Specification: Platform

General

The Platform set of services contains services for monitoring and control of devices on-board of a spacecraft platform. The following services are contained in the Platform services set:
The Camera service allows a consumer to take and stream pictures.
The GNSS service allows a consumer to retrieve satellite navigation data.
The Autonomous ADCS service allows a consumer to determine the attitude, and additionally to control the attitude by selecting the desired definition.
The Software-defined Radio service allows a consumer to configure and receive a stream of data from a Software-defined Radio.
The Optical Data Receiver service allows a consumer to stream data from the Optical Data Receiver.
The Magnetometer service allows a consumer to acquire the magnetic field.
The Power Control service allows a consumer to control the power of the different subsystems.

This section details the Platform services. The area and structures are defined in terms of the MO Message Abstraction Layer (MAL), so it is possible to deploy them over any supported protocol and message transport.

Service: Camera

General

The Camera service allows a consumer to acquire pictures and control a camera in the spacecraft platform. The service can perform format conversions in case the consumer selects a specific format other than raw. The service can also stream pictures periodically.

Table 0-1: Camera Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	Camera	105	1	1
Interaction Pattern	**Operation Identifier**	**Operation Number**	**Support in Replay**	**Capability Set**
PUBLISH-SUBSCRIBE	streamPictures	1	No	1
SUBMIT	setStreaming	2	No	
SUBMIT	unsetStreaming	3	No	
REQUEST	previewPicture	4	No	2
INVOKE	takePicture	5	No	3
REQUEST	getProperties	6	Yes	4

High Level Requirements

a) The Camera service shall provide:
   a. the capability for streaming pictures;
   b. the capability for previewing pictures;
   c. the capability for taking pictures;

d. the capability for requesting the service and camera properties.

b)

Functional Requirements

OPERATION: streamPictures

General

The streamPictures operation allows a consumer to subscribe for picture updates.

Operation Identifier	streamPictures	
Interaction Pattern	PUBLISH-SUBSCRIBE	
Pattern Sequence	Message	Body Type
OUT	PUBLISH/NOTIFY	picture : (Picture)

Structures

a) The picture in streaming mode.
b) The MAL EntityKey.firstSubKey shall be the value provided by the consumer during the setStreaming operation.
c) The MAL EntityKey.secondSubKey shall hold a unique object instance identifier.
d) The MAL EntityKey.thirdSubKey shall hold the width value of the resolution object provided by the consumer during the setStreaming operation.
e) The MAL EntityKey.fourthSubKey shall hold the height value of the resolution object provided by the consumer during the setStreaming operation.
f) The timestamp of the update shall be the time of when the picture was taken.

Errors

The operation does not return any errors.

OPERATION: setStreaming

General

The setStreaming operation allows a consumer to set the rate, dimension and format of the Pictures being streamed.

Operation Identifier	setStreaming	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	streamingRate : (MAL::Duration) resolution : (PixelResolution) format : (PictureFormat) firstEntityKey : (MAL::Identifier) exposureTime : (MAL::Duration)

Structures

a) The streamingRate field shall hold the streaming rate of the pictures.
b) The resolution field shall hold the desired streaming pictures resolution.

c) The format field shall hold the desired streaming picture format.
d) The firstEntityKey field holds the first entity key that will be present during the broadcast of the streamPictures operation.
e) The firstEntityKey field must not empty, nor be NULL nor the wildcard '*'. An INVALID error shall be returned in this case.
f) The exposureTime field shall hold the exposure time of each frame.

Errors

The operation may return one of the following errors:

ERROR: INVALID

a) The requested streaming rate is not supported.
b) The extra information fied shall hold the minimum duration that can be selected.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	MAL::Duration

ERROR: INVALID

a) The requested resolution is not supported.
b) The extra information fied shall hold the list of available resolutions.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<PixelResolution>

ERROR: INVALID

a) The requested format is not supported.
b) The extra information fied shall hold the list of available formats.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<PictureFormat>

ERROR: INVALID

The firstEntityKey field cannot be a null nor a wildcard.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	Not Used

ERROR: DEVICE_IN_USE

The Camera is currently being used. Use the unsetStreaming operation in order to manually unset the streaming and try again.

Error	Error #	ExtraInfo Type
DEVICE_IN_USE	10509	Not Used

ERROR: DEVICE_NOT_AVAILABLE

The Camera unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: unsetStreaming

General

Operation Identifier	unsetStreaming	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	

Structures

Errors

The operation does not return any errors.

OPERATION: previewPicture

General

The previewPicture operation allows a consumer to quickly get a raw picture from the camera with a lower quality. This operation intendes to
provide a quick snap of what the camera is observing.

Operation Identifier	previewPicture	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	
OUT	RESPONSE	picture : (Picture)

Structures

a) The picture field shall hold the picture preview.

Errors

The operation may return one of the following errors:

ERROR: DEVICE_IN_USE

The Camera is currently being used. Use the unsetStreaming operation in order to manually unset the streaming and try again.

Error	Error #	ExtraInfo Type
DEVICE_IN_USE	10509	Not Used

ERROR: DEVICE_NOT_AVAILABLE

The Camera unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: takePicture

General

The takePicture operation allows a consumer to take a picture from the camera. The appropriate dimension and format of the picture can be selected.

Operation Identifier	takePicture	
Interaction Pattern	INVOKE	
Pattern Sequence	Message	Body Type
IN	INVOKE	resolution : (PixelResolution) format : (PictureFormat) exposureTime : (MAL::Duration)
OUT	ACK	
OUT	RESPONSE	picture : (Picture)

Structures

a) The resolution field shall hold the desired picture resolution.
b) The format field shall hold the desired streaming picture format.
c) The exposureTime field shall hold the exposure time of the camera.
d) The picture field shall hold the picture.

Errors

The operation may return one of the following errors:

ERROR: INVALID

a) The requested resolution is not supported.
b) The extra information fied shall hold the list of available resolutions.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<PixelResolution>

ERROR: INVALID

a) The requested format is not supported.
b) The extra information fied shall hold the list of available formats.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<PictureFormat>

ERROR: DEVICE_IN_USE

The Camera is currently being used. Use the unsetStreaming operation in order to manually unset the streaming and try again.

Error	Error #	ExtraInfo Type
DEVICE_IN_USE	10509	Not Used

ERROR: DEVICE_NOT_AVAILABLE

The Camera unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: getProperties

General

The getProperties operation allows a consumer to request the properties of the service and camera. The service shall provide information about the available resolutions, formats and some extra information.

Operation Identifier	getProperties	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	
OUT	RESPONSE	availableResolutions : (List<PixelResolution>) availableFormats : (List<PictureFormat>) extraInfo : (MAL::String)

Structures

a) The availableResolutions field shall hold the list of the available resolutions by the camera.
b) The availableFormats field shall hold a list of available formats by the service.
c) The info field shall hold additional properties of the camera. The actual content is undefined.

Errors

The operation does not return any errors.

Service: GPS

General

The GPS service provides the ability to retrieve satellite navigation data from a Global Navigation Satellite System (GNSS) device receiver in the spacecraft platform. The GPS service provides the capability for streaming NMEA messages; the capability for enabling/disabling the streaming of NMEA messages; the capability for getting the last known position from the receiver; the capability for getting the satellites GNSS information; the capability for maintaining the list of nearby position events.
The nearbyPosition operation allows a consumer to receive a message from the service when the spacecraft enters or exists a certain position. These can be set using the addNearbyPosition and removed using the removeNearbyPosition.

Table 0-2: GPS Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	GPS	105	2	1
Interaction Pattern	Operation Identifier	Operation Number	Support in Replay	Capability Set
INVOKE	getNMEASentence	1	No	1
REQUEST	getLastKnownPosition	2	No	2
INVOKE	getPosition	3	No	3
INVOKE	getSatellitesInfo	4	No	4

REQUEST	listNearbyPosition	5	No	5
REQUEST	addNearbyPosition	6	No	6
SUBMIT	removeNearbyPosition	7	No	
PUBLISH-SUBSCRIBE	nearbyPosition	8	No	7

High Level Requirements

a) The GPS service shall provide:
   a. the capability for streaming GPS NMEA messages;
   b. the capability for enabling/disabling the streaming of NMEA messages;
   c. the capability for having getting the last known position from the GPS;
   d. the capability for getting the satellites GPS information;
   e. The capability for maintaining the list of nearby position events.

b)

Functional Requirements

COM usage

Table 0-3: GPS Service Object Types

Object Name	Object Number	Object Body Type	Related points to	Source points to
NearbyPosition	1	NearbyPositionDefinition		The source link of the NearbyPosition object should be the object that caused it to be created, most likely a COM OperationActivity object or an operator login in the case of off-line editors being used.
NearbyPositionAlert	2	MAL::Boolean	1	

COM Object Relationships

The Figure below shows the COM object relationships for this service:

Figure 0-1: GPS Service COM object relationships

COM Archive Service usage

a) NearbyPosition objects should be stored in the COM archive.
b) When a nearby event is published, the NearbyPosition object should be stored in the COM archive by the publisher.

OPERATION: getNMEASentence

General

The getNMEASentence operation allows a consumer to request a NMEA sentence from a sentence identifier.

Operation Identifier	getNMEASentence	
Interaction Pattern	INVOKE	
Pattern Sequence	Message	Body Type
IN	INVOKE	sentenceIdentifier : (MAL::String)
OUT	ACK	
OUT	RESPONSE	sentence : (MAL::String)

Structures

a) The sentenceIdentifier field shall hold the sentence identifier of the request.
b) The sentence field shall hold the NMEA sentence.

Errors

The operation may return one of the following errors:

ERROR: INVALID

The requested sentence identifier is invalid.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	Not Used

ERROR: DEVICE_NOT_AVAILABLE

The GPS unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: getLastKnownPosition

General

The getLastKnownPosition operation allows a consumer to retrieve the last known position that was provided by the GPS unit.

Operation Identifier	getLastKnownPosition	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	
OUT	RESPONSE	position : (Position) elapsedTime : (MAL::Duration)

Structures

a) The position field shall hold the last known position.
b) The elapsedTime field shall hold the elapsed time since the position's determination.

Errors

The operation may return the following error:

ERROR: UNKNOWN

The position is unknown.

Error	Error #	ExtraInfo Type
UNKNOWN	Defined in MAL	Not Used

OPERATION: getPosition

General

The getPosition operation allows a consumer to obtain a position from the GPS unit.

Operation Identifier	getPosition	
Interaction Pattern	INVOKE	
Pattern Sequence	Message	Body Type
IN	INVOKE	
OUT	ACK	
OUT	RESPONSE	position : (Position)

Structures

a) The position field shall hold the current position.

Errors

The operation may return one of the following errors:

ERROR: UNKNOWN

The position is unknown.

Error	Error #	ExtraInfo Type

UNKNOWN	Defined in MAL	Not Used

ERROR: DEVICE_NOT_AVAILABLE

The GPS unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: getSatellitesInfo

General

The getSatellitesInfo operation allows a consumer to obtain the satellites information from the GPS.

Operation Identifier	getSatellitesInfo	
Interaction Pattern	INVOKE	
Pattern Sequence	Message	Body Type
IN	INVOKE	
OUT	ACK	
OUT	RESPONSE	gpsSatellitesInfo : (List<SatelliteInfo>)

Structures

a) The gpsSatellitesInfo field shall hold the information of the satellites.

Errors

The operation may return the following error:

ERROR: DEVICE_NOT_AVAILABLE

The GPS unit is not available.

Error	Error #	ExtraInfo Type
DEVICE_NOT_AVAILABLE	10510	Not Used

OPERATION: listNearbyPosition

General

The listNearbyPositionEvent operation allows a consumer to request the object instance identifiers of the existing nearby position events in the service. The operation is expected to be used in conjunction with the COM archive which holds the actual nearby position objects.

Operation Identifier	listNearbyPosition	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	names : (List<MAL::Identifier>)
OUT	RESPONSE	objInstIds : (List<MAL::Long>)

Structures

a) The names field shall hold a list of NearbyPositionEvent names.
b) The objInstIds field shall hold a list of the corresponding object instance identifiers for the selected names.

c) The request may contain the wildcard value of '*' to return all supported nearby position events.
d) The returned list shall maintain the same order as the submitted list unless the wildcard value was included in the request.

Errors

The operation does not return any errors.

OPERATION: addNearbyPosition

General

The addNearbyPositionEvent operation allows a consumer to define a list of nearby position events in the service.The new NearbyPosition objects are expected to be stored in the COM Archive by the provider of the GPS service.

Operation Identifier	addNearbyPosition	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	nearbyPositionDefinitions : (List<NearbyPositionDefinition>)
OUT	RESPONSE	objInstIds : (List<MAL::Long>)

Structures

a) The nearbyPosition field shall hold the definition of a position.
b) The objInstIds field shall hold a list of the corresponding object instance identifiers for the selected names.

Errors

The operation may return one of the following errors:

ERROR: INVALID

a) One of the supplied attitudeDefinitions objects contains an invalid name.
b) The extra information field contains a list of the indexes of the erroneous values from the originating list supplied.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<MAL::UInteger>

ERROR: DUPLICATE

a) One or more of the nearbyPosition objects being added has a name that is already in use in the domain.
b) The extra information field contains a list of the indexes of the erroneous values from the originating list supplied.

Error	Error #	ExtraInfo Type
DUPLICATE	Defined in COM	MAL::UInteger

OPERATION: removeNearbyPosition

General

The removeNearbyPositionEvent operation allows a consumer to remove a list of nearby position events set in the service.

Operation Identifier	removeNearbyPosition	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	objInstIds : (List<MAL::Long>)

Structures

a) The objInstIds field shall hold a list of the corresponding object instance identifiers of the NearbyPosition objects.

Errors

The operation may return the following error:

ERROR: UNKNOWN

a) One of the supplied NearbyPosition object instance identifiers is unknown.
b) A list of the indexes of the error values shall be contained in the extra information field.

Error	Error #	ExtraInfo Type
UNKNOWN	Defined in MAL	List<MAL::UInteger>

OPERATION: nearbyPosition

General

The nearbyPosition allows a consumer to subscribe to nearby position notifications. The notifications shall be generated upon entering or exiting a nearby position.

Operation Identifier	nearbyPosition	
Interaction Pattern	PUBLISH-SUBSCRIBE	
Pattern Sequence	Message	Body Type
OUT	PUBLISH/NOTIFY	isEntering : (MAL::Boolean)

Structures

a) The isEntering field shall hold the entering state of the current position.
b) If the GPS current position has entered the nearby position, then the field shall be set to TRUE otherwise FALSE.
c) The MAL EntityKey.firstSubKey shall contain the NearbyPosition name.
d) The MAL EntityKey.secondSubKey shall contain the NearbyPosition object instance identifier.
e) The MAL EntityKey.thirdSubKey shall contain the NearbyPositionAlert object instance identifier.
f) The MAL EntityKey.fourthSubKey shall be NULL.
g) The timestamp of the update shall be on-board clock at the time of the notification.
h) The ObjectId shall be set to NULL.

Errors

The operation does not return any errors.

Service: AutonomousADCS

General

The AutonomousADCS service allows a consumer to monitor the attitude from an ADCS device in the spacecraft platform and to set/unset the desired attitude from a list of attitude definitions.

Table 0-4: AutonomousADCS Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	AutonomousADCS	105	3	1
Interaction Pattern	**Operation Identifier**	**Operation Number**	**Support in Replay**	**Capability Set**
PUBLISH-SUBSCRIBE	monitorAttitude	1	No	1
SUBMIT	setDesiredAttitude	2	No	2
SUBMIT	unsetAttitude	3	No	
REQUEST	listAttitudeDefinition	4	No	3
REQUEST	addAttitudeDefinition	5	No	4
SUBMIT	removeAttitudeDefinition	6	No	

High Level Requirements

a) The Autonomous ADCS service shall provide:
   a. the capability for periodic monitoring of the spacecraft's attitude;
   b. the capability for setting and unsetting the spacecraft's desired attitude;
   c. the capability for maintaining the list of attitude definitions;
   d. the capability for listing the object instance identifiers for the attitude definitions.

b)

Functional Requirements

a) // Add the validation checks criteria

b)

COM usage

a) An AttitudeDefinitionBDot COM object represents the definition of a BDot attitude. The object body shall hold an AttitudeDefinitionBDot structure.
   a. The AttitudeDefinitionBDot COM object source link should be the object that caused it to be created, most likely a COM OperationActivity object.

b) An AttitudeDefinitionSingleSpinning COM object represents the definition of a Single Spinning attitude. The object body shall hold an AttitudeDefinitionSingleSpinning structure.
   a. The AttitudeDefinitionSingleSpinning COM object source link should be the object that caused it to be created, most likely a COM OperationActivity object.

c) An AttitudeDefinitionSunPointing COM object represents the definition of a Sun Pointing attitude. The object body shall hold an AttitudeDefinitionSunPointing structure.
    a. The AttitudeDefinitionSunPointing COM object source link should be the object that caused it to be created, most likely a COM OperationActivity object.
d) An AttitudeDefinitionTargetTracking COM object represents the definition of a Target Tracking attitude. The object body shall hold an AttitudeDefinitionTargetTracking structure.
    a. The AttitudeDefinitionTargetTracking COM object source link should be the object that caused it to be created, most likely a COM OperationActivity object.
e) An AttitudeDefinitionNadirPointing COM object represents the definition of a Nadir Pointing attitude. The object body shall hold an AttitudeDefinitionNadirPointing structure.
    a. The AttitudeDefinitionNadirPointing COM object source link should be the object that caused it to be created, most likely a COM OperationActivity object.

Table 0-5: AutonomousADCS Service Object Types

Object Name	Object Number	Object Body Type	Related points to	Source points to
AttitudeDefinitionBDot	2	AttitudeDefinitionBDot		
AttitudeDefinitionSingleSpinning	3	AttitudeDefinitionSingleSpinning		
AttitudeDefinitionSunPointing	4	AttitudeDefinitionSunPointing		
AttitudeDefinitionTargetTracking	5	AttitudeDefinitionTargetTracking		
AttitudeDefinitionNadirPointing	6	AttitudeDefinitionNadirPointing		

COM Event Service usage

a) An ADCSProblemDetected COM event represents the detection of a problem on the ADCS. The object body can hold a blob of data containing implementation-specific data.
    a. The ADCSProblemDetected COM event shall be generated upon the detection of a problem with the ADCS.

Table 0-6: AutonomousADCS Service Events

Event Name	Object Number	Object Body Type	Related points to	Source points to
ADCSProblemDetected	1	MAL::Blob		

COM Object Relationships

The Figure below shows the COM object and event relationships for this service:

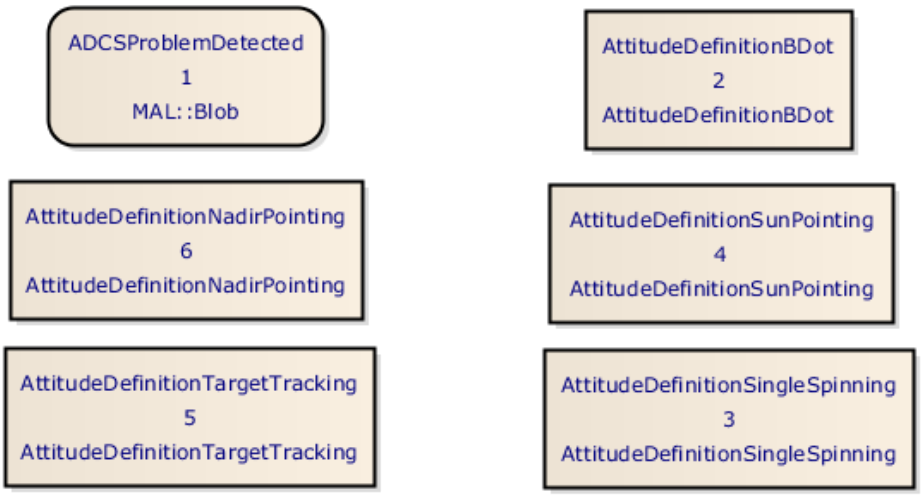

Figure 0-2: AutonomousADCS Service COM object and event relationships

COM Archive Service usage

a) AttitudeDefinitionBDot COM objects should be stored in the COM archive.
b) AttitudeDefinitionSingleSpinning COM objects should be stored in the COM archive.
c) AttitudeDefinitionSunPointing COM objects should be stored in the COM archive.
d) AttitudeDefinitionTargetTracking COM objects should be stored in the COM archive.
e) AttitudeDefinitionNadirPointing COM objects should be stored in the COM archive.

OPERATION: monitorAttitude

General

The monitorAttitude operation allows a consumer to subscribe for the satellite's current attitude.
The pointingTo field shall contain the attitude instance in a reference frame.
The MAL EntityKey.firstSubKey shall contain the AttitudeDefinition name.
The MAL EntityKey.secondSubKey shall contain the AttitudeDefinition object instance identifier.
The MAL EntityKey.thirdSubKey shall contain the numeric value of the AttitudeMode of the AttitudeDefinition.
The MAL EntityKey.fourthSubKey shall be NULL.
The timestamp of the update shall be on-board clock at the time of the sampling.
The ObjectId shall be set to NULL.

Operation Identifier	monitorAttitude	
Interaction Pattern	PUBLISH-SUBSCRIBE	
Pattern Sequence	Message	Body Type
OUT	PUBLISH/NOTIFY	attitudeInstance : (AttitudeInstance)

Structures

a) The attitudeInstance field shall hold the instance of the current attitude.

Errors

The operation does not return any errors.

OPERATION: setDesiredAttitude

General

The setDesiredAttitude operation allows a consumer to set the spacecraft's attitude from an attitude definition.

Operation Identifier	setDesiredAttitude	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	objInstId : (MAL::Long) autoUnset : (MAL::Duration) streamingRate : (MAL::Duration)

Structures

a) The object instance identifier of the attitude definition to be set.
b) The autoUnset field holds the duration after which the attitude definition shall be automatically unset.
c) If the field is null, then the attitude definition won't be automatically unset, in this case the manual unsetAttitude operation must be used to disengage it.
d) The streamingRate field shall contain the publishing frequency.

Errors

The operation may return one of the following errors:

ERROR: UNKNOWN

The submited object instance identifier is unknown.

Error	Error #	ExtraInfo Type
UNKNOWN	Defined in MAL	Not Used

ERROR: INVALID

a) The selected attitude definition contains an invalid argument.
b) Contains the field name of the first field that did not pass the validation checks of the attitude definition.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	MAL::String

ERROR: UNSUPPORTED_OPERATION

The selected attitude definition is unsupported by the current implementation of the service.

Error	Error #	ExtraInfo Type
UNSUPPORTED_OPERATION	Defined in MAL	Not Used

ERROR: INVALID

a) The streamingRate is out of limits.

b) The minimum valid streamingRate.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	MAL::Duration

ERROR: ADCS_NOT_AVAILABLE

The ADCS unit is not available.

Error	Error #	ExtraInfo Type
ADCS_NOT_AVAILABLE	10	Not Used

ERROR: DEVICE_IN_USE

a) The ADCS is currently being used.
b) The service will unset the current selected attitude definition in the duration provided in the extra information field. If the extra information field is set to null, then the attitude definition shall not be automatically unset. The consumer should use the unsetAttitude operation to manually disengage it.

Error	Error #	ExtraInfo Type
DEVICE_IN_USE	10509	MAL::Duration

OPERATION: unsetAttitude

General

The unsetAttitude operation allows a consumer to unset the spacecraft's attitude from the current selected attitude definition. This operation is expected to be used after a certain attitude definition is set by the setDesiredAttitude operation. If the attitude was set with the automatic unsetting enabled, then the unsetAttitude operation will override it and the attitude will be unset immediately.

Operation Identifier	unsetAttitude	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	

Structures

Errors

The operation may return the following error:

ERROR: ADCS_NOT_AVAILABLE

The ADCS unit is not available.

Error	Error #	ExtraInfo Type
ADCS_NOT_AVAILABLE	10	Not Used

OPERATION: listAttitudeDefinition

General

The listAttitudeDefinition operation allows a consumer to request the object instance identifiers of the attitude definition objects for the supported parameters of the provider. The operation is expected to be used in conjunction with the COM archive which holds the actual ParameterDefinition objects.

Operation Identifier	listAttitudeDefinition	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	names : (List<MAL::Identifier>)
OUT	RESPONSE	objIds : (List<MAL::Long>)

Structures

a) The names of the Attitude definitions to be listed.
b) The names field may contain the wildcard value of '*' to return all supported ParameterDefinition objects.
c) The objIds field holds the object instance identifiers of the Attitude definitions.
d) The returned list shall maintain the same order as the submitted list unless the wildcard value was included in the request.

Errors

The operation may return the following error:

ERROR: UNKNOWN

a) One of the supplied AttitudeDefinition object instance identifiers is unknown.
b) A list of the indexes of the error values shall be contained in the extra information field.

Error	Error #	ExtraInfo Type
UNKNOWN	Defined in MAL	List<MAL::UInteger>

OPERATION: addAttitudeDefinition

General

The addAttitudeDefinition operation allows a consumer to define one or more attitude definitions that do not currently exist. The new AttitudeDefinition object is expected to be stored in the COM archive by the provider of the AutonomousADCS service.

Operation Identifier	addAttitudeDefinition	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	attitudeDefinitions : (List<AttitudeDefinition>)
OUT	RESPONSE	objIds : (List<MAL::Long>)

Structures

a) The attitudeDefinitions field holds the attitude definitions.

b) The name field of the supplied AttitudeDefinition structures must not be NULL, the wildcard '*', or empty. An INVALID error shall be returned in this case.
c) The supplied name must be unique among all AttitudeDefinition objects for the domain of the provider otherwise a DUPLICATE error shall be returned.
d) If an error is returned then no new attitude definitions shall be added as a result of this operation call.
e) The objIds field holds the object instance identifiers of the attitude definitions.
f) The returned list shall maintain the same order as the submitted definitions.

Errors

The operation may return one of the following errors:

ERROR: INVALID

a) One of the supplied attitudeDefinitions objects contains an invalid name.
b) The extra information field contains a list of the indexes of the erroneous values from the originating list supplied.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	List<MAL::UInteger>

ERROR: DUPLICATE

a) One or more of the attitudeDefinitions objects being added has supplied a parameter name that is already in use in the domain.
b) The extra information field contains a list of the indexes of the erroneous values from the originating request list.

Error	Error #	ExtraInfo Type
DUPLICATE	Defined in COM	List<MAL::UInteger>

ERROR: INVALID

a) The selected attitude definition contains an invalid argument.
b) Contains the field name of the first field that did not pass the validation checks of the attitude definition.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	MAL::String

OPERATION: removeAttitudeDefinition

General

The removeAttitudeDefinition operation allows a consumer to remove one or more attitude definitions from the list of attitudes supported by the service.
The operation does not remove the attitude definitions object from the COM archive, merely removes the object from the provider.

Operation Identifier	removeAttitudeDefinition	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	objIds : (List<MAL::Long>)

Structures

a) The object instance identifiers of the attitude definition to be removed.
b) The list may contain the wildcard value of '0'.
c) If a provided ParameterDefinition object instance identifier does not include a wildcard and does not match an existing definition then this operation shall fail with an UNKNOWN error.
d) Matched attitude definition objects shall not be removed from the COM archive only from the list of attitude definitions objects in the provider.
e) If an error is raised then no definitions shall be removed as a result of this operation call.
f) If the operation succeeds then the provider shall no longer be able to set the removed attitude definitions.

Errors

The operation may return the following error:

ERROR: UNKNOWN

a) One of the supplied AttitudeDefinition object instance identifiers is unknown.
b) A list of the indexes of the error values shall be contained in the extra information field.

Error	Error #	ExtraInfo Type
UNKNOWN	Defined in MAL	List<MAL::UInteger>

Service: SoftwareDefinedRadio

General

The Software-defined Radio provides a generic mechanism to set, configure and receive data from a Software-defined Radio device.

Table 0-7: SoftwareDefinedRadio Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	SoftwareDefinedRadio	105	4	1
Interaction Pattern	**Operation Identifier**	**Operation Number**	**Support in Replay**	**Capability Set**
PUBLISH-SUBSCRIBE	streamRadio	1	No	1
SUBMIT	enableSDR	2	No	2
SUBMIT	updateConfiguration	3	No	3

High Level Requirements

Functional Requirements

OPERATION: streamRadio

General

The streamRadio operation allows a consumer to subscribe for Software-defined Radio data updates.

Operation Identifier	streamRadio	
Interaction Pattern	PUBLISH-SUBSCRIBE	
Pattern Sequence	Message	Body Type
OUT	PUBLISH/NOTIFY	iqComponents : (IQComponents)

Structures

a) The iqComponents field shall hold the in-phase and quadrature data from the Software-defined Radio unit.

Errors

The operation does not return any errors.

OPERATION: enableSDR

General

The enableSDR operation allows a consumer to enable or disable the Software-defined Radio.

Operation Identifier	enableSDR	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	enable : (MAL::Boolean) initialConfiguration : (SDRConfiguration) publishingPeriod : (MAL::Duration)

Structures

a) The enable field shall hold the flag status to enable/disable the Software-defined Radio.
b) If the enable field is true then the Software-defined Radio shall be enabled otherwise disabled.
c) The
d) initialConfiguration field shall hold the configuration to be set right after the SDR is enabled.

Errors

The operation may return one of the following errors:

ERROR: INVALID

The provided configuration is invalid.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	Not Used

ERROR: INTERNAL

The Software-defined Radio could not be enabled.

Error	Error #	ExtraInfo Type
INTERNAL	Defined in MAL	Not Used

OPERATION: updateConfiguration

General

The setConfiguration operation allows a consumer to set a configuration to the Software-defined Radio.

Operation Identifier	updateConfiguration	
Interaction Pattern	SUBMIT	
Pattern Sequence	Message	Body Type
IN	SUBMIT	configuration : (SDRConfiguration)

Structures

a) The configuration field holds the configuration of the SDR.

Errors

The operation may return the following error:

ERROR: INVALID

The provided configuration is invalid.

Error	Error #	ExtraInfo Type
INVALID	Defined in COM	Not Used

Service: OpticalDataReceiver

General

The Optical Data Receiver service provides a mechanism to receive messages from an Optical Data Receiver device.

Table 0-8: OpticalDataReceiver Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	OpticalDataReceiver	105	5	1
Interaction Pattern	**Operation Identifier**	**Operation Number**	**Support in Replay**	**Capability Set**
PUBLISH-SUBSCRIBE	streamData	1	No	1
REQUEST	setPublishingFrequency	2	No	

High Level Requirements

Functional Requirements

OPERATION: streamData

General

The streamData operation allows a consumer to subscribe to a stream feed from the Optical Data Receiver.

Operation Identifier	streamData	
Interaction Pattern	PUBLISH-SUBSCRIBE	
Pattern Sequence	Message	Body Type
OUT	PUBLISH/NOTIFY	data : (MAL::Blob)

Structures

a) The data field holds a blob of data coming from the Optical Data Receiver.

Errors

The operation does not return any errors.

OPERATION: setPublishingFrequency

General

The setPublishingFrequency operation allows a consumer to set the publishing frequency or disable it.

Operation Identifier	setPublishingFrequency	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	publishingPeriod : (MAL::Duration)
OUT	RESPONSE	

Structures

a) The publishingPeriod field shall hold the period of updates to be streamed.
b) If set to 0, then no updates will be generated.

Errors

The operation does not return any errors.

Service: Magnetometer

General

The Magnetometer service provides a generic mechanism to retrieve the magnetic field from a magnetometer in the spacecraft platform.

Table 0-9: Magnetometer Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	Magnetometer	105	6	1

Interaction Pattern	Operation Identifier	Operation Number	Support in Replay	Capability Set
REQUEST	getMagneticField	1	No	1

OPERATION: getMagneticField

General

The getMagneticField operation allows a consumer to retrieve the magnetic field instance from a magnetometer unit.

Operation Identifier	getMagneticField	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	
OUT	RESPONSE	magneticField : (MagneticFieldInstance)

Structures

a) The magneticField field shall hold the magnetic field instance of the magnetometer.

Errors

The operation does not return any errors.

Service: PowerControl

General

The Power Control service provides a generic mechanism to list the available power units in a spacecraft platform and to enable/disable them.

Table 0-10: PowerControl Service Operations

Area Identifier	Service Identifier	Area Number	Service Number	Area Version
Platform	PowerControl	105	7	1
Interaction Pattern	Operation Identifier	Operation Number	Support in Replay	Capability Set
REQUEST	listUnitsAvailable	1	No	1
REQUEST	enableUnit	2	No	2

OPERATION: listUnitsAvailable

General

The listUnitsAvailable operation allows a consumer to request the list of the units available and their respective status.

Operation Identifier	listUnitsAvailable	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type

IN	REQUEST	names : (List<MAL::Identifier>)
OUT	RESPONSE	unitObjInstIds : (List<MAL::Long>) enabled : (List<MAL::Boolean>)

Structures

a) The names field holds the name of the units.
b) The unitObjInstIds field holds the object instance identifier of the units.
c) The enabled field holds the status of the unit. True if enabled, false if disabled.

Errors

The operation does not return any errors.

OPERATION: enableUnit

General

The enableUnit operation allows a consumer to enable and disable a specific Unit.

Operation Identifier	enableUnit	
Interaction Pattern	REQUEST	
Pattern Sequence	Message	Body Type
IN	REQUEST	enable : (MAL::Boolean) unitObjInstId : (MAL::Long)
OUT	RESPONSE	

Structures

a) The enable field holds the boolean value to enable or disable the unit.
b) The unitObjInstId field holds the object instance identifier of the unit to be enabled or disabled.

Errors

The operation does not return any errors.

Data types

Area data types: Platform

Composite: Vector3D

The Vector3D holds a 3D Vector.

Name	Vector3D		
Extends	MAL::Composite		
Short Form Part	17		
Field	Type	Nullable	Comment
x	MAL::Double	Yes	The x component of the Vector. The unit shall be defined by each specific case.
y	MAL::Double	Yes	The y component of the Vector. The unit shall be defined by each specific

			case.
z	MAL::Double	Yes	The z component of the Vector. The unit shall be defined by each specific case.

Composite: WheelSpeed

The WheelSpeed holds the speed of the wheels.

Name	WheelSpeed		
Extends	MAL::Composite		
Short Form Part	2		
Field	Type	Nullable	Comment
velocity	List<MAL::Double>	No	Velocity of the wheels in rpm.

Composite: Quaternions

The Quaternions holds the quaternion components.

Name	Quaternions		
Extends	MAL::Composite		
Short Form Part	16		
Field	Type	Nullable	Comment
q1	MAL::Float	Yes	Quaternion component 1. Equivalent to the i component.
q2	MAL::Float	Yes	Quaternion component 2. Equivalent to the j component.
q3	MAL::Float	Yes	Quaternion component 3. Equivalent to the k component.
q4	MAL::Float	Yes	Quaternion component 4. Equivalent to the l component.

Service data types: Camera

Composite: Picture

The Picture structure holds the details of the picture.

Name	Picture		
Extends	MAL::Composite		
Short Form Part	1		
Field	Type	Nullable	Comment
content	MAL::Blob	No	The content of the picture.
creationDate	MAL::Time	Yes	The time of creation.
dimension	PixelResolution	Yes	The dimension of the picture.
format	PictureFormat	No	The format of the picture.

Composite: PixelResolution

The PixelResolution structure holds the pixel resolution of a picture.

Name	PixelResolution
Extends	MAL::Composite
Short Form Part	2

Field	Type	Nullable	Comment
width	MAL::UInteger	No	The width of the picture.
height	MAL::UInteger	No	The height of the picture.

ENUMERATION: PictureFormat

PictureFormat is an enumeration definition holding the format of the picture.

Name	PictureFormat	
Short Form Part	3	
Enumeration Value	Numerical Value	Comment
RAW	1	RAW format.
BMP	3	Bitmap format.
PNG	4	PNG format.
JPG	5	JPG format.

Service data types: GPS

Composite: Position

The Position structure holds the position of the spacecraft given by the GPS unit.

Name	Position		
Extends	MAL::Composite		
Short Form Part	1		
Field	Type	Nullable	Comment
latitude	MAL::Double	No	The latitude of the position. The unit is in decimal degrees.
longitude	MAL::Double	No	The longitude of the position. The unit is in decimal degrees.
altitude	MAL::Double	No	Altitude in meters according to the WGS-84 ellipsoid
extraDetails	PositionExtraDetails	Yes	Extra details about the position.

Composite: SatelliteInfo

The SatelliteInfo structure holds the information about the satellites obtained from the GPS unit.

Name	SatelliteInfo		
Extends	MAL::Composite		
Short Form Part	2		
Field	Type	Nullable	Comment
azimuth	MAL::Float	Yes	The azimuth of the satellite.
elevation	MAL::Float	Yes	The elevation of the satellite.
prn	MAL::Integer	Yes	The pseudorandom noise number.
almanac	MAL::Double	Yes	The almanac of the satellite.
ephemeris	MAL::Double	Yes	The ephemeris of the satellite.
recentFix	MAL::Time	Yes	The time of the fix.
svn	MAL::UInteger	Yes	Space vehicle number.

Composite: PositionExtraDetails

The PositionExtraDetails structure holds extra information that can be provided by a GPS unit.

Name	PositionExtraDetails		
Extends	MAL::Composite		
Short Form Part	4		
Field	Type	Nullable	Comment
utc	MAL::Time	Yes	UTC time status of position.
fixQuality	MAL::Integer	Yes	Fix Quality: 0 = Invalid; 1 = GPS fix; 2 = DGPS fix.
numberOfSatellites	MAL::Integer	Yes	The number of satellites in view for this position.
hdop	MAL::Float	Yes	Horizontal Dilution of Precision. The relative accuracy of horizontal position.
undulation	MAL::Float	Yes	The relationship between the geoid and the WGS84 ellipsoid. The unit is meters.

Composite: NearbyPositionDefinition

The NearbyPositionDefinition structure holds a definition of a certain Position.

Name	NearbyPositionDefinition		
Extends	MAL::Composite		
Short Form Part	26		
Field	Type	Nullable	Comment
name	MAL::Identifier	Yes	The name of the definition.
description	MAL::String	Yes	A textual description of the definition.
distanceBoundary	MAL::Double	Yes	The distance boundary of this definition. The distance boundary shall define a spherical zone around the position. The unit is meters.
position	Position	Yes	The position of the definition.

Service data types: AutonomousADCS

ENUMERATION: AttitudeMode

AttitudeMode is an enumeration definition holding the attitude modes.

Name	AttitudeMode	
Short Form Part	4	
Enumeration Value	Numerical Value	Comment
BDOT	1	B dot mode. Can also be used for detumbling and momentum unloading.
SUNPOINTING	2	Sun Pointing mode.
SINGLESPINNING	3	Single Spinning mode.
TARGETTRACKING	4	Target Pointing mode.
NADIRPOINTING	5	Nadir Pointing mode.

ENUMERATION: ReferenceFrame

ReferenceFrame is an enumeration definition holding the frames of reference.

Name	ReferenceFrame

Short Form Part	5	
Enumeration Value	Numerical Value	Comment
EULER_ANGLES	1	Euler angles reference frame.
UNIT_QUATERNIONS	2	Quaternions reference frame.
ROTATION_MATRIX	3	Rotation Matrix reference frame.

Composite: AttitudeInstance

The AttitudeInstance holds an attitude instance.

Name	AttitudeInstance
Extends	MAL::Composite
Abstract	

Composite: AttitudeInstanceBDot

The AttitudeInstanceBDot structure holds an attitude instance of type BDot.

Name	AttitudeInstanceBDot		
Extends	AttitudeInstance		
Short Form Part	11		
Field	Type	Nullable	Comment
magneticField	Vector3D	No	The magnetic field instance.
wheelSpeed	WheelSpeed	Yes	The wheels speed instance.
mtqDipoleMomentum	Vector3D	Yes	The magnetorquer momentum.

Composite: AttitudeInstanceSunPointing

The AttitudeInstanceSunPointing structure holds an attitude instance of type Sun Pointing.

Name	AttitudeInstanceSunPointing		
Extends	AttitudeInstance		
Short Form Part	12		
Field	Type	Nullable	Comment
sunVector	Vector3D	No	The sun vector instance.
valid	MAL::Boolean	No	The validity of the instance.
wheelSpeed	WheelSpeed	Yes	The wheels speed instance.
mtqDipoleMomentum	Vector3D	Yes	This value shall not be used

Composite: AttitudeInstanceSingleSpinning

The AttitudeInstanceSingleSpinning structure holds an attitude instance of type Single Spinning.

Name	AttitudeInstanceSingleSpinning		
Extends	AttitudeInstance		
Short Form Part	13		
Field	Type	Nullable	Comment
sunVector	Vector3D	No	The sun vector instance.
magneticField	Vector3D	No	The magnetic field instance.
currentQuaternions	Quaternions	No	The quaternions of the current attitude instance.
angularMomentum	Vector3D	Yes	The angular momentum vector.
mtqDipoleMomentum	Vector3D	Yes	The magnetorquer momentum.

Composite: AttitudeInstanceTargetTracking

The AttitudeInstanceTargetTracking structure holds an attitude instance of type Target Tracking.

Name	AttitudeInstanceTargetTracking		
Extends	AttitudeInstance		
Short Form Part	14		
Field	Type	Nullable	Comment
currentQuaternions	Quaternions	No	The quaternions of the current attitude instance.
targetQuaternions	Quaternions	No	The quaternions of the target attitude instance.
wheelSpeed	WheelSpeed	Yes	The wheels speed instance.
positionVector	Vector3D	Yes	WGS84 reference.
angularVelocity	Vector3D	Yes	The angular velocity in rpm.

Composite: AttitudeInstanceNadirPointing

The AttitudeInstanceNadirPointing structure holds an attitude instance of type Nadir Pointing.

Name	AttitudeInstanceNadirPointing		
Extends	AttitudeInstance		
Short Form Part	15		
Field	Type	Nullable	Comment
currentQuaternions	Quaternions	No	The quaternions of the current attitude instance.
targetQuaternions	Quaternions	No	The quaternions of the target attitude instance.
speed	WheelSpeed	Yes	The wheels speed instance.
positionVector	Vector3D	Yes	WGS84 reference.
angularVelocity	Vector3D	Yes	The angular velocity in rpm.

Composite: AttitudeDefinition

The AttitudeInstance holds an attitude definition.

Name	AttitudeDefinition		
Extends	MAL::Composite		
Abstract			
Field	Type	Nullable	Comment
name	MAL::Identifier	Yes	The name of the attitude definition.
description	MAL::String	Yes	The description of the attitude definition.

Composite: AttitudeDefinitionBDot

The AttitudeDefinitionBDot structure holds an attitude definition of type BDot.

Name	AttitudeDefinitionBDot
Extends	AttitudeDefinition
Short Form Part	21

Composite: AttitudeDefinitionSingleSpinning

The AttitudeDefinitionSingleSpinning structure holds an attitude definition of type Sun Pointing.

Name	AttitudeDefinitionSingleSpinning		
Extends	AttitudeDefinition		
Short Form Part	22		
Field	Type	Nullable	Comment
bodyAxis	Vector3D	No	The axis defined in the body reference frame for spinning.
angularVelocity	MAL::Double	No	The magnitude of the angular velocity of the spinning in rpm. The right-hand rule shall be followed to indicate the positive direction of the angular velocity.

Composite: AttitudeDefinitionSunPointing

The AttitudeDefinitionSunPointing structure holds an attitude definition of type Single Spinning.

Name	AttitudeDefinitionSunPointing
Extends	AttitudeDefinition
Short Form Part	23

Composite: AttitudeDefinitionTargetTracking

The AttitudeDefinitionTargetTracking structure holds an attitude definition of type Target Tracking.

Name	AttitudeDefinitionTargetTracking		
Extends	AttitudeDefinition		
Short Form Part	24		
Field	Type	Nullable	Comment
latitude	MAL::Double	No	The latitude of the target to be tracked. The unit is in decimal degrees.
longitude	MAL::Double	No	The longitude of the target to be tracked. The unit is in decimal degrees.

Composite: AttitudeDefinitionNadirPointing

The AttitudeDefinitionNadirPointing structure holds an attitude definition of type Nadir Pointing.

Name	AttitudeDefinitionNadirPointing
Extends	AttitudeDefinition
Short Form Part	25

Service data types: SoftwareDefinedRadio

Composite: SDRConfiguration

It holds a configuration for the SDR.

Name	SDRConfiguration		
Extends	MAL::Composite		
Short Form Part	1		
Field	Type	Nullable	Comment

LOFrequency	MAL::Double	Yes	Local Oscillator Frequency.
LNA	MAL::Integer	Yes	Low-noise Amplifier Gain.
VGA1	MAL::Integer	Yes	Variable Gain Amplifier 1.
VGA2	MAL::Integer	Yes	Variable Gain Amplifier 2.
LPF	MAL::Double	Yes	Low Pass Filter frequency in GHz.
sampleRate	MAL::Double	Yes	The frequency in MHz.

Composite: IQComponents

It holds the In-phase and Quadrature components.

Name	IQComponents		
Extends	MAL::Composite		
Short Form Part	27		
Field	Type	Nullable	Comment
inPhase	List<MAL::Double>	Yes	The in-phase component.
quadrature	List<MAL::Double>	Yes	The quadrature component.

Service data types: Magnetometer

Composite: MagneticFieldInstance

An instance of the magnetic field vector.

Name	MagneticFieldInstance		
Extends	MAL::Composite		
Short Form Part	1		
Field	Type	Nullable	Comment
x	MAL::Double	No	The X component of the magetic field in microTesla.
y	MAL::Double	No	The Y component of the magetic field in microTesla.
z	MAL::Double	No	The Z component of the magetic field in microTesla.

Error codes

The following table lists the errors defined in this specification:

Table 0-1: Platform Error Codes

Error	Error #	Comment
DEVICE_IN_USE	10509	The device is currently in use.
DEVICE_NOT_AVAILABLE	10510	The device is currently not available.
ADCS_NOT_AVAILABLE	10	The ADCS is not available.