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

Revision Summary

Date	Revision History	Revision Class	Comments
10/22/2006	0.01		MCPP Milestone 1 Initial Availability
01/19/2007	1.0		MCPP Milestone 1
03/02/2007	1.1		Monthly release
04/03/2007	1.2		Monthly release

Date	Revision History	Revision Class	Comments
05/11/2007	1.3		Monthly release
05/11/2007	1.4	Minor	Updated the technical content.
06/01/2007	1.4.1	Editorial	Revised and edited the technical content.
07/03/2007	2.0	Major	Extensive revision of MS-Quarantine-IPFilter and MS-IPv6-Filter.
07/20/2007	2.0.1	Editorial	Revised and edited the technical content.
08/10/2007	2.0.2	Editorial	Revised and edited the technical content.
09/28/2007	3.0	Major	Added additional vendor-specific attributes.
10/23/2007	4.0	Major	Updated and revised the technical content.
11/30/2007	4.1	Minor	Updated the technical content.
01/25/2008	4.1.1	Editorial	Revised and edited the technical content.

Table of Contents

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]:

Access Profile
Anywhere Access Gateway
Certification Authority (CA)
DHCP Scope
DHCP Server
Endpoint
Filter
Globally Unique Identifier (GUID)
Health Policy Server
Health Registration Authority (HRA)
Network Access Policy
Network Access Protection (NAP)
Network Access Server (NAS)
Public-Private Key Pair
RADIUS Attribute
RADIUS Client
RADIUS Server
Registration Authority (RA)
Relative Identifier (RID)
Remote Access Service (RAS) Server
Security Identifier (SID)
Statement of Health (SoH)
Statement of Health Response (SoHR)

The following terms are specific to this document:

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

Vendor-Specific Attribute (VSA): A **RADIUS Attribute** (as specified in [RFC2865] section 5.26) whose **Value** field contains a vendor identifier, vendor type, and 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

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/application/pdf/en/us/guest/netsol/ns617/c654/cdccont_0900aecd8051fc24.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", January 2007.

[MS-GLOS] Microsoft Corporation, "Windows Protocols Master Glossary", March 2007.

[MS-HCEP] Microsoft Corporation, "Health Certificate Enrollment Protocol Specification", January 2007.

[MS-MSRP] Microsoft Corporation, "Messenger Service Remote Protocol Specification", August 2007.

[MS-SOH] Microsoft Corporation, "Statement of Health for Network Access Protection (NAP) Protocol Specification", January 2007.

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

[RFC2284] Blunk, L. and Vollbrecht, J., "PPP Extensible Authentication Protocol (EAP)", RFC 2284, March 1998, http://www.ietf.org/rfc/rfc2284.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

[RFC2866] Rigney, C., "RADIUS Accounting", RFC 2866, June 2000, http://www.ietf.org/rfc/rfc2866.txt

[RFC2867] Zorn, G., Aboba, B., and Mitton, D., "RADIUS Accounting Modifications for Tunnel Protocol Support", RFC 2867, June 2000, http://www.ietf.org/rfc/rfc2867.txt

[RFC2868] Zorn, G., Leifer, D., Rubens, A., Shriver, J., Holdrege, M., and Goyret, I., "RADIUS Attributes for Tunnel Protocol Support", RFC 2868, June 2000, http://www.ietf.org/rfc/rfc2868.txt

[RFC2869] Rigney, C., Willats, W., and Calhoun, P., "RADIUS Extensions", RFC 2869, June 2000, http://www.ietf.org/rfc/rfc2869.txt

[RFC3004] Stump, G., Droms, R., Gu, Y., Vyaghrapuri, R., Demirtjis, A., Beser, B., and Privat, J., "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

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

[MSDN-ANSI-CODEPAGE] Microsoft Corporation, "WideCharToMultiByte", 2006, http://msdn2.microsoft.com/en-us/library/aa450989.aspx

[MS-CHAP] Microsoft Corporation, "Extensible Authentication Protocol Method for Microsoft Challenge Handshake Authentication Protocol (CHAP) Specification", January 2007.

[MS-PEAP] Microsoft Corporation, "Protected Extensible Authentication Protocol (PEAP) Specification", January 2007.

[MSFT-NAQC] Microsoft Corporation, "Network Access Quarantine Control in Windows Server 2003", 2004, http://www.microsoft.com/technet/itsolutions/network/vpn/quarantine.mspx

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

[RFC3748] Aboba, B., Blunk, L., Vollbrecht, J., Carlson, J., and Levkowetz, H., "Extensible Authentication Protocol (EAP)", RFC 3748, June 2004, http://www.ietf.org/rfc/rfc3748.txt

1.3 Protocol Overview (Synopsis)

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. 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.

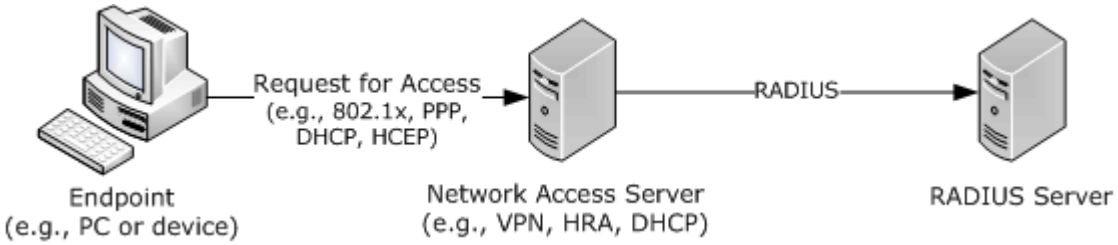


Figure 1: Common RNAP deployment model

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 as to the network restrictions to enforce on the endpoint, if appropriate.

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

1.4 Relationship to Other Protocols

The vendor-specific attributes (VSAs) specified in this document rely on and are transported within the Remote Authentication Dial-In User Service (RADIUS) Protocol.

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

1. Unless otherwise noted, **RADIUS attribute** are sent only between a **RADIUS client** and 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 13.

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 sets a limit on the time that a client can remain connected through a particular NAS, regardless of the protocol between the client and NAS.

1.5 Prerequisites/Preconditions

The Remote Authentication Dial-In User Service (RADIUS) Protocol and a set of **Network Access Policies** MUST be configured for use between an NAS and a RADIUS server for the Microsoft vendor-specific attributes (VSAs) to be used; specifically, an administrator is required to configure a RADIUS shared secret between an NAS and a RADIUS server.

1.6 Applicability Statement

The use of RADIUS vendor-specific attributes (VSAs) is applicable in those environments where the Remote Authentication Dial-In User Service (RADIUS) Protocol is used to authenticate and authorize network access requests.

1.7 Versioning and Capability Negotiation

See the individual vendor-specific attributes (VSAs) documented in Message Syntax (section 2.2) for information about version fields.

1.8 Vendor-Extensible Fields

The Microsoft vendor-specific attributes (VSAs) themselves do not define any additional vendor-extensible fields.

1.9 Standards Assignments

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

2 Messages

The following sections specify how Microsoft vendor-specific attributes (VSAs) are transported.

2.1 Transport

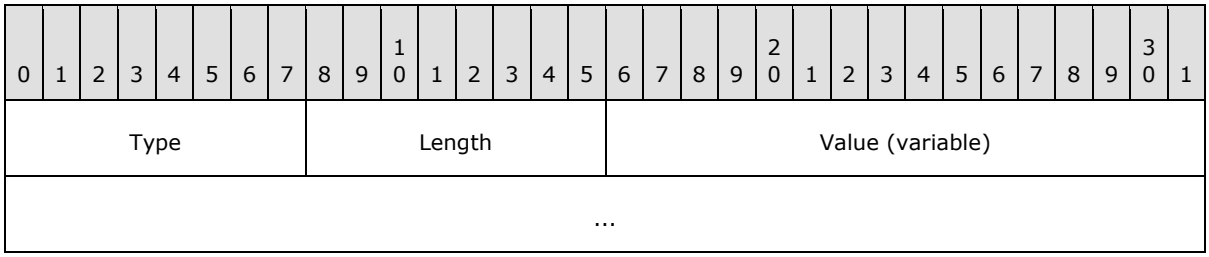
The Remote Authentication Dial In User Service (RADIUS) protocol, specified in [RFC2865], defines the transport of RADIUS and associated attributes over the User Datagram Protocol (UDP).

2.2 Message Syntax

2.2.1 Microsoft Vendor-Specific Attributes (VSAs)

The Remote Authentication Dial-In User Service (RADIUS) Protocol specification [RFC2865] defines attribute type 0x1A as a vendor-specific attribute (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.

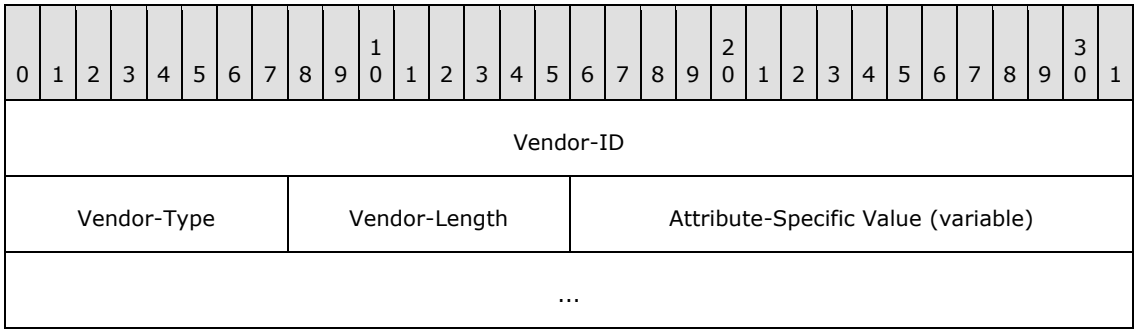
When representing a VSA, the fields MUST be set as follows (for more information, see [RFC2865]).



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.

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.



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 vendor-specific attributes MUST have the **Vendor-ID** field set to 311 (0x00000137).

Vendor-Type (1 byte): An 8-bit unsigned integer that MUST specify the vendor-specific attribute 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 2.2.1.18 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**. Its value MUST be at least 3.

Attribute-Specific Value (variable): The value of the vendor-specific attribute 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 2.2.1.18 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 vendor-specific attribute, 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** vendor-specific attribute 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 information about MS-RAS-Client-Name, see sections 3.1.5.4.1 and 3.2.5.4.1.

2.2.1.2 MS-RAS-Client-Version

MS-RAS-Client-Version is a vendor-specific attribute, 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** and **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 information about MS-RAS-Client-Version, see sections 3.1.5.4.2 and 3.2.5.4.2.

2.2.1.3 MS-Quarantine-IPFilter

MS-Quarantine-IPFilter is a vendor-specific attribute, 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]).

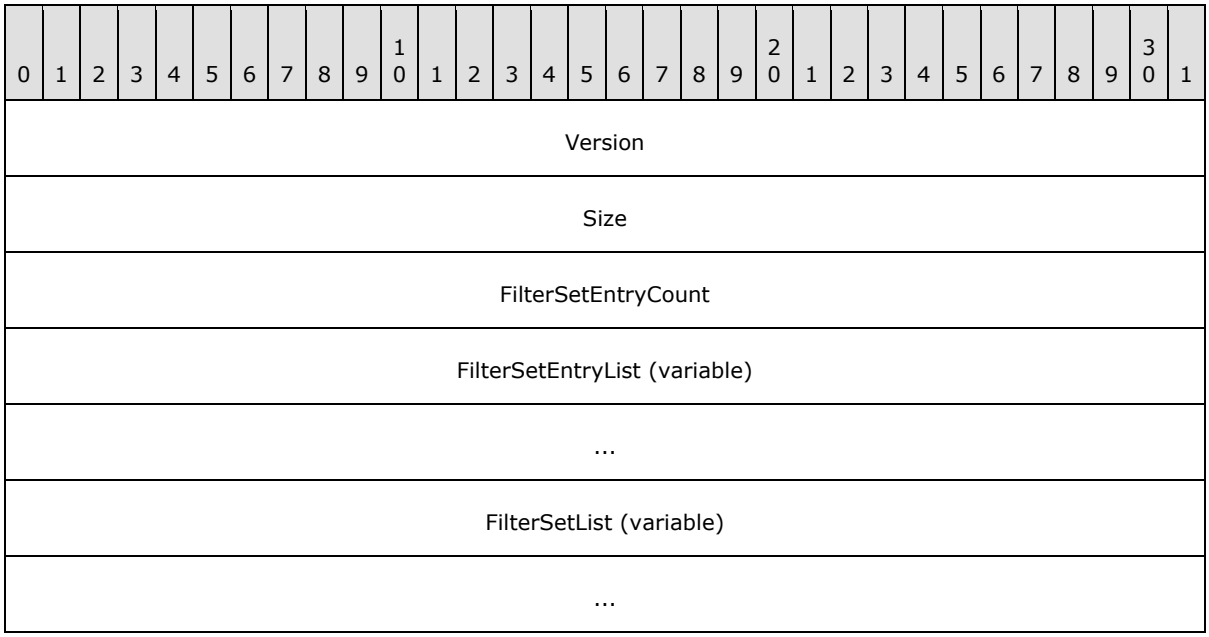
The fields of MS-Quarantine-IPFilter MUST be set as follows:

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:

This attribute MAY be included in RADIUS Access-Accept and RADIUS Accounting-Request packets. If multiple MS-Quarantine-IPFilter vendor-specific 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-Quarantine-IPFilter value.

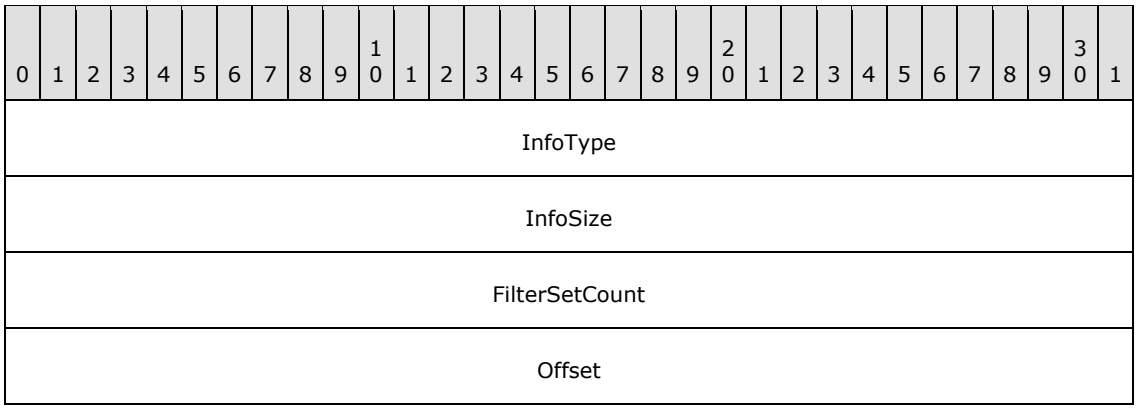


Version (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST be set to 0x00000001. No other versions are defined. See section 3.1.5.3 for processing details.

Size (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST specify the size of the vendor-specific attribute 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.



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.

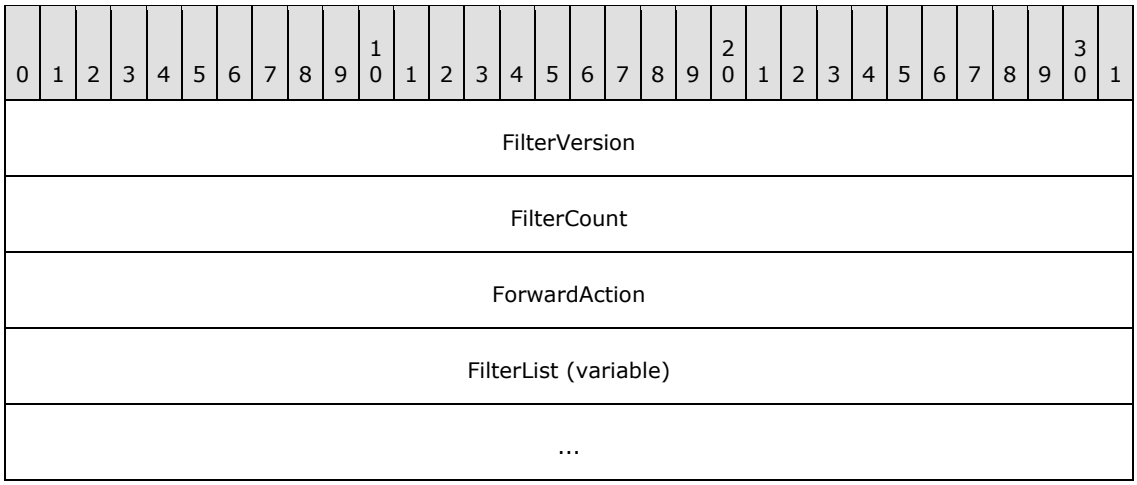
Value	Meaning
0xffff0001	Input Filter: The filter MUST be applied to IP packets sent from the endpoint to the Network Access Server (NAS).
0xffff0002	Output Filter: The filter MUST be applied to IP packets sent from the NAS to the endpoint.
0xffff0009	Site-to-Site Connection: IP traffic that matches 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.



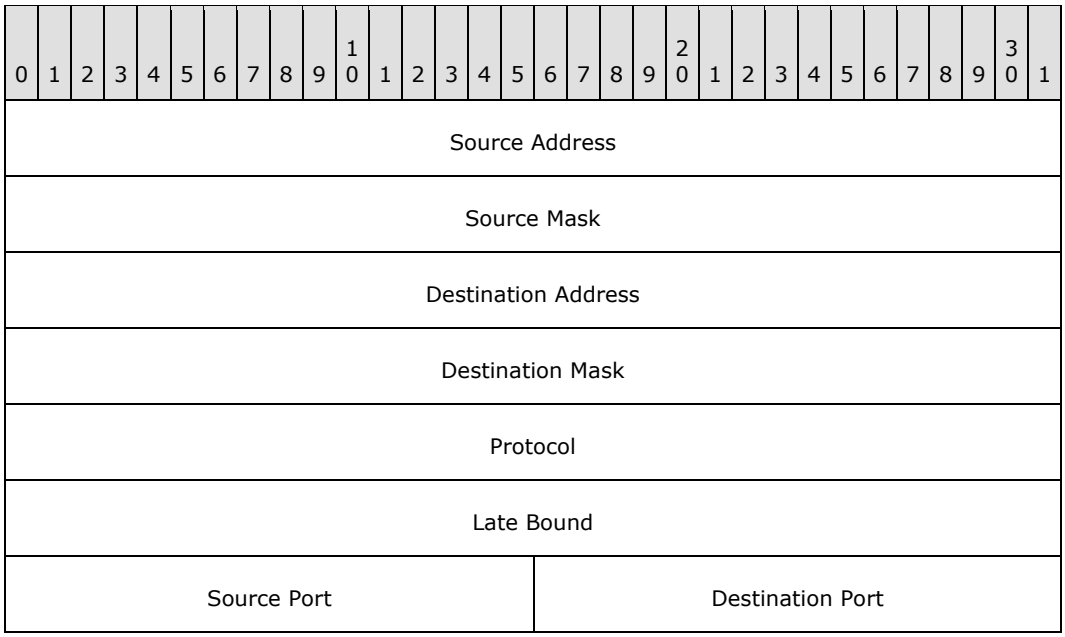
FilterVersion (4 bytes): A 32-bit unsigned integer in little-endian byte order that MUST be set to 0x00000001. No other versions are defined. For processing details, see section 3.1.5.3.

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:



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 0x0000000 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 MAY be 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 information about MS-Quarantine-IPFilter, see sections 3.1.5.4.3 and 3.2.5.4.3.

2.2.1.4 MS-Quarantine-Session-Timeout

MS-Quarantine-Session-Timeout is a vendor-specific attribute (VSA), as specified in 2.2.1. It is used to specify a timeout value used by an **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 information about MS-Quarantine-Session-Timeout, see sections 3.1.5.4.4 and 3.2.5.4.4.

2.2.1.5 MS-User-Security-Identity

MS-User-Security-Identity is a Vendor-Specific Attribute, as specified in section 2.2.1. It is used to specify the **security-identifier (SID)** 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 vendor-specific attribute (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 information about MS-Identity-Type, see sections 3.1.5.4.6 and 3.2.5.4.6.

2.2.1.7 MS-Service-Class

MS-Service-Class is a vendor-specific attribute (VSA), as specified in section 2.2.1. It is used to specify which group of **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 **DHCP server**.

For more information about MS-Service-Class, see sections 3.1.5.4.7 and 3.2.5.4.7.

2.2.1.8 MS-Quarantine-User-Class

MS-Quarantine-User-Class is a vendor-specific attribute (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 Network Access Protection (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. Its value MUST be at least 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 Windows ANSI code page (see [MSDN-ANSI-CODEPAGE]) in ANSI format (that is, the string is sent with ANSI code page). For more information about the DHCP option for user class, see [RFC3004].

For more information about MS-Quarantine-User-Class, see sections 3.1.5.4.8 and 3.2.5.4.8.

2.2.1.9 MS-Quarantine-State

MS-Quarantine-State is a vendor-specific attribute (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 information about MS-Quarantine-State, see sections 3.1.5.4.9 and 3.2.5.4.9.

2.2.1.10 MS-Quarantine-Grace-Time

MS-Quarantine-Grace-Time is a vendor-specific attribute (VSA), as specified in section 2.2.1. It is used to specify the amount of time a host has to become conformant with 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 1/1/1970 UTC (GMT) 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 information about MS-Quarantine-Grace-Time, see sections 3.1.5.4.10 and 3.2.5.4.10.

2.2.1.11 MS-Network-Access-Server-Type

MS-Network-Access-Server-Type is a vendor-specific attribute (VSA), as specified in section 2.2.1. It is used to specify the type of a 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 Network Access Server (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	HCAP Server
All Other Values	A tag value used to identify applicable network access policies on the RADIUS server.

For more information about MS-Network-Access-Server-Type, see sections 3.1.5.4.11 and 3.2.5.4.11.

2.2.1.12 MS-AFW-Zone

MS-AFW-Zone is a vendor-specific attribute (VSA), as specified in section 2.2.1. It is used as a hint for dynamic selection of a preconfigured Internet Protocol security (IPsec) policy by the endpoint requesting access.<3>

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 information about MS-AFW-Zone, see sections 3.1.5.4.12 and 3.2.5.4.12.

2.2.1.13 MS-AFW-Protection-Level

MS-AFW-Protection-Level is a vendor-specific attribute (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 information about MS-AFW-Protection-Level, see sections 3.1.5.4.13 and 3.2.5.4.13.

2.2.1.14 MS-Machine-Name

MS-Machine-Name is a vendor-specific attribute (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 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 information about MS-Machine-Name, see sections 3.1.5.4.14 and 3.2.5.4.14.

2.2.1.15 MS-IPv6-Filter

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

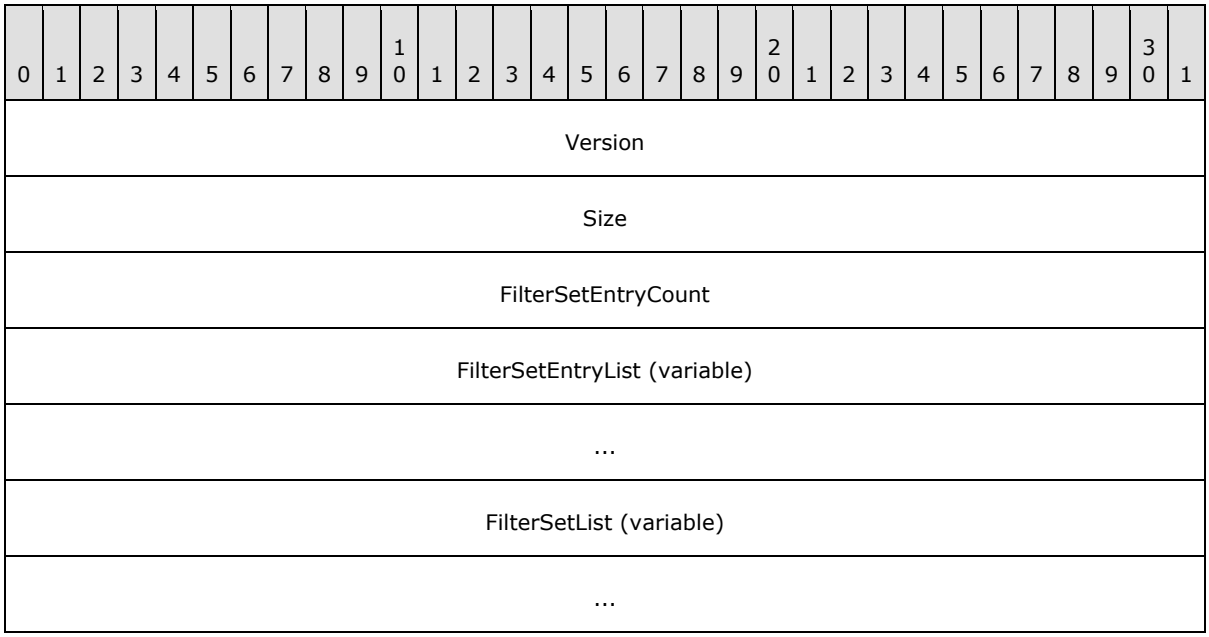
The fields of MS-IPv6-Filter MUST be set as follows:

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.

This attribute MAY be included in RADIUS Access-Accept and RADIUS Accounting-Request packets. 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.

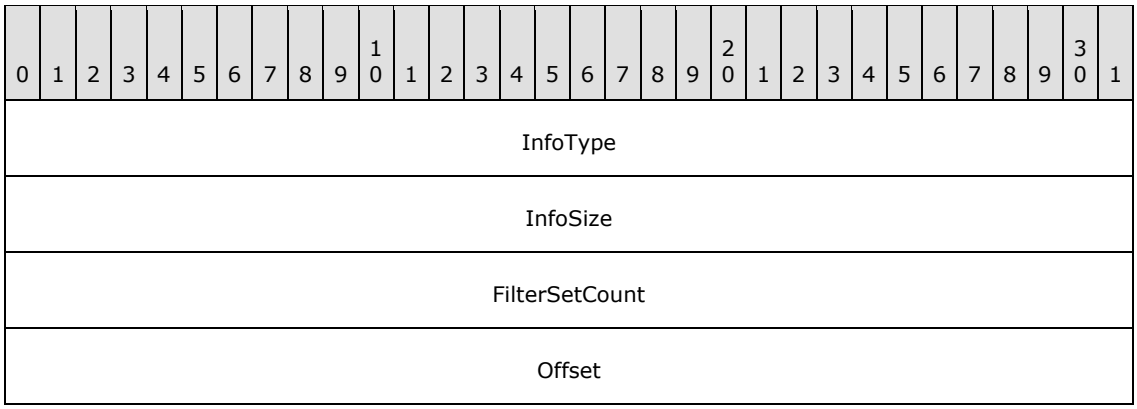


Version (4 bytes): A 32-bit unsigned integer in network byte order that MUST be set to 0x00000001. No other versions are defined. For processing details, see section 3.1.5.3.

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.



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.

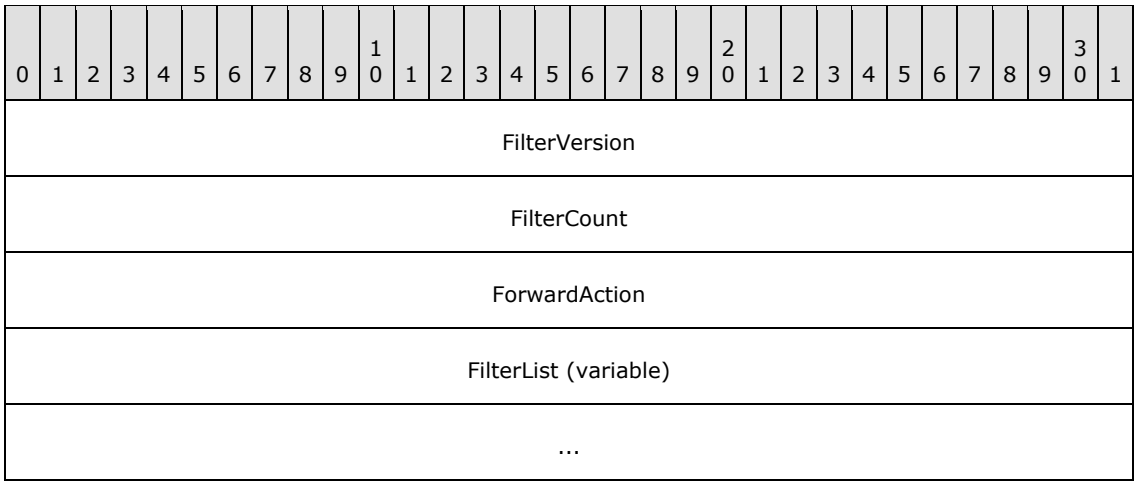
Value	Meaning
0xffff0001	Input Filter – The filter Network Access Server (NAS)MUST be applied to IP packets sent from the endpoint to the .
0xffff0002	Output Filter – The filter MUST be applied to IP packets sent from the NAS to the endpoint.
0xffff0009	Site-to-Site Connection – IP traffic that matches 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 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 (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 (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.



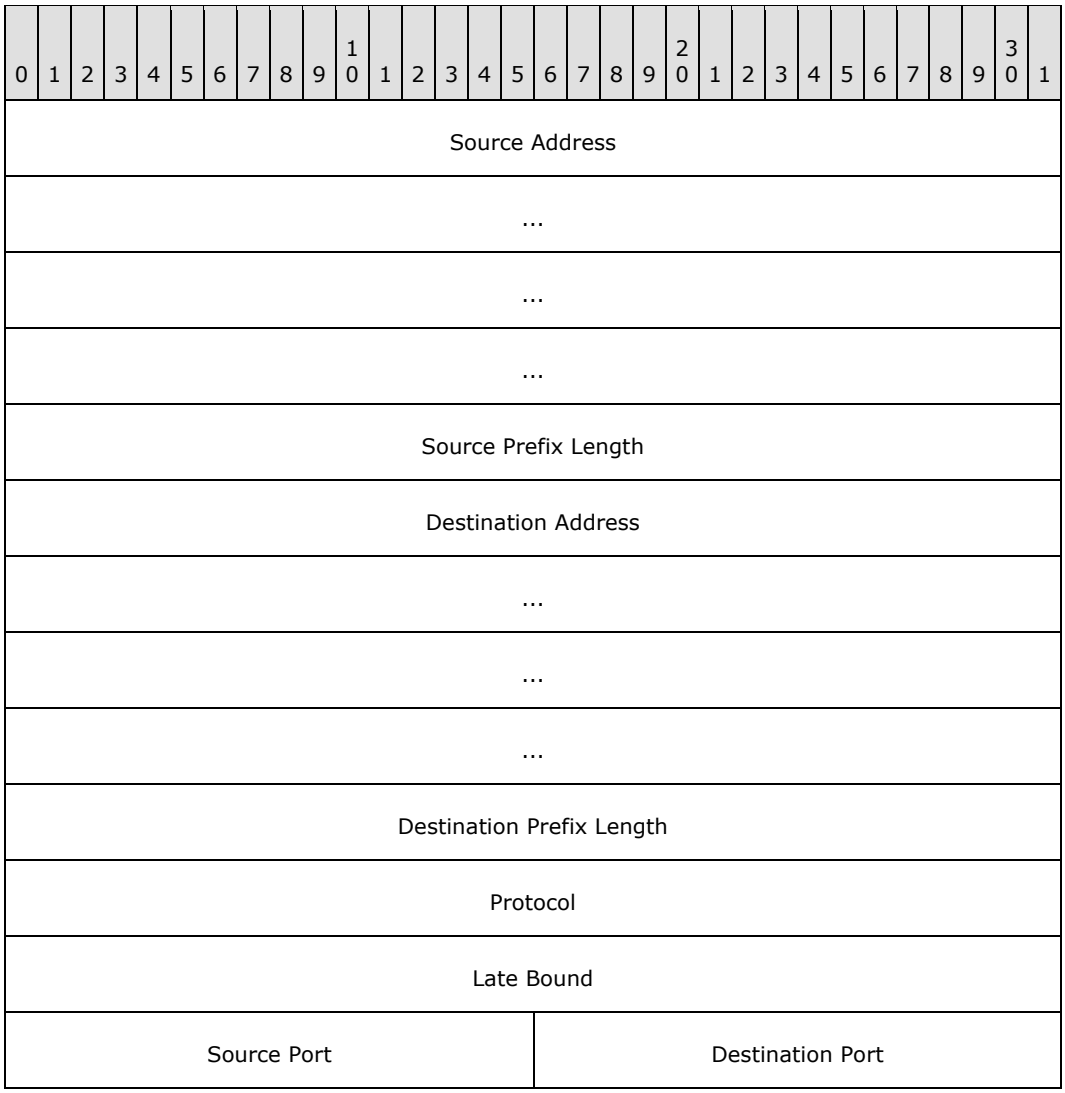
FilterVersion (4 bytes): A 32-bit unsigned integer in network byte order that MUST be set to 0x00000001. No other versions are defined. For processing details, see section 3.1.5.3.

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.



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 Network Access Server (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 information about MS-IPv6-Filter, see sections 3.1.5.4.15 and 3.1.5.4.15.

2.2.1.16 MS-IPv4-Remediation-Servers

MS-IPv4-Remediation-Servers is a vendor-specific attribute (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 5 whose value modulo 4 equals 2 are valid.

Attribute-Specific Value: A list of IPv4 addresses that the RADIUS server authorizes a restricted endpoint to access. The value 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 information about MS-IPv4-Remediation-Servers, see sections 3.1.5.4.16 and 3.2.5.4.16.

2.2.1.17 MS-IPv6-Remediation-Servers

MS-IPv6-Remediation-Servers is a vendor-specific attribute (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 17 whose value modulo 16 equals 2 are valid.

Attribute-Specific Value: This field MUST be a list of IPv6 addresses that the RADIUS server authorizes a restricted endpoint to access. The value 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 information about MS-IPv6-Remediation-Servers, see sections 3.1.5.4.17 and 3.2.5.4.17.

2.2.1.18 Not-Quarantine-Capable

Not-Quarantine-Capable is a vendor-specific attribute (VSA) used by a RADIUS client to specify whether an endpoint sent an SoH or not, 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 Network Access Server (NAS). It MUST be one of the following values.

Value	Meaning
0x00000000	The endpoint sent a **Statement of Health (SoH)**.
0x00000001	The endpoint did not send an SoH.

For more information about Not-Quarantine-Capable, see sections 3.1.5.4.18 and 3.2.5.4.18.

2.2.1.19 MS-Quarantine-SOH

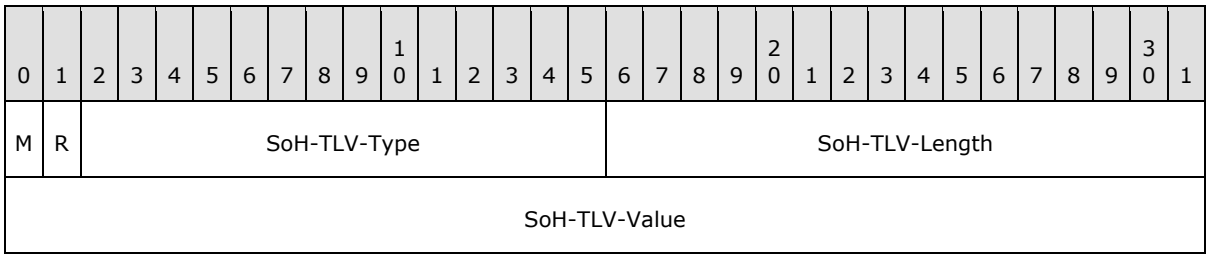
MS-Quarantine-SOH is a vendor-specific attribute (VSA), as specified in 2.2.1. It is used to carry Statement of Health information (as specified in [MS-SOH]).

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 specified in the following diagram.



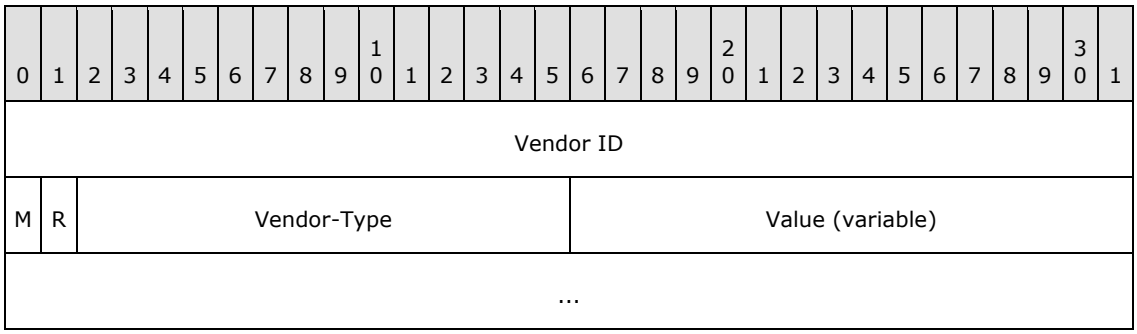
M (1 bit): [Mandatory] Within an MS-Quarantine-SoH VSA, the M bit MUST be set to 0, denoting that the SoH is not a mandatory TLV.

R (1 bit): [Reserved] The R bit is reserved. It MUST be set to zero and ignored on receipt.

SoH-TLV-Type (14 bits): A 14-bit unsigned integer that MUST be set to 0x07 indicating the value field contains a Vendor-Specific TLV.

SoH-TLV-Length (2 bytes): A 16-bit unsigned integer in network-byte order that MUST specify the length, in bytes, of the **Value** field. This MUST be set to a minimum of 6.

SoH-TLV-Value (4 bytes): This field MUST be formatted as an MS-SoH-Payload-TLV (as specified in [MS-SOH]). The following is a summary of the MS-SOH-Payload-TLV attribute format.



Vendor ID (4 bytes): A 32-bit unsigned integer in network byte order that MUST be set to 0x00000137 (Microsoft).

M (1 bit): [Mandatory] The M bit MUST be set to 0, denoting that this is not a mandatory TLV.

R (1 bit): [Reserved] The R bit is reserved. It MUST be set to 0 and ignored on receipt.

Vendor-Type (14 bits): A 14-bit unsigned integer that MUST be set to 0x01 for MS-SOH-Payload-TLV.

Value (variable): The **Value** field MUST contain the Statement of Health (SoH) payload in an access request message and the **Statement of Health Response (SoHR)** in an access accept message.

For more information about MS-Quarantine-SOH, see sections 3.1.5.4.19 and 3.2.5.4.19.

2.2.1.20 MS-RAS-Correlation-ID

The MS-RAS-Correlation-ID is a vendor-specific attribute (VSA), as specified in section 2.2.1.

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 41.

Attribute-Specific Value: A 128-bit unsigned integer that SHOULD specify a **globally unique identifier (GUID)** and be represented as a string of 36 ASCII characters, followed by 3 octets each set to 0.

2.2.1.21 MS-Extended-Quarantine-State

MS-Extended-Quarantine-State is a vendor-specific attribute (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 vendor-specific attribute (VSA) used to specify user groups information received over a 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 for which a HCAP user belongs to (as specified in [MS-HCEP]).

2.2.1.23 HCAP-Location-Group-Name

HCAP-Location-Group-Name is a vendor-specific attribute (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 vendor-specific attribute (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 vendor-specific attribute (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 vendor-specific attribute (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-TSG-Device-Redirection

MS-TSG-Device-Redirection is a vendor-specific attribute (VSA) specifying filters used by a Terminal Server Gateway, as specified in section 2.2.1.

The fields of MS-TSG-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	Disable drives
1	Disable printers
2	Disable serial ports
3	Disable clipboard
4	Disable plug and play devices
5-28	<Reserved for additional devices>
29	Disable all devices
30	Enable all devices
31	<Unused>

3 Protocol Details

The following sections specify protocol details, including abstract data models and message processing rules.

3.1 Server Details

3.1.1 Abstract Data Model

The Remote Authentication Dial-In User Service (RADIUS) Protocol is a stateless protocol, as specified in [RFC2865]).

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

3.1.2 Timers

No timers are required. For a discussion of retransmission hints, see the Remote Authentication Dial-In User Service (RADIUS) Protocol documentation, as specified in [RFC2865] .

3.1.3 Initialization

There is no initialization for the vendor-specific attributes (VSAs) in this document.

3.1.4 Higher-Layer Triggered Events

The RADIUS exchange is triggered by a user request to a network access server (NAS).

3.1.5 Message Processing Events and Sequencing Rules

3.1.5.1 Windows Implementation of RADIUS Attributes

The following section specifics on the Windows implementation of RADIUS attributes.<4>

3.1.5.2 Microsoft VSA Support of RADIUS Messages

The Remote Authentication Dial-In User Service (RADIUS) Protocol standard (as specified in [RFC2865] section 4) defines the messages sent between a RADIUS client and RADIUS server. Each Microsoft VSA is only valid 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 MAY be present in packet.
0-1	Zero or one instance of this attribute MAY be present in packet.

Microsoft Vendor-Specific Attribute	Request	Accept	Reject	Challenge	Acct-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-Identity-Type	0-1	0	0	0	0
MS-Service-Class	0-1	0	0	0	0
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	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-TSG-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<5> ignore vendor-specific attributes (VSAs) with unknown types.

3.1.5.4 Attributes Details on Server Side

RADIUS servers are responsible for receiving endpoint connection requests fromnetwork access servers (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 on the connectivity that the NAS grants the endpoint.

3.1.5.4.1 MS-RAS-Client-Name

When the RADIUS server receives this attribute, it MAY log it.

For more information about this attribute, see section 2.2.1.1.

3.1.5.4.2 MS-RAS-Client-Version

When the RADIUS server receives this attribute, it MAY log it.

For more information about this attribute, see section 2.2.1.2.

3.1.5.4.3 MS-Quarantine-IPFilter

The RADIUS server MAY send this attribute to a network access server (NAS) in Access-Accept to specify how to restrict network access for an endpoint.

For the usage details of this filter, see section 3.2.5.4.15. For more information about this attribute, see section 2.2.1.3.

3.1.5.4.4 MS-Quarantine-Session-Timeout

The RADIUS server MAY send this attribute to a network access server (NAS) in Access-Accept to specify the time in seconds that a restricted VPN connection can remain in a restricted state before being disconnected.

For more information about this attribute, see section 2.2.1.4.

3.1.5.4.5 MS-User-Security-Identity

Both a user name and user SID can be used to represent the identity of a user who is requesting network access. In most of cases, NAS is expected to send user name to represent the user identity.

NAS MAY use this attribute as an alternative way (as against using the standard RADIUS User-Name attribute [RFC2865]) to specify the identity of the user who is the user requesting access by sending the user SID of this user instead of the name.

For more information on this attribute, see 2.2.1.5.

3.1.5.4.6 MS-Identity-Type

This attribute indicates whether a RADIUS server should do only a machine health check (as specified in [MS-SOH]) or not.

A network access server (NAS) MAY send this attribute to a RADIUS server in an Access-Request message.

If a RADIUS server receives this attribute and its value is 0x00000001, then the RADIUS server MUST NOT perform authentication; instead, it MUST do a machine health check on this request.

For more information about this attribute, see section 2.2.1.6.

3.1.5.4.7 MS-Service-Class

This attribute carries the name of a service class.

A RADIUS server receiving this attribute knows the service class to which a DHCP client requesting an IP address from a DHCP server belongs.

For more information about this attribute, see section 2.2.1.7.

3.1.5.4.8 MS-Quarantine-User-Class

The RADIUS server MAY send this attribute to a network access server (NAS) to specify the name of a special DHCP user class (see [RFC3004]) to which a DHCP client should be assigned.

For more information about this attribute, see section 2.2.1.8.

3.1.5.4.9 MS-Quarantine-State

The RADIUS server MAY send this attribute to a network access server (NAS) in Access-Accept to specify the Quarantine state for a user requesting access to this NAS.

For more information about this attribute, see section 2.2.1.9.

3.1.5.4.10 MS-Quarantine-Grace-Time

The RADIUS server MAY send this attribute to a network access server (NAS) in Access-Accept to specify an expiration time until an NAS gives full access to a endpoint requesting network access.

For more information about this attribute, see section 2.2.1.10.

3.1.5.4.11 MS-Network-Access-Server-Type

This attribute tells the access type of a network access server (NAS). An NAS MAY send this attribute to RADIUS server to indicate the type of this NAS in an Access-Request message.

For more information about this attribute, see section 2.2.1.11.

3.1.5.4.12 MS-AFW-Zone

This attribute carries the information about the Network Access Protection (NAP) zone (see [MS-HCEP] and [MS-SOH]) in which an endpoint should be. RADIUS server MAY send this attribute in an Access-Accept message to a network access server (NAS) in an Access-Accept message.

For more information about this attribute, see section 2.2.1.12.

3.1.5.4.13 MS-AFW-Protection-Level

A RADIUS server MAY send this attribute in an Access-Accept message to a network access server (NAS), which in turn sends to the endpoint requesting network access.

For more information about this attribute, see section 2.2.1.13.

3.1.5.4.14 MS-Machine-Name

A RADIUS server receiving this attribute learns the machine name. This can be used to determine the machine group the user's machine belongs to.

For more information about this attribute, see section 2.2.1.14.

3.1.5.4.15 MS-IPv6-Filter

The RADIUS server MAY send this attribute to a network access server in Access-Accept to define the filters to be applied to the endpoint. (It is used only for IPv6 addresses and MS-Filter [RFC2548] VSA is the corresponding attribute for IPv4 addresses.)

For more information about this attribute, see 2.2.1.15.

3.1.5.4.16 MS-IPv4-Remediation-Servers

This attribute specifies the IPv4 addresses of the remediation servers. A RADIUS server MAY send this attribute to a network access server (NAS) in an Access-Accept message.

For more information about this attribute, see section 2.2.1.16.

3.1.5.4.17 MS-IPv6-Remediation-Servers

This attribute specifies the IPv6 addresses of the rededication servers. A RADIUS server MAY send this attribute to a network access server (NAS) in an Access-Accept message.

For more information about this attribute, see section 2.2.1.17.

3.1.5.4.18 Not-Quarantine-Capable

This attribute indicates whether the endpoint requesting network access is NAP–capable or not. A RADIUS server MAY send this attribute to a network access server (NAS) in an Access-Accept message.

For more information about this attribute, see section 2.2.1.18.

3.1.5.4.19 MS-Quarantine-SoH

This attribute is used only to carry Statement of Health (SoH) information (as specified in [MS-SOH]) when EAP is not used. A RADIUS server MAY send it to a network access server (NAS) in an Access-Accept message.

If this vendor-specific attribute (VSA) is received by a RADIUS server in an Access-Request message, it MAY contain an EAP-TLV-TYPE of vendor-specific TLV and contain a vendor type of MS-SOH-Payload-TLV. The value of the SoH payload is used to evaluate the endpoint's compliance to locally configured policy, as specified in [MS-SOH].

If an SoH payload is received in the access request, the RADIUS server MAY return an SoH payload in the access accept message. The value of the payload MUST be the statement of health response (SoHR), as specified in [MS-SOH].

For more information about this attribute, see section 2.2.1.19.

3.1.5.4.20 MS-RAS-Correlation-ID

The RRAS server uses this attribute to match its Access-Requests with RADIUS server responses. When the RADIUS server receives this attribute, it MAY log it.

For more information about this attribute, see section 2.2.1.20.

3.1.5.4.21 MS-Extended-Quarantine-State

The RADIUS server MAY send this attribute to an NAS in Access-Accept to specify the additional restricted state information for an endpoint requesting access to this NAS.

For more information about this attribute, see section 2.2.1.21.

3.1.5.4.22 HCAP-User-Groups

If a RADIUS server receives this attribute, it can find out which group the user corresponding to the request belongs to.

For more information about this attribute, see section 2.2.1.22.

3.1.5.4.23 HCAP-Location-Group-Name

If a RADIUS server receives this attribute, it can find out what location group the user's machine corresponding to the request belongs to.

For more information about this attribute, see section 2.2.1.23.

3.1.5.4.24 HCAP-User-Name

If a RADIUS server receives this attribute, it can find out the user name corresponding to the request.

For more information about this attribute, see section 2.2.1.24.

3.1.5.4.25 MS-User-IPv4-Address

If a RADIUS server receives this attribute, it can find out the IPv4 address of the endpoint that requested network access.

For more information about this attribute, see section 2.2.1.25.

3.1.5.4.26 MS-User-IPv6-Address

If a RADIUS server receives this attribute, it can find out the IPv6 address of the endpoint that requested network access.

For more information about this attribute, see section 2.2.1.26.

3.1.5.4.27 MS-TSG-Device-Redirection

The RADIUS server MAY send this attribute to a network access server (NAS) to specify the device redirection settings for Terminal Service Gateway.

For more information about this attribute, see section 2.2.1.27.

3.1.6 Timer Events

No timer events are required for this protocol.

For a discussion on retransmission hints, see [RFC2865].

3.1.7 Other Local Events

No other local events are required for this protocol.

3.2 Client Details

3.2.1 Abstract Data Model

See section 3.1.1.

3.2.2 Timers

No timers are required for this protocol.

For a discussion on retransmission hints, see [RFC2865].

3.2.3 Initialization

There is no initialization for vendor-specific attributes (VSAs) in this document.

3.2.4 Higher-Layer Triggered Events

The RADIUS exchange is triggered by a endpoint request to a network access server (NAS) for network access.

3.2.5 Message Processing Events and Sequencing Rules

3.2.5.1 Windows Implementation of RADIUS Attributes

See section 3.1.5.1.

3.2.5.2 Microsoft VSA Support of RADIUS Messages

See section 3.1.5.2.

3.2.5.3 Processing of RADIUS Attributes

See section 3.1.5.3.

3.2.5.4 Attributes Details on Client Side

A network access server (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.

3.2.5.4.1 MS-RAS-Client-Name

A Microsoft Routing and Remote Access Service (RRAS) client sends its client name to identify itself. The RRAS server then uses this attribute to forward this information to the Microsoft RADIUS server for logging purposes.<6>

For more information about this attribute, see section 2.2.1.1.

3.2.5.4.2 MS-RAS-Client-Version

A Microsoft Routing and Remote Access Service (RRAS) client sends its client name to identify itself. The RRAS server then uses this attribute to forward this information to Microsoft RADIUS server for accounting purposes.<7>

For more information about this attribute, see section 2.2.1.2.

3.2.5.4.3 MS-Quarantine-IPFilter

When a network access server (NAS) receives this attribute, it MAY restrict the network access for the endpoint that is requesting access based on the value of this attribute.<8>

For more information about this attribute, see section 2.2.1.3.

3.2.5.4.4 MS-Quarantine-Session-Timeout

When a network access server (NAS) receives this attribute, it MAY wait for the time in seconds specified in this attribute before it disconnects a restricted VPN connection.<9>

For more information about this attribute, see section 2.2.1.4.

3.2.5.4.5 MS-User-Security-Identity

Both a user name and user SID can be used to represent the identity of a user requesting network access. In most of the cases, NAS is expected to send user name to represent the user identity.

NAS MAY use this attribute as an alternative (as against using the standard RADIUS User-Name attribute [RFC2865]) to specifying the identity of the user requesting access by sending the user SID of this user instead of the name.

For more information on this attribute, see 2.2.1.5.

3.2.5.4.6 MS-Identity-Type

This attribute indicates whether or not a RADIUS server should do only a machine health check, as specified in [MS-SOH]. A network access server (NAS) MAY send this attribute to a RADIUS server in an Access-Request message. If a NAS sends this attribute to a RADIUS server and its value is 0x00000001, then this NAS requests that this RADIUS server do only a machine health check and not do any authentication.

For more information about this attribute, see section 2.2.1.6.

3.2.5.4.7 MS-Service-Class

This attribute carries the name of the service class corresponding to the client requesting access.<10>

A network access server (NAS) MAY send this attribute to a RADIUS server.

For more information about this attribute, see section 2.2.1.7.

3.2.5.4.8 MS-Quarantine-User-Class

When a network access server (NAS) receives this attribute, it MAY assign the DHCP client to the DHCP user class, as specified in [RFC3004].<11>

For more information about this attribute, see section 2.2.1.8.

3.2.5.4.9 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 used in Microsoft Network Access Protection (NAP) scenarios, as specified in section 4.3.

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

When a Microsoft DHCP server receives this attribute from a Microsoft RADIUS 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 vendor-specific attribute (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 3.2.5.4.16) and MS-IPv6-Remediation-Servers (see section 3.2.5.4.17) 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 3.2.5.4.16) and MS-IPv6-Remediation-Servers (see section 3.2.5.4.17) 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 expiry for the endpoint before or at the same time specified in the MS-Quarantine-Grace-Time (see section 3.2.5.4.10) VSA.
- The HRA MUST ignore this attribute.

For more information about this attribute, see section 2.2.1.9.

3.2.5.4.10 MS-Quarantine-Grace-Time

When a network access server (NAS) receives this attribute in an Access-Accept message, it MUST on expiration give full access to a endpoint requesting network access until the time specified by this attribute expires.

For more information about this attribute, see section 2.2.1.10.

3.2.5.4.11 MS-Network-Access-Server-Type

This attribute carries the type information of a network access server (NAS).<12>

A NAS MAY send this attribute to RADIUS server to indicate the type of NAS in an Access-Request message.

For more information about this attribute, see section 2.2.1.11.

3.2.5.4.12 MS-AFW-Zone

This attribute carries the information about the Network Access Protection (NAP) zone (see [MS-HCEP] and [MS-SOH]) that an endpoint should be in.<13>

When an network access server (NAS) receives this attribute, it MAY decide which zone to put an endpoint to (for example, secure zone, boundary zone, or quarantine zone). The NAS accordingly applies a different IPSec policy to this endpoint.

For more information about this attribute, see section 2.2.1.12.

3.2.5.4.13 MS-AFW-Protection-Level

A network access server (NAS) that receives this attribute from the RADIUS server in an Access-Accept MUST send it to the endpoint that is requesting network access.<14>

When an NAS receives this attribute, it MAY set protection level accordingly based on the value of this attribute and indicate the endpoints requesting network access the protection level they should use.

For more information about this attribute, see section 2.2.1.13.

3.2.5.4.14 MS-Machine-Name

A network access server (NAS) MAY use this attribute to pass the machine name of the endpoint requesting network access to a RADIUS server, which may then use this information to make an authentication or authorization decision.<15>

For more information about this attribute, see section 2.2.1.14.

3.2.5.4.15 MS-IPv6-Filter

This attribute MAY<16> be used by network access server (NAS) to define the network access scope of the endpoint. It is used only for IPv6 addresses and MS-Filter, [RFC2548] vendor-specific attribute (VSA) is the corresponding attribute for IPv4 addresses.<17>

When a Microsoft Routing and Remote Access Service (RRAS) server receives this attribute, it sets the network access scope for the endpoint that is requesting network access based on the value of this attribute.

This attribute defines traffic filters to a NAS for restricting access for a specific network access connection. The filters defined in this attribute MUST be implemented on the endpoint 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.

For more information about this attribute, see section 2.2.1.15.

3.2.5.4.16 MS-IPv4-Remediation-Servers

This attribute specifies the IPv4 addresses of the remediation servers.<18>

When a network access server (NAS) receives this attribute from a Microsoft RADIUS server in an Access-Accept message, it MAY authorize a restricted endpoint to access the IPv4 addresses carried in this attribute.

For more information about this attribute, see section 2.2.1.16.

3.2.5.4.17 MS-IPv6-Remediation-Servers

This attribute specifies the IPv6 addresses of the remediation servers.<19>

When a network access server (NAS) receives this attribute from a Microsoft RADIUS server in an Access-Accept message, it MAY authorize a restricted endpoint to access the IPv6 addresses carried in this attribute.

For more information about this attribute, see section 2.2.1.17.

3.2.5.4.18 Not-Quarantine-Capable

This attribute indicates whether or not the endpoint requesting network access is Network Access Protection (NAP)–capable.<20>

When a network access server (NAS) receives this attribute from a Microsoft RADIUS server, it knows whether the endpoint requesting network access is NAP–capable or not and may take different actions accordingly.

For more information about this attribute, see section 2.2.1.18.

3.2.5.4.19 MS-Quarantine-SoH

This attribute carries a Statement of Health (SoH) (as specified in [MS-SOH]) information when EAP is not used.<21>

A network access server (NAS) can forward the SoH (as specified in [MS-SOH]) that is provided by the client to a Microsoft RADIUS server in Access-Request by this attribute, which contains an EAP-TLV-TYPE of vendor-specific TLV and is a MS-SOH-Payload-TLV that contains the SoH (as specified in [MS-SOH]).

For more information about this attribute, see section 2.2.1.19.

3.2.5.4.20 MS-RAS-Correlation-ID

A network access server uses this attribute in RADIUS [RFC2865] Access-Request or Accounting-Request messages for correlation of log events. <22>

For more information about this attribute, see section 2.2.1.20.

3.2.5.4.21 MS-Extended-Quarantine-State

When an 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. <23>

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.

For more information about this attribute, see section 2.2.1.21.

3.2.5.4.22 HCAP-User-Groups

An NAS MAY use this attribute to pass the group name of the user requesting network access to a RADIUS server, which may then use this information to make authentication or authorization decisions.

For more information about this attribute, see section 2.2.1.22.

3.2.5.4.23 HCAP-Location-Group-Name

An NAS MAY use this attribute to pass the location group name of the endpoint requesting network access to a RADIUS server, which may then use this information to make authentication or authorization decisions.

For more information about this attribute, see section 2.2.1.23.

3.2.5.4.24 HCAP-User-Name

An NAS MAY use this attribute to pass the name of the user requesting network access to a RADIUS server, which may then use this information to make authentication or authorization decisions.

For more information about this attribute, see section 2.2.1.24.

3.2.5.4.25 MS-User-IPv4-Address

An NAS MAY use this attribute to pass the IPv4 address of the endpoint requesting network access to a RADIUS server, which may then use this information to make authentication or authorization decisions.<24>

For more information about this attribute, see section 2.2.1.25.

3.2.5.4.26 MS-User-IPv6-Address

An NAS MAY use this attribute to pass the IPv6 address of the endpoint requesting network access to a RADIUS server, which may then use this information to make authentication or authorization decisions.<25>

For more information about this attribute, see section 2.2.1.27.

3.2.5.4.27 MS-TSG-Device-Redirection

When Microsoft Terminal Service Gateway receives this attribute, it MUST disable or enable the device redirection functionality based on the bits that are set in the attribute. For the meaning of the bits, see section 3.1.5.4.27.

When bit 29 (disable all devices) is set, the device redirection functionality MUST be disabled for all the devices regardless of the value of bit 30 (enable all devices) and bits 0–4 (disable a particular device). When bit 29 is not set but bit 30 is set, device redirection functionality for all the devices must be enabled regardless of the value of bits 0–4.<26>

For more information about this attribute, see section 2.2.1.27.

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

No other local events are required for this protocol.

4 Protocol Examples

The following sections describe several operations as used in common scenarios to illustrate the function of the RADIUS Vendor-Specific Attributes for Network Access Protection (NAP) Protocol.

4.1 VPN Connection with RQC/RQS Quarantine

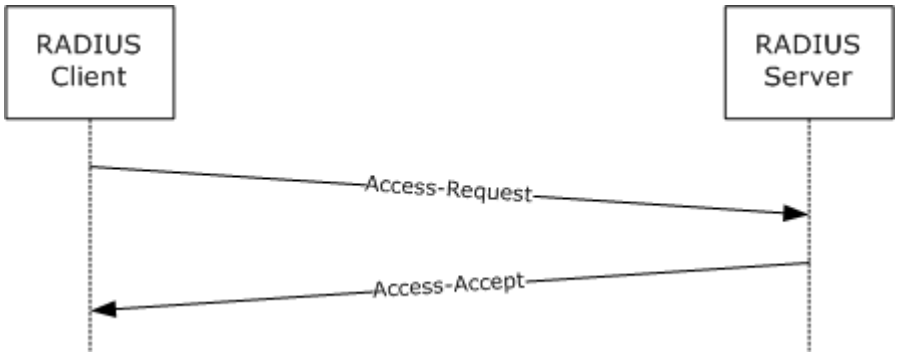


Figure 2: VPN Connection with RQC/RQS Quarantine example

In this example, a Remote Access Service (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
- Attribute 10: Tunnel-Medium-Type = IP
- Attribute 11: Tunnel-Client-Endpt = 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

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

4.2 Health Registration Authority (HRA)

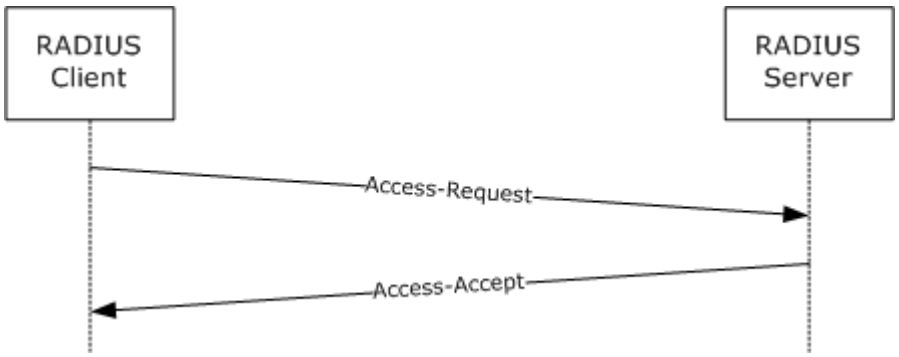


Figure 3: Health Registration Authority (HRA) example

In this example, a health registration authority (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 = fqdn client name in ASCII characters with ANSI code page.
- Attribute 6: MS-SoH-Payload-Type = SoH blob
- Attribute 7: NAS-Identifier-Type = HCS server fqdn name in ASCII characters with the code page to be the current system 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
- Attribute 3: MS-IPv4-Remediation-Servers = List of IPv4 addresses

4.3 DHCP NAP

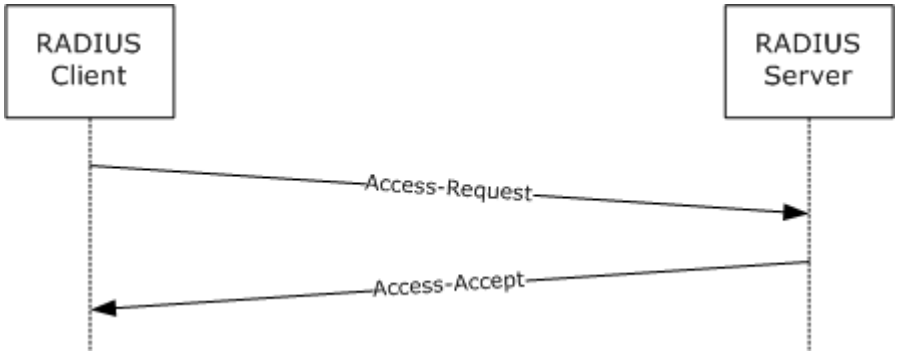


Figure 4: DHCP NAP example

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 = fqdn client name in ANSI
- Attribute 6: MS-SoH-Payload-Type = SoH blob
- Attribute 7: NAS-Identifier-Type = HCS server fqdn name 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-AFW-Zone = Non-Boundary
- Attribute 2: MS-AFW-Protection-Level = Encrypted
- Attribute 3: MS-IPv4-Remediation-Servers = List of IPv4 addresses
- Attribute 4:MS-Quarantine-User-Class = User class

4.4 VPN NAP

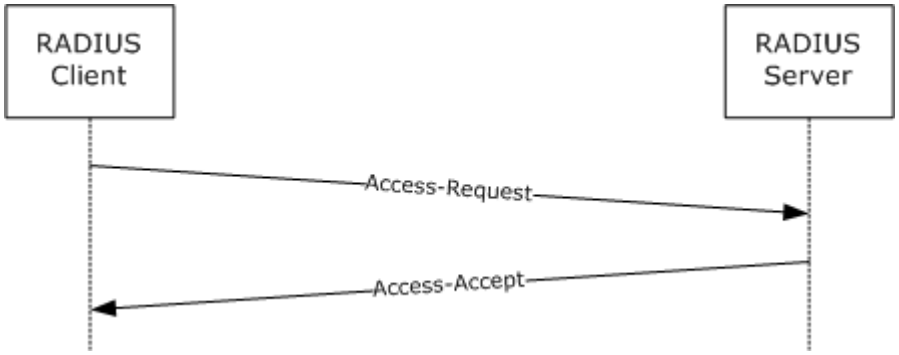


Figure 5: VPN NAP example

In this example, a Remote Access Service (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
- Attribute 8: Tunnel-Medium-Type = IP
- Attribute 9: Tunnel-Client-Endpt = 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
- 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

5 Security

The following section specifies security considerations for implementers.

5.1 Security Considerations for Implementers

The Microsoft RADIUS vendor-specific attributes (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 not necessarily be 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 MAY<27> decide to support a mode of operation wherein RADIUS will not be sent or received unless protected by IPSec, as specified in [RFC3579] section 4.2.

6 Appendix A: Windows Behavior

The information in this specification is applicable to the following versions of Windows:

- Windows 2000
- Windows XP
- Windows Server 2003
- Windows Vista
- Windows Server 2008

Exceptions, if any, are noted below. Unless otherwise specified, any statement of optional behavior in this specification prescribed using the terms SHOULD or SHOULD NOT implies Windows behavior in accordance with the SHOULD or SHOULD NOT prescription. Unless otherwise specified, the term MAY implies that Windows 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 MUST be 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 Routing and Remote Access Service (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 Server 2003 and earlier.) Also note that this service is deprecated in Windows Vista and Windows Server 2008 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 2.2.1.12: This is used as a hint for dynamic selection of a preconfigured policy by the consumer of the health certificate on the endpoint.

<4> 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 vendor-specific attribute (VSA) for use by implementers to extend the attribute set. Microsoft has created a number of vendor-specific attributes (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 what RADIUS VSAs are implemented in Windows 2000 and later:

Windows Server					
Microsoft Vendor-Specific Attribute	**Reference**	**Section**	**Windows2000 Server**	**Windows Server2003**	**Windows Server2008**
MS-CHAP-Response	[RFC2548]	2.1.3	X	X	X
MS-CHAP-Domain	[RFC2548]	2.1.4	X	X	X
MS-CHAP-Error	[RFC2548]	2.1.5	X	X	X

Windows Server					
Microsoft Vendor-Specific Attribute	**Reference**	**Section**	**Windows2000 Server**	**Windows Server2003**	**Windows Server2008**
MS-CHAP-CPW-1	[RFC2548]	2.1.6	X	X	X
MS-CHAP-CPW-2	[RFC2548]	2.1.7	X	X	X
MS-CHAP-LM-Enc-PW	[RFC2548]	2.1.8	X	X	X
MS-CHAP-NT-Enc-PW	[RFC2548]	2.2	X	X	X
MS-CHAP2-Response	[RFC2548]	2.3.2	X	X	X
MS-CHAP2-Success	[RFC2548]	2.3.3	X	X	X
MS-CHAP2-CPW	[RFC2548]	2.3.4	X	X	X
MS-CHAP-MPPE-Keys	[RFC2548]	2.4.1	X	X	X
MS-MPPE-Send-Key	[RFC2548]	2.4.2	X	X	X
MS-MPPE-Recv-Key	[RFC2548]	2.4.3	X	X	X
MS-MPPE-Encryption-Types	[RFC2548]	2.4.4	X	X	X
MS-MPPE-Encryption-Policy	[RFC2548]	2.4.5	X	X	X
MS-BAP-Usage	[RFC2548]	2.5.1	X	X	X
MS-Link-Utilization-Threshold	[RFC2548]	2.5.2	X	X	X
MS-Link-Drop-Time-Limit	[RFC2548]	2.5.3	X	X	X
MS-Old-ARAP-Password	[RFC2548]	2.6.1	X		
MS-New-ARAP-Password	[RFC2548]	2.6.2	X		

Windows Server					
Microsoft Vendor-Specific Attribute	**Reference**	**Section**	**Windows2000 Server**	**Windows Server2003**	**Windows Server2008**
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
MS-RAS-Version	[RFC2548]	2.7.2	X	X	X
MS-Filter	[RFC2548]	2.7.3	X	X	X
MS-Acct-Auth-Type	[RFC2548]	2.7.4	X	X	X
MS-Acct-EAP-Type	[RFC2548]	2.7.5	X	X	X
MS-Primary-DNS-Server	[RFC2548]	2.7.6	X	X	X
MS-Secondary-DNS-Server	[RFC2548]	2.7.7	X	X	X
MS-Primary-NBNS-Server	[RFC2548]	2.7.8	X	X	X
MS-Secondary-NBNS-Server	[RFC2548]	2.7.9	X	X	X
MS-RAS-Client-Name	This document	MS-RAS-Client-Name (section 2.2.1.1)		X	X
MS-RAS-Client-Version	This document	MS-RAS-Client-Version (section 2.2.1.2)		X	X
MS-Quarantine-IPFilter	This document	MS-Quarantine-IPFilter (section 2.2.1.3)		X	X
MS-Quarantine-Session-Timeout	This document	MS-Quarantine-Session-Timeout (section 2.2.1.4)		X	X
MS-Identity-Type	This document	MS-Identity-Type (section 2.2.1.6)			X
MS-Service-Class	This document	MS-Service-Class (section 2.2.1.7)			X

Windows Server					
Microsoft Vendor-Specific Attribute	**Reference**	**Section**	**Windows2000 Server**	**Windows Server2003**	**Windows Server2008**
MS-Quarantine-User-Class	This document	MS-Quarantine-User-Class (section 2.2.1.8)			X
MS-Quarantine-State	This document	MS-Quarantine-State (section 2.2.1.9)			X
MS-Quarantine-Grace-Time	This document	MS-Quarantine-Grace-Time (section 2.2.1.10)			X
MS-Network-Access-Server-Type	This document	MS-Network-Access-Server-Type (section 2.2.1.11)			X
MS-AFW-Zone	This document	MS-AFW-Zone (section 2.2.1.12)			X
MS-AFW-Protection-Level	This document	MS-AFW-Protection-Level (section 2.2.1.13)			X
MS-Machine-Name	This document	MS-Machine-Name (section 2.2.1.14)			X
MS-IPv6-Filter	This document	MS-IPv6-Filter (section 2.2.1.15)			X
MS-IPv4-Remediation-Servers	This document	MS-IPv4-Remediation-Servers (section 2.2.1.16)			X
MS-IPv6-Remediation-Servers	This document	MS-IPv6-Remediation-Servers (section 2.2.1.17)			X
Not-Quarantine-Capable	This document	Not-Quarantine-Capable (section 2.2.1.18)			X
MS-Quarantine-SOH	This document	MS-Quarantine-SOH (section 2.2.1.19)			X

Windows Server					
Microsoft Vendor-Specific Attribute	**Reference**	**Section**	**Windows2000 Server**	**Windows Server2003**	**Windows Server2008**
MS-RAS-Correlation-ID	This document	MS-RAS-Correlation-ID (section 2.2.1.20)			X
MS-Extended-Quarantine-State	This document	MS-Extended-Quarantine-State (section 2.2.1.21)			X
HCAP-User-Groups	This document	HCAP-User-Groups (section 2.2.1.22)			X
HCAP-Location-Group-Name	This document	HCAP-Location-Group-Name (section 2.2.1.23)			X
HCAP-User-Name	This document	HCAP-User-Name (section 2.2.1.24)			X
MS-IPv4-User-Name	This document				X
MS-IPv6-User-Name	This document				X
MS-TSG-Device-Redirection	This document				X

<5> Section 3.1.5.3: Microsoft RADIUS clients and RADIUS servers ignore vendor-specific attributes (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-CapableVSA 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 a VSA with an unknown vendor ID / vendor type combination (for example, a RADIUS client receives a VSA with the vendor ID set to 0x00000137 and a vendor-type set to 0xAA).

<6> Section 3.2.5.4.1: When configured to support Network Access Protection (NAP), the Microsoft Routing and Remote Access Service (RRAS) server sends this attribute in an Access-Request to the RADIUS server.

<7> Section 3.2.5.4.2: When configured to support Network Access Protection (NAP), the Microsoft Routing and Remote Access Service (RRAS) server sends this attribute in an Access-Request to the RADIUS server

<8> Section 3.2.5.4.3: Only the Microsoft Routing and Remote Access Service (RRAS)RADIUS client supports this attribute when configured to support RQS/RQC; if received by a health registration authority (HRA) or DHCP server acting as a RADIUS client, it is silently discarded.

For more information about RQS/RQC, see section 4.1.

<9> Section 3.2.5.4.4: Only the Microsoft Routing and Remote Access Service (RRAS) server RADIUS client supports this attribute when configured to support RQS/RQC; if received by an health registration authority (HRA) or DHCP RADIUS client, it is silently discarded.

For RQS/RQC, see section VPN Connection with RQC / RQS quarantine (section 4.1).

<10> Section 3.2.5.4.7: When configured to support Network Access Protection (NAP), the Microsoft DHCP server sends this attribute in an Access-Request to the RADIUS server.

<11> Section 3.2.5.4.8: Only the DHCP RADIUS client supports this attribute when configured to support Network Access Protection (NAP); if received by an health registration authority (HRA) or Microsoft Routing and Remote Access Service (RRAS) RADIUS client, it is silently discarded.

<12> Section 3.2.5.4.11: When configured to support Network Access Protection (NAP), the Microsoft Routing and Remote Access Service (RRAS)), DHCP, and health registration authority (HRA) RADIUS client send this attribute in an Access-Request to the RADIUS server.

<13> Section 3.2.5.4.12: Only the health registration authority (HRA) RADIUS client (see sections 4.2 and [MS-HCEP]) supports this attribute; if received by a Microsoft Routing and Remote Access Service (RRAS) server or DHCP RADIUS client, it is silently discarded.

<14> Section 3.2.5.4.13: Only the health registration authority (HRA) RADIUS client (see section 4.2 and [MS-HCEP]) supports this attribute; if received by a Microsoft Routing and Remote Access Service (RRAS) server or DHCP server acting as a RADIUS client, it is silently discarded.

<15> Section 3.2.5.4.14: When configured to support Network Access Protection (NAP), the Microsoft Routing and Remote Access Service (RRAS), DHCP, and health registration authority (HRA)RADIUS client send this attribute in an Access-Request to a RADIUS server.

<16> Section 3.2.5.4.15: When a Microsoft Routing and Remote Access Service (RRAS) server receives this attribute, it sets the network access scope for the endpointendpoint requesting network access based on the value of this attribute. This attribute defines traffic filters to a network access server (NAS) for restricting access for a specific network access connection. The filters defined in this attribute MUST be implemented on the client 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. 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. A NAS MAY ignore this flag and can consider this as reserved with a value of zero.

<17> Section 3.2.5.4.15: When Windows is operating as a network access server (NAS) in a Remote Access Service (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 which 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.

<18> Section 3.2.5.4.16: Only the Microsoft Routing and Remote Access Service (RRAS) server and DHCP servers acting as server acting as a RADIUS clients support this attribute when configured to support Network Access Protection (NAP); if received by an health registration authority (HRA) RADIUS client, it is silently discarded.

<19> Section 3.2.5.4.17: Only the Microsoft Routing and Remote Access Service (RRAS) server and DHCP servers acting as RADIUS clients support this attribute when configured to support Network Access Protection (NAP); if received by an health registration authority (HRA) RADIUS client, it is silently discarded.

<20> Section 3.2.5.4.18: Only the Microsoft Routing and Remote Access Service (RRAS) server clients support this attribute when configured to support NAP (for example, if received by an health registration authority (HRA) or DHCP servers acting as s RADIUS client, it is silently discarded).

<21> Section 3.2.5.4.19: When configured to support Network Access Protection (NAP), the Microsoft DHCP, Microsoft Routing and Remote Access Service (RRAS), and health registration authority (HRA) RADIUS client sends this attribute in an Access-Request to the RADIUS server.

<22> Section 3.2.5.4.20: The Microsoft RRAS server sends this attribute in Access-Request and Accounting-Request messages to the RADIUS server.

<23> Section 3.2.5.4.21: This attribute is used in Microsoft NAP scenarios (see section 4.3).

<24> Section 3.2.5.4.25: The Microsoft HCAP server sends this attribute in Access-Request messages to the RADIUS server.

<25> Section 3.2.5.4.26: The Microsoft HCAP server sends this attribute in Access-Request messages to the RADIUS server.

<26> Section 3.2.5.4.27: Only the Microsoft Terminal Server Gateway (TSG) server clients support this attribute (for example, if received by a health registration authority (HRA) or DHCP server acting as a RADIUS client or RRAS server, it is silently discarded).

<27> Section 5.1: Windows does not support such a mode. However, IPSec can be configured on Windows to ensure equivalent behavior.

7 Index

N

O

P

R

S

T

V

W