[MS-HGSA-Diff]:

Host Guardian Service: Attestation Protocol

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Revision Summary

Date	Revision History	Revision Class	Comments
3/16/2017	1.0	New	Released new document.
6/1/2017	2.0	Major	Significantly changed the technical content.

Table of Contents

1 Introduction

This document specifies the Host Guardian Services Attestation (HGSA) Protocol.

Host Guardian Service provides secure services such as Attestation Service and Key Protection Service. Together these two services provide security assurance for shielded VMs by ensuring that shielded VMs can be run only on known and trusted fabric hosts that have a legitimate configuration. Key Protection Service is out of scope of the document.

Sections 1.5, 1.8, 1.9, 2, and 3 of this specification are normative. All other sections and examples in this specification are informative.

1.1 Glossary

This document uses the following terms:

EK public key (EKPub): The public key portion of an endorsement key's private/public key pair.

globally unique identifier (GUID): A term used interchangeably with universally unique identifier (UUID) in Microsoft protocol technical documents (TDs). Interchanging the usage of these terms does not imply or require a specific algorithm or mechanism to generate the value. Specifically, the use of this term does not imply or require that the algorithms described in [RFC4122] or [C706] must be used for generating the GUID. See also universally unique identifier (UUID).

Hypertext Transfer Protocol (HTTP): An application-level protocol for distributed, collaborative, hypermedia information systems (text, graphic images, sound, video, and other multimedia files) on the World Wide Web.

trusted platform module (TPM): A component of a trusted computing platform. The TPM stores keys, passwords, and digital certificates. See [TCG-Architect] for more information.

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

1.2 References

Links to a document in the Microsoft Open Specifications library point to the correct section in the most recently published version of the referenced document. However, because individual documents in the library are not updated at the same time, the section numbers in the documents may not match. You can confirm the correct section numbering by checking the Errata.

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.

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

[MS-KPS] Microsoft Corporation, "Key Protection Service Protocol".

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

[RFC2616] Fielding, R., Gettys, J., Mogul, J., et al., "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999, http://www.rfc-editor.org/rfc/rfc2616.txt

[RFC2818] Rescorla, E., "HTTP Over TLS", RFC 2818, May 2000, http://www.rfc-editor.org/rfc/rfc2818.txt

1.2.2 Informative References

None.

1.3 Overview

The Host Guardian Service Attestation protocol uses REST-based transport protocol.

The Host Guardian Service provides secure services such as the Attestation Service and the Key Protection Service.

For TPM-based attestation:

- A client initiates TPM-based attestation by providing its Remote TPM public endorsement key ("EKPub") to the Host Guardian Service.
- The Host Guardian Service uses the EKPub to initiate an underlying Remote TPM ("RTPM") protocol to the client to read TPM measurements from the client. The reply includes the current RTPM protocol context.
- The client reads the context provided by the service and continues the RTPM protocol by sending another request containing a new RTPM protocol context to the server.
- When the service has completed the TPM read, it compares the measurements therein with the configured TPM-based attestation policy. If policy evaluation succeeds, it returns a valid attestation health certificate to the client.

For Active Directory(AD)-based attestation:

- The server checks that the client credentials are a member of a registered authorized host group.
- A client initiates AD-based attestation by initiating an AD-based attestation request to the Host Guardian Service.
- The service uses the Kerberos protocol to authenticate the client request. If the credentials belong to a configured, authorized Active Directory host group, the service returns a valid attestation health certificate to the client.

The client can choose AD-based or TPM-based attestation depending upon the server configuration.

1.4 Relationship to Other Protocols

For key protection service, the Host Guardian Service uses Key Protection services, as specified in [MS-KPS].

1.5 Prerequisites/Preconditions

The server is configured to either the TPM-based attestation or AD-based attestation mode and can operate on only one mode at a time.

The following is the list of prerequisites/preconditions to perform TPM-based attestation.

- The client is required to be registered in the server configuration with its EKPub.

Following is the prerequisite/precondition needed to perform AD-based attestation.

- The Security Identifier of the client is required to be registered in the server configuration.

1.6 Applicability Statement

The "Host Guardian Service" includes the Attestation Service and the Key Protection Service as critical components that enable secure virtual machines in a cloud-based environment.

1.7 Versioning and Capability Negotiation

None.

1.8 Vendor-Extensible Fields

There are no vendor-extensible fields for the Host Guardian Service Attestation Protocol.

1.9 Standards Assignments

None.

2 Messages

2.1 Transport

This protocol uses HTTP or secure HTTP 1.1 as transport, as specified in [RFC2616] and [RFC2818].

2.2 Common Data Types

2.2.1 Enumerations

The following sections specify the enumerations defined in this specification.

2.2.1.1 AttestationOperationMode

AttestationOperationMode represents the operation mode of the Attestation Service.

Value	Meaning
0x00000000	Unknown attestation mode
0x00000001	TPM - Platform TPM–based attestation mode
0x00000002	AD - Active Directory–based attestation mode

2.2.1.2 AttestationContentType

AttestationContentType represents the type of the content being requested or returned by the Attestation Service.

Value	Request or Reply Type	Meaning
0x00000001	TpmRequest	The virtual secure mode identity key (VSMIDK) is being requested as a health certificate. The VSMIDK will be determined from the contents of the TCG log after the RTPM exchange.
0x00000001	ADRequest	The VSMIDK is being requested as a health certificate. The VSMIDK is passed as part of the request, in a **TupleOfAttestationContentTypebase64Binary** with the content type so that it is recognizable by the server.
0x00000001	HealthCertificateReply	The VSMIDK certificate (X509Certificate2) is being returned with the reply, in a **TupleOfAttestationContentTypebase64Binary** with the content type so that it is recognizable by the client.

2.2.1.3 TPMVersion

The **TPMVersion** denotes the version of TPM.

Value	Meaning
TPM_VERSION_UNKOWN 0x00000000	Unknown version.

Value	Meaning
TPM_VERSION_12 0x00000001	TPM 1.2
TPM_VERSION_20 0x00000002	TPM 2.0

2.2.1.4 TpmInterfaceType

The **TpmInterfaceType** denotes the type of TPM interface.

Value	Meaning
TPM_IFTYPE_UNKNOWN 0x00000000	Unknown interface type.
TPM_IFTYPE_1 0x00000001	TPM 1.2 interface type that uses port-mapped or memory-mapped I/O.
TPM_IFTYPE_TRUSTZONE 0x00000002	TPM 2.0 TrustZone interface.
TPM_IFTYPE_HW 0x00000003	TPM 2.0 hardware interface.
TPM_IFTYPE_EMULATOR 0x00000004	TPM 2.0 software emulator interface.

2.2.2 Common Data Structures

The following sections are the set of common data structures defined by this specification. Common data types are specified in [MS-DTYP].

JSON schema objects represented in this section are assumed to exist in the [MS-HGSA] document root. Order of "__type" object property matters and, when present, must be placed before all other properties. Enumerations from the previous section may also be presented as JSON schema references in the format "[MS-HGSA]#/EnumerationName".

2.2.2.1 TpmRequest

The **TpmRequest** structure defines the base type of all TPM-based protocol requests.

```
{
    "id": "TpmRequest",
    "allOf": [{
        "type": "object",
        "properties": {
            "RequestedContent": {
                "type": "array",
                "items": {
                    "$ref": "[MS-HGSA]#/AttestationContentType"
                },
                "required": true
```

```
            },
            "RtpmPublicEndorsementKey": {
                "type": "string",
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolRequestBase"
    }]
}
```

RequestedContent: The type of content requested to be returned upon successful attestation. For TPM-based attestation, the value of the content will be determined based on the **RequestedContent** and information from the RTPM exchange.

RtpmPublicEndorsementKey: A base64Binary string representing the remote TPM public endorsement key of the client that tried to perform attestation.

2.2.2.2 TpmRequestInitial

The **TpmRequestInitial** structure defines the initial request for triggering TPM-based attestation.

```
{
    "id": "TpmRequestInitial",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["TpmRequestInitial:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
        }
    },{
        "$ref": "[MS-HGSA]#/TpmRequest"
    }]
}
```

2.2.2.3 TpmRequestContinue

The **TpmRequestContinue** structure defines the subsequent request after receiving new remote TPM context as the response from the server.

```
{
    "id": "TpmRequestContinue",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["TpmRequestContinue:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "RtpmNewContext": {
                "type": "string",
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/TpmRequest"
```

```
    }]
}
```

RtpmNewContext: A base64Binary string representing the new remote TPM context received from the server in response to the initial TPM request as defined in section 2.2.2.22.

2.2.2.4 ADRequest

The **ADRequest** structure defines the initial request for performing Active Directory–based attestation.

```
{
    "id": "ADRequest",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["ADRequest:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "RequestedContent": {
                "type": "array",
                "items": {
                    "$ref": "[MS-HGSA]#/TupleOfAttestationContentTypebase64Binary"
                },
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolRequestBase"
    }]
}
```

RequestedContent: A tuple of the type of content being attested as well as the content itself.

2.2.2.5 TpmReplyContinue

The **TpmReplyContinue** structure defines the TPM-based attestation replies, preceding the final reply.

```
{
    "id": "TpmReplyContinue",
    "description": "TPM Based attestation: response from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["TpmReplyContinue:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "RtpmActiveContext": {
                "type": "string"
            },
            "required": ["RtpmActiveContext"]
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolReplyBase"
    }]
}
```

RtpmActiveContext: A base64Binary string representing the new Remote TPM context, as defined in section 2.2.2.22, received from the server in response to the initial TPM request.

2.2.2.6 HealthCertificateReply

The **HealthCertificateReply** structure defines the final attestation reply that is received from the server that contains the health certificate.

```
{
    "id": "HealthCertificateReply",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["HealthCertificateReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "Content": {
                "type": "array",
                "items": {
                    "$ref": "[MS-HGSA]#/TupleOfAttestationContentTypebase64Binary"
                },
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolReplyBase"
    }]
}
```

Content: A **TupleOfAttestationContentTypebase64Binary** containing the requested content type and the attested content itself.

2.2.2.7 TupleOfAttestationContentTypebase64Binary

```
{
    "id": "TupleOfAttestationContentTypebase64Binary",
    "type": "object",
    "properties": {
        "m_Item1": {
            "$ref": "[MS-HGSA]#/AttestationContentType",
            "required": true
        },
        "m_Item2": {
            "type": "string",
            "required": true
        }
    }
}
```

m_Item1: The **AttestationContentType** that identifies to the client or server what the base64Binary string in **m_Item2** represents.

m_Item2: The base64Binary string of the content type identified in **m_Item1**.

2.2.2.8 ServiceInfoReply

ServiceInfoReply denotes the information about the **Server** service.

```
{
```

```
    "id": "ServiceInfoReply",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["ServiceInfoReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "FunctionalLevel": {
                "type": "integer",
                "minimum": 0,
                "maximum": 4294967295,
                "required": true
            },
            "OperationMode": {
                "$ref": "[MS-HGSA]#/AttestationOperationMode",
                "required": true
            },
            "SupportedFunctionalLevels": {
                "type": "array",
                "items": {
                    "type": "integer",
                    "minimum": 0,
                    "maximum": 4294967295
                },
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolReplyBase"
    }]
}
```

FunctionalLevel: An integer representing the current functional level of the server.

OperationMode: An attestation operation mode representing the current operating mode of the server as defined in section 2.2.1.1.

SupportedFunctionalLevels: An array of integers representing the supported function levels of the server.

2.2.2.9 ErrorReply

The **ErrorReply** structure defines the base type of all protocol replies containing an error and the generic reply used when an error is not associated with other types of errors. Other errors can be any one of the following structures mentioned in sections 2.2.2.12, 2.2.2.13, 2.2.2.14, 2.2.2.15, 2.2.2.16, 2.2.2.17, 2.2.2.18, 2.2.2.19, 2.2.2.20, or 2.2.2.21.

```
{
    "id": "ErrorReply",
    "allOf": [{
        "type": "object",
        "properties": {
            "Retryable": {
                "type": "boolean",
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ProtocolReplyBase"
    }]
}
```

Retryable: A Boolean representing whether the client can meaningfully retry the request that resulted in an error.

2.2.2.10 EndorsementKey

The **EndorsementKey** structure defines the remote TPM public endorsement key that holds the buffer of the key.

```
{
    "id": "EndorsementKey",
    "description": "Unmanaged Remote TPM public key structure",
    "type": "object",
    "properties": {
        "Key": {
            "type": "string"
            "required": true
        }
    },
    "additionalProperties": false
}
```

Key: A base64Binary string representing the public endorsement key of the Remote TPM.

2.2.2.11 EvaluationLog

The **EvaluationLog** structure defines the policy evaluation log entry indicating whether the attestation has passed or not.

```
{
    "id": "EvaluationLog",
    "description": "Verifies the Evaluation Log entry ",
    "type": "object",
    "properties": {
        "Result": {
            "type": "boolean"
            "required": true
        },
        "Reason": {
            "type": "string"
            "required": true
        },
        "additionalProperties": false
    }
}
```

Result: A Boolean indicating whether policy evaluation is successful or not. True if the policy evaluation is successful; otherwise, False.

Reason: A base64Binary string representing policy evaluation failure reasons. The list of GUIDs identifying the type of policy evaluation failure are given below.

GUID	Name/Policy Description
6a460ee1-62ea-416f-ae6c-04e29634506d	SecureBootEnabledGuid - Secure Boot is enabled.
756dc455-9528-479a-a86a-c646417316c9	SecureBootSettingsGuid - Secure Boot measurements match the expected values.
20188fda-d40b-460d-b078-2e7898a42ae9	DebugModeUefiGuid - UEFI debug mode is disabled.
81f110ba-53c5-4064-9d64-51029fa24f49	SystemIntegrityCiKnownGoodGuid - Code Integrity

GUID	Name/Policy Description
	measurements match the expected values.
75ad09c9-7254-4d00-96f3-3b09d0aaac54	FullBootGuid - The last boot was a full boot.
75d595de-12f5-41e9-a61e-469d3205ecca	VsmIdkPresent - The Virtual Secure Mode Identity Key is present.
6c0a6d29-5bcb-4f28-bafb-f71eb60fdae0	VsmRunning - Virtual Secure Mode is running.
da0776e5-6570-44b3-9a17-7e95b4fc7779	IommuEnabled - IOMMU required for VSM to launch.
347da547-d266-4939-bf3d-9ec73a90bdbc	BitLockerEnabled - BitLocker enabled.
12df0ee9-b38e-4086-90f8-703d9e7cb878	PagefileEncryptionEnabled - Pagefile encryption enabled.
5408BD30-3250-4AC1-A150-C410AF756699	HypervisorEnforcedCiPolicy - Policy which ensures that CI is being enforced by the hypervisor.
A32022C6-DCCD-4BF5-BE76-3B5CA1542559	NoHibernation- Policy which ensures that hibernation is disabled.
2A796E36-E918-454F-B610-60F086E8D334	NoDumps - Policy which ensures that crash dumps are disabled.
6F390A71-753C-43AA-A326-74E30AEDCD9D	DumpEncryption - Policy which ensures that crash dumps are encrypted if they are enabled.
85DAC0A4-8BA9-4A7F-A342-211862CE0BE8	DumpEncryptionKey - Policy which ensures that the crash dump encryption key is expected if crash dumps are enabled.

2.2.2.12 OperationModeErrorReply

OperationModeErrorReply structure defines the error reply due to incorrect operation mode specified by the client.

```
{
    "id": "OperationModeErrorReply",
    "description": "Error reply from server for Operation mode",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["OperationModeErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "ExpectedOperationMode": {
                "type": {
                    "$ref": "[MS-HGSA]#/AttestationOperationMode"
                    "required": true
                }
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ErrorReply"
    }]
}
```

ExpectedOperationMode: Expected mode of operation from the server; possible modes of operation are specified in section 2.2.1.1.

2.2.2.13 PayloadErrorReply

PayloadErrorReply structure defines the error in which a request sent by the client is not supported by the server.

```
{
    "id": "PayloadErrorReply",
    "description": "Payload Error reply from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["PayloadErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                }
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ErrorReply"
    }]
}
```

2.2.2.14 PolicyEvaluationErrorReply

PolicyEvaluationErrorReply structure defines the error due to failure in the policy.

```
{
    "id": "PolicyEvaluationErrorReply",
    "description": "Policy Evaluation Error reply from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum":
["PolicyEvaluationErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                },
            "Reasons": {
                "type": "array",
                "items": {
                    "$ref": "[MS-HGSA]#/EvaluationLog"
                },
                "required": true
            }
        }
    },{
        "$ref": "[MS-HGSA]#/ErrorReply"
    }]
}
```

EvaluationLog: Policy evaluation log specified in section 2.2.2.11.

2.2.2.15 ProtocolReplyBase

ProtocolReplyBase structure represents the base type of attestation protocol replies from the server.

```
{
    "id": "ProtocolReplyBase",
    "description": "Protocol reply from server",
    "type": "object",
    "properties": {}
```

```
}
```

2.2.2.16 ProtocolRequestBase

ProtocolRequestBase structure represents the base type of attestation protocol requests from the client to the server.

```
{
    "id": "ProtocolRequestBase",
    "description": "Protocol Request base",
    "type": "object",
    "properties": {
        "SessionId": {
            "type": "string"
        },
        "required": ["SessionId"]
    }
}
```

SessionId: A GUID of type base64Binary string representing the attestation session.

2.2.2.17 RtpmErrorReply

RtpmErrorReply structure represents an error received from the underlying remote TPM protocol.

```
{
    "id": "RtpmErrorReply",
    "description": "Rtpm Error reply from server",
    "allOf": [{"$ref": "#/definitions.ErrorReply"},
    {
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["RtpmErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                }
        }
    }]
}
```

2.2.2.18 TcgLogValidationErrorReply

TcgLogValidationErrorReply structure represents that an error is received from the server in TCG log validation.

```
{
    "id": "TcgLogValidationErrorReply",
    "description": "TCG log validation Error reply from server",
    "allOf": [
    {
        "type": "object",
        "properties": {
            "__type": {
                "enum":
["TcgLogValidationErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                }
        }
    },{
        "$ref": "#/definitions.ErrorReply"
```

```
        }]
    }
```

2.2.2.19 UnauthorizedErrorReply

UnauthorizedErrorReply structure represents that an error is received from the server due to an unauthorized client.

```
{
    "id": "UnauthorizedErrorReply",
    "description": "Unauthorized client Error reply from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["UnauthorizedErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                }
        }
    },{
        "$ref": "#/definitions.ErrorReply"
    }]
}
```

2.2.2.20 UnavailableErrorReply

UnavailableErrorReply structure represents that an error reply is received from the server due to service is unavailable.

```
{
    "id": "UnavailableErrorReply",
    "description": "Host Unavailable or Service Unavailable Error reply from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum": ["UnavailableErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
                "required": true
                }
        }
    },{
        "$ref": "#/definitions.ErrorReply"
    }]
}
```

2.2.2.21 VirtualSecureModeErrorReply

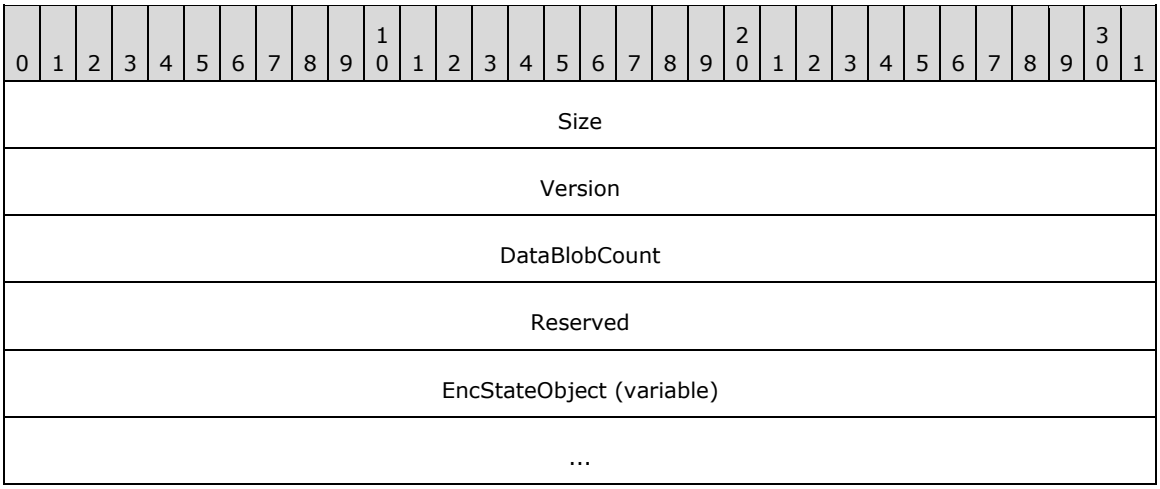
VirtualSecureModeErrorReply structure represents an error in fetching or parsing the VSMIDK or detecting VSM's presence.

```
{
    "id": "VirtualSecureModeErrorReply",
    "description": "Virtual Secure Mode Error reply from server",
    "allOf": [{
        "type": "object",
        "properties": {
            "__type": {
                "enum":
["VirtualSecureModeErrorReply:#Microsoft.Windows.RemoteAttestation.Core"]
```

```
                    "required": true
                    }
                }
            },{
                "$ref": "#/definitions.ErrorReply"
            },]
    }
```

2.2.2.22 Context

The main header remote TPM **Context** structure followed by a variable number of **Data Blobs** defined in section 2.2.2.24.



Size (4 bytes): The size, in bytes of the entire context.

Version (4 bytes): The version of the context. This MUST be set to 1.

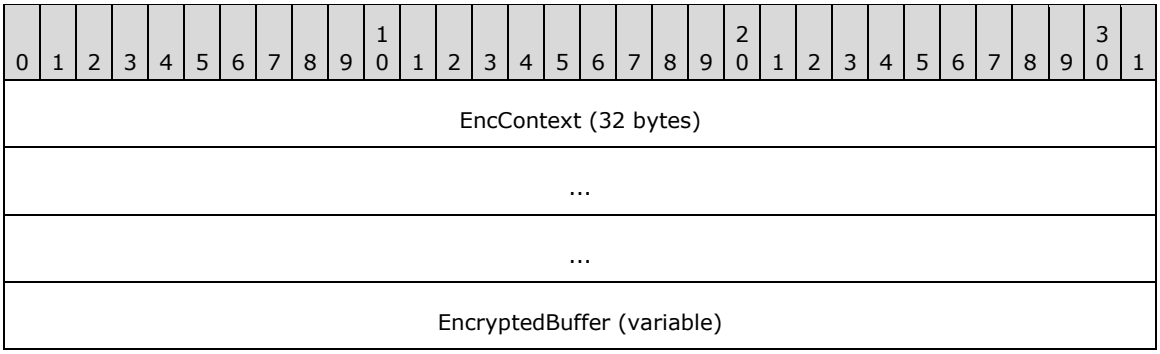
DataBlobCount (4 bytes): The number of data blobs preceding the context.

Reserved (4 bytes): This field is used for padding. This field is set to 0 by client and server MUST ignore this field.

EncStateObject (variable): Encrypted blob containing the TPM state as defined in section 2.2.2.23**.**

2.2.2.23 EncryptedStateObject

The **EncryptedStateObject** is an encrypted blob containing the TPM state.



...

EncContext (32 bytes): The encrypted context**.**

EncryptedBuffer (variable): The encrypted buffer containing the state information.

2.2.2.24 Data Blob

The **Data Blob** contains the payload and is one of the following.

Payload	Meaning
WBCL	WBCL_INFO as defined in section 2.2.2.24.1.
DeviceInfo	TPM_DEVICE_INFO as defined in section 2.2.2.24.2.
TPM command	TPM_COMMAND as defined TCG. The list of supported commands is specified in section 2.2.2.24.3.

2.2.2.24.1 WBCL_INFO

The **WBCL_INFO** structure defines the Windows Boot Counter Log (WBCL).

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
Size																															
Data																															

Size (4 bytes): The size, in bytes, of the WBCL**.**

Data (4 bytes): The actual TCG log.

2.2.2.24.2 TPM_DEVICE_INFO

The **TPM_DEVICE_INFO** provides information about the version of the TPM.

0	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1
StructVersion																															
TpmVersion																															
TpmInterfaceType																															
TpmImplVersion																															

StructVersion (4 bytes): Structure version is set to 1.

TpmVersion (4 bytes): TPM version as defined in section 2.2.1.3.

TpmInterfaceType (4 bytes): TPM interface type as defined in section 2.2.1.4

TpmImplVersion (4 bytes): Implementation-specific revision of the TPM.

2.2.2.24.3 TPM_COMMAND

The list of supported TPM_Commands is as follows.

Name	Command code
TPM_CC_CreatePrimary	0x00000131
TPM_CC_Create	0x00000153
TPM_CC_ReadPublic	0x00000173
TPM_CC_StartAuthSession	0x00000176
TPM_CC_PCR_Read	0x0000017E

3 Protocol Details

3.1 Server Details

3.1.1 Abstract Data Model

This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with that described in this document.

3.1.1.1 Global

SecurityGroup: List of domain-joined hosts that are known to be secure.

AttestationHealthCertificate: The health certificate as an X509Certificate2.

SupportedFunctionalLevels: An array of integers representing the supported functional levels of the server.

3.1.1.2 Per Attestation Request

SecurityIdentifier: A unique value of variable length used to identify a client.

isauthorized: A Boolean that determines whether the client is authorized or not.

RtpmNewContext: A base64Binary string representing the Remote TPM context, as defined in section 2.2.2.22, received from the server in response to initial TPM request.

EvaluationLog: A log containing the result of policy evaluation after performing attestation as specified in section 2.2.2.11.

AttestationOperationMode: The mode of operation of the Attestation Service as defined in section 2.2.1.1.

FunctionalLevel: An integer representing the functional level of the server.

3.1.2 Timers

None.

3.1.3 Initialization

The server MUST implement the following:

Isauthorized: MUST be set to zero.

EvaluationLog: MUST be set to empty.

AttestationHealthCertificate: MUST be set to NULL.

RtpmNewContext: MUST be set to NULL.

AttestationOperationMode: MUST be set to configured operation mode on the server.

FunctionalLevel: MUST be set to the current highest functional level.

SupportedFunctionalLevels: MUST be set to an array of integers representing all supported functional levels of the server.

3.1.4 Higher-Layer Triggered Events

None.

3.1.5 Message Processing Events and Sequencing Rules

The following sections describe the sequence of operations performed by the server.

3.1.5.1 TPM Based Attestation

The server is configured to operate in TPM mode.

3.1.5.1.1 POST

The operation can be invoked through the following URI.

```
http://<configuredServiceName>.<configuredDomain>/Attestation/versionMajorMinor/attest
```

VersionMajorMinor: Represents the major and minor version numbers separated by a decimal—for example, v1.0

The following is an example of a complete URI for this operation.

```
http://attest.hgs151209.com/Attestation/v1.0/attest
```

3.1.5.1.1.1 Request Body

The request body for this method contains any one of the following structures:

TpmRequestInitial: Structure representing the initial TPM-based attestation request as specified in section 2.2.2.2.

TpmRequestContinue: Structure representing the subsequent TPM-based attestation protocol requests, following the initial request as specified in section 2.2.2.3.

3.1.5.1.1.2 Response Body

The response body for this method contains any one of the following structures:

TpmReplyContinue: Structure representing the reply to the initial TPM-based attestation request, preceding the final reply as specified in section 2.2.2.5.

HealthCertificateReply: Structure representing the final reply for attestation that contains the health certificate as specified in section 2.2.2.6.

ErrorReply: Structure containing the attestation protocol errors as specified in section 2.2.2.9.

3.1.5.1.1.3 Processing Details

If the request received is **TpmRequestInitial** or **TpmRequestContinue** and the received URI terminates with "/domainattest", the server MUST return **PayloadErrorReply** to the client.

If the server is configured to TPM mode, request received is **ADRequest** and received URI terminate with "/domainattest, the server MUST return **OperationModeErrorReply** to the client.

If the request received is **TpmRequestInitial**, the server MUST perform the following:

- Check if a matching entry is found between registered EKPub modules and the EKPub of the client that initiated the request.
    - If a matching entry is not found, set **isauthorized** to FALSE and return an **UnauthorizedErrorReply** message to the client.

      If a matching entry is found, set **isauthorized** to TRUE and construct a **TpmReplyContinue** message in an implementation-specific manner to the client's **RtpmPublicEndorsementKey**.

If the request received is **TpmRequestContinue** from the client, the server MUST process the following:

- Check if a matching entry is found between registered EKPub modules and the EKPub of the client. Update **isauthorized** to TRUE if a matching entry is found.
- If **isauthorized** is FALSE for **RtpmPublicEndorsementKey** received from client, return **UnauthorizedErrorReply** to the client.
- If **isauthorized** is TRUE and **RtpmNewContext** received from the client is empty, return **TpmReplyContinue** message to the client with the empty context.

Otherwise,

- Perform the policy evaluation against the list of policies the server is configured to, in an implementation-specific manner with the TCG log that is retrieved from the underlying RTPM protocol and the **RtpmPublicEndorsementKey**.
- If the policy evaluation is successful, the server MUST return **HealthCertificateReply** with the new **AttestationHealthCertificate** ~~received from KPS~~ to the client.

      Otherwise,

      return **PolicyEvaluationErrorReply** with **EvaluationLog** to the client.

3.1.5.2 Active Directory Based Attestation

The server is configured to operate in AD-based mode.

3.1.5.2.1 POST

The operation can be invoked through the following URI.

```
http://<configuredServiceName>.<configuredDomain>/Attestation/VersionMajorMinor/domainattest
```

VersionMajorMinor: Represents the major and minor version numbers separated by a decimal—for example, v1.0.

The following is an example of a complete URI for this operation.

```
http://attest.hgs151209.com/Attestation/v1.0/domainattest
```

3.1.5.2.1.1 Request Body

The request body for this method contains the following structure:

ADRequest: Structure representing the initial AD-based attestation request as specified in section 2.2.2.4.

3.1.5.2.1.2 Response Body

The response body for this method contains any one of the following:

HealthCertificateReply: Structure representing the final reply for attestation that contains the health certificate as specified in section 2.2.2.6.

ErrorReply: Structure containing the attestation protocol errors as specified in section 2.2.2.9.

3.1.5.2.1.3 Processing Details

If the request received is **ADRequest** and received URI terminate with "/attest", the server MUST return **PayloadErrorReply** to the client.

If the server is configured to AD mode, request received is **TpmRequestInitial** or **TpmRequestContinue** and received URI terminate with "/attest", the server MUST return **OperationModeErrorReply** to the client.

If the request received is **ADRequest**, the server MUST perform the following:

- If policy evaluation is successful, update **AttestationHealthCertificate** and return **HealthCertificateReply** to the client.
- Otherwise, return **PolicyEvaluationErrorReply** to the client with **EvaluationLog** indicating policy evaluation has failed on the server side.

If the **VSMIKD** received is invalid, the server MUST return **VirtualSecureModeErrorReply** to the client.

3.1.5.3 Receiving GetInfo

3.1.5.3.1 GET

The operation can be invoked through the following URI and transported by HTTP GET.

```
http://<configuredServiceName>.<configuredDomain>/Attestation/Getinfo
```

3.1.5.3.1.1 Request Body

There is no request body.

3.1.5.3.1.2 Response Body

The response body for this method contains the following:

ServiceInfoReply: Structure representing the information about the server service as specified in section 2.2.2.8.

3.1.5.3.1.3 Processing Details

The server MUST return the **FunctionalLevel, SupportedFunctionalLevels,** and **AttestationOperationMode,** to which it is configured, to the client.

3.1.6 Timer Events

None.

3.1.7 Other Local Events

None.

3.2 Client Details

3.2.1 Abstract Data Model

This section describes a conceptual model of possible data organization that an implementation maintains to participate in this protocol. The described organization is provided to facilitate the explanation of how the protocol behaves. This document does not mandate that implementations adhere to this model as long as their external behavior is consistent with that described in this document.

3.2.1.1 Global

SecurityIdentifier: A Security Identifier (SID) uniquely identifies a security principal. Each security principal has a unique SID that is issued by a security agent.

3.2.1.2 Per Attestation Request

SessionId: Unique session identifier of the client performing attestation.

ExpectedOperationMode: The mode of operation supported by the server as specified in section 2.2.1.1**.**

AttestationHealthCertificate: The attestation health certificate that is an x509Certificate2.

RtpmPublicEndorsementKey: The public portion of remote TPM Public endorsement key of the client that tried to perform attestation.

VsmIdk: String representing the virtual security mode identity key of the host that initiated the AD request

Retryable: A Boolean representing whether the client can meaningfully retry the request.

FunctionalLevel: An integer representing the current functional level.

3.2.2 Timers

None.

3.2.3 Initialization

The client MUST implement the following:

AttemptedOperationMode: SHOULD<1> be set to an implementation specific value.

AttestationHealthCertificate: MUST be set to NULL.

RtpmPublicEndorsementKey: MUST be set to NULL.

VsmIdk: MUST be set to NULL.

SessionId: MUST be set to zero.

FunctionalLevel: MUST be set to 0x00000001

Retryable: MUST be set to FALSE.

3.2.4 Higher-Layer Triggered Events

The following sections describe the operations performed by the client to perform attestation initiation and to receive the attested health certificate.

3.2.4.1 Application Requests Attestation

The client performs TPM based attestation or AD-based attestation based on the configuration supported on the client and be able to start any of the attestation modes.

If configuration on the client supports TPM, the client updates its **AttemptedOperationMode** to TPM and constructs a new **TpmRequestIntial** with the following:

- A unique **SessionId** that it generates**.**
- **RtpmPublicEndorsementKey**.

The client MUST perform the steps as specified in section 3.2.5.1 to perform the TPM-based attestation procedures.

If configuration on the client supports AD, the client updates its **AttemptedOperationMode** to AD and constructs a new **ADrequest** with the following parameters:

- A unique **SessionID** that it generates.
- **Vsmidk** of the client.

The client MUST perform the steps as specified in section 3.2.5.2 to perform the AD-based attestation procedures.

3.2.4.2 Application Requests Information

The client requests **GetInfo** to get information about server configuration details **FunctionalLevel** and **AttestationOperationMode**.

3.2.5 Message Processing Events and Sequencing Rules

3.2.5.1 TPM Based Attestation

The following sections describe the sequence of operations performed by the client.

If the client validation is successful on the server, the client receives the **TpmReplyContinue** message as part of the initial reply from the server.

If the response received is **TpmReplyContinue**, the client MUST invoke the underlying RTPM protocol to read TPM measurements and update the **RtpmActiveContext** in an implementation-specific manner. The client MUST construct a new **TpmRequestContinue** message with the following and send via an HTTP POST message.

- **SessionId**.
- **RtpmPublicEndorsementKey**.

- Updated **RtpmActiveContext**.

If the type of response is **ErrorReply**, the client MUST process as specified in section 3.2.5.3.

If the type of response is **HealthCertificateReply**, the client MUST send the successful attestation to the calling application.

3.2.5.2 Active Directory Based Attestation

The **SecurityIdentifier** of the client is validated against the list of domain-joined clients that are known to be secure.

If the **SecurityIdentifier** is not valid, the client is not issued with **AttestationHealthCertificate** by the server.

The following sections describe the sequence of operations performed by the client upon successful validation of **SecurityIdentifier**.

Client initiates Active Directory–based attestation by sending **ADrequest**.

If the response received is **ErrorReply**, the client MUST process as specified in section 3.2.5.3.

If the response received is **HealthCertificateReply**, the client is successfully authenticated and allowed to use the resources of the server.

3.2.5.3 Receiving Error Reply

If **ErrorReply** received is and **Retryable** flag is set, the client MAY retry performing attestation.

If **AttemptedOperationMode** in client is not equal to the **ExpectedOperationMode** received in **OperationModeErrorReply,** the client performs the following:

- The client MUST update **AttemptedOperationMode** with the mode of operation received from the server.
- If the **ExpectedOperationMode** received is TPM and client supports TPM 2.0, and the **Retryable** flag is set, client MAY retry performing attestation by sending the subsequent **Tpmrequestinitial**.
- If the **ExpectedOperationMode** received is AD and the **Retryable** flag is set, client MAY retry performing attestation by sending the subsequent **ADrequest**.

If the client receives **PolicyEvaluationErrorReply**, the client performs the following:

- The client receives **EvaluationLog** from the server indicating failure in attestation. If the **Retryable** flag is set, the client MAY retry performing attestation based on the **Reason** in **EvaluationLog**.

If the client receives **UnauthorizedErrorReply,** the client performs the following:
- If the **Retryable** flag is set, the client MAY retry with **TpmRequestInitial** or **ADRequest** based on server configuration.

3.2.6 Timer Events

None.

3.2.7 Other Local Events

None.

4 Protocol Examples

5 Security

5.1 Security Considerations for Implementers

The client is expected to use an implementation-dependent authentication mechanism to obtain a security token and include that token in the standard HTTP Authorization header. The server will validate the token and use it to authorize the request.

5.2 Index of Security Parameters

None.

6 Appendix A: Product Behavior

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

Windows 10 v1703 operating system

Windows Server 2016 operating system

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

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

<1> Section 3.2.3: For Windows clients with TPM 2.0, **AttemptedOperationMode** is initialized to TPM.

7 Change Tracking

~~No table of~~ This section identifies changes ~~is available. The~~ that were made to this document ~~is either new or has had no changes~~ since ~~its~~the last release. Changes are classified as Major, Minor, or None.

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

- A document revision that incorporates changes to interoperability requirements.
- A document revision that captures changes to protocol functionality.

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

The revision class **None** means that no new technical changes were introduced. Minor editorial and formatting changes may have been made, but the relevant technical content is identical to the last released version.

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

Section	Description	Revision class
3.1.5.1.1.3 Processing Details	7431 : Added message HealthCertificateReply as the mechanism by which the AttestationHealthCertifcate is sent.	Major

8 Index