

ONVIF™ PTZ Service Specification

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1 Scope

This document defines the web service interface for configuration and operation of pan tilt zoom controllers. Additionally the associated events are defined.

Web service usage is outside of the scope of this document. Please refer to the ONVIF core specification.

2 Normative references

ONVIF Core Specification

<<http://www.onvif.org/specs/core/ONVIF-Core-Specification.pdf>>

ONVIF Media Service Specification

<<http://www.onvif.org/specs/srv/media/ONVIF-Media-Service-Spec.pdf>>

3 Terms and Definitions

3.1 Definitions

Digital PTZ	Function that diminishes or crops an image to adjust the image position and ratio.
Optical zoom	Changes the focal length (angle of view) for the device by moving the zoom lens in the camera's optics.
PTZ node	Low-level PTZ entity that maps to the PTZ device and its capabilities.
Field of View	The part of the world that is visible through the camera at a particular position and orientation in space.
Nadir	The direction below a dome camera that is mounted in the ceiling and looking downwards.
E-flip	The behaviour when a PTZ Dome rotates the image and control directions as it passes the nadir during a tilt movement.

3.2 Abbreviations

PTZ	Pan/tilt/zoom
E-Flip	Electrical flip
FOV	Field of View

4 Overview

The PTZ model groups the possible movements of the PTZ unit into a pan/tilt component and into a Zoom component. To steer the PTZ unit, the service provides absolute move, relative move and continuous move operations. Different coordinate systems and units are used to feed these operations.

The PTZ service provides an AbsoluteMove operation to move the PTZ device to an absolute position. The service expects the absolute position as an argument referencing an absolute coordinate system. The speed of the pan/tilt movement and the Zoom movement can be specified optionally. Speed values are positive scalars and do not contain any directional information. It is not possible to specify speeds for Pan and Tilt separately without knowledge about the current position. This approach to specifying a desired position generally produces a non-smooth and non-intuitive action.

A RelativeMove operation is introduced by the PTZ service in order to steer the dome relative to the current position, but without the need to know the current position. The operation expects a positional translation as an argument referencing a relative coordinate system. This specification distinguishes between relative and absolute coordinate systems, since there are cases where no absolute coordinate system exists for a well-defined relative coordinate system. An optional speed argument can be added to the RelativeMove operation with the same meaning as for the AbsoluteMove operation.

Finally, the PTZ device can be moved continuously via the ContinuousMove command in a certain direction with a certain speed. Thereby, a velocity vector represents both, the direction and the speed information. The latter is expressed by the length of the vector.

The pan/tilt and Zoom coordinates can be uniquely specified by augmenting the coordinates with appropriate space URIs. A space URI uniquely represents the underlying coordinate system. Section 5.7 defines a standard set of coordinate systems. A PTZ node shall implement these coordinate systems if the corresponding type of movement is supported by the PTZ node. In many cases, the pan/tilt position is represented by pan and tilt angles in a spherical coordinate system. A digital PTZ, operating on a fixed megapixel camera, may express the camera's viewing direction by a pixel position on a static projection plane. Therefore, different coordinate systems are needed in this case in order to capture the physical or virtual movements of the PTZ device. Optionally, the PTZ node may define its own device specific coordinate systems to enable clients to take advantage of the specific properties of this PTZ node.

The PTZ node description retrieved via the GetNode or GetNodes operation contains all coordinate systems supported by a specific PTZ node. Each coordinate system belongs to one of the following groups:

- AbsolutePanTiltPositionSpace
- RelativePanTiltTranslationSpace
- ContinuousPanTiltVelocitySpace
- PanTiltSpeedSpace
- AbsoluteZoomPositionSpace
- RelativeZoomTranslationSpace
- ContinuousZoomVelocitySpace
- ZoomSpeedSpace

If the PTZ node does not support the coordinate systems of a certain group, the corresponding move operation will not be available for this PTZ node. For instance, if the list does not contain an AbsolutePanTiltPositionSpace, the AbsoluteMove operation shall fail when an absolute pan/tilt position is specified. The corresponding command section describes those spaces that are required for a specific move command.

WSDL for this service is specified in <http://www.onvif.org/onvif/ver20/ptz/wsd/ptz.wsd>.

Table 1: Referenced namespaces (with prefix)

Prefix	Namespace URI
env	http://www.w3.org/2003/05/soap-envelope
ter	http://www.onvif.org/ver10/error
xs	http://www.w3.org/2001/XMLSchema
tt	http://www.onvif.org/ver10/schema
tptz	http://www.onvif.org/ver20/ptz/wsd

5 Service

5.1 PTZ Node

5.1.1 General

A PTZ-capable device can have multiple PTZ nodes. The PTZ nodes can represent mechanical PTZ drivers, uploaded PTZ drivers or digital PTZ drivers. PTZ nodes are the lowest level entities in the PTZ control API and reflect the supported PTZ capabilities. The PTZ node is referenced either by its name or by its reference token. The PTZ Service does not provide operations to create or manipulate PTZ nodes.

The following properties shall be provided for all PTZ nodes:

- **Token** – A unique identifier used to reference PTZ nodes.
- **Name** – A name given by the installer.
- **SupportedPTZSpaces** – A list of coordinate systems available for the PTZ node. For each Coordinate System, the PTZ node shall specify its allowed range.
- **MaximumNumberOfPresets** – All preset operations shall be available for this PTZ node if one preset is supported.
- **HomeSupported** – A boolean operator specifying the availability of a home position. If set to true, the Home Position operations shall be available for this PTZ node.
- **AuxiliaryCommands** – A list of supported Auxiliary commands. If the list is not empty, the Auxiliary Operations shall be available for this PTZ node. A device may use auxiliary commands that are described in Core Specification.
- **MaximumNumberOfPresetTours** – Indicates number of preset tours that can be created. Required preset tour operations shall be available for this PTZ node if one or more preset tours are supported.

5.1.2 GetNodes

A PTZ-capable device shall implement this operation and return all PTZ nodes available on the device.

REQUEST:

This is an empty message.

RESPONSE:

- **PTZNode - optional, unbounded [tt:PTZNode]**
List of the existing PTZ nodes on the device.

FAULTS:

None

ACCESS CLASS:

READ_MEDIA

5.1.3 GetNode

A PTZ-capable device shall implement the GetNode operation and return the properties of the requested PTZ node, if it exists. Otherwise, the device shall respond with an appropriate fault message.

REQUEST:

- **NodeToken [tt:ReferenceToken]**
Reference to the requested PTZ node.

RESPONSE:

- **PTZNode [tt:PTZNode]**
The requested PTZ node properties.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoEntity**
No such PTZ node on the device.

ACCESS CLASS:

READ_MEDIA

5.2 PTZ Configuration

5.2.1 General

The PTZConfiguration contains a reference to the PTZ node in which it belongs. This reference cannot be changed by a client.

The following elements are part of the PTZ Configuration:

- PTZNodeToken – A mandatory reference to the PTZ node that the PTZ configuration belongs to.
- DefaultAbsolutePanTiltPositionSpace – If the PTZ node supports absolute pan/tilt movements, it shall specify one absolute pan/tilt position space as default.
- DefaultRelativePanTiltTranslationSpace – If the PTZ node supports relative pan/tilt movements, it shall specify one relative pan/tilt translation space as default.
- DefaultContinuousPanTiltVelocitySpace – If the PTZ node supports continuous pan/tilt movements, it shall specify one continuous pan/tilt velocity space as default.
- DefaultPanTiltSpeedSpace – If the PTZ node supports absolute or relative movements, it shall specify one pan/tilt speed space as default.
- DefaultAbsoluteZoomPositionSpace – If the PTZ node supports absolute zoom movements, it shall specify one absolute zoom position space as default.
- DefaultRelativeZoomTranslationSpace – If the PTZ node supports relative zoom movements, it shall specify one relative zoom translation space as default.
- DefaultContinuousZoomVelocitySpace – If the PTZ node supports continuous zoom movements, it shall specify one continuous zoom velocity space as default.
- DefaultPTZSpeed – If the PTZ node supports absolute or relative PTZ movements, it shall specify corresponding default pan/tilt and zoom speeds.
- DefaultPTZTimeout – If the PTZ node supports continuous movements, it shall specify a default timeout, after which the movement stops.
- PanTiltLimits – The pan/tilt limits element should be present for a PTZ node that supports an absolute pan/tilt. If the element is present it signals the support for configurable pan/tilt limits. If limits are enabled, the pan/tilt movements shall always stay within the specified range. The pan/tilt limits are disabled by setting the limits to $-\text{INF}$ or $+\text{INF}$.
- ZoomLimits – The zoom limits element should be present for a PTZ node that supports absolute zoom. If the element is present it signals the supports for configurable zoom limits. If limits are enabled the zoom movements shall always stay within the specified range. The zoom limits are disabled by settings the limits to $-\text{INF}$ and $+\text{INF}$.
- MoveRamp – The optional acceleration ramp used by the device when moving.
- PresetRamp – The optional acceleration ramp used by the device when recalling presets.
- PresetTourRamp – The optional acceleration ramp used by the device when executing PresetTours.

The default position/translation/velocity spaces are introduced to allow clients sending move requests without the need to specify a certain coordinate system. The default speeds are introduced to control the speed of move requests (absolute, relative, preset), where no explicit speed has been set.

The allowed pan and tilt range for pan/tilt limits are defined by a two-dimensional space range that is mapped to a specific absolute pan/tilt position space. At least one pan/tilt position space is required by the PTZNode to support pan/tilt limits. The limits apply to all supported absolute, relative and continuous pan/tilt movements. The limits shall be checked within the coordinate system for which the limits have been specified. What this means in practice is that even if movements are specified in a different coordinate system, the requested movements shall be transformed to the coordinate system of

the limits where the limits can be checked. When a relative or continuous movements is specified, which would leave the specified limits, the PTZ unit has to move along the specified limits. The zoom limits have to be interpreted accordingly.

5.2.2 GetConfigurations

A PTZ-capable device shall return all available PTZConfigurations through the GetConfigurations operation.

REQUEST:

This is an empty message.

RESPONSE:

- **PTZConfiguration - optional, unbounded [tt:PTZConfiguration]**
List of all existing PTZConfigurations on the device.

FAULTS:

None

ACCESS CLASS:

READ_MEDIA

5.2.3 GetConfiguration

A PTZ-capable device shall return the requested PTZ configuration, if it exists, through the GetConfiguration operation.

REQUEST:

- **ConfigurationToken [tt:ReferenceToken]**
Reference to the requested PTZ configuration.

RESPONSE:

- **PTZConfiguration[tt:PTZConfiguration]**
The requested PTZ node configuration.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoConfig**
The requested configuration does not exist.

ACCESS CLASS:

READ_MEDIA

5.2.4 GetConfigurationOptions

A PTZ-capable device shall implement the GetConfigurationOptions operation. It returns the list of supported coordinate systems including their range limitations. Therefore, the options MAY differ depending on whether the PTZ configuration is assigned to a profile(see ONVIF Media Service Specification) containing a VideoSourceConfiguration. In this case, the options may contain additional coordinate systems referring to the image coordinate system described by the VideoSourceConfiguration. Each listed coordinate system belongs to one of the groups listed in Section 4. If the PTZ node supports continuous movements, it shall return a timeout range within which timeouts are accepted by the PTZ node.

REQUEST:

- **ConfigurationToken [tt:ReferenceToken]**
Reference to the requested PTZ configuration.

RESPONSE:

- **PTZConfigurationOptions[tt:PTZConfigurationOptions]**
The requested PTZ node configuration options.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoConfig**
The requested configuration does not exist.

ACCESS CLASS:

READ_MEDIA

5.2.5 SetConfiguration

A PTZ-capable device shall implement the SetConfiguration operation. The ForcePersistence flag indicates if the changes remain after reboot of the device.

REQUEST:

- **ConfigurationToken [tt:ReferenceToken]**
Reference to the PTZ configuration to be modified.
- **PTZConfigurationOptions[tt:PTZConfigurationOptions]**
The requested PTZ node configuration options.
- **ForcePersistence [xs:boolean]**
Deprecated modifier for temporary settings if supported by the device.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoConfig**
The requested configuration does not exist.
- **env:Sender - ter:InvalidArgVal - ter:ConfigModify**
The configuration parameters cannot be set.
- **env:Receiver - ter:Action - ter:ConfigurationConflict**
The new settings conflict with other uses of the configuration.

ACCESS CLASS:

ACTUATE

5.2.6 GetCompatibleConfigurations

A device signalling support for GetCompatibleConfigurations via the capability GetCompatibleConfigurations shall return all available PTZConfigurations that can be added to the referenced media profile through the GetComatibleConfigurations operation.

A device providing more than one PTZConfiguration or more than one VideoSourceConfiguration or which has any other resource interdependency between PTZConfiguration entities and other resources listable in a media profile should implement this operation. PTZConfiguration entities returned by this operation shall not fail on adding them to the referenced media profile.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Token of an existing media profile.

RESPONSE:

- **PTZConfiguration - optional, unbounded [tt:PTZConfiguration]**
List of compatible PTZ node configurations.

FAULTS:

- **env:Receiver - ter:ActionNotSupported - ter:OptionalActionNotSupported**
This method is not implemented by the device.

ACCESS CLASS:

READ_MEDIA**5.3 Move Operations**

This section describes three operations to move the PTZ unit absolutely, relatively or continuously. All operations require a profile token referencing a Media Profile that includes a PTZConfiguration.

All move commands shall be implemented non-blocking, meaning they shall not wait until the requested move operation has finished. The last move operation can be overwritten by sending another move request.

Due to the wide range of physical devices this specification addresses covers, the specification does not require a specific response time to PTZ move operations is not required. However, a device shall strive for minimal latency regarding PTZ move command request-to-response time. Note that the device does not have full control of the lag from PTZ control input and device movement. Network delays and client delays can further increase lag. Implementations should minimize device lag as much as possible.

5.3.1 AbsoluteMove

If a PTZ node supports absolute pan/tilt or absolute zoom movements, it shall support the AbsoluteMove operation. The position argument of this command specifies the absolute position to which the PTZ unit moves. It splits into an optional pan/tilt element and an optional zoom element. If the pan/tilt position is omitted, the current pan/tilt movement shall not be affected by this command. The same holds for the zoom position.

The spaces referenced within the position shall be absolute position spaces supported by the PTZ node. If the space information is omitted, the corresponding default spaces of the PTZ configuration, a part of the specified media profile, is used. A device may support absolute pan/tilt movements, absolute zoom movements or no absolute movements by providing only absolute position spaces for the supported cases.

An existing Speed argument overrides DefaultSpeed of the corresponding PTZ configuration during movement to the requested position. If spaces are referenced within the Speed argument, they shall be speed spaces supported by the PTZ node.

The operation shall fail if the requested absolute position is not reachable.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **Position [tt:PTZVector]**
Vector specifying the absolute target position.
- **Speed - optional [tt:PTZSpeed]**
Optional speed vector.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.

- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space is referenced that is not supported by the PTZ node.
- **env:Sender - ter:InvalidArgVal - ter:InvalidPosition**
The requested position is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:InvalidSpeed**
The requested speed is out of bounds.

ACCESS CLASS:

ACTUATE

5.3.2 RelativeMove

If a PTZ node supports relative pan/tilt or relative zoom movements, then it shall support the RelativeMove operation. The translation argument of this operation specifies the difference from the current position to the position to which the PTZ device is instructed to move. The operation is split into an optional pan/tilt element and an optional zoom element. If the pan/tilt element is omitted, the current pan/tilt movement shall NOT be affected by this command. The same holds for the zoom element.

The spaces referenced within the translation element shall be translation spaces supported by the PTZ node. If the space information is omitted for the translation argument, the corresponding default spaces of the PTZ configuration, which is part of the specified media profile, is used. A device may support relative pan/tilt movements, relative Zoom movements or no relative movements by providing only translation spaces for the supported cases.

An existing speed argument overrides DefaultSpeed of the corresponding PTZ configuration during movement by the requested translation. If spaces are referenced within the speed argument, they shall be speed spaces supported by the PTZ node.

The command can be used to stop the PTZ unit at its current position by sending zero values for pan/tilt and zoom. Stopping shall have the very same effect independent of the relative space referenced.

If the requested translation leads to an absolute position which cannot be reached, the PTZ node shall move to a reachable position along the border of valid positions.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **Translation [tt:PTZVector]**
Vector specifying the positional translation relative to the current position.
- **Speed - optional [tt:PTZSpeed]**
Optional speed vector.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space is referenced which is not supported by the PTZ node.
- **env:Sender - ter:InvalidArgVal - ter:InvalidTranslation**
The requested translation is out of bounds.

- **env:Sender - ter:InvalidArgVal - ter:InvalidSpeed**
The requested speed is out of bounds.

ACCESS CLASS:

ACTUATE

5.3.3 ContinuousMove

A PTZ-capable device shall support continuous movements. The velocity argument of this command specifies a signed speed value for the pan, tilt and zoom. The combined pan/tilt element is optional and the Zoom element itself is optional. If the pan/tilt element is omitted, the current pan/tilt movement shall not be affected by this command. The same holds for the zoom element. The spaces referenced within the velocity element shall be velocity spaces supported by the PTZ node. If the space information is omitted for the velocity argument, the corresponding default spaces of the PTZ configuration belonging to the specified media profile is used. A device may support continuous pan/tilt movements and/or continuous zoom movements by providing only velocity spaces for the supported cases.

An existing timeout argument overrides the DefaultPTZTimeout parameter of the corresponding PTZ configuration for this Move operation. The timeout parameter specifies how long the PTZ node continues to move.

A device shall stop movement in a particular axis (Pan, Tilt, or Zoom) when zero is sent as the ContinuousMove parameter for that axis. Stopping shall have the same effect independent of the velocity space referenced. This command has the same effect on a continuous move as the stop command specified in section 5.3.5.

If the requested velocity leads to absolute positions which cannot be reached, the PTZ node shall move to a reachable position along the border of its range. A typical application of the continuous move operation is controlling PTZ via joystick.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **Velocity [tt:PTZSpeed]**
Speed vector specifying the velocity of pan, tilt and zoom.
- **Timeout - optional [xs:duration]**
Optional timeout.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space is referenced which is not supported by the PTZ node.
- **env:Sender - ter:InvalidArgVal - ter:InvalidTranslation**
The requested translation is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:TimeoutNotSupported**
The specified timeout argument is not within the supported timeout range.
- **env:Sender - ter:InvalidArgVal - ter:InvalidVelocity**
The requested speed is out of bounds.

ACCESS CLASS:

ACTUATE

5.3.4 GeoMove

A device signaling GeoMove in one of its PTZ nodes shall support this command.

The optional AreaHeight and AreaWidth parameters can be added to the request, so that the PTZ-capable device can internally determine the zoom factor. In case both AreaHeight and AreaWidth are not provided, the unit will not change the zoom. AreaHeight and AreaWidth are expressed in meters.

An existing speed argument overrides the DefaultSpeed of the corresponding PTZ configuration during movement by the requested translation. If spaces are referenced within the speed argument, they shall be speed spaces supported by the PTZ node.

If the PTZ-capable device does not support automatic retrieval of the geolocation, it shall be configured by using SetGeoLocation before it can perform geo-referenced commands. If the client requests a GeoMove command before the geolocation of the device is configured, the device shall return an error.

Depending on the kinematics of the PTZ-capable device, the requested position may not be reachable. In this situation the device shall return an error, signalling that it cannot perform the requested action due to physical limitations.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **Target [tt:GeoLocation]**
Target coordinates.
- **Speed - optional [tt:PTZSpeed]**
Speed vector specifying the velocity of pan, tilt and zoom.
- **AreaWidth - optional [xs:float]**
Optional area to be shown.
- **AreaHeight - optional [xs:float]**
Optional area to be shown.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:GeoMoveNotSupported**
The device does not support geo move.
- **env:Sender - ter:InvalidArgVal - ter:UnreachablePosition**
The requested translation is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:TimeoutNotSupported**
The requested position is not reachable.
- **env:Sender - ter:InvalidArgVal - ter:GeoLocationUnknown**
The unit is not able to perform GeoMove because its geolocation is not configured or available.

ACCESS CLASS:

ACTUATE

5.3.5 Stop

A PTZ-capable device shall support the Stop operation. If no stop filter arguments are present, this command stops all ongoing pan, tilt and zoom movements. The Stop operation can be filtered to stop a specific movement by setting the corresponding stop argument.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PanTilt - optional [xs:boolean]**
Stop pan and tilt operation (defaults to true).
- **Zoom - optional [xs:boolean]**
Stop zoom operation (defaults to true).

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.

ACCESS CLASS:

ACTUATE

5.3.6 MoveAndStartTracking

A device signaling MoveAndTrack in one of its PTZ nodes shall support this command. The purpose of this action is to send an atomic command to the device: move the camera to a wanted position and then delegate the PTZ control to the tracking algorithm. With the atomic command the latency is minimized. The move position is optional and can be set in three different modes:

- By GeoLocation coordinates
- By a preset token
- By a PTZVector position

An existing Speed argument overrides DefaultSpeed of the corresponding PTZ configuration during movement to the requested position. If spaces are referenced within the Speed argument, they shall be speed spaces supported by the PTZ node.

If the detection and the tracking are done in the same device, an ObjectID reference can be passed as an argument, in order to specify which object should be tracked.

The operation shall fail if the requested absolute position is not reachable.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

- **GeoLocation – optional [tt:GeoLocation]**
Optional target coordinates
- **PresetToken – optional [tt:ReferenceToken]**
Optional reference to an existing preset token.
- **TargetPosition – optional [tt:PTZVector]**
Optional Vector specifying the absolute target position.
- **Speed - optional [tt:PTZSpeed]**
Optional speed vector.
- **ObjectID - optional [tt:ObjectId]**
Optional object ID of the object to track.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space is referenced that is not supported by the PTZ node.
- **env:Sender - ter:InvalidArgVal - ter:InvalidPosition**
The requested position is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:InvalidSpeed**
The requested speed is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:GeoMoveNotSupported**
The device does not support geo move.
- **env:Sender - ter:InvalidArgVal - ter:UnreachablePosition**
The requested translation is out of bounds.
- **env:Sender - ter:InvalidArgVal - ter:GeoLocationUnknown**
The unit is not able to perform GeoMove because its geolocation is not configured or available.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset token does not exist.

ACCESS CLASS:

ACTUATE

5.3.7 GetStatus

A PTZ-capable device shall be able to report its PTZ status through the GetStatus command. The PTZ status contains the following information:

- **Position (optional)** – Specifies the absolute position of the PTZ unit together with the space references. The default absolute spaces of the corresponding PTZ configuration shall be referenced within the position element. This information shall be present if the device signals support via the capability StatusPosition.
- **MoveStatus (optional)** – Indicates if the pan/tilt/zoom device unit is currently moving, idle or in an unknown state. This information shall be present if the device signals support via the capability MoveStatus. The state Unknown shall not be used during normal operation, but is reserved to initialization or error conditions.

- Error (optional) – States a current PTZ error condition. This field shall be present if the MoveStatus signals Unkown.
- UTC Time – Specifies the UTC time when this status was generated.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

RESPONSE:

- **PTZStatus [tt:PTZStatus]**
PTZStatus for the requested MediaProfile.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Receiver - ter:Action - ter:NoStatus**
No PTZ status is available in the requested Media Profile.

ACCESS CLASS:

READ_MEDIA

5.4 Preset operations

This section describes operations that manage the presets of a PTZ node. These operations shall be implemented for PTZ nodes supporting presets. All operations require a profile token referencing a media profile that includes a PTZConfiguration.

5.4.1 SetPreset

The SetPreset command saves the current device position parameters so that the device can move to the saved preset position through the GotoPreset operation.

If the PresetToken parameter is absent, the device shall create a new preset. Otherwise it shall update the stored position and optionally the name of the given preset. If creation is successful, the response contains the PresetToken which uniquely identifies the preset. An existing preset can be overwritten by specifying the PresetToken of the corresponding preset. In both cases (overwriting or creation) an optional PresetName can be specified. The operation fails if the PTZ device is moving during the SetPreset operation.

The device may internally save additional states such as imaging properties in the PTZ preset which then should be recalled in the GotoPreset operation. A device shall accept a valid SetPresetRequest that does not include the optional element PresetName.

Devices may require unique preset names and reject a request that contains an already existing PresetName by responding with the error message ter:PresetExist.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetToken - optional [tt:ReferenceToken]**
Optional existing preset token to update a preset position.

- **PresetName - optional [xs:string]**
Optional name to be assigned to the preset position.

RESPONSE:

- **PresetToken [tt:ReferenceToken]**
Reference token assigned by the device to the preset.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.
- **env:Sender - ter:InvalidArgVal - ter:PresetExist**
The requested name already exist for another preset.
- **env:Sender - ter:InvalidArgVal - ter:InvalidPresetName**
The PresetName is either too long or contains invalid characters.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset token does not exist.
- **env:Receiver - ter:Action - ter:MovingPTZ**
Preset cannot be set while PTZ unit is moving.
- **env:Receiver - ter:Action - ter:TooManyPresets**
Maximum number of Presets reached.

ACCESS CLASS:

ACTUATE

5.4.2 GetPresets

The GetPresets operation returns the saved presets consisting of the following elements:

- **Token** – A unique identifier to reference the preset.
- **Name** – An optional mnemonic name.
- **PTZ Position** – An optional absolute position. If the PTZ node supports absolute pan/tilt position spaces, the pan/tilt position shall be specified. If the PTZ node supports absolute zoom position spaces, the zoom position shall be specified.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

RESPONSE:

- **Preset - optional, unbounded [tt:PTZPreset]**
List of presets for the requested MediaProfile.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.

ACCESS CLASS:

READ_MEDIA

5.4.3 GotoPreset

The GotoPreset operation recalls a previously set preset. If the speed parameter is omitted, the default speed of the corresponding PTZ configuration shall be used. The speed parameter can only be specified when speed spaces are available for the PTZ node. The GotoPreset command is a non-blocking operation and can be interrupted by other move commands.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetToken [tt:ReferenceToken]**
Reference to an existing preset token.
- **Speed - optional [PTZSpeed]**
Optional speed.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space that is not supported by the PTZ node is referenced.
- **env:Sender - ter:InvalidArgVal - ter:InvalidSpeed**
The requested speed is out of bounds.

ACCESS CLASS:

ACTUATE

5.4.4 RemovePreset

The RemovePreset operation removes a previously set preset.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetToken [tt:ReferenceToken]**
Existing preset token to be removed.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.

- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset token does not exist.

ACCESS CLASS:

ACTUATE

5.5 Home position operations

This section describes operations used to manage the home position of a PTZ node. These operations shall be implemented for PTZ nodes supporting home positions. All operations require a profile token referencing a media profile including a PTZConfiguration.

The “home” position MAY be set by the SetHome operation or is a fix position of the PTZ unit.

5.5.1 GotoHomePosition

This operation moves the PTZ unit to its home position. If the speed parameter is omitted, the default speed of the corresponding PTZ configuration shall be used. The speed parameter can only be specified when speed spaces are available for the PTZ node. The command is non-blocking and can be interrupted by other move commands.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **Speed - optional [PTZSpeed]**
Optional speed.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoHomePosition**
No home position has been defined for this Profile.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.
- **env:Sender - ter:InvalidArgVal - ter:InvalidSpeed**
The requested speed is out of bounds.

ACCESS CLASS:

ACTUATE

5.5.2 SetHomePosition

The SetHome operation saves the current position parameters as the home position, so that the GotoHome operation can request that the device move to the home position.

The SetHomePosition command shall return with a failure if the “home” position is fixed and cannot be overwritten. If the SetHomePosition is successful, it shall be possible to recall the home position with the GotoHomePosition command.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.
- **env:Receiver - ter:Action - ter:CannotOverwriteHome**
The home position is fixed and cannot be overwritten.

ACCESS CLASS:

ACTUATE

5.6 Auxiliary operations

This section describes operations to manage auxiliary commands of a PTZ node, such as an infrared (IR) lamp, a heater or a wiper.

These operations shall be implemented for PTZ nodes indicating auxiliary commands in the node properties. All operations require a profile token referencing a media profile that includes a PTZConfiguration.

5.6.1 SendAuxiliaryCommand

This operation is used to call an auxiliary operation on the device. The supported commands can be retrieved via the PTZ node properties. The auxiliary command should match the supported command listed in the PTZ node; no other syntax is supported. If the PTZ node lists the tt:IRLamp command, then the parameter of AuxiliaryCommand command shall conform to the syntax specified in Section 8.6 Auxiliary operation of ONVIF Core Specification. The SendAuxiliaryCommand shall be implemented when the PTZ node supports auxiliary commands.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **AuxiliaryData [tt:AuxiliaryData]**
Auxiliary command to be applied.

RESPONSE:

- **AuxiliaryResponse[tt:AuxiliaryData]**
Auxiliary response information.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
Reference to an existing preset token.

ACCESS CLASS:

ACTUATE

5.7 Predefined PTZ Spaces

Spaces are used to specify absolute, relative and continuous movements. Whereas absolute movements require an absolute position, relative movements are specified by a position translation. Continuous movements require the specification of a velocity (relative movement over time). For these three cases, different coordinate systems are used describing the desired movement. The generic spaces do not absolutely specify the underlying PTZ model, so that it can be applied to any PTZ hardware.

Note: this document includes additional non-normative spaces defined in Annex A.

5.7.1 Absolute position spaces

The absolute position spaces are used when the client wants to move the camera to a certain position. The absolute movement from current position A to an arbitrarily chosen position B doesn't have to follow a specific path. Instead, the PTZ device may choose the shortest path in order to reach the target destination.

For devices with dynamic ranges of values (for example, enabling or disabling a "digital zoom" feature will change the total zoom range), it is expected that the generic spaces will be remapped at runtime to match the full range of values.

5.7.1.1 Generic pan/tilt position space

The generic pan/tilt position space shall be provided by every PTZ node that supports absolute pan/tilt, since it does not relate to a specific physical range. Instead, the range should be defined as the full range of the PTZ unit normalized to the range -1 to 1 resulting in the following space description:

```
<tt:AbsolutePanTiltPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/PositionGenericSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
  <tt:Yrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Yrange>
</tt:AbsolutePanTiltPositionSpace>
```

5.7.1.2 Spherical pan/tilt position space in degrees

Figure 1 shows a camera with pan and tilt mechanics and the corresponding spherical coordinate system. The space description assumes that the dome is mounted on the ceiling. The definition of a Pan movement is the rotation of the camera module around the pan axis. Thereby, the tilt axis is also rotated in the same direction in the plane orthogonal to the pan axis, so that it is still orthogonal to the camera lens axis. Tilt movement is the rotation of the camera module around the tilt axis. With the tilt axis the camera direction can be changed from looking downward to looking at the horizon. Some devices may support a camera which can look above the horizon.

The angles describing the rotation around pan and tilt axis are referred to as pan and tilt angles, where pan is represented by the X coordinate of the position vector and tilt is represented by the Y coordinate of the position vector. Both angles are specified in degrees. The initial position of this coordinate system is when the direction of the camera lens is parallel to the ceiling. The pan and tilt angles in this initial direction are zero (0,0).

When starting from the initial direction and increasing the pan angle, objects that have previously been in the centre of the image will move towards the left of the image. When starting from the initial direction and increasing the tilt angle, objects which have been previously in the middle of the image move towards the bottom of the image.

The maximum range for pan and tilt angles are between -180 and +180 degrees¹. The device can restrict the tilt range arbitrarily. The tilt angle of a camera can change its direction in the space of a hemisphere like a dome camera that is

¹-180 and +180 is the same pan position in the space and the camera can choose to represent the pan position using any of them

typically bounded from 0 to -90 degrees. If a device cannot pan the full range, it may limit the pan range to an appropriate interval.

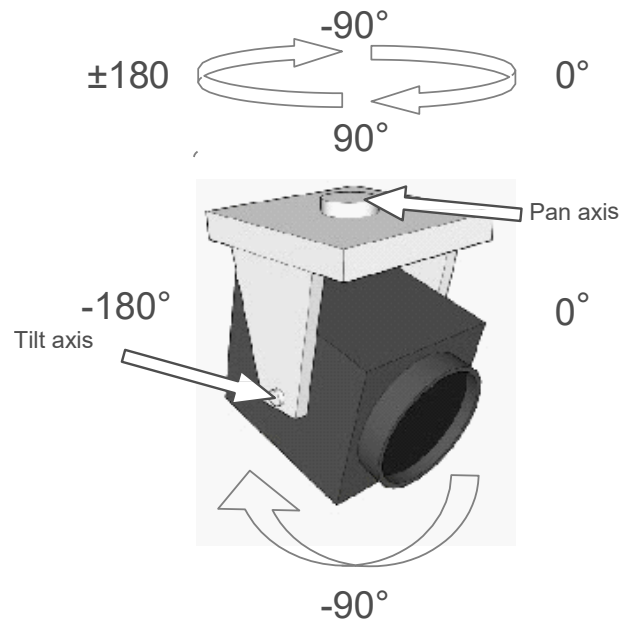


Figure 1: Spherical pan/tilt position space in degrees for a camera mounted on the ceiling.

A camera that does not support e-flip (or has disabled it) and allows an absolute tilt range between

0 and -180°, shall not rotate the image and directions when requesting a tilt movement of less than -90°.

If a camera supports e-flip and a client requests a tilt movement that passes nadir, the following behaviour is to be expected:

- There could be a hysteresis ($\pm\alpha^\circ$) room around the position of nadir, such that the image and direction rotation doesn't occur exactly at the nadir, which could generate irritating oscillation.
- When the camera rotates the image and move directions (after passing the nadir $\pm\alpha^\circ$), the following changes to the coordinate system will occur:
 - The new pan angle will be $P_{\text{new}} = P_{\text{old}} + 180^\circ$
 - The new tilt angle will be $T_{\text{new}} = -180^\circ - T_{\text{old}}$, $-180 \leq T_{\text{old}} \leq -90$
 - If ignoring the hysteresis area, there is a one-to-one mapping between viewing directions and pan/tilt coordinates, even though there are two mechanical positions of the camera matching the same viewing direction but with rotated image. For example, the two mechanical directions $P_1 : 35$, $T_1 : -20$ and $P_2 : -145$, $T_2 : -160$, would be represented by the coordinate $P : 35$, $T : -20$ since a tilt of $< -90 - \alpha$ would update the coordinates as described above.

The spherical pan/tilt position space is defined as follows:²

```
<tt:AbsolutePanTiltPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/SphericalPositionSpace
    Degrees
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
```

²The particular device should reference the proposed name space but the actual ranges are device specific. The ranges indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

```

<tt:YRange>
  <tt:Min>-180.0</tt:Min>
  <tt:Max>180.0</tt:Max>
</tt:YRange>
</tt:AbsolutePanTiltPositionSpace>

```

The Min and Max elements of the XRange are set to plus and minus infinity to indicate that the range is not bounded to either side.

5.7.1.3 Generic zoom position space

The generic zoom position space shall be provided by every PTZ node that supports absolute zoom, since it does not relate to a specific physical range. Instead, the range should be defined as the full range of the zoom normalized to the range 0 (wide) to 1 (tele). There is no assumption about how the generic zoom range is mapped to magnification, FOV or other physical zoom dimension. This results in the following space description:

```

<tt:AbsoluteZoomPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/PositionGenericSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
</tt:AbsoluteZoomPositionSpace>

```

5.7.1.4 Zoom position space in millimeters

The zoom position space in millimeters expresses the absolute focal length of a zoom camera. The maximum and minimum focal length is camera specific. The zoom position space in millimeters is defined as follows:³

```

<tt:AbsoluteZoomPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/PositionSpaceMillimeter
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:AbsoluteZoomPositionSpace>

```

The current zoom magnification (M) for a camera can be calculated from the focal length as follows:

$$M = \frac{fc}{f0},$$

where $f0$ is the minimum focal length and fc is the current focal length.

The current angle of view can be calculated with the following formula:

$$\alpha = 2\arctan\frac{d}{2fc},$$

where d represents the size of the sensor in the direction of interest and fc is the current focal length.

5.7.1.5 Normalized digital zoom position space

The normalized digital zoom position space represents the mapping between the width of the window (Ww) used for a video stream and the width of the Bounds element of the video source configuration (Sw). This space requires a Media Profile that includes a VideoEncoderConfiguration and a VideoSourceConfiguration.

³The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

The normalized digital zoom factor is calculated as $Z = 1 / \left(\frac{W_w}{S_w} \right)$.

The maximum zoom level that can be represented by this space is limited by the smallest size of the window allowed by the camera.

The normalized digital position zoom space is defined as follows: ⁴

```
<tt:AbsoluteZoomPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/NormalizedDigitalPosition
    Space
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>1.0</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:AbsoluteZoomPositionSpace>
```

It's important to notice that a zoom operation using this space doesn't affect the current resolution of the video stream being configured in the VideoEncoderConfiguration of the Media Profile. Instead it changes the width and height of the window configured in the VideoSourceConfiguration.

5.7.1.5.1 Example: Zoom level for cropped area

For example, a digital PTZ unit with a natively cropped VGA (640x 480) window on a 3MP sensor (2048x1536) would have the zoom level $Z = 1 / \left(\frac{640}{2048} \right) = 3.2$.

5.7.2 Relative translation spaces

A Relative pan/tilt Translation Space moves the PTZ unit a certain translation in a certain direction without knowing the camera's current pan/tilt position.

A relative pan/tilt translation can be derived from a corresponding (digital/spherical) absolute pan/tilt position space by taking the difference of two absolute pan/tilt positions. However, there are also relative pan/tilt translations where no corresponding absolute pan/tilt space can be defined. An example is the relative translation space in field of view described in Section A.3.2.

If the camera supports e-flip, the following additional behaviour should be expected by the space defined in Section A.3.1:

If the tilt translation is passing nadir position (including the room for a hysteresis $\pm\alpha^\circ$), the camera should rotate the image at nadir $\pm\alpha^\circ$ as described in section 5.7.1.2 (only for cameras supporting absolute pan/tilt positioning). When a rotation occurs, the camera will continue the current movements according to the directions given when the command was issued. If the command is interrupted with a new request (after the flip), that request will be handled according to the new (flipped) direction and coordinates. A camera that doesn't support e-flip or has it disabled will not rotate the image and directions during a tilt movement passing the nadir.

5.7.2.1 Generic pan/tilt translation space

The generic pan/tilt translation space shall be provided by every PTZ node that supports relative pan/tilt, since it does not relate to a specific physical range. Instead, the range should be defined as the full positive and negative translation range of the PTZ unit normalized to the range -1 to 1, where positive translation would mean clockwise rotation or movement in right/up direction resulting in the following space description:

```
<tt:RelativePanTiltTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/TranslationGenericSpace
  </tt:SpaceURI>
```

⁴The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum range limit for the space.

```

<tt:Xrange>
  <tt:Min>-1.0</tt:Min>
  <tt:Max>1.0</tt:Max>
</tt:Xrange>
<tt:Yrange>
  <tt:Min>-1.0</tt:Min>
  <tt:Max>1.0</tt:Max>
</tt:Yrange>
</tt:RelativePanTiltTranslationSpace>

```

5.7.2.2 Generic zoom translation space

The generic zoom translation space shall be provided by every PTZ node that supports relative zoom, since it does not relate to a specific physical range. Instead, the corresponding absolute range should be defined as the full positive and negative translation range of the Zoom normalized to the range -1 to 1, where a positive translation maps to a movement in tele direction. The translation is signed to indicate direction (negative is to wide, positive is to tele). There is no assumption about how the generic zoom range is mapped to magnification, field of view or other physical zoom dimension. This results in the following space description:

```

<tt:RelativeZoomTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/TranslationGenericSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
</tt:RelativeZoomTranslationSpace>

```

5.7.3 Continuous velocity spaces

The continuous velocity spaces are used to continuously move the PTZ unit in a certain direction.

If a camera supports e-flip (specified in section A.3.1), and it's enabled, the following behaviour should be expected by the pan/tilt spaces defined in Section 5.7.3.2 and A.4.1:

If the tilt translation is passing nadir position (including the room for a hysteresis $\pm\alpha^\circ$), the camera should rotate the image at nadir $\pm\alpha^\circ$ as described in section 5.7.1.2 (only for cameras supporting absolute pan/tilt positioning). When a rotation occurs, the camera will continue the current movements according to the directions given when the command was issued. If the command is interrupted with a new request (after the flip), that request will be handled according to the new (flipped) direction and coordinates. A camera that doesn't support e-flip or has it disabled will not rotate the image and directions during a tilt movement passing nadir.

5.7.3.1 Generic pan/tilt velocity space

The generic pan/tilt velocity space shall be provided by every PTZ node, since it does not relate to a specific physical range. Instead, the range should be defined as a range of the PTZ unit's speed normalized to the range -1 to 1, where a positive velocity would map to clockwise rotation or movement in the right/up direction. A signed speed can be independently specified for the pan and tilt component resulting in the following space description:

```

<tt:ContinuousPanTiltVelocitySpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/VelocityGenericSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
  <tt:Yrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Yrange>

```

```
</tt:ContinuousPanTiltVelocitySpace>
```

5.7.3.2 pan/tilt Velocity Space in Degrees per Second

The pan/tilt Velocity Space In Degrees Per Second describes a continuous rotation around the pan and tilt axis (specified in section 5.7.1.2) with a constant rotation speed. Thereby, the velocity describes the signed pan and tilt angle change in degrees per second. The pan velocity is expressed by the X coordinate of the direction vector and the tilt velocity by the Y coordinate and the space is defined as follows:⁵

```
<tt:ContinuousPanTiltVelocitySpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/VelocitySpaceDegrees
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:YRange>
</tt:ContinuousPanTiltVelocitySpace>
```

5.7.3.3 Generic zoom velocity space

The generic zoom velocity space specifies a zoom factor velocity without knowing the underlying physical model. The range should be normalized from -1 to 1, where a positive velocity would map to TELE direction. A generic zoom velocity space description resembles the following:

```
<tt:ContinuousZoomVelocitySpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/VelocityGenericSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>-1.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
</tt:ContinuousZoomVelocitySpace>
```

5.7.4 Speed spaces

The speed spaces specify the speed for a pan/tilt and zoom movement when moving to an absolute position or to a relative translation. In contrast to the velocity spaces, speed spaces do not contain any directional information. The speed of a combined pan/tilt movement is represented by a single non-negative scalar value.

If relative translation space and continuous velocity space are already defined, the corresponding speed space is derived as follows: requesting a continuous movement with a velocity V for T seconds, is identical (up to acceleration and positional inaccuracies) to requesting a relative movement with relative position R and speed S , where R equals V times T and S equals the length of vector V . Therefore, speed values are always positive.

5.7.4.1 Generic pan/tilt speed space

The generic pan/tilt speed space shall be provided by every PTZ node that supports configurable speed for pan/tilt, since it does not relate to a specific physical range. Instead, the range should be defined as the full range of the speed range normalized to the range 0 (stopped) to 1 (full speed). This results in the following space description:

```
<tt:PanTiltSpeedSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/GenericSpeedSpace
```

⁵The particular device should reference the proposed name space but the actual ranges are device specific. The ranges indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

```

</tt:SpaceURI>
<tt:Xrange>
  <tt:Min>0.0</tt:Min>
  <tt:Max>1.0</tt:Max>
</tt:Xrange>
</tt:PanTiltSpeedSpace>

```

5.7.4.2 Pan/tilt speed space in degrees per Second

The pan/tilt speed space in degrees per second derives from the absolute pan/tilt position space in degrees for absolute and relative movements. The pan/tilt speed space in degrees per second is defined as follows:⁶

```

<tt:PanTiltSpeedSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/SpeedSpaceDegrees
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:PanTiltSpeedSpace>

```

5.7.4.3 Generic zoom speed space

The generic zoom speed space shall be provided by every PTZ node that supports configurable speed for zoom, since it does not relate to a specific physical range. Instead, the range should be defined as the full range of the speed range normalized to the range 0 (stopped) to 1 (full speed). This results in the following space description:

```

<tt:ZoomSpeedSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/ZoomGenericSpeedSpace
  </tt:SpaceURI>
  <tt:Xrange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>1.0</tt:Max>
  </tt:Xrange>
</tt:ZoomSpeedSpace>

```

5.7.4.4 Zoom speed space in millimeter per second

The zoom speed space in millimeter per second derives from the zoom velocity space in millimeter per second as defined in section A.4.2 and specifies the absolute change per second of the focal length. If the device supports the zoom speed space The zoom speed space in millimeter per second is defined as follows:⁷

```

<tt:ZoomSpeedSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/SpeedSpaceMillimeter
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:ZoomSpeedSpace>

```

5.8 Preset Tour Operations

Preset tour is a feature for PTZ-capable devices, enabling the PTZ unit to move on specified presets sequentially at some interval.

⁶The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

⁷The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limit for the space.

This section describes operations that manage the preset tours. These operations shall be implemented when a PTZ node in the PTZ service indicates support of preset tours with `MaximumNumberOfPresetTours>0` capability value, All operations require a profile token referencing a Media Profile including a PTZConfiguration. All operations for preset tours shall always be persistent.

PresetTours can have forward and backward directions, and in case direction is omitted, it is assumed to be forward. However, it is possible to specify random execution by setting the `RandomPresetOrder` attribute. In case `RandomPresetOrder` is set to true and `Direction` is also present, `Direction` will be ignored and presets of the Tour will be recalled randomly.

5.8.1 GetPresetTours

A device supporting Preset Tour feature shall return all available preset tours through `GetPresetTours`.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

RESPONSE:

- **PresetTour - optional, unbounded [tt:PTZPresetTour]**
List of preset tours defined for the requested MediaProfile.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.

ACCESS CLASS:

READ_MEDIA

5.8.2 GetPresetTour

A device supporting preset tours shall return the requested preset tour through `GetPresetTour`.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetTourToken [tt:ReferenceToken]**
Reference to an existing preset tour.

RESPONSE:

- **PresetTour [tt:PTZPresetTour]**
The requested preset tour.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset tour token does not exist.

ACCESS CLASS:

READ_MEDIA

5.8.3 GetPresetTourOptions

A device supporting preset tours shall provide options for how preset tours can be configured through GetPresetTourOptions.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetTourToken - optional [tt:ReferenceToken]**
Optional reference to an existing preset tour.

RESPONSE:

- **PresetTour [tt:PTZPresetTourOptions]**
The requested preset tour options.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.

ACCESS CLASS:

READ_MEDIA

5.8.4 CreatePresetTour

A device supporting Preset Tour feature shall allow creating a new Preset Tour through the CreatePresetTour.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.

RESPONSE:

- **PresetTourToken [tt:ReferenceToken]**
Reference to an existing preset tour.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:TooManyPresetTours**
There is not enough space in the device to create the new preset tour for the profile

ACCESS CLASS:

ACTUATE

5.8.5 ModifyPresetTour

A device supporting preset tours shall allow modifying a preset tour through ModifyPresetTour.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetTour [tt:PTZPresetTour]**
The preset tour parameters to be set.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:InvalidPresetTour**
The requested PresetTour includes invalid parameter(s).
- **env:Sender - ter:InvalidArgVal - ter:TooManyPresets**
Too many TourSpots are included in the PresetTour.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset tour token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:SpaceNotSupported**
A space is referenced which is not supported by the PTZ node.

ACCESS CLASS:

ACTUATE

5.8.6 OperatePresetTour

A device supporting preset tours shall allow starting, stopping, or pausing a preset tour through OperatePresetTour.

Preset tour can be operated with the PresetTourOperation parameter of OperatePresetTour command.

- **Start:** indicates starting the preset tour or re-starting the paused preset tour.
- **Stop:** indicates stopping the preset tour.
- **Pause:** Indicates pausing the preset tour.

When receiving another OperatePresetTour command of Start operation for a preset tour which has already been started, the preset tour shall be restarted with the newly requested parameter.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetTourToken [tt:PTZPresetTourToken]**
Reference to an existing preset tour.
- **Operation [tt:PTZPresetTourOperation]**
Operation information.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset tour token does not exist.
- **env:Sender - ter:InvalidArgVal - ter:InvalidPresetTour**
The requested PresetTour includes invalid parameter(s).
- **env:Receiver - ter:InvalidArgVal - ter:ActivationFailed**
The requested preset tour cannot be activated while PTZ unit is moving or another preset tour is now activated.

ACCESS CLASS:

ACTUATE

5.8.7 RemovePresetTour

A device supporting preset tours shall support removing preset tours through RemovePresetTour.

REQUEST:

- **ProfileToken [tt:ReferenceToken]**
Reference to an existing media profile.
- **PresetTourToken [tt:PTZPresetTourToken]**
Reference to an existing preset tour.

RESPONSE:

This is an empty message.

FAULTS:

- **env:Sender - ter:InvalidArgVal - ter:NoProfile**
The requested profile token ProfileToken does not exist.
- **env:Sender - ter:InvalidArgVal - ter:NoPTZProfile**
The requested profile token does not reference a PTZ configuration.
- **env:Sender - ter:InvalidArgVal - ter:NoToken**
The requested preset tour token does not exist.

ACCESS CLASS:

ACTUATE

5.8.8 Preset tour parameters

A preset tour is composed of following parameters:

PresetTour: Configuration of a preset tour.

- Name: Name of the preset tour [Optional]

- Status: Indicates the current status of the preset tour. This parameter in the argument of the ModifyPresetTour command shall be ignored.
 - Idle: Preset tour is not activated.
 - Touring: Preset tour is activated and now under touring.
 - Paused: Preset tour is under pause at the middle of the tour by client. This status requires Start operation from a client to re-start.
- AutoStart: Flag to enable the preset tour activated always. When this flag is set to True in a preset tour, the device shall set the flags of all other preset tours referring to the same PTZNode to False, so that only one tour on the device is marked as AutoStart. Starting and stopping the preset tour by OperatePresetTour shall change this flag to False. Pausing and resuming the preset tour by OperatePresetTour shall not change this flag.
- TourSpot: Presets with its configuration for touring [Optional]
 - PresetDetail: Detail configuration of the preset for the tour spot. One out of the three options below shall be chosen.
 - PresetToken: Specifies an existing PresetToken as this tour spot.
 - Home: Specifies the home position as the tour spot. Only “True” to this Boolean parameter shall be valid. “False” shall be treated as an error due to an invalid argument.
 - PTZPosition: Specifies the vector of PTZ node as the tour spot
 - Speed: PTZ speed moving to this tour spot. [Optional]
 - StayTime: Time duration of stay on the spot. [Optional]
- PresetTourStartingCondition: Configuration of the starting preset tour.
 - RecurringTime: Parameter to specify how many times the preset tour is recurred. [Optional]
 - RecurringDuration: Parameter to specify how long duration time the preset tour is recurred [Optional]
 - If both conditions RecurringTime and RecurringDuration are configured, the preset tour shall finish with one of the conditions satisfied earlier. If both are omitted, PresetTour shall be recurred without limitation.
 - PresetTourDirection: A device refers this flag to choose which direction the preset tour goes. It is omissible parameter and Forward shall be chosen in case it is omitted. [Optional]
 - Forward: Preset tour goes in forward order.
 - Backward: Preset tour goes in backward order.
- Token: Unique identifier of the preset tour

5.9 Pan/tilt control direction configuration

Pan/tilt control direction configuration is one set of parameters in PTZ configuration used to configure the movement directions of pan and tilt in the two following ways:

1. E-Flip

E-Flip is flipping of the control directions of pan/tilt when the lens passes the nadir or the zenith direction during a tilt movement. This functionality is useful when controlling domes using a human joystick control, where a client can track an object that passes the nadir and doesn't have to bother about inverted controls.

2. Reverse

The Reverse parameter is for switching the positive and negative positions of the pan/tilt control direction. This feature can be used to configure appropriate control direction of pan/tilt based on directions that the device is mounted, for example, in the ceiling downwards or on the surface upwards.

Figure 2 to Figure 5 show an example how the control directions of pan/tilt are changed by E-Flip feature and Reverse feature.

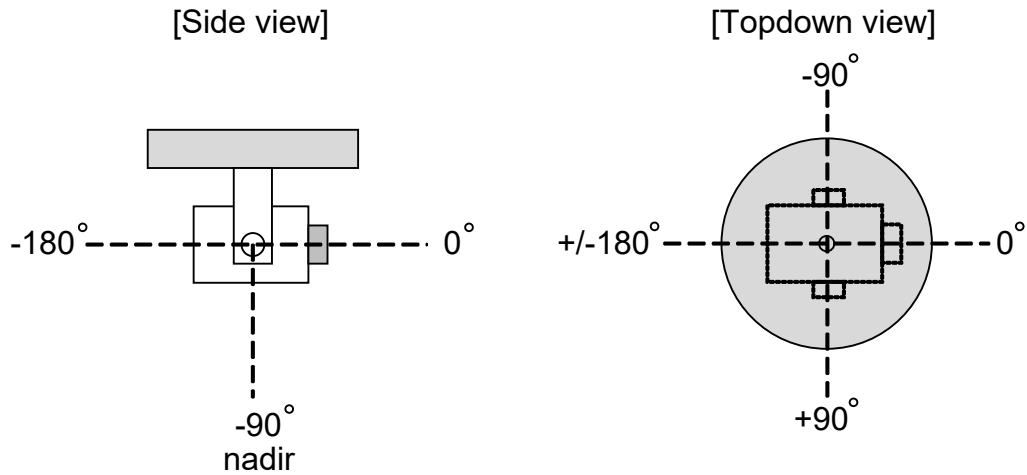


Figure 2: Normal pan/tilt control direction

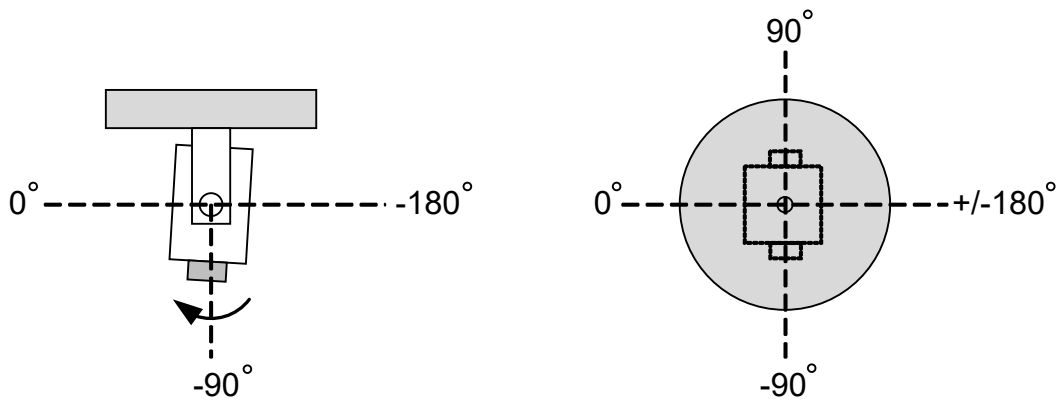


Figure 3: Normal pan/tilt control direction with E-Flip activated

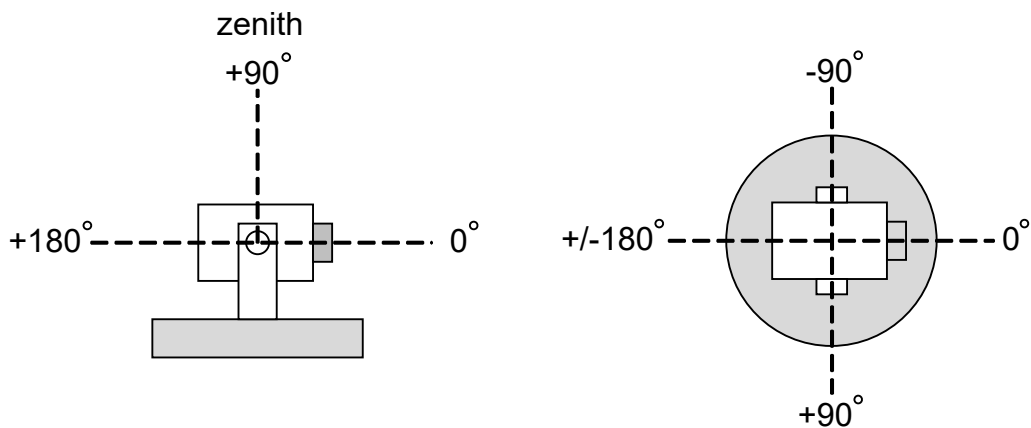


Figure 4: Reversed pan/tilt control direction

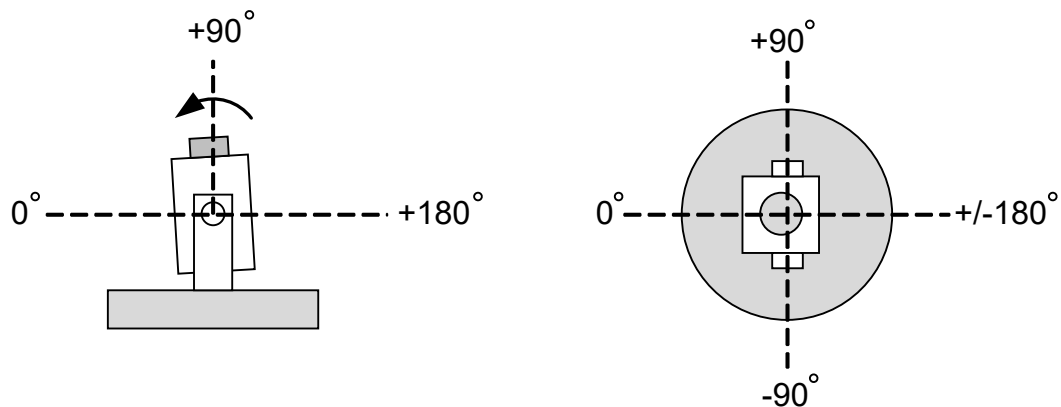


Figure 5: Reversed pan/tilt control direction with E-Flip activated

If the control direction of pan/tilt is changed, it is recommended to adapt the orientation of the video image via the Rotation parameter of VideoSourceConfiguration to align pan/tilt and video.

5.10 GetServiceCapabilities

The capabilities reflect optional functions and functionality of a service. The information is static and does not change during device operation. The following capabilities are available:

EFlip	Indicates whether or not E-Flip is supported.
Reverse	Indicates whether or not reversing of pan/tilt control direction is supported.
GetCompatibleConfigurations	Indicates the support for GetCompatibleConfigurations command.
MoveStatus	Indicates that the PTZStatus includes MoveStatus information.
StatusPosition	Indicates that the PTZStatus includes Position information.
MoveAndTrack	Indicates level of support for MoveAndStartTracking. Options are PresetToken, GeoLocation, PTZVector and ObjectID.

REQUEST:

This is an empty message.

RESPONSE:

- **Capabilities [ptz:Capabilities]**
List of the above defined capabilities.

FAULTS:

None

ACCESS CLASS:

PRE_AUTH

5.11 Events

A device supporting the PTZ service dispatches events listed in this chapter through the event service.

5.11.1 PTZ Presets

A device supporting the PTZ service specifies handling of PTZ presets. Since the move operations are non-blocking, a client is not informed when the PTZ preset has been reached. Therefore, a device supporting the PTZ service should support the following events which inform subscribers about the status of preset movements.

Topic:
 tns1:PTZController/PTZPresets/Invoked
 tns1:PTZController/PTZPresets/Reached
 tns1:PTZController/PTZPresets/Aborted
 tns1:PTZController/PTZPresets/Left

The typical sequence of events is that first a client requests a certain preset. When the device accepts this request, it will send out an invoked event. The invoked event has to follow either a reached event or an aborted event. The former is used when the PTZ unit was able to reach the invoked preset position, the latter in any other case. A reached event has to follow a left event, as soon as the PTZ unit moves away from the preset position.

The message structure of these events is given by the following message description:

```
<tt:MessageDescription>
  <tt:Source>
    <tt:SimpleItemDescription Name="PTZConfigurationToken"
      Type="tt:ReferenceToken" />
  </tt:Source>
  <tt>Data>
    <tt:SimpleItemDescription Name="PresetToken" Type="tt:ReferenceToken" />
    <tt:SimpleItemDescription Name="PresetName" Type="tt:Name" />
  </tt>Data>
</tt:MessageDescription>
```

5.11.2 PresetTours

When a PTZ node in a device supporting the PTZ service indicates support of Preset Tour with `MaximumNumberOfPresetTours` greater than 0 capability value, the device shall support the following topic to inform subscribers about preset tour events. Whenever a change in Preset Tours occurs, the PTZ service shall dispatch this event:

```
Topic: tns1:PTZController/PTZPresetTours/Configuration
<tt:MessageDescription isProperty=True>
  <tt:Source>
    <tt:SimpleItemDescriptionName="ProfileToken" Type="tt:ReferenceToken" />
    <tt:SimpleItemDescriptionName="PresetTourToken" Type="tt:ReferenceToken" />
  </tt:Source>
  <tt>Data>
    <tt:SimpleItemDescriptionName="StateChange" Type="xs:boolean" />
    <tt:ElementItemDescription Name="PresetTour" Type="tt:PTZPresetTour" />
  </tt>Data>
</tt:MessageDescription>
```

Note, the `StateChange` flag in the data part becomes true when the mentioned Preset Tour includes any changes of its State.

Annex A. Additional PTZ Spaces (Informative)

A.1 Introduction

This section lists additional spaces originally defined in a white paper. For a list of normative spaces refer to section 5.7.

A.2 Absolute Position Spaces

A.2.1 Digital pan/tilt Position Space

The Digital pan/tilt Position Space is suitable for Digital PTZ cameras, where the pan and tilt coordinates represent the centre point of a window positioned on a sensor, also known as absolute Digital PTZ. This space requires a Media Profile that includes a VideoEncoderConfiguration and a VideoSourceConfiguration [ONVIF Core Spec].

The pan movement is a horizontal movement in the X direction on the sensor plane and the tilt movement is a vertical movement in the Y direction on the sensor plane. The coordinate system originates from the lower left of the sensor. Figure A.1 exemplifies a window located at the left upper most coordinate (0.1, 0.9) with a window size of (0.2 * plane width, 0.2 * plane height).

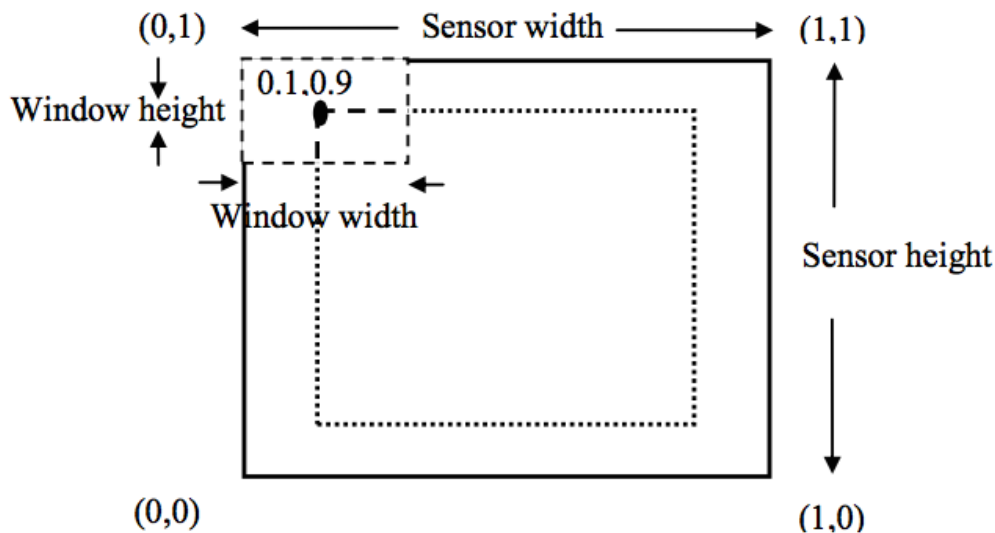


Figure A.1: Digital pan/tilt Position Space.

The Digital pan/tilt Position space is defined as follows:

```
<tt:AbsolutePanTiltPositionSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/DigitalPositionSpace
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>0</tt:Min>
    <tt:Max>1</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>0</tt:Min>
    <tt:Max>1</tt:Max>
  </tt:YRange>
</tt:AbsolutePanTiltPositionSpace>
```

A.2.2 Example: Positions of a window on sensor

A window with VGA resolution (640x480) that is natively mapped to the same number of pixels of a cropped area on a 3MP (2048x1536) sensor, would have the pan and tilt range of:

$$X_{\min} = \frac{\left(\frac{W_w}{2}\right)}{S_w} \Rightarrow \frac{\left(\frac{640}{2}\right)}{2048} = 0.15625, \quad X_{\max} = 1 - \frac{\left(\frac{W_w}{2}\right)}{S_w} \Rightarrow 1 - \frac{\left(\frac{640}{2}\right)}{2048} = 0.84375.$$

$$Y_{\min} = \frac{\left(\frac{W_w}{2}\right)}{S_w} \Rightarrow \frac{\left(\frac{480}{2}\right)}{1536} = 0.15625, \quad Y_{\max} = 1 - \frac{\left(\frac{W_w}{2}\right)}{S_w} \Rightarrow 1 - \frac{\left(\frac{480}{2}\right)}{1536} = 0.84375$$

As long as the aspect ratio of the window and the sensor are identical, the same ranges for pan and tilt are expected. The device will automatically adjust the ranges based on the amount of source pixels represented in the window of interest (its width and height configured in the VideoSourceConfiguration of the requested profile).

A.3 Relative Translation Spaces

A.3.1 Spherical pan/tilt Translation Space in Degrees

The Spherical pan/tilt Translation Space In Degrees derives from the Absolute Spherical pan/tilt Position Space In Degrees (see section 5.7.1.2). Instead of an absolute Position space where the reference position is fixed, the relative spherical space specifies the reference position as the cameras current position at all times. Thereby, the pan/tilt Translation is expressed as the coordinate difference from the current position to the target position. If a client wants to pan the camera by 5 degrees, it can use this relative spherical space and set the X coordinate of the direction to 5 and the Y coordinate to 0.

The spherical pan/tilt translation space is defined as follows:¹

```
<tt:RelativePanTiltTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/SphericalTranslation
    Space Degrees
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-360</tt:Min>
    <tt:Max>+360</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>+INF</tt:Max>
  </tt:YRange>
</tt:RelativePanTiltTranslationSpace>
```

A.3.2 Pan/tilt Translation Space in FOV

The Relative pan/tilt Translation Space in FOV is introduced to simplify the navigation with dome cameras in graphical user interfaces. When the user wants to center the camera on a certain position in the current camera view, the user requests a movement with respect to the current FOV. Due to the mechanics of a dome, the image content may rotate (see Figure 1). Figure A.2 shows a rectangle representing the image content. The relative pan/tilt Translation Space in FOV has its origin in the centre of the image. The upper right corner corresponds to the normalized coordinate (1,1). This Space shall not be available in profiles without a VideoSourceConfiguration. The Space does not assume a certain dome model and can therefore be implemented on digital and mechanical domes.

¹The particular device should reference the proposed name space but the actual ranges are device specific. The ranges indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

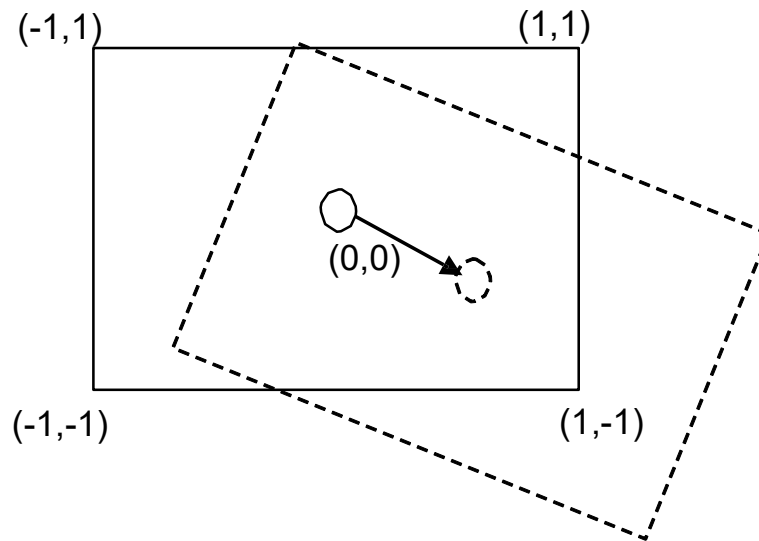


Figure A.2: Relative pan/tilt Translation Space in FOV for a mechanical dome.

The proposed minimum range for this relative direction space ranges from minus infinity to plus infinity. However, a device may provide a different range. The relative direction space is defined as follows:²

```
<tt:RelativePanTiltTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/TranslationSpaceFov
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>+INF</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>+INF</tt:Max>
  </tt:YRange>
</tt:RelativePanTiltTranslationSpace>
```

A.3.3 Digital pan/tilt Translation Space

The Digital pan/tilt Translation Space is derived from the Absolute Digital pan/tilt Position Space (see section A.2.1). Instead of an absolute position space where the reference position is fixed, the relative space specifies the reference position as the camera's current position at all times. Thereby, the pan/tilt translation is expressed as the coordinate difference from the current position to the target position. If a client wants to move the window area of the Video Source Configuration by a tenth of the sensor width horizontally, it can use this relative spherical space and set the X coordinate of the direction to 0.1 and the Y coordinate to 0. This Space shall not be available in profiles without a VideoSourceConfiguration.

The following Figure A.3 shows the space description of this Digital pan/tilt Translation coordinate system. The outer box represents the image sensor, the dotted inner box the cropped area, and the arrow demonstrates a translation request of the cropped area with a pan/tilt vector of (0.1,-0.2).

²The particular device should reference the proposed name space but the actual ranges are device specific. The ranges indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

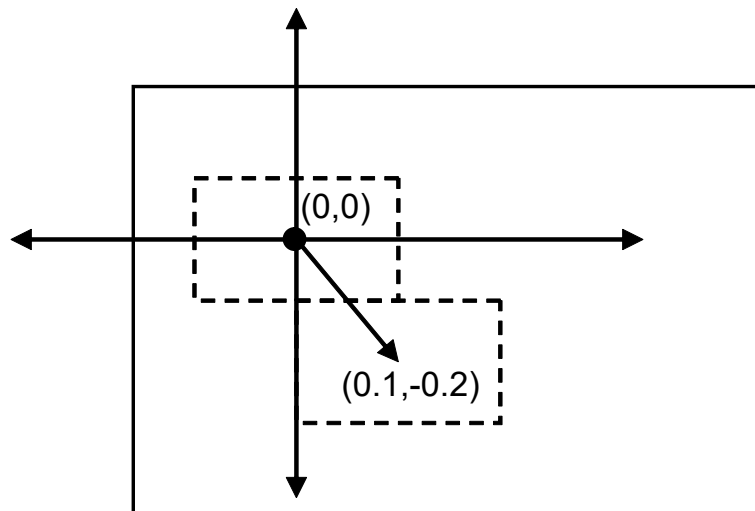


Figure A.3: Relative Digital pan/tilt Translation Space.

The maximum translation in positive direction for pan and tilt in this coordinate system would be represented by (1,1) the same way as the maximum negative translation would map to the coordinate (-1,-1). For example, a translation of a cropped area on a megapixel sensor from its lower left corner to its upper right corner corresponds to a relative movement using the translation vector (1,1) assuming that the cropped area has zero size. The Digital pan/tilt Translation Space is defined as follows:

```
<tt:RelativePanTiltTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/DigitalTranslationSpace
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-1</tt:Min>
    <tt:Max>+1</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>-1</tt:Min>
    <tt:Max>+1</tt:Max>
  </tt:YRange>
</tt:RelativePanTiltTranslationSpace>
```

A.3.4 Zoom Translation Space In Millimeter

The Zoom Translation Space In Millimeter derives from the Absolute Zoom Position Space In Millimeter specified in section 5.7.1.4 and specifies the translation of the focal length in the camera optics. If the device supports absolute zoom movements using the Absolute Zoom Position Space In Millimeter, the maximum negative and positive translation is given by the difference of the maximum and minimum position in Millimeter.

The Zoom Translation Space In Millimeter is defined as follows:³

```
<tt:RelativeZoomTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/TranslationSpaceMillimeter
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:RelativeZoomTranslationSpace>
```

³The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

A.3.5 Normalized digital zoom Translation Space

The normalized digital zoom Translation Space derives from the Absolute normalized digital zoom Position Space specified in section 5.7.1.5 specifies the translation of the mapping between the width of a window on a sensor and the width of the full sensor. A translation change in positive direction would make the window smaller in percentage of the sensor and thereby decreasing the field of view and increasing the zoom factor. This space requires a MediaProfile that includes a VideoEncoderConfiguration and a VideoSourceConfiguration.

Notice that a translation operation that uses this space will affect the width and height of the crop window that is configured in the VideoSourceConfiguration of the requested profile.

The normalized digital zoom Translation Space is defined as follows: ⁴

```
<tt:RelativeZoomTranslationSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/NormalizedDigital
    TranslationSpace
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:RelativeZoomTranslationSpace>
```

A.4 Continuous Velocity Spaces

A.4.1 FOV Scaled pan/tilt Velocity Space per Second

The FOV Scaled pan/tilt Velocity Space Per Second is introduced to support keyboard and joystick control, where the requested velocities are internally scaled by the current zoom factor of the dome. A pan/tilt vector in this space describes the move with respect to the current centre of the image. The length of this vector specifies the desired translation per second. This Space shall not be available in profiles without a VideoSourceConfiguration. The Space does not assume a certain dome model and can therefore be implemented on digital and mechanical domes.

The FOV scaled pan/tilt velocity space is defined as follows: ⁹

```
<tt:ContinuousPanTiltVelocitySpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/VelocitySpaceFOV
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
  <tt:YRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:YRange>
</tt:ContinuousPanTiltVelocitySpace>
```

A.4.2 Zoom Velocity Space In Millimeter Per Second

The Zoom Velocity Space In Millimeter Per Second derives from the Zoom Translation Space In Millimeter in section A.3.4 and specifies the change per second of the focal length. The Zoom Velocity Space in Millimeter Per Second space is defined as follows: ⁵

```
<tt:ContinuousZoomVelocitySpace>
  <tt:SpaceURI>
```

⁴The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

⁵The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

```

    http://www.onvif.org/ver10/tptz/ZoomSpaces/VelocitySpaceMillimeter
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:ContinuousZoomVelocitySpace>

```

A.4.3 Normalized digital zoom Velocity Space Per Second

The normalized digital zoom Velocity Space Per Second derives from the normalized digital zoom Translation Space in section A.3.5 and specifies the signed change per second of the ratio between window width and sensor width. The Normalized Digital Zoom Velocity Space Per Second is defined as follows:⁶

```

<tt:ContinuousZoomVelocitySpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/ZoomSpaces/NormalizedDigitalVelocity
    Space
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>-INF</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:ContinuousZoomVelocitySpace>

```

A.5 Speed Spaces

A.5.1 Pan/tilt Speed Space In FOV Per Second

The pan/tilt Speed Space in FOV Per Second derives from the Relative pan/tilt Translation Space in FOV. When the client requests a relative movement with a pan/tilt Speed of 0.5 FOV Per Second, the scene part which was first observed at the centre of the image will have been moved to the image border after one second. This Space shall not be available in profiles without a VideoSourceConfiguration. The Space does not assume a certain dome model and can therefore be implemented on digital and mechanical domes.

The ONVIF pan/tilt speed space in FOV per second is defined as follows:⁷

```

<tt:PanTiltSpeedSpace>
  <tt:SpaceURI>
    http://www.onvif.org/ver10/tptz/PanTiltSpaces/SpeedSpaceFOV
  </tt:SpaceURI>
  <tt:XRange>
    <tt:Min>0.0</tt:Min>
    <tt:Max>INF</tt:Max>
  </tt:XRange>
</tt:PanTiltSpeedSpace>

```

A.5.2 Normalized digital zoom Speed Space Per Second

The Normalized Digital Zoom Speed Space Per Second derives from the Normalized Digital Zoom Translation Space in section A.3.5 and specifies the absolute change per second of the ratio between window width and sensor width. If the device supports absolute or relative zoom movements using the normalized digital zoom Position Space or the normalized digital zoom Position Space, the desired speed can be set using the normalized digital zoom Speed Space Per Second. The normalized digital zoom Speed Space Per Second is defined as follows:⁸

```

<tt:ZoomSpeedSpace>

```

⁶The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

⁷The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

⁸The particular device should reference the proposed name space but the actual range is device specific. The range indicated in the definition shall be interpreted as the maximum and minimum range limits for the space.

```
<tt:SpaceURI>
  http://www.onvif.org/ver10/tptz/ZoomSpaces/NormalizedDigitalSpeedSpace
</tt:SpaceURI>
<tt:XRange>
  <tt:Min>0</tt:Min>
  <tt:Max>INF</tt:Max>
</tt:XRange>
</tt:ZoomSpeedSpace>
```

Annex B. GeoMove Positioning Space (Informative)

B.1 Introduction

This section aims to provide a standard procedure to check if a given GeoLocated Point (Lat_2, Lon_2, H_2) can be seen by a GeoLocated PTZ Device (Lat_1, Lon_1, H_1) .

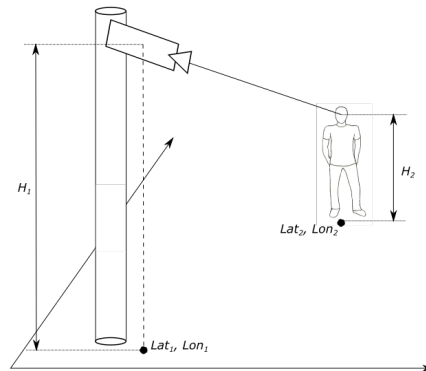


Figure B.1: Geo-located device pointing a geo-located target.

B.2 Preconditions

The procedure described by this annex, can be applied only if the device, that we are going to use for our Geo pointing purposes, satisfies the two assumptions described in the following subsection.

B.2.1 Absolute Pan Tilt Position Space

In order to check if a GeoLocated point can be seen by the device, the device shall export its ranges for PAN and TILT angles using the Spherical pan/tilt Position Space in Degrees as follows:

```
<tpz:GetNodeResponse>
  <tpz:PTZNode>
    <tpz:SupportedPTZSpaces>
      <tt:AbsolutePanTiltPositionSpace>
        <tt:URI>...</tt:URI>
        <tt:XRange>
          <tt:Min>-70</tt:Min>
          <tt:Max>90</tt:Max>
        </tt:XRange>
        <tt:YRange>
          <tt:Min>-15</tt:Min>
          <tt:Max>10</tt:Max>
        </tt:YRange>
      </tt:AbsolutePanTiltPositionSpace>      ...
    </tpz:SupportedPTZSpaces>
  </tpz:PTZNode>
</tpz:GetNodeResponse>
```

In the example the device limits are:

- $max_{pan} = 90^\circ$
- $min_{pan} = -70^\circ$

- $max_{tilt} = 10^\circ$
- $min_{tilt} = -15^\circ$

B.2.2 GeoOrientation

In order to check if a GeoLocated point can be seen by the device, the Yaw coordinate of the device GeoOrientation γ_{angle} shall indicate the angular offset between the Geographical North N and the 0° Pan position P_0 .

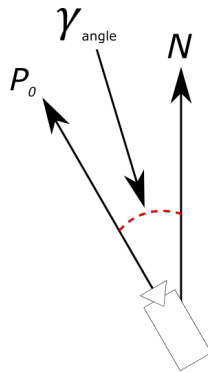


Figure B.2: Yaw angle convention for a geo-located PTZ device

B.3 Procedure

Let's consider a geo-located PTZ unit installed on a pole and a target that would like to point with the PTZ unit.

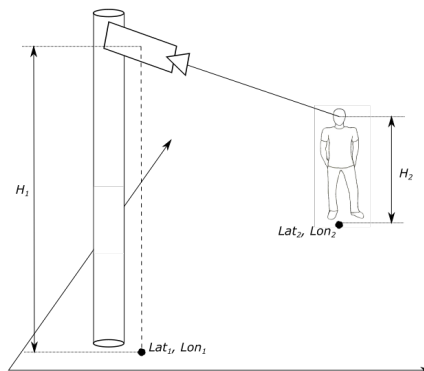


Figure B.3: Geo located coordinates of PTZ device and target .

The PTZ unit will be referenced with the geo coordinates :

- Lat_1 : the latitude value returned by the device in the GetGeoLocationResponse.
- Lon_1 : the longitude value returned by the device in the GetGeoLocationResponse.
- H_1 : the elevation value returned by the device in the GetGeoLocationResponse.

The target will be referenced with the geo coordinates :

- Lat_2 : the latitude of the target
- Lon_2 : the longitude of the target
- H_2 : the elevation of the target

Before proceeding with the calculations we need to project the two geo-located points (Lat_1, Lon_1) and (Lat_2, Lon_2) on a Cartesian plane¹. In this way we could easily apply the trigonometric functions needed to check if the angles that device should cover to point the target are within the PAN and TILT ranges of the PTZ node.

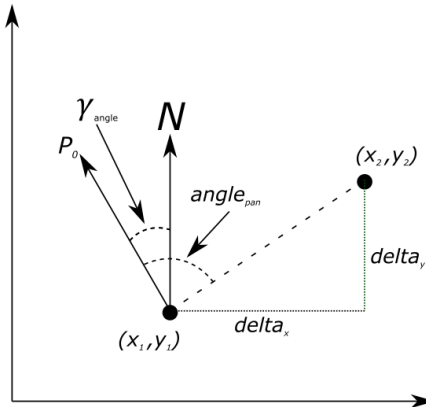


Figure B.4: anglepan representation.

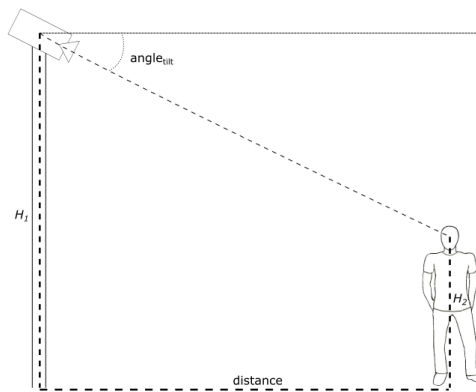


Figure B.5: angletilt representation.

Once we have converted the geo-located points (Lat_1, Lon_1) and (Lat_2, Lon_2) into Cartesian points (x_1, y_1) and (x_2, y_2) we can calculate PAN and TILT angles at which the device should move to point the target.

To calculate the PAN angle, the following formula can be used :

$$angle_{pan} = atan2\left(\frac{x_2 - x_1}{y_2 - y_1}\right) + \gamma_{angle}$$

To calculate the TILT angle, the following formula can be used :

$$angle_{tilt} = atan2\left(\frac{H_2 - H_1}{\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}}\right)$$

Once we have both anglepan and angletilt we can compare them with PAN and TILT angles ranges to check if they can be reached by the device.

$$min_{pan} \leq angle_{pan} \leq max_{pan}$$

¹This can be achieved by converting WGS84 coordinates to [Universal Transverse Mercator Coordinate System](https://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system) [https://en.wikipedia.org/wiki/Universal_Transverse_Mercator_coordinate_system].

$$\min_{\text{ilt}} \leq \text{angle}_{\text{ilt}} \leq \max_{\text{ilt}}$$

If both inequality are satisfied by the calcuted angles we can conclude that the target can be pointed by the device otherwise we can conclude that the target is out of the field of view of the device.

Annex C. Revision History

Rev.	Date	Editor	Changes
2.1	Jul-2011	Hans Busch	Split from Core 2.0 without change of content.
2.1.1	Jan-2012	Hans Busch	Change Requests 262, 434, 535, 554
2.2	May-2012	Takahiro Iwasaki	Addition of Preset Tour and PT Control Direction features Change Request 648
2.2.1	Sep-2012	Hans Busch	Change Request 708, 825
2.4	Mar-2013	Daniel Fiala	Change Request 871
2.4.1	Dec-2013	Michio Hirai	Change Request 1207, 1215
2.4.2	Jun-2014	Michio Hirai	Change Request 1360, 1361, 1362
2.5	Dec-2014	Ottavio Campana, Michio Hirai	Addition of Ramp feature Change Request 1322
2.6	Jun-2015	Michio Hirai	Change Request 1660, 1668
2.6.1	Dec-2015	Hiroyuki Sano	Change Request 1700
16.12	Dec-2016	Andrew Downs	Incorporate PTZ spaces
17.06	Jun-2017	Hans Busch, Hiroyuki Sano, Enrico Campana	Update method layouts. Change Request 2044 Change Request 1843, 2001, 2030, 2031, 2035, 2043 Add GeoMove
17.12	Dec-2017	Enrico Campana	Add Annex B - GeoMove Positioning Space
18.12	Dec-2018	Hiroyuki Sano	Change Request 2362, 2379, 2380, 2381
20.12	Dec-2020	Davide Cristanelli	Add MoveAndStartTracking
23.06	Jun-2023	Michael Adam	Add clarification to PTZ spec regarding dynamic space ranges.