of the endpoint that is requesting access.
- **HCAPUserGroup:** A list of octet strings containing characters from Windows ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format. The list is used to specify the group name to which an HCAP user belongs.
- **HCAPLocationGroupName:** A list of octet strings containing characters from Windows ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format. The list is used to specify the location group name for the HCAP entity.
- **HCAPUserName:** A list of octet strings containing characters from Windows ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)) in ANSI format. The list is used to specify the name for the HCAP user.
- **UserIPv4Address:** A list of 32-bit unsigned integers in network byte order. The list is used to restrict the allowed IPv4 addresses of the endpoint that is requesting access. Possible values for list items are specified in section [2.2.1.25](#).
- **UserIPv6Address:** A list of 128-bit unsigned integers in network byte order. The list is used to restrict the allowed Ipv6 addresses of the endpoint that is requesting access. Possible values for list items are specified in section [2.2.1.26](#).

3.2.2 Timers

No timers are required. For a discussion of retransmission hints, see the RADIUS Protocol documentation, as specified in [\[RFC2865\]](#).

3.2.3 Initialization

An administration agent of an **RNAP server** SHOULD allow configuring of NAP compatibility for clients. This configuration SHOULD be passed to the RADIUS server using the following abstract interface:

```
HRESULT SetClientNAPCompatibility([in] IPAddress clientAddress, [in] Boolean
isNAPCompatible);
```

The RADIUS server SHOULD store this configuration in the **ClientNapCompatibility Mapping** ADM element. For more information about this ADM element, see section [3.2.1](#).

The RNAP server uses the policy configuration for the RADIUS authorization. This configuration is maintained in an XML file on the server machine and is loaded into the **PolicyConfiguration structure** that is specified in section [3.2.1](#) when the server starts. The configuration is updated by the network administrator.

3.2.4 Higher-Layer Triggered Events

The RADIUS exchange is triggered by an Access-Request message sent from a NAS as described in [RFC2865](#) section 2.

3.2.4.1 Abstract Interface for Setting an SoHR

SendRadiusAccessAccept: An abstract interface for setting a **statement of health response (SoHR)** message and additional information to be encapsulated in an Access-Accept message that is sent to the PEP server, as described in [MS-NAPSO](#) section 10.3.8. The interface is defined as follows. Encapsulating this information in the Access-Accept message is described in section [3.2.5.2](#).

```
HRESULT SendRadiusAccessAccept(    [in] SoHR message,    [in] DWORD quarantineState,    [in]
DWORD extendedQuarantineState,    [in] IPv4Filter ipv4Filter,    [in] IPv6Filter ipv6Filter,
[in] DWORD quarantineSessionTimeout,    [in] DWORD quarantineGraceTime,    [in] IPv4Address[]
ipv4RemediationServers,    [in] IPv6Address[] ipv6RemediationServers,    [in] String
dhcpQuarantineUserClass,    [in] DWORD rdgDeviceRedirection,    [in] DWORD afwZone,    [in]
DWORD afwProtectionLevel);
```

Unless otherwise specified, all multibyte elements are in host-byte order.

The following abstract type definitions are common to several parameters.

```
enum LateBoundFlags{    NoReplacement = 0x00,    ReplaceSourceAddress = 0x01,
ReplaceDestinationAddress = 0x04,    ReplaceSourceMaskOrPrefix = 0x10,
ReplaceDestinationMaskOrPrefix = 0x20,}enum ForwardAction{    Forward = 0,    Drop = 1}struct
IPv4Address{    Byte[4] bytes;}struct IPv6Address{    Byte[16] bytes;}
```

The remainder of this section describes the individual parameters of the SendRadiusAccessAccept abstract interface.

message: Opaque binary data containing the SoHR message.

```
struct SoHR{    Byte[] bytes;}
```

quarantineState: A DWORD value that specifies the quarantine state, as described in [\[MS-SOH\]](#) section 2.2.4.2.

extendedQuarantineState: A DWORD value that specifies the extended quarantine state, as described in [\[MS-SOH\]](#) section 2.2.4.2.

ipv4Filter: An object of an IPv4Filter abstract type that specifies the network access scope of the endpoint. The IPv4Filter abstract type is defined as follows.

```
struct Filter_IPv4{    IPv4Address sourceAddress;    IPv4Address sourceMask;    IPv4Address destinationAddress;    IPv4Address destinationMask;    DWORD protocol;    DWORD lateBoundFlags; // Bitwise combination of LateBoundFlags values}struct FilterSet{ForwardAction forwardAction;    Filter_IPv4[] filters;}enum InfoType_IPv4{    InputFilter = 0xffff0001,    OutputFilter = 0xffff0002,    SiteToSiteConnection = 0xffff0009}struct FilterSetEntry_IPv4{    InfoType_IPv4 infoType;    FilterSet_IPv4[] filterSets;}struct IPv4Filter{    FilterSetEntry_IPv4[] filterEntries;}
```

For more information about the meaning of individual fields and values, see section [2.2.1.3](#).

ipv6Filter: An object of an IPv6Filter abstract type that specifies the network access scope of the endpoint. The IPv6Filter abstract type is defined as follows.

```
struct Filter_IPv6{    IPv6Address sourceAddress;    DWORD sourcePrefixLength;    IPv6Address destinationAddress;    DWORD destinationPrefixLength;    DWORD protocol;    DWORD lateBoundFlags; // Bitwise combination of LateBoundFlags values}struct FilterSet_IPv6{ForwardAction forwardAction;    Filter_IPv6[] filters;}enum InfoType_IPv6{    InputFilter = 0xffff0011,    OutputFilter = 0xffff0012}struct FilterSetEntry_IPv6{    InfoType_IPv6 infoType;    FilterSet_IPv6[] filterSets;}struct IPv6Filter{    FilterSetEntry_IPv6[] filterEntries;}
```

For more information about the meaning of individual fields and values, see section [2.2.1.15](#).

quarantineSessionTimeout: A DWORD value that specifies the time, in seconds, that a restricted connection can remain in a restricted state before being disconnected.

quarantineGraceTime: A DWORD value that specifies the end of the time period during which a noncompliant endpoint can get full access before being moved to a restricted connection. The time is represented as the number of seconds since January 1, 1970 UTC.

ipv4RemediationServers: An array of objects of the IPv4Address abstract type (defined earlier in this section) that specifies the addresses of available IPv4 remediation servers.

ipv6RemediationServers: An array of objects of the IPv6Address abstract type (defined earlier in this section) that specifies the addresses of available IPv6 remediation servers.

dhcpQuarantineUserClass: A string that specifies the user class to be used when assigning an IP address to an endpoint that has been granted restricted access. This parameter is applicable only when the client is a DHCP server. Otherwise, it should be ignored.

rdgDeviceRedirection: A DWORD value that specifies the device redirection options. For more information about possible values, see section [2.2.1.27](#). This parameter is applicable only when the client is an RDG server. Otherwise, it should be ignored.

afwZone: A DWORD value that specifies the NAP zone, as described in [\[MS-HCEP\]](#). This parameter is applicable only when the client is an HCEP server. Otherwise, it should be ignored.

afwProtectionLevel: A DWORD value that specifies the NAP protection level, as described in [MS-HCEP]. This parameter is applicable only when the client is an HCEP server. Otherwise, it should be ignored.

Remarks:

Note that the correlation ID is included in the SoHR as specified in [MS-SOH]. The authentication is independent of the SoHR. It is handled by the underlying RADIUS protocol implementation and is outside the scope of this document.

3.2.5 Message Processing Events and Sequencing Rules

In general, RADIUS messages are handled as described in section [3.1.5](#). The following subsections describe details applicable to RADIUS servers.

RADIUS servers are responsible for receiving endpoint connection requests from NASs, authenticating the user and/or computer, and authorizing the endpoint. The RADIUS server responds to the NAS with a set of RADIUS attributes that place restrictions on, or otherwise specify requirements for, the connectivity that the NAS grants to the endpoint.

An RNAP server receives an SoH within an Access-Request message. An SoHR is generated based on the SoH, and the policy is sent in an Access-Accept message, as specified in section [3.2.4.1](#). The following subsections describe the processing of Access-Request messages and the construction of Access-Accept messages.

3.2.5.1 Processing RADIUS Access-Request Messages

When an RNAP server receives an Access-Request message sent from a NAS (as specified in [\[RFC2865\]](#)) that contains NAP-specific VSAs, every VSA is processed as described in the following sections.

3.2.5.1.1 MS-RAS-Client-Name

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.RASClientName** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match is not found, the server SHOULD send an Access-Reject message to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.1](#).

3.2.5.1.2 MS-RAS-Client-Version

When the RADIUS server receives this attribute, it uses the value of this VSA to log the NAS version that sent the access request.

For more details about this attribute, see section [2.2.1.2](#).

3.2.5.1.3 MS-User-Security-Identity

If the RADIUS User-Name attribute ([\[RFC2865\]](#) section 5.1) is found in the request, the RADIUS server MUST ignore this attribute. Otherwise, the RADIUS server SHOULD convert the SID to a Fully Qualified User Name using **Active Directory Domain Services (AD DS)**. Once the Fully Qualified User Name is available, the server MUST follow the same processing rules specified in section [3.2.5.1.1](#). If the server fails to obtain the Fully Qualified User Name from AD DS, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see [2.2.1.5](#).

3.2.5.1.4 MS-Identity-Type

This attribute indicates whether a RADIUS server should perform only a machine health check (as specified in [\[MS-SOH\]](#)).

If a RADIUS server receives this attribute and its value is 0x00000001, the RADIUS server MUST NOT perform authentication; instead, it MUST perform a machine health check on this request. If a RADIUS server receives this attribute and its value is not 0x00000001, or a RADIUS server does not receive this attribute at all, it SHOULD perform authentication as well as a machine health check on this request.

The machine health check should be performed as specified in [\[MS-SOH\]](#), using the SoH statement received either in the MS-Quarantine-SoH attribute (see section [3.2.5.1.8](#)) or inside the **Extensible Authentication Protocol (EAP)** packet (see [\[MS-PEAP\]](#) section 2.2.8.2.2).

For more details about this attribute, see section [2.2.1.6](#).

3.2.5.1.5 MS-Service-Class

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.ServiceClass** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match is not found, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.7](#).

3.2.5.1.6 MS-Network-Access-Server-Type

When the **RADIUS server** receives this VSA, it MUST search the **PolicyConfiguration.NetworkAccessServerType** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match was not found, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.11](#).

3.2.5.1.7 MS-Machine-Name

If a RADIUS server receives this attribute, it SHOULD determine the machine groups to which the machine specified in the attribute belongs, and it MUST search the **PolicyConfiguration.MachineName** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match was not found, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.14](#).

3.2.5.1.8 MS-Quarantine-SoH

This attribute carries the SoH from the endpoint (specified in [\[MS-SOH\]](#)) when the Extensible Authentication Protocol (EAP) is not used.

The RADIUS server MUST pass the value of the SoH payload as a parameter to the Receive SoH Task described in [\[MS-NAPSO\]](#) section 8.

For more details about this attribute, see section [2.2.1.19](#).

3.2.5.1.9 MS-RAS-Correlation-ID

A RADIUS client MAY include this GUID value attribute in Access-Request or Accounting-Request RADIUS [\[RFC2865\]](#) messages to uniquely identify a session. The server SHOULD use the value of this attribute, if present, for correlation of log events. <7>

For more details about this attribute, see section [2.2.1.20](#).

3.2.5.1.10 HCAP-User-Groups

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.HCAPUserGroup** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match is not found, the server SHOULD send an Access-Reject message to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.22](#).

3.2.5.1.11 HCAP-Location-Group-Name

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.HCAPLocationGroupName** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match is not found, the server SHOULD send an Access-Reject message to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.23](#).

3.2.5.1.12 HCAP-User-Name

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.HCAPUserName** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match was not found, the server SHOULD send an Access-Reject message to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.24](#).

3.2.5.1.13 MS-User-IPv4-Address

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.UserIPv4Address** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match was not found, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.25](#).

3.2.5.1.14 MS-User-IPv6-Address

When the RADIUS server receives this VSA, it MUST search the **PolicyConfiguration.UserIPv6Address** ADM element specified in section [3.2.1](#) for the value of the VSA. If a match is not found, the server SHOULD send an Access-Reject message back to the NAS and stop processing.

For more details about this attribute, see section [2.2.1.26](#).

3.2.5.1.15 Tunnel-Type

A RADIUS server MUST process the Tunnel-Type RADIUS attribute as specified in [\[RFC2868\]](#), with one additional enhancement: if the value of the Tunnel-Type RADIUS attribute is 0x00013701, it SHOULD be taken as a hint to the RADIUS server that the tunneling protocol supported by the tunnel endpoint is SSTP. <8>

When the RADIUS server receives this attribute, it checks the policy that has been configured by the server administrator. If configured to do so, the RADIUS server uses the value of this attribute to authorize the request.

For more details about this vendor-specific value for the Tunnel-Type RADIUS attribute, see section [2.2.2.1](#).

3.2.5.2 Creating RADIUS Access-Accept Messages

When an RNAP server's SendRadiusAccessAccept abstract interface is called, the RNAP server MUST create an Access-Accept message. It SHOULD add relevant NAP-specific VSAs as described in the following subsections. Such a RADIUS server SHOULD look up the RADIUS client's IP address in the **ClientNapCompatibility Mapping** ADM element and check the client's NAP compatibility. If the client is not NAP-compatible, the server SHOULD NOT include in the response any NAP-specific quarantine attributes. For more information about the **ClientNapCompatibility Mapping** ADM element, see section [3.2.1](#). <9>

If the RADIUS server does not support NAP machine-health checks or if the machine health was not evaluated, the attributes described in this section MUST NOT be used.

3.2.5.2.1 MS-Quarantine-IPFilter

If the *ipv4Filter* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a filter, the RADIUS server MUST add the MS-Quarantine-IPFilter attribute to the Access-Accept message in order to specify the network access scope of the endpoint. This attribute is constructed as described in section [2.2.1.3](#). The attribute-specific value is obtained by serializing the *ipv4Filter* parameter to the format described in that section.

3.2.5.2.2 MS-Quarantine-Session-Timeout

If the *quarantineSessionTimeout* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a time-out, the RADIUS server MUST add the MS-Quarantine-Session-Timeout attribute to the Access-Accept message in order to specify the time that a restricted connection can remain in a restricted state before being disconnected. This attribute is constructed as described in section [2.2.1.4](#). The attribute-specific value is obtained by converting the *quarantineSessionTimeout* parameter to network byte order.

3.2.5.2.3 MS-Quarantine-User-Class

If the *dhcpQuarantineUserClass* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a user class and the RADIUS client is a DHCP server, the RADIUS server MUST add the MS-Quarantine-User-Class attribute to the Access-Accept message in order to specify the user class to be used when assigning an IP address to an endpoint that has been granted restricted access. This attribute is constructed as described in section [2.2.1.8](#). The attribute-specific value is obtained by serializing the *dhcpQuarantineUserClass* parameter to the format described in that section.

If the client is not a DHCP server, this attribute MUST NOT be used.

3.2.5.2.4 MS-Quarantine-State

The RADIUS server MUST add the MS-Quarantine-State attribute to the Access-Accept message in order to specify the network access level that the RADIUS server authorizes for the endpoint. This attribute is constructed as described in section [2.2.1.9](#). The attribute-specific value is obtained by converting the *quarantineState* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) to network byte order.

3.2.5.2.5 MS-Quarantine-Grace-Time

If the *quarantineGraceTime* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a grace time, the RADIUS server SHOULD add the MS-Quarantine-Grace-Time attribute to the Access-Accept message in order to specify the end of the time period during which the noncompliant endpoint can have full access before being moved to a restricted connection. This attribute is constructed as described in section [2.2.1.10](#). The attribute-specific value is obtained by converting the *quarantineGraceTime* parameter to network byte order.

3.2.5.2.6 MS-AFW-Zone

If the *afwZone* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a zone, and if the RADIUS client is an HCEP server [\[MS-HCEP\]](#), the RADIUS server MUST add the MS-AFW-Zone attribute to the Access-Accept message in order to specify the NAP zone. This attribute is constructed as described in section [2.2.1.12](#). The attribute-specific value is obtained by converting the *afwZone* parameter to network byte order.

If the client is not an HCEP server, this attribute MUST NOT be used.

3.2.5.2.7 MS-AFW-Protection-Level

If the *afwProtectionLevel* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a protection level, and if the RADIUS client is an HCEP server [\[MS-HCEP\]](#), the RADIUS server MUST add the MS-AFW-Protection-Level attribute to the Access-Accept message in order to specify the NAP protection level. This attribute is constructed as described in section [2.2.1.13](#). The attribute-specific value is obtained by converting the *afwProtectionLevel* parameter to network byte order.

If the client is not an HCEP server, this attribute MUST NOT be used.

3.2.5.2.8 MS-IPv6-Filter

If the *ipv6Filter* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies a filter, the RADIUS server MUST add the MS-IPv6-Filter attribute to the Access-Accept message in order to specify the network access scope of the endpoint. This attribute is constructed as described in section [2.2.1.15](#). The attribute-specific value is obtained by serializing the *ipv6Filter* parameter to the format described in that section.

3.2.5.2.9 MS-IPv4-Remediation-Servers

If the *ipv4RemediationServers* parameter of the SendRadiusAccessAccept abstract interface (section [3.2.4.1](#)) specifies remediation servers, the RADIUS server SHOULD add the MS-IPv4-Remediation-Servers attribute to the Access-Accept message in order to specify IPv4 remediation servers. This attribute is constructed as described in section [2.2.1.16](#). The attribute-specific value is obtained by serializing the *ipv4RemediationServers* parameter to the format described in that section.

3.2.5.2.10 MS-IPv6-Remediation-Servers

If the *ipv6RemediationServers* parameter of the *SendRadiusAccessAccept* abstract interface (section [3.2.4.1](#)) specifies remediation servers, the RADIUS server SHOULD add the MS-IPv6-Remediation-Servers attribute to the Access-Accept message in order to specify IPv6 remediation servers. This attribute is constructed as described in section [2.2.1.17](#). The attribute-specific value is obtained by serializing the *ipv6RemediationServers* parameter to the format described in that section.

3.2.5.2.11 Not-Quarantine-Capable

The RADIUS server SHOULD add the Not-Quarantine-Capable attribute to the Access-Accept message. The RADIUS server should set the value of the attribute to 0x00000001 if the server received an SoH payload (either in the [MS-Quarantine-SoH](#) attribute or inside the EAP payload). If the server did not receive an SoH payload, it SHOULD set the value to 0x00000000.

For more details about this attribute, see section [2.2.1.18](#).

3.2.5.2.12 MS-Quarantine-SoH

This attribute carries the SoH from the endpoint and the SoHR from the RADIUS server (as specified in [\[MS-SOH\]](#)) when the Extensible Authentication Protocol (EAP) is not used.

If EAP is not used, the RADIUS server MUST add the MS-Quarantine-SoH attribute to the Access-Accept message in order to transfer the SoHR. This attribute is constructed as described in section [2.2.1.19](#). The attribute-specific value is obtained by copying the *message* parameter of the *SendRadiusAccessAccept* abstract interface (section [3.2.4.1](#)).

3.2.5.2.13 MS-Extended-Quarantine-State

If the *extendedQuarantineState* parameter of the *SendRadiusAccessAccept* abstract interface (section [3.2.4.1](#)) specifies extended state, the RADIUS server MUST add the MS-Extended-Quarantine-State attribute to the Access-Accept message in order to specify additional information about a restricted access decision. This attribute is constructed as described in section [2.2.1.21](#). The attribute-specific value is obtained by converting the *extendedQuarantineState* parameter to network byte order.

3.2.5.2.14 MS-RDG-Device-Redirection

If the *rdgDeviceRedirection* parameter of the *SendRadiusAccessAccept* abstract interface (section [3.2.4.1](#)) specifies device redirection options, and if the client is an RDG server, the RADIUS server MUST add the MS-RDG-Device-Redirection attribute to the Access-Accept message in order to specify the device redirection options. This attribute is constructed as described in section [2.2.1.27](#). The attribute-specific value is obtained by converting the *rdgDeviceRedirection* parameter to network byte order.

3.2.6 Timer Events

No timer events are required for this protocol.

For a discussion on retransmission hints, see [\[RFC2865\]](#).

3.2.7 Other Local Events

None.

3.3 Client Details

3.3.1 Abstract Data Model

None.

3.3.2 Timers

No timers are required for this protocol.

For a discussion on retransmission hints, see [\[RFC2865\]](#).

3.3.3 Initialization

None.

3.3.4 Higher-Layer Triggered Events

The RADIUS exchange is triggered by an endpoint request to a NAS for network access.

3.3.4.1 Abstract Interface for Sending an SoH

SendRadiusAccessRequest: An abstract interface used by the NAS to send an SoH that was received from the PEP server as described in [\[MS-NAPSO\]](#) section 7.3.8. The interface is defined as follows.

```
HRESULT SendRadiusAccessRequest (    [in] SoH message      [in] String clientName,    [in]  
String clientVersion,    [in] SID securityIdentity,    [in] bool identityType,    [in] String  
serviceClass,    [in] DWORD networkAccessServerType,    [in] String machineName,    [in] GUID  
rasCorrelationId,    [in] IPv4Address userIpv4Address,    [in] IPv6Address userIpv6Address);  
);
```

Unless otherwise specified, all multibyte elements are in host-byte order and all strings are **Unicode** strings.

The remainder of this section describes the individual parameters of the SendRadiusAccessRequest abstract interface.

message: Binary data containing the SoH message.

The following is the description of the SoH structure.

```
struct SoH{    void *pData,    DWORD dataLength}pData: A pointer to opaque binary data that  
contains the SoH.dataLength: The number of bytes in the SoH data.
```

clientName: The name of the RAS client endpoint machine.[<10>](#)

clientVersion: The version of the RAS client on the endpoint machine.[<11>](#)

securityIdentity: A binary data structure containing the security identifier (SID) of the requesting user.

The following is a description of the SID structure:

```
struct SID{    Void* pSidData,    DWORD sidDataLength}pSidData: A pointer to opaque binary data that contains the SID.sidDataLength: The number of bytes in the SID data.
```

identityType: Indicates the type of authentication that the RADIUS server should perform. When this parameter is set to true, the RADIUS server MUST NOT perform authentication; instead, it MUST perform a machine health check on this request. If this parameter is set to false, the RADIUS server SHOULD perform authentication as well as a machine health check on this request.

serviceClass: The name of a group of DHCP scopes that correspond to the endpoint that is requesting access. This parameter MUST be set to NULL in the case where the calling NAS is not a DHCP server.

networkAccessServerType: This parameter MUST indicate the type of the NAS according to section [2.2.1.11](#).

machineName: The machine name of the endpoint that is requesting network access. [<12>](#)

rasCorrelationId: A GUID value sent in the RADIUS [\[RFC2865\]](#) Access-Request or Accounting-Request messages to uniquely identify a RADIUS session. See section [3.2.5.1.9](#) for additional information.

The RRAS server maintains a correlation ID property in its communication with the RRAS client in order to be able to set the MS-RAS-Correlation-ID attribute (section [3.3.5.1.9](#)) with the value of the RRAS correlation ID. [<13>](#)

userIpv4Address: A NAS sets this parameter with the value of the IPv4 address of the endpoint requesting network access.

The following is the structure definition of this parameter:

```
struct IPv4Address{    Byte[4] bytes;}
```

userIpv6Address: A NAS that supports IPv6 sets this attribute with the value of the IPv6 address of the endpoint requesting network access. [<14>](#)

A NAS that does not support IPv6 MUST set all the bytes of the structure to zero.

The following is the structure definition of this parameter.

```
struct IPv6Address{    Byte[16] bytes;}
```

Remarks:

Note that the correlation ID is included in the SoH as specified in [\[MS-SOH\]](#). The authentication is independent of the SoH. It is handled by the underlying RADIUS protocol implementation and is outside the scope of this document.

3.3.5 Message Processing Events and Sequencing Rules

In general, RADIUS messages are handled as described in section [3.1.5](#). The following subsections describe details applicable to RADIUS clients.

A NAS operates as a client of RADIUS. The RADIUS client is responsible for passing user information to its designated RADIUS server and then acting on the response that is returned.

3.3.5.1 Creating RADIUS Access-Request Messages

When an **RNAP client's** `SendRadiusAccessRequest` abstract interface is called, the RNAP client MUST create an Access-Request message. It SHOULD add relevant NAP-specific attributes as described in the following subsections.

3.3.5.1.1 MS-RAS-Client-Name

If the *clientName* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) is set to NULL, this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *clientName* parameter to the format described in section [2.2.1.1](#).

3.3.5.1.2 MS-RAS-Client-Version

If the *clientVersion* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) is set to NULL, this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *clientVersion* parameter to the format described in section [2.2.1.2](#).

3.3.5.1.3 MS-User-Security-Identity

If the RADIUS User-Name attribute ([\[RFC2865\]](#) section 5.1) is not found in the RADIUS access_request, the MS-User-Security-Identity attribute is used for authentication on the RADIUS server as specified in section [3.2.5.1.3](#).

If the RADIUS User-Name attribute ([\[RFC2865\]](#) section 5.1) is not NULL, this attribute MUST NOT be set.

If the **sidDataLength** field of the *securityIdentity* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) is set to zero, this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *securityIdentity* parameter to the format described in section [2.2.1.5](#).

3.3.5.1.4 MS-Identity-Type

If the *identityType* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) is set to false, this attribute MUST NOT be set. Otherwise, the attribute-specific value is set to 0x00000001 according to the format described in section [2.2.1.6](#).

3.3.5.1.5 MS-Service-Class

If the *serviceClass* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) is set to NULL, this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *serviceClass* parameter to the format described in section [2.2.1.7](#).

3.3.5.1.6 MS-Network-Access-Server-Type

The attribute-specific value is obtained by serializing the *networkAccessServerType* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) to the format described in section [2.2.1.11](#).

3.3.5.1.7 MS-Machine-Name

The attribute-specific value is obtained by serializing the *machineName* parameter of the `SendRadiusAccessRequest` abstract interface (section [3.3.4.1](#)) to the format described in section [2.2.1.14](#).

3.3.5.1.8 MS-Quarantine-SoH

The attribute-specific value is obtained by serializing the *message* parameter of the SendRadiusAccessRequest abstract interface (section [3.3.4.1](#)) to the format described in section [2.2.1.19](#).

3.3.5.1.9 MS-RAS-Correlation-ID

If the *rasCorrelationId* parameter of the SendRadiusAccessRequest abstract interface (section [3.3.4.1](#)) is set to the NULL GUID (all bytes are set to zero), this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *rasCorrelationId* parameter to the format described in section [2.2.1.20](#).

3.3.5.1.10 HCAP-User-Groups

This VSA is used only by Cisco Network Admission Control. For additional information on HCAP, see [\[CM-HCAP\]](#).

3.3.5.1.11 HCAP-Location-Group-Name

This VSA is used only by Cisco Network Admission Control. For additional information on HCAP, see [\[CM-HCAP\]](#).

3.3.5.1.12 HCAP-User-Name

This VSA is used only by Cisco Network Admission Control. For additional information on HCAP, see [\[CM-HCAP\]](#).

3.3.5.1.13 MS-User-IPv4-Address

The attribute-specific value is obtained by serializing the *userIPv4Address* parameter of the SendRadiusAccessRequest abstract interface (section [3.3.4.1](#)) to the format described in section [2.2.1.25](#).

3.3.5.1.14 MS-User-IPv6-Address

If the *userIPv6Address* parameter of the SendRadiusAccessRequest abstract interface (section [3.3.4.1](#)) is set to a NULL address (all bytes are set to zero), this attribute MUST NOT be set. Otherwise, the attribute-specific value is obtained by serializing the *userIPv6Address* parameter to the format described in section [2.2.1.26](#).

3.3.5.1.15 Tunnel-Type

A RADIUS client MUST set the Tunnel-Type RADIUS attribute as specified in [\[RFC2868\]](#), with one additional enhancement: A VPN server that supports the Secure Socket Tunneling Protocol (SSTP) SHOULD use the vendor-specific value 0x00013701 for the RADIUS Tunnel-Type attribute in Access-Request messages that are sent to a RADIUS server, which indicates that the tunnels configured by it are as described in [\[MS-SSTP\].<15>](#)

For more details about this vendor-specific value for the Tunnel-Type RADIUS attribute, see section [2.2.2.1](#).

3.3.5.2 Processing RADIUS Access-Accept Messages

3.3.5.2.1 MS-Quarantine-IPFilter

When a NAS that supports this attribute [<16>](#) receives it, the NAS MUST apply the filters defined in this attribute on the endpoint connection.

For the late bound field, this is used to allow a NAS to change a field in the filter after the connection with the endpoint is complete. For example, the attribute would be configured for "ANY" to be used as the source address. The filter is implemented on the NAS as ANY. When the connection with the endpoint completes and the client is assigned an address, the filter should be replaced with a specific value.

For more details about this attribute, see section [2.2.1.3](#).

3.3.5.2.2 MS-Quarantine-Session-Timeout

When a NAS that supports this attribute receives the attribute, it applies a time-out for the endpoint client connection set to the attribute's value, in seconds.

If the same endpoint client later gets an Access-Accept without this attribute (unrestricted), the time-out is dropped.

If the time-out expires while the connection is still in restricted quarantine, the NAS disconnects the endpoint connection. [<17>](#)

Clients that do not support this attribute ignore it.

For more details about this attribute, see section [2.2.1.4](#).

3.3.5.2.3 MS-Quarantine-User-Class

This attribute is to be consumed by a DHCP RADIUS client only.

When a DHCP RADIUS client receives this attribute, it assigns the DHCP client to the DHCP user class specified by this attribute, as specified in [\[RFC3004\]](#).

Other RADIUS clients silently ignore this attribute.

For more information about this attribute, see section [2.2.1.8](#).

3.3.5.2.4 MS-Quarantine-State

When a network access server (NAS) receives this attribute, it assigns the restrictive state specified by this attribute (see [\[MS-SOH\]](#)) to the endpoint requesting access.

This attribute indicates the level of network access that the RADIUS server authorizes to the endpoint.

When an RNAP-aware DHCP server receives this attribute from an RNAP server in an Access-Accept message, it gives access rights accordingly to the endpoint requesting network access (for example, gives full access or restricted access).

If the value of the MS-Quarantine-State VSA indicates a restricted state, the RADIUS client MUST restrict the endpoint's network connectivity accordingly to locally configured policy and according to the following rules:

- The VPN server and Dial-up server MUST block all IP packets from the endpoint except for those specified in the MS-IPv4-Remediation-Servers (see section [3.3.5.2.9](#)) and MS-IPv6-Remediation-Servers (see section [3.3.5.2.10](#)) VSAs (if received).
- The DHCP server MUST assign host-specific routes to the DHCP client for the IP addresses specified in the MS-IPv4-Remediation-Servers (see section [3.3.5.2.9](#)) and MS-IPv6-Remediation-Servers (see section [3.3.5.2.10](#)) VSAs (if received). The DHCP server MUST NOT assign the client a default gateway.
- The health registration authority (HRA) MUST NOT issue a certificate to the endpoint.

If the value of the MS-Quarantine-State VSA is either "Full Access" or "On Probation", the RADIUS client MUST NOT restrict the network connectivity of the endpoint.

If the value of the MS-Quarantine-State VSA is "On Probation", the RADIUS client MUST do the following:

- The VPN or Dial-Up Server MUST disconnect the endpoint after the time specified in the MS-Quarantine-Grace-Time elapses.
- The DHCP server MUST ensure that the DHCP lease expires for the endpoint before or at the same time specified in the MS-Quarantine-Grace-Time (see section [3.3.5.2.5](#)) VSA.
- The HRA MUST ignore this attribute.

For more details about this attribute, see section [2.2.1.9](#).

3.3.5.2.5 MS-Quarantine-Grace-Time

When a NAS receives this attribute in an Access-Accept message, it applies a time-out to the endpoint requesting network access set to expire at the time given by the attribute's value.

The NAS gives full access to the endpoint as long as the time-out has not expired.

After the time-out expires, the NAS moves the client to a restricted quarantine connection.

If the NAS later gets another Access-Accept for this endpoint, the previous grace time-out is dropped. Either the endpoint will get unrestricted access or a new grace time-out will be applied if this attribute is set again.

For more details about this attribute, see section [2.2.1.10](#).

3.3.5.2.6 MS-AFW-Zone

This attribute is processed only by RADIUS clients that are configured to support NAPIsec policies.

When a network access server (NAS) that understands this attribute receives it in an Access-Accept from a RADIUS server, it uses the value of this attribute to select which NAP zone (see [\[MS-HCEP\]](#) and [\[MS-SOHI\]](#)) to put an endpoint to (for example, secure zone, boundary zone, or quarantine zone).

The NAS then sends the NAP zone to the endpoint using a mechanism that is understood by both NAS and the endpoint (for example, HCEP, as documented in [\[MS-HCEP\]](#) section 3.2.5.2), and applies the IPsec policy according to the new zone to this endpoint.

Other NAS RADIUS clients ignore this attribute.

For more details about this attribute, see section [2.2.1.12](#).

3.3.5.2.7 MS-AFW-Protection-Level

This attribute is processed only by RADIUS clients that are configured to support NAPIsec policies.

A NAS that receives this attribute from the RADIUS server in an Access-Accept message communicates to the endpoint, via a mechanism understood by both NAS and the endpoint, the protection level (see [\[MS-HCEP\]](#)) that it should use as indicated by this attribute.

RADIUS clients that are not configured to support IPsec policies ignore this attribute.

For more details about this attribute, see section [2.2.1.13](#).

3.3.5.2.8 MS-IPv6-Filter

Only the Microsoft Routing and Remote Access Service (RRAS) RADIUS client supports this attribute when configured to support RQS/RQC. If received by other RADIUS clients, it is silently discarded.

When a NAS that supports this attribute receives it, the NAS MUST apply the defined filters on the endpoint connection.

For the late bound field, this is used to allow a NAS to change a field in the filter after the connection with the endpoint is complete. For example, the attribute could be configured for "ANY" to be used as the source address. The filter is implemented on the NAS as ANY. When the connection with the endpoint completes and the client is assigned an address, the filter could be replaced with a specific value.

For more details about this attribute, see section [2.2.1.15](#).

3.3.5.2.9 MS-IPv4-Remediation-Servers

This attribute specifies the IPv4 addresses of the remediation servers. The first 8-bit unsigned integer, which is reserved and set to 0 by the RADIUS server, MAY be ignored by the RADIUS client.

When a NAS that understands this attribute receives it, it SHOULD [≤18>](#) authorize a restricted endpoint to access the IPv4 addresses carried in this attribute.

If the RADIUS client does not support this attribute or does not support the required service (restricting the endpoint's access to remediation servers either via configuration (for example, DHCP) or filtering (for example, RRAS)), then it SHOULD ignore this attribute.

For more details about this attribute, see section [2.2.1.16](#).

3.3.5.2.10 MS-IPv6-Remediation-Servers

This attribute specifies the IPv6 addresses of the remediation servers. The first 8-bit unsigned integer, which is reserved and set to 0 by the RADIUS server, MAY be ignored by the RADIUS client.

When a NAS that understands this attribute receives it, it SHOULD authorize a restricted endpoint to access the IPv6 addresses carried in this attribute.

A RADIUS client that does not implement this attribute or does not support the requested service (restriction of endpoint access to remediation servers) SHOULD ignore this attribute.

For more details about this attribute, see section [2.2.1.17](#).

3.3.5.2.11 Not-Quarantine-Capable

This attribute indicates whether or not the endpoint requesting network access is Network Access Protection (NAP)–capable.

When a NAS receives this attribute from an RNAP server, it can determine if the endpoint requesting networking access sent an SoH. A NAS supporting the VSAs specified in this document that receives a Not-Quarantine-Capable Attribute with a value indicating that the SoH was not sent (0x00000000) SHOULD NOT send NAP-related information to the endpoint.

A RADIUS client that does not implement this attribute or does not support the requested service (restriction of access based on NAP-capability) SHOULD ignore this attribute.

For more details about this attribute, see section [2.2.1.18](#).

3.3.5.2.12 MS-Quarantine-SoH

This attribute carries SoHR information (as specified in [\[MS-SOH\]](#)) when EAP is not used. The RADIUS client MUST pass the value of the attribute to the Proxy SoHR Task described in [\[MS-NAPSO\]](#) section 12.

For more details about this attribute, see section [2.2.1.19](#).

3.3.5.2.13 MS-Extended-Quarantine-State

When a NAS receives this attribute, it MUST assign the extended Quarantine state specified by this attribute, as specified in [\[MS-SOH\]](#), to the client requesting access. This attribute is used in NAP scenarios.

This attribute further qualifies the level of network access that the RADIUS server authorizes to the endpoint. When a network access server receives this attribute from a RADIUS server in an Access-Accept message, it MAY combine the value of this attribute with the value of MS-Quarantine-State attribute in an implementation specific manner.[<19>](#)

For more details about this attribute, see section [2.2.1.21](#).

3.3.5.2.14 MS-RDG-Device-Redirection

This attribute is consumed only by the Microsoft Remote Desktop Gateway RADIUS client.

When a Microsoft RDG server receives this attribute in an Access-Accept message, it applies the device redirection functionality indicated by the bits set in the attribute's value. For the meaning of the bits, see section [2.2.1.27](#).

If bit 29 (disable all devices) is set, the client disables device redirection for all devices, regardless of the value of bit 30 (enable all devices) and bits 0–4 (disable a particular device).

If bit 29 is not set but bit 30 is set, the client enables device redirection for all devices, regardless of the value of bits 0–4.

A NAS that is not a Microsoft RDG server ignores this attribute.

For more details about this attribute, see section [2.2.1.27](#).

3.3.5.3 Processing RADIUS Access-Reject Messages

No **RNAP** attributes are present in Access-Reject messages.

3.3.6 Timer Events

No timer events are required for this protocol.

For a discussion on retransmission hints, see [\[RFC2865\]](#).

3.3.7 Other Local Events

None.

4 Protocol Examples

The following sections describe several operations as used in common scenarios to illustrate the function of the RADIUS Protocol.

4.1 VPN Connection with RQC/RQS Quarantine

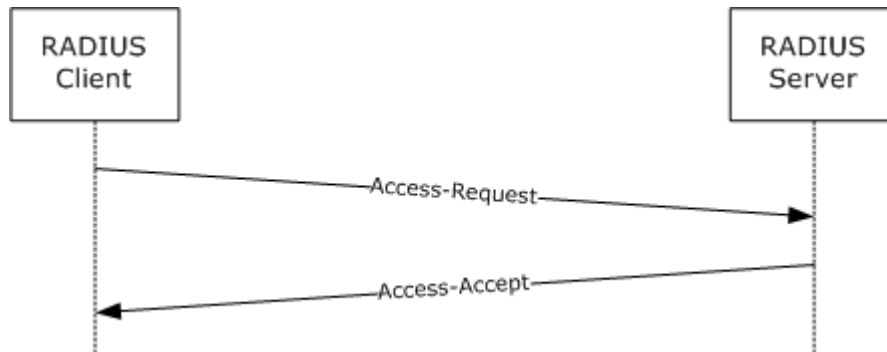


Figure 2: VPN Connection with RQC/RQS Quarantine example

In this example, a RAS server is configured as a RADIUS client to use RADIUS as the authentication, authorization, and accounting protocol to a RADIUS server. Based on the data known to RAS, the RAS server formulates an Access-Request packet as follows:

- Attribute 0: NAS-Identifier = NAS Computer Name
- Attribute 1: MS-RAS-Client-Name = MSRAS-0-<NAS Client ComputerName>
- Attribute 2: MS-RAS-Client-Version = MSRASV5.20
- Attribute 3: NAS-IP-Address = IP address of the RAS server
- Attribute 4: Service-Type = Framed OR Callback Framed
- Attribute 5: Framed-Protocol = PPP
- Attribute 6: NAS-port = Port number
- Attribute 7: NAS-port-Type = Virtual
- Attribute 8: Calling-Station-ID = NAS client IP address
- Attribute 9: Tunnel-Type = PPTP/L2TP/SSTP
- Attribute 10: Tunnel-Medium-Type = IP
- Attribute 11: Tunnel-Client-Endpoint = NAS client IP address
- Attribute 12: MS-RAS-Version = MSRASV5.20

This is forwarded to the RADIUS server. The RADIUS server authenticates and authorizes the request. Based on the RADIUS server configuration, it responds with an Access-Accept packet with the following attributes:

- Attribute 0: MS-Quarantine-State = 0 [Full access]

- Attribute 1: MS-Quarantine-Session-Timeout = Time in seconds
- Attribute 2: MS-Quarantine-IPFilter = List of IPv4 traffic filters
- Attribute 3: MS-Filter = List IPv4 traffic filters
- Attribute 4: MS-IPv6-Filter = List IPv6 traffic filters
- Attribute 5: Tunnel-Type = List of tunnel types (PPTP/L2TP)

Note: Attributes 5 would be in the Access-Accept packet, provided they are set in the Settings placeholder other than the Conditions place holder for the relevant Network Policy configured on a RADIUS server.

For more information on RQC/RQS Quarantine, see [\[MSFT-NAQC\]](#).

4.2 Health Registration Authority (HRA)

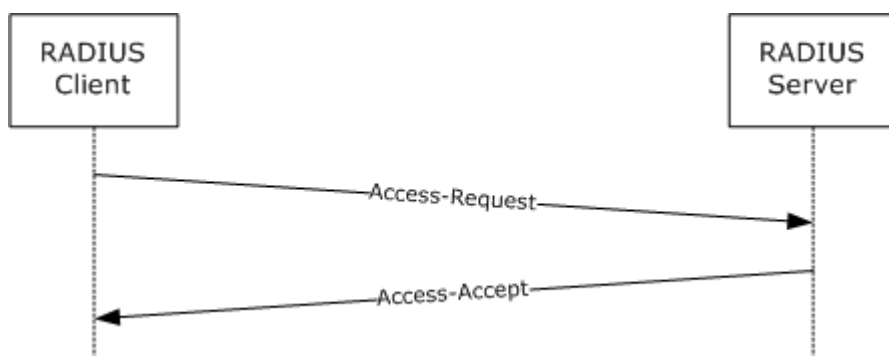


Figure 3: Health Registration Authority (HRA) example

In this example, an HRA is configured as a RADIUS client to use RADIUS as the authentication, authorization, and accounting protocol to a RADIUS server. Based on data collected from the access client, the HRA formulates an Access-Request packet as follows:

- Attribute 0: MS-Network-Access-Server-Type = 5 HRA
- Attribute 1: Acct-Session-Id = Transaction-id
- Attribute 2: Service-Type = Authorize-only
- Attribute 3: MS-Identity-Type = Machine health check
- Attribute 4: NAS-Port-Type = Ethernet
- Attribute 5: MS-Attribute-Machine-Name = The client's FQDN in ASCII characters with ANSI code page.
- Attribute 6: MS-SoH-Payload-Type = SoH blob
- Attribute 7: NAS-Identifier-Type = HCS server FQDN in ASCII characters with the code page to be the current system Microsoft Windows® ANSI code page (see [\[MSDN-ANSI-CODEPAGE\]](#)).
- Attribute 8: NAS-Ip-Address = Server address

This is forwarded to the RADIUS server where the RADIUS server authenticates and authorizes the request. Based on the RADIUS server configuration, it responds with an Access-Accept packet with the following attributes:

- Attribute 0: MS-Quarantine-State = Full access
- Attribute 1: MS-AFW-Zone = Non-Boundary
- Attribute 2: MS-AFW-Protection-Level = Encrypted

4.3 DHCP NAP

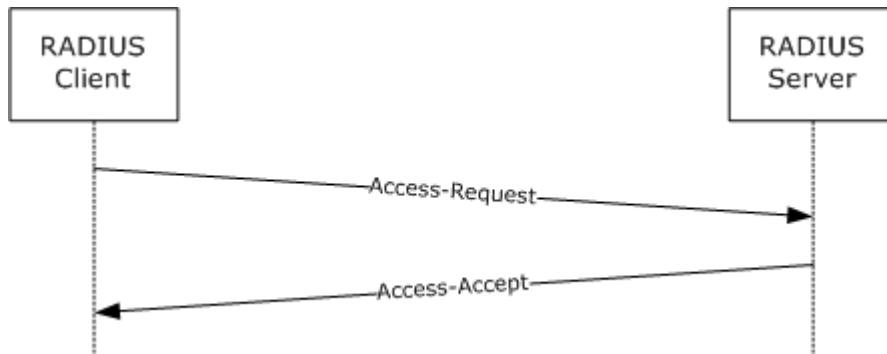


Figure 4: DHCP NAP example

In this example, a DHCP Server is configured as a RADIUS client to use RADIUS as the authentication, authorization, and accounting protocol to a RADIUS server. Based on data collected from the endpoint, the DHCP Server formulates an Access-Request packet as follows:

- Attribute 0: MS-Network-Access-Server-Type = 3 (DHCP)
- Attribute 1: Acct-Session-Id = Transaction-id
- Attribute 2: Service-Type = Authorize-only
- Attribute 3: MS-Identity-Type = Machine health check
- Attribute 4: NAS-Port-Type = Ethernet
- Attribute 5: MS-Attribute-Machine-Name = The client's FQDN in ANSI
- Attribute 6: MS-SoH-Payload-Type = SoH blob
- Attribute 7: NAS-Identifier-Type = HCS server FQDN in ANSI
- Attribute 8: NAS-Ip-Address = Server address
- Attribute 9: MS-Service-Class = DHCP service class

This is forwarded to the RADIUS server where the RADIUS server authenticates and authorizes the request. Based on the RADIUS server configuration, it responds with an Access-Accept packet with the following attributes:

- Attribute 0: MS-Quarantine-State = Full access
- Attribute 1: MS-IPv4-Remediation-Servers = List of IPv4 addresses

- Attribute 2: MS-Quarantine-User-Class = User class

4.4 VPN NAP

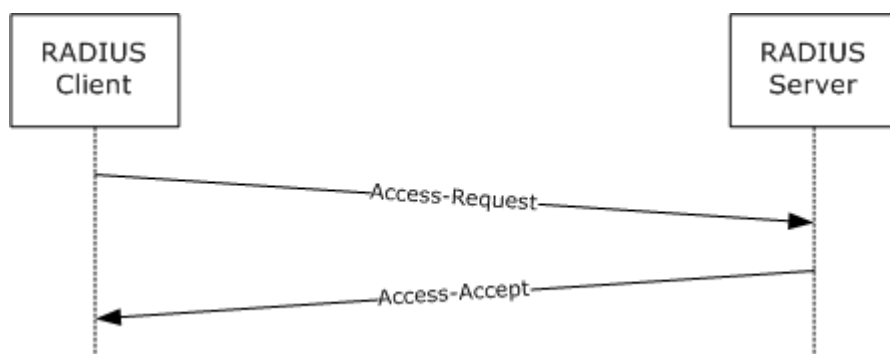


Figure 5: VPN NAP example

In this example, a RAS server is configured as a RADIUS client to use RADIUS as the authentication, authorization, and accounting protocol to a RADIUS server. Based on the data known to RAS, RAS server formulates an Access-Request packet as follows:

- Attribute 0: NAS-Identifier = NAS computer name
- Attribute 1: NAS-IP-Address = IP address of the RAS server
- Attribute 2: Service-Type = Framed OR Callback Framed
- Attribute 3: Framed-Protocol = PPP
- Attribute 4: NAS-port = Port number
- Attribute 5: NAS-port-Type = Virtual
- Attribute 6: Calling-Station-Id = NAS client IP address
- Attribute 7: Tunnel-Type = PPTP/L2TP/SSTP
- Attribute 8: Tunnel-Medium-Type = IP
- Attribute 9: Tunnel-Client-Endpoint = NAS client IP address
- Attribute 10: MS-RAS-Version = MSRASV5.20
- Attribute 11: MS-Network-Access-Server-Type = 2 [RAS]

This is forwarded to the RADIUS server. The RADIUS server authenticates and authorizes the request. Based on the RADIUS server configuration, it responds with an Access-Accept packet with the following attributes:

- Attribute 0: MS-Quarantine-State = 1 [Restricted Access]
- Attribute 1: MS-Quarantine-Session-Timeout = Time in seconds
- Attribute 2: MS-Filter = List IPv4 traffic filters (the structure of MS-Filter is identical to the structure of MS-Quarantine-IPFilter, as specified in [section 2.2.1.3](#)).

- Attribute 3: MS-IPv6-Filter = List IPv6 traffic filters
- Attribute 4: MS-IPv4-Remediation-Servers= List of IPv4 Addresses
- Attribute 5: MS-IPv6-Remediation-Servers= List of IPv6 Addresses
- Attribute 6: Tunnel-Type = List of tunnel types (PPTP/L2TP)

Note: Attributes 6 would be in the Access-Accept packet, provided they are set in the Settings place holder other than the Conditions place holder for the relevant Network Policy configured on RADIUS server.

5 Security

5.1 Security Considerations for Implementers

The Microsoft RADIUS VSAs rely on the security of the RADIUS Protocol in which they are transported. There are many security considerations for the RADIUS Protocol, as specified in [\[RFC2865\]](#) section 8 and [\[RFC3579\]](#) section 4. It is best to deploy RADIUS over IPsec (as specified in [\[RFC3579\]](#) section 4.2) to mitigate the potential attacks against RADIUS alone.

Recommendations exist to mitigate most of the attacks against RADIUS. However, it cannot be assumed that these recommendations are universally deployed. As a result, in some environments, it is possible for an attacker to tamper with or spoof the RADIUS VSAs.

Implementers should perform validation checks against all VSAs received to prevent remote protocol parsing attacks. These validation checks will include, but are not necessarily limited to, the following:

1. Ensuring that the VSA lengths fit within the containing RADIUS attribute.
2. Ensuring that the VSA lengths fit within the RADIUS packet itself.
3. Ensuring that all field values fall within acceptable ranges.

In addition, implementers can support a mode of operation wherein RADIUS will not be sent or received unless protected by IPsec, as specified in [\[RFC3579\]](#) section 4.2.[<20>](#)

5.2 Index of Security Parameters

Security parameter	Section
MS-User-Security-Identity	2.2.1.5

6 Appendix A: Product Behavior

The information in this specification is applicable to the following Microsoft products or supplemental software. References to product versions include released service packs:

- Microsoft Windows® 2000 operating system
- Windows® XP operating system
- Windows Server® 2003 operating system
- Windows Vista® operating system
- Windows Server® 2008 operating system
- Windows® 7 operating system
- Windows Server® 2008 R2 operating system

Exceptions, if any, are noted below. If a service pack or Quick Fix Engineering (QFE) number appears with the product version, behavior changed in that service pack or QFE. The new behavior also applies to subsequent service packs of the product unless otherwise specified. If a product edition appears with the product version, behavior is different in that product edition.

Unless otherwise specified, any statement of optional behavior in this specification that is prescribed using the terms SHOULD or SHOULD NOT implies product behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term MAY implies that the product does not follow the prescription.

[<1> Section 2.2.1.1:](#) Windows endpoints always use the format MS-RAS-x-<RAS Client Computer Name> (for example, MS-RAS-0-Laptop where "Laptop" is the name of the computer). The value of x is either 0 or 1, where 0 indicates that the messenger service is not running on the endpoint machine and 1 indicates that the messenger service is running. This information is useful to decide whether the Microsoft RRAS Administrator can send messages to the user by using messenger service. (This is a UI/API option to "Send Messages to User" in Windows NT, Windows 2000, Windows XP, and Windows Server 2003.) Also note that this service is deprecated in Windows Server 2008 and Windows Vista and PPP always sends "MSRAS-0<>" on a Windows Vista client. For Windows Messenger Service, see [\[MS-MSRP\]](#).

[<2> Section 2.2.1.2:](#) For Windows XP, the **Attribute-Specific Value** is "MSRASV5.10" and for Windows Vista, this value is "MSRASV5.20"

[<3> Section 2.2.1.15:](#) When Windows is operating as a NAS in a RAS server or VPN server role, the late bound flag uses the late bound flag in the following way:

1. An endpoint initiates a connection to a NAS.
2. The NAS forwards the connection request to the RADIUS server using an access-request message.
3. The RADIUS server processes the request and returns an access-accept message that contains the MS-IPv6-Filter attribute with a list of filters.
4. The NAS implements the filter list for the endpoint connection and begins filtering traffic.

5. The NAS and endpoint complete the connection request and the endpoint receives IP address information for the RAS connection.
6. The NAS uses the IP addresses to alter the implemented filter list for the client connection. The filter list, if modified, based on the Late Bound flag is as follows:
 - 0x00000001: The source address is replaced with the address assigned to the endpoint.
 - 0x00000004: This is not implemented in Windows.
 - 0x00000010: The source prefix is replaced with 64.

<4> [Section 2.2.2.1](#): Only Windows Server 2008 R2RADIUS servers support this vendor-specific value for the RADIUS Tunnel-Type attribute.

<5> [Section 3.1.5.1](#): The Remote Authentication Dial-In User Service (RADIUS) Protocol standard, as specified in [\[RFC2865\]](#), defines RADIUS attributes. One of the attributes in [\[RFC2865\]](#) section 5.26 defines a VSA for use by implementers to extend the attribute set. Microsoft has created a number of VSAs for use with RADIUS to support authenticated network access. Some of these VSAs are as specified in [\[RFC2548\]](#). The remaining VSAs will be documented in section [2.2.1](#) of this document. The following table shows which RADIUS VSAs are implemented in the various versions of Windows.

Windows Server						
Microsoft VSA	Reference	Section	Windows Server 2000	Windows Server2003	Windows Server2008	Windows Server 2008 R2
MS-CHAP-Response	[RFC2548]	2.1.3	X	X	X	X
MS-CHAP-Domain	[RFC2548]	2.1.4	X	X	X	X
MS-CHAP-Error	[RFC2548]	2.1.5	X	X	X	X
MS-CHAP-CPW-1	[RFC2548]	2.1.6	X	X	X	X
MS-CHAP-CPW-2	[RFC2548]	2.1.7	X	X	X	X
MS-CHAP-LM-Enc-PW	[RFC2548]	2.1.8	X	X	X	X
MS-CHAP-NT-Enc-PW	[RFC2548]	2.2	X	X	X	X
MS-CHAP2-Response	[RFC2548]	2.3.2	X	X	X	X
MS-CHAP2-Success	[RFC2548]	2.3.3	X	X	X	X
MS-CHAP2-CPW	[RFC2548]	2.3.4	X	X	X	X

Windows Server						
MS-CHAP-MPPE-Keys	[RFC2548]	2.4.1	X	X	X	X
MS-MPPE-Send-Key	[RFC2548]	2.4.2	X	X	X	X
MS-MPPE-Recv-Key	[RFC2548]	2.4.3	X	X	X	X
MS-MPPE-Encryption-Types	[RFC2548]	2.4.4	X	X	X	X
MS-MPPE-Encryption-Policy	[RFC2548]	2.4.5	X	X	X	X
MS-BAP-Usage	[RFC2548]	2.5.1	X	X	X	X
MS-Link-Utilization-Threshold	[RFC2548]	2.5.2	X	X	X	X
MS-Link-Drop-Time-Limit	[RFC2548]	2.5.3	X	X	X	X
MS-Old-ARAP-Password	[RFC2548]	2.6.1	X			
MS-New-ARAP-Password	[RFC2548]	2.6.2	X			
MS-ARAP-PW-Change-Reason	[RFC2548]	2.6.3	X			
MS-ARAP-Challenge	[RFC2548]	2.6.4	X			
MS-RAS-Vendor	[RFC2548]	2.7.1	X	X	X	X
MS-RAS-Version	[RFC2548]	2.7.2	X	X	X	X
MS-Filter	[RFC2548]	2.7.3	X	X	X	X
MS-Acct-Auth-Type	[RFC2548]	2.7.4	X	X	X	X
MS-Acct-EAP-Type	[RFC2548]	2.7.5	X	X	X	X
MS-Primary-	[RFC2548]	2.7.6	X	X	X	X

Windows Server						
DNS-Server						
MS-Secondary-DNS-Server	[RFC2548]	2.7.7	X	X	X	X
MS-Primary-NBNS-Server	[RFC2548]	2.7.8	X	X	X	X
MS-Secondary-NBNS-Server	[RFC2548]	2.7.9	X	X	X	X
MS-RAS-Client-Name	This document	MS-RAS-Client-Name (section 2.2.1.1)		X	X	X
MS-RAS-Client-Version	This document	MS-RAS-Client-Version (section 2.2.1.2)		X	X	X
MS-Quarantine-IPFilter	This document	MS-Quarantine-IPFilter (section 2.2.1.3)		X	X	X
MS-Quarantine-Session-Timeout	This document	MS-Quarantine-Session-Timeout (section 2.2.1.4)		X	X	X
MS-Identity-Type	This document	MS-Identity-Type (section 2.2.1.6)			X	X
MS-Service-Class	This document	MS-Service-Class (section 2.2.1.7)			X	X
MS-Quarantine-User-Class	This document	MS-Quarantine-User-Class (section 2.2.1.8)			X	X
MS-Quarantine-State	This document	MS-Quarantine-State (section 2.2.1.9)			X	X
MS-Quarantine-Grace-Time	This document	MS-Quarantine-Grace-Time			X	X

Windows Server						
		(section 2.2.1.10)				
MS-Network-Access-Server-Type	This document	MS-Network-Access-Server-Type (section 2.2.1.11)			X	X
MS-AFW-Zone	This document	MS-AFW-Zone (section 2.2.1.12)			X	X
MS-AFW-Protection-Level	This document	MS-AFW-Protection-Level (section 2.2.1.13)			X	X
MS-Machine-Name	This document	MS-Machine-Name (section 2.2.1.14)			X	X
MS-IPv6-Filter	This document	MS-IPv6-Filter (section 2.2.1.15)			X	X
MS-IPv4-Remediation-Servers	This document	MS-IPv4-Remediation-Servers (section 2.2.1.16)			X	X
MS-IPv6-Remediation-Servers	This document	MS-IPv6-Remediation-Servers (section 2.2.1.17)			X	X
Not-Quarantine-Capable	This document	Not-Quarantine-Capable (section 2.2.1.18)			X	X
MS-Quarantine-SoH	This document	MS-Quarantine-SOH (section 2.2.1.19)			X	X
MS-RAS-Correlation-ID	This document	MS-RAS-Correlation-ID (section 2.2.1.20)			X	X
MS-Extended-Quarantine-	This document	MS-Extended-Quarantine-			X	X

Windows Server						
State		State (section 2.2.1.21)				
HCAP-User-Groups	This document	HCAP-User-Groups (section 2.2.1.22)			X	X
HCAP-Location-Group-Name	This document	HCAP-Location-Group-Name (section 2.2.1.23)			X	X
HCAP-User-Name	This document	HCAP-User-Name (section 2.2.1.24)			X	X
MS-User-IPv4-Address	This document	MS-User-IPv4-Address (section 2.2.1.25)			X	X
MS-User-IPv6-Address	This document	MS-User-IPv6-Address (section 2.2.1.26)			X	X
MS-RDG-Device-Redirection	This document	MS-RDG-Device-Redirection (section 2.2.1.27)			X	X
MS-Tunnel-Type	This document	MS-Tunnel-Type (section 2.2.2.1)				X

<6> Section 3.1.5.3: Microsoft RADIUS clients and RADIUS servers ignore VSAs in the following conditions:

- A VSA is received in a RADIUS message by a RADIUS client or RADIUS server that it is not supported per the preceding table. For example, A [Not-Quarantine-Capable](#) VSA should not be sent to a RADIUS server in an Access-Request message, so if a RADIUS server receives such an attribute in an Access-Request message, it ignores it.
- A VSA is received by a RADIUS client or RADIUS server with invalid data (for example, a RADIUS client receives a Not-Quarantine-Capable VSA with a length of 2).
- A VSA is received with an unknown vendor ID/vendor type combination (for example, a RADIUS client receives a VSA with the vendor ID set to 0x00000137 and the vendor type set to 0xAA).

<7> Section 3.2.5.1.9: The Microsoft RRAS server sends this attribute in Access-Request and Accounting-Request messages to the RADIUS server. This attribute can be sent by any RADIUS client, not just RRAS.

[<8> Section 3.2.5.1.15:](#) Only Windows Server 2008 R2 RADIUS servers support this vendor-specific value for the RADIUS Tunnel-Type attribute.

[<9> Section 3.2.5.2:](#) When sending a response to a client configured as not compatible with NAP, starting with Microsoft Windows Server 2008, RADIUS servers will exclude from the response the following attributes, described in section [3.2.5](#): MS-Quarantine-User-Class, MS-Quarantine-State, MS-Quarantine-Grace-Time, MS-Machine-Name, MS-IPv4-Remediation-Servers, MS-IPv6-Remediation-Servers, Not-Quarantine-Capable, and MS-Extended-Quarantine-State.

[<10> Section 3.3.4.1:](#) Windows endpoints always use the format MS-RAS-x-<RAS Client Computer Name> (for example, MS-RAS-0-Laptop, where "Laptop" is the name of the computer in a string format). The value of x is either 0 or 1, where 0 indicates that the messenger service is not running on the endpoint machine and 1 indicates that the messenger service is running. This information is useful to decide whether the Microsoft RRAS Administrator can send messages to the user by using the messenger service. (This is a UI/API option to "Send Messages to User" in Windows NT, Windows 2000, Windows XP, and Windows Server 2003.) Also note that this service is deprecated in Windows Server 2008 and Windows Vista and PPP always sends "MSRAS-0<>" on a Windows Vista client. For Windows Messenger Service, see [\[MS-MSRP\]](#).

[<11> Section 3.3.4.1:](#) For Windows XP, the **Attribute-Specific Value** is "MSRASV5.10"; for Windows Vista, Windows Server 2008, Windows 7, and Windows Server 2008 R2, this value is "MSRASV5.20".

[<12> Section 3.3.4.1:](#) When configured to support NAP, the Microsoft RRAS, DHCP, and HRA RADIUS client send this attribute in an Access-Request message to a RADIUS server.

[<13> Section 3.3.4.1:](#) When configured to support NAP, the Microsoft RRAS server sends this attribute in an Access-Request message to the RADIUS server.

[<14> Section 3.3.4.1:](#) The Microsoft HCAP server sends this attribute in Access-Request messages to the RADIUS server.

Microsoft HCAP allows a user to integrate a Microsoft NAP solution with Cisco Network Admission Control, and the endpoint's IPv6 address obtained from Cisco Network Admission Control is put into this attribute by Microsoft HCAP.

[<15> Section 3.3.5.1.15:](#) Only Windows Server 2008 R2 VPN servers support this vendor-specific value for the RADIUS Tunnel-Type Attribute.

[<16> Section 3.3.5.2.1:](#) Only the Microsoft RRAS RADIUS client supports this attribute when configured to support RQS/RQC; if received by an HRA or a DHCP server acting as a RADIUS client, it is silently discarded.

[<17> Section 3.3.5.2.2:](#) Only the Microsoft RRAS server RADIUS client supports this attribute when configured to support RQS/RQC; if received by an HRA or a DHCP RADIUS client, it is silently discarded.

For RQS/RQC, see [VPN Connection with RQC / RQS quarantine \(section 4.1\)](#).

[<18> Section 3.3.5.2.9:](#) Only the Microsoft RRAS server and DHCP servers acting as RADIUS clients support this attribute when configured to support NAP; if received by an HRA RADIUS client, it is silently discarded.

[<19> Section 3.3.5.2.13:](#) No existing Microsoft product acting as a RADIUS client uses this VSA.

[<20> Section 5.1:](#) Windows does not support such a mode. However, IPsec can be configured on Windows to ensure equivalent behavior.

7 Change Tracking

This section identifies changes that were made to the [MS-RNAP] protocol document between the May 2011 and June 2011 releases. Changes are classified as New, Major, Minor, Editorial, or No change.

The revision class **New** means that a new document is being released.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements or functionality.
- An extensive rewrite, addition, or deletion of major portions of content.
- The removal of a document from the documentation set.
- Changes made for template compliance.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **Editorial** means that the language and formatting in the technical content was changed. Editorial changes apply to grammatical, formatting, and style issues.

The revision class **No change** means that no new technical or language changes were introduced. The technical content of the document is identical to the last released version, but minor editorial and formatting changes, as well as updates to the header and footer information, and to the revision summary, may have been made.

Major and minor changes can be described further using the following change types:

- New content added.
- Content updated.
- Content removed.
- New product behavior note added.
- Product behavior note updated.
- Product behavior note removed.
- New protocol syntax added.
- Protocol syntax updated.
- Protocol syntax removed.
- New content added due to protocol revision.
- Content updated due to protocol revision.
- Content removed due to protocol revision.
- New protocol syntax added due to protocol revision.

- Protocol syntax updated due to protocol revision.
- Protocol syntax removed due to protocol revision.
- New content added for template compliance.
- Content updated for template compliance.
- Content removed for template compliance.
- Obsolete document removed.

Editorial changes are always classified with the change type **Editorially updated**.

Some important terms used in the change type descriptions are defined as follows:

- **Protocol syntax** refers to data elements (such as packets, structures, enumerations, and methods) as well as interfaces.
- **Protocol revision** refers to changes made to a protocol that affect the bits that are sent over the wire.

The changes made to this document are listed in the following table. For more information, please contact protocol@microsoft.com.

Section	Tracking number (if applicable) and description	Major change (Y or N)	Change type
1.2 References	Added explanatory statement regarding the removal of the publishing year from Microsoft Open Specification document references.	N	Content updated.

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