ONVIF™
Thermal Service Specification

Version 16.06
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ONVIF Core Specification
<http://www.onvif.org/onvif/specs/core/ONVIF-Core-Specification-v220.pdf>

3 Terms and Definitions

3.1 Definitions

Thermal Imaging — Thermal imaging devices are capable of producing a VideoSource based on thermal differences between objects in the scene.

Color Palette — Thermal images can be mapped to the visible spectrum for display using different Look Up Tables, also called Color Palettes. These look up tables are used to map each pixel in the original grayscale, temperature based image from a Thermal Imager, using different color maps (e.g. Iron, Sepia, Rainbow).

NUC Table — A NUC, or Non-Uniformity Correction Table is a table of values used by Thermal Imagers to produce a uniform image, calibrating imperfections of the thermal detector (different responses to temperature from each pixel in the sensor array) and lens optical path. Thermal cameras can offer the possibility to use different NUC Tables for each ambient temperature range, optimizing sensitivity and range.

Polarity — The grayscale image coming from a Thermal Imaging Device can be interpreted from mapping its histogram in one direction or the other, resulting in “Black Hot” or “White Hot” polarity images. When using Black Hot polarity black pixels represent hot objects, while as white pixels represent cold objects.

Cooler — In order to increase their sensitivity (and range), the detector of some Thermal Imaging Devices is refrigerated. This is done by a component of the device called cryo cooler, or cooler, which is a mechanicl pump requiring maintenance. In order to facilitate predictive maintenance, based on the MTBF of the thermal manufacturer, the hours of operation of the camera/cooler are usually monitored, and the cooler can be disabled in some cameras when the thermal device is not in use.

Radiometry — Some thermal devices are calibrated in the factory and sold as radiometric cameras. These can provide absolute temperature readings for objects in the scene. Measurement items such as Spots and Boxes are used to define measurement areas.

4 Overview

The thermal (imaging) service provides configuration and control data for specific properties of thermal imaging devices. WSDL is part of the framework and provided in the Thermal WSDL file.

The service includes the following operations:

- Get and set imaging parameters (e.g. Polarity).
- Get thermal imaging configuration options (valid ranges for imaging parameters).
- Get Cooler status and runtime information from cooled thermal devices.

Common Imaging Settings of Thermal and Visible Video Sources, such as Brightness or Contrast, or Lens Focus operations, remain in the Imaging Service.

WSDL for this service is specified in http://www.onvif.org/ver10/thermal/wsdl/thermal.wsdl.

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
tth	http://www.onvif.org/ver10/thermal/wsdl
tns1	http://www.onvif.org/ver10/topics

5 Service

The thermal service provides operations used to control and configure imaging properties on a thermal imaging device. A device that has one or more video sources should support the imaging service as defined in [ONVIF Imaging WSDL]. In the same way the imaging settings are part of the VideoSource entity, the thermal imaging settings represent an extension of these, to cover thermal specific settings which are exclusive of thermal video sources. Imaging parameters affect any video source (visible or thermal), while as thermal imaging parameters affect thermal video sources specifically. Common parameters to both visible and thermal video sources remain as shared settings under the imaging service.

5.1 Thermal Configuration

The thermal service provides operations to get or set thermal imaging parameters and the valid ranges for those parameters. Most parameters are common to all thermal video sources, with the exception of the Cooler Options, which are specific of thermal imaging devices which contain this kind of component. The following settings are available through the thermal imaging service operations:

Color Palette: Indicates the color map currently used to represent temperatures in each pixel.

Polarity: Adjusts the image polarity to represent hot or cold objects in the high or low end of the histogram:

- White Hot:Represents hot objects on the high end of the histogram
- Black Hot: Represents cold objects on the high end of the histogram

NUC Table: Indicates the Non Uniformity Correction Table currently loaded among the ones available in the thermal device. NUC Tables are used to compensate for non-uniformity artifacts that will show on the image as a result of the difference in the response of the sensor elements to ambient temperature. A thermal imaging device will normally be calibrated at the factory and loaded with two or three different NUC Tables to be used in different temperature ranges. This parameter indicates which of these NUC Tables is in use by the device.

Cooler: For better sensitivity (range) performance, some thermal devices include a cooler. This mechanical component cools down the thermal detector, in order to improve its sensitivity to temperature differences, with a positive impact in range. Coolers are a mechanical component with a limited MTBF (usually 8.000-10.000 hours). Therefore most

cooled thermal imaging devices offer settings to disable the cooler while the imager is not in use, and an indication of the runtime so that predictive maintenance can be scheduled.

Other settings of a thermal VideoSource which are common with visible VideoSources, such as Contrast, Brightness, Focus, Image Stabilization, etc, can be managed using the Imaging Service. The Thermal Service just complements these with thermal specific parameters, which are only applicable to thermal VideoSources.

The available imaging settings can be retrieved through the GetVideoSources command, part of the media service, as specified in the ONVIF Media Service Specification. The thermal imaging settings apply to those video sources that use thermal technology.

5.1.1 Get Configuration

This operation requests the thermal imaging settings for a thermal video source on the device. A device implementing the thermal service shall support this command.

If the thermal Video Source supports any of the settings as defined by the Configuration type in the [ONVIF Thermal WSDL], then it shall be possible to retrieve the imaging settings from the device through the GetConfiguration command.

The thermal configuration parameters are described in Section 5.1.

Table 2: GetConfiguration command

GetConfiguration	Access Class: READ_MEDIA
Message name	**Description**
GetConfigurationRequest	*This message contains a reference to the VideoSource for which the Configuration shall be requested.* tt:ReferenceToken **VideoSourceToken**[1][1]
GetConfigurationResponse	*This message contains the Configuration for the VideoSource that was requested* tth:Configuration **Configuration** [1][1]
Fault codes	**Description**
env:Sender ter:InvalidArgVal ter:NoSource	*The requested VideoSource does not exist.*
env:Receiver ter:ActionNotSupported ter:NoThermalForSource	*The requested VideoSource does not support thermal config settings.*

5.1.2 Set Configuration

This operation sets the thermal configuration for a thermal video source on a device. A device implementing the thermal service shall support this command.

If the device supports any of the thermal configuration as defined by the Configuration type in [ONVIF Thermal WSDL], then it shall be possible to configure these parameters in the device through the SetConfiguration command.

The possible configurable thermal configuration parameters are described in Section 5.1. Configuration options are obtained through the command defined in Section 5.1.3

Table 3: SetConfiguration command

SetConfigurationSettings	Access Class: ACTUATE
Message name	**Description**
SetConfigurationRequest	*This message shall contain a reference to the VideoSource and to the Configuration that shall be set.* *The **ForcePersistence** element determines if the configuration changes shall be stored and remain after reboot. If true, changes shall be persistent. If false, changes MAY revert to previous values after reboot.* tt:ReferenceToken **VideoSourceToken**[1][1] tth:Configuration **Configuration** [1][1] xs:boolean **ForcePersistence** [0][1]
SetConfigurationResponse	*This message contains no response.*
Fault codes	**Description**
env:Sender ter:InvalidArgVal ter:NoSource	*The requested VideoSource does not exist.*
env:Receiver ter:ActionNotSupported ter:NoThermalForSource	*The requested VideoSource does not support thermal configuration.*
env:Sender ter:InvalidArgVal ter:InvalidConfiguration	*The requested configuration is incorrect.*

5.1.3 Get Configuration Options

This operation gets the valid ranges for the thermal configurtion parameters that have device specific ranges. A device implementing the thermal service shall support this command. The command shall return all supported parameters and their ranges such that these can be applied to the SetConfigurationSettings command.

Table 4:GetConfigurationOptions command

GetConfigurationOptions	Access Class: READ_MEDIA
Message name	**Description**
GetConfigurationOptionsRequest	*Reference to the VideoSource for which the thermal configuration parameter options are requested.* tt:ReferenceToken **VideoSourceToken**[1][1]
GetConfigurationOptionsResponse	*This message shall contain the valid ranges for the thermal configuration parameters that are categorized as device specific.* tth:ConfigurationOptions **ConfigurationOptions**[1][1]
Fault codes	**Description**
env:Sender ter:InvalidArgVal ter:NoSource	*The requested VideoSource does not exist.*
env:Receiver ter:ActionNotSupported ter:NoThermalForSource	*The requested VideoSource does not support thermal settings.*

5.1.4 Capabilities

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

Radiometry: Indicates support for radiometric thermal measurements and alarms.

Table 5: GetServiceCapabilities command

GetServiceCapabilities	Access Class: PRE_AUTH
Message name	**Description**
GetServiceCapabilitiesRequest	*This is an empty message.*
GetServiceCapabilitiesResponse	*The capability response message contains the requested service capabilities using a hierarchical XML capability structure.* tth: Capabilities **Capabilities** [1][1]
Fault codes	**Description**
	No command specific faults!

5.2 Service specific data types

5.2.1 ThermalPolarity

```
<xs:simpleType name="ThermalPolarity">
   <xs:restriction base="xs:string">
     <xs:enumeration value="WhiteHot"/>
     <xs:enumeration value="BlackHot"/>
   </xs:restriction>
</xs:simpleType>
```

5.2.2 ColorPaletteType

```
<xs:simpleType name="ColorPaletteType">
     <xs:annotation>
            <xs:documentation>Describes standard Color Palette types, used
            to facilitate multi-language support and client display.
            "Custom" Type shall be used when Color Palette Name does not
            match any of the types included in the standard classification.
            </xs:documentation>
     </xs:annotation>
     <xs:restriction base="xs:string">
            <xs:enumeration value="Custom"/>
            <xs:enumeration value="Grayscale"/>
            <xs:enumeration value="BlackHot"/>
            <xs:enumeration value="WhiteHot"/>
            <xs:enumeration value="Sepia"/>
            <xs:enumeration value="Red"/>
            <xs:enumeration value="Iron"/>
            <xs:enumeration value="Rain"/>
            <xs:enumeration value="Rainbow"/>
            <xs:enumeration value="Isotherm"/>
     </xs:restriction>
```

```
</xs:simpleType>
```

- "Custom" Type shall be used when Color Palette Name does not match any of the types included in the standard classification.

5.2.3 ColorPalette

```
<xs:complexType name="ColorPalette">
    <xs:annotation>
          <xs:documentation>Describes a Color Palette
          element.</xs:documentation>
    </xs:annotation>
    <xs:sequence>
          <xs:element name="Name" type="tt:Name">
                <xs:annotation>
                      <xs:documentation>
                            User readable Color Palette name.
                      </xs:documentation>
                </xs:annotation>
          </xs:element>
    </xs:sequence>
    <xs:attribute name="token" type="tt:ReferenceToken" use="required">
          <xs:annotation>
                <xs:documentation>Unique identifier of this Color
          Palette.</xs:documentation>
          </xs:annotation>
    </xs:attribute>
    <xs:attribute name="Type" type="xs:String" use="required">
          <xs:annotation>
                <xs:documentation>Indicates Color Palette Type. Use
          tth:ColorPaletteType.
                Used for multi-language support and
          display.</xs:documentation>
          </xs:annotation>
    </xs:attribute>
    <xs:anyAttribute processContents="lax"/>
</xs:complexType>
```

- **Name**
  Name of the color palette

- **token**
  Reference Token for the Color Palette in the list of LUTs supported by the Video Source.

- **Type**
  Indicates Color Palette Type. Uses “tth:ColorPaletteType”. Used for Multi-language support and display.

5.2.4 NUCTable

```
<xs:complexType name="NUCTable">
    <xs:annotation>
          <xs:documentation> Type describing a NUC Table
          element.</xs:documentation>
    </xs:annotation>
    <xs:sequence>
          <xs:element name="Name" type="tt:Name">
                <xs:annotation>
                      <xs:documentation>
                            User reabable name for the Non-Uniformity
          Correction (NUC) Table.
                      </xs:documentation>
                </xs:annotation>
          </xs:element>
```

```
    </xs:sequence>
    <xs:attribute name="token" type="tt:ReferenceToken" use="required">
          <xs:annotation>
                <xs:documentation>Unique identifier of this NUC
          Table.</xs:documentation>
          </xs:annotation>
    </xs:attribute>
    <xs:attribute name="LowTemperature" type="xs:float">
          <xs:annotation>
                <xs:documentation>Low Temperature limit for application
          of NUC Table, in Kelvin.</xs:documentation>
          </xs:annotation>
    </xs:attribute>
    <xs:attribute name="HighTemperature" type="xs:float">
          <xs:annotation>
                <xs:documentation>High Temperature limit for application
          of NUC Table, in Kelvin.</xs:documentation>
          </xs:annotation>
    </xs:attribute>
    <xs:anyAttribute processContents="lax"/>
</xs:complexType>
```

- **Name**
  Name of the NUC Table.

- **token**
  Reference Token for the NUC Table in the list of NUCs supported by the video source.

- **LowTemperature**
  Low Temperature limit for application of NUC Table, in Kelvin.

- **HighTemperature**
  High Temperature limit for application of NUC Table, in Kelvin.

5.2.5 Cooler

```
<xs:complexType name="Cooler">
    <xs:annotation>
          <xs:documentation>Type describing the Cooler
          settings.</xs:documentation>
    </xs:annotation>
    <xs:sequence>
          <xs:element name="Enabled" type="xs:boolean">
                <xs:annotation>
                      <xs:documentation>
                            Indicates whether the Cooler is enabled
          (running) or not.
                      </xs:documentation>
                </xs:annotation>
          </xs:element>
          <xs:element name="RunTime" type="xs:float" minOccurs="0">
                <xs:annotation>
                      <xs:documentation>
                            Number of hours the Cooler has been running
          (unit: hours). Read-only.
                      </xs:documentation>
                </xs:annotation>
          </xs:element>
    </xs:sequence>
</xs:complexType>
```

- **Enabled**
  Operational status of the cooler (running or stopped).

- **RunTime**
  Number of hours the cooler has been running. This parameter is Read-Only.

5.2.6 CoolerOptions

```
<xs:complexType name="CoolerOptions">
    <xs:annotation>
           <xs:documentation>Describes valid ranges for the thermal device
           cooler settings.
           Only applicable to cooled thermal devices. </xs:documentation>
    </xs:annotation>
    <xs:sequence>
           <xs:element name="Enabled" type="xs:boolean" minOccurs="0">
                 <xs:annotation>
                       <xs:documentation>
                             Indicates the Device allows cooler status to
           be changed from running (Enabled) to stopped (Disabled), and
           viceversa.
                       </xs:documentation>
                 </xs:annotation>
           </xs:element>
    </xs:sequence>
</xs:complexType>
```

- **Enabled**
  Indicates the Device allows cooler status to be changed from running (Enabled) to stopped (Disabled), and viceversa.

5.2.7 Configuration

```
<xs:complexType name="Configuration">
  <xs:sequence>
    <xs:element name="ColorPalette" type="tth:ColorPalette">
           <xs:annotation>
           <xs:documentation>
                 Current Color Palette in use by the Thermal Device.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:element name="Polarity" type="tth:ThermalPolarity">
           <xs:annotation>
           <xs:documentation>
                 Polarity configuration of the Thermal Device.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:element name="NUCTable" type="tth:NUCTable" minOccurs="0">
           <xs:annotation>
           <xs:documentation>
                 Current Non-Uniformity Correction (NUC) Table in use by
           the Thermal Device.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:element name="Cooler" type="tth:Cooler" minOccurs="0">
           <xs:annotation>
           <xs:documentation>
                 Cooler settings of the Thermal Device.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:any namespace="##any" processContents="lax" minOccurs="0"
           maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>
```

- **ColorPalette**
  Color palette, reference token and name.

- **Polarity**
  Polarity mode.

- **NUCTable**
  Selected NUC Table, reference token and name.

- **Cooler**
  Cooler running status and runtime.

5.2.8 ConfigurationOptions

```
<xs:complexType name="ConfigurationOptions">
  <xs:sequence>
    <xs:element name="ColorPalette" type="tth:ColorPalette"
           maxOccurs="unbounded">
           <xs:annotation>
           <xs:documentation>
                 List of Color Palettes available for the requested
           Thermal VideoSource.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:element name="NUCTable" type="tth:NUCTable" minOccurs="0"
           maxOccurs="unbounded">
           <xs:annotation>
           <xs:documentation>
                 List of Non-Uniformity Correction (NUC) Tables available
           for the requested Thermal VideoSource.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:element name="CoolerOptions" type="tth:CoolerOptions"
           minOccurs="0">
           <xs:annotation>
           <xs:documentation>
                 Specifies Cooler Options for cooled thermal devices.
           </xs:documentation>
           </xs:annotation>
    </xs:element>
    <xs:any namespace="##any" processContents="lax" minOccurs="0"
           maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>
```

- **ColorPalette**
  List of possible color palettes supported by the device. Standard Color Palette types are provided to facilitate Multi-language support and client display. "Custom" Type shall be used when Color Palette Name does not match any of the types included in the standard classification.

- **NUCTable**
  List of Non-uniformity Correction tables supported by the device.

- **CoolerOptions**
  Cooler options available for the cooled thermal device.

5.3 Events

The Message structure of these events is given by the following Message Description:

```
<tt:MessageDescription IsProperty="true">
  <tt:Source>
    <tt:SimpleItemDescription Name="Source" Type="tt:ReferenceToken"/>
  </tt:Source>
  <tt:Data>
    <tt:SimpleItemDescription Name="State" Type="xs:boolean"/>
  </tt:Data>
</tt:MessageDescription>
```

The SourceToken points to the source the image is coming from. This is in case of the Analytics or Image Service a VideoSource token and in case of the Recording Service the Recording job token.

5.3.1 Radiometry Alarms

When a thermal video source has radiometry capabilities it can measure temperature. If Rules can be created to trigger temperature measurement alarms (e.g by an Analytics Service), it can inform a client using this event. This event is a basic temperature measurement alarm condition event that shall be supported by any thermal imaging devices that support radiometry. If a device is capable of processing more complex temperature analysis algorithms it can provide additional vendor specific temperature measurement events (e.g. temperature trending, ambient temperature comparisons, etc.). If the device supports radiometry it shall provide at least the following event:

`tns1:VideoSource/RadiometryAlarm`

5.4 Service specific fault codes

Table 6 lists the thermal service specific fault codes. In addition each command can also generate a generic fault.

The specific faults are defined as subcode of a generic fault. The parent generic subcode is the *subcode* at the top of each row below and the specific fault *subcode* is at the bottom of the cell.

Table 6: Imaging specific fault codes

Fault Code	Parent Subcode Subcode	Fault Reason	Description
env:Receiver	ter:ActionNotSupported Ter:NotAThermalVideoSource	VideoSource does not support thermal settings	The requested VideoSource does not support thermal settings.
env:Sender	ter:InvalidArgVal Ter: InvalidConfiguration	Invalid configuration	The requested settings are incorrect.
env:Sender	ter:InvalidArgVal Ter:NoSource	Video source does not exist	The requested VideoSource does not exist.

Annex A. Revision History

Rev.	Date	Editor	Changes
16.06	Jun-2016	Arsenio Vilallonga	Initial version.