



exactAIS Geospatial Web Services™ Specification Document

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Overview

exactAIS Geospatial Web Services™ (GWS) provide certified Open Geospatial Consortium (OGC) compliant Web Map Services (WMS) and Web Feature Services (WFS) which allow on-demand access to exactAIS® data (Data-as-a-Service, DaaS) to retrieve vessel position, static, voyage, and historical track and position information. The WMS services generated from exactEarth allow users to get requested images of exactAIS® data in a variety of formats including PNG, JPEG, KML, etc. The WFS services generated from exactEarth allow users to get features (data) in a variety of standard formats including CSV, GML, GeoJSON, and Shapefile.

Accessing Web Services

GWS is available from the exactEarth Data Processing Centre (DPC). GWS uses HTTPS and user authentication via user token or user name and password to access information and is available at, <https://gws.exactearth.com>.

Service Type	URL
WMS	https://gws.exactearth.com/wms?service=wms&version=1.3.0&request=GetCapabilities
WFS	https://gws.exactearth.com/wfs?service=wfs&version=1.1.0&request=GetCapabilities

Certified OGC Compliant Support

GWS supports all OGC WMS operations from implementation WMS 1.1.1 and WMS 1.3.0 and all OGC WFS operations from implementations WFS 1.0.0 and WFS 1.1.0, excluding Transaction. GWS is OGC-compliant WMS 1.3.0 and WFS 1.1.0.

Service Type	Service Modes	Versions	Common Parameters	Output Formats	Output File Sizes	Response Times
WMS	GetMap, GetCapabilities, GetFeatureInfo, and GetLegendGraphic	1.1.1 and 1.3.0	SERVICE, VERSION, REQUEST, LAYERS, STYLES, BBOX, WIDTH, HEIGHT, SRS, FORMAT, and FILTER	PNG, JPEG, GIF, and KML/KMZ	Dynamic <1MB	< 3s.
WFS	GetCapabilities, GetFeature, and DescribeFeatureType	1.0.0 and 1.1.0	SERVICE, VERSION, REQUEST, TYPENAME, MAXFEATURES, OUTPUTFORMAT, and FILTER	CSV, GML (2, 3.1, 3.2), GeoJSON, and Shapefile	Approx. 1 KB / Record	< 1.5s. / 50 Records

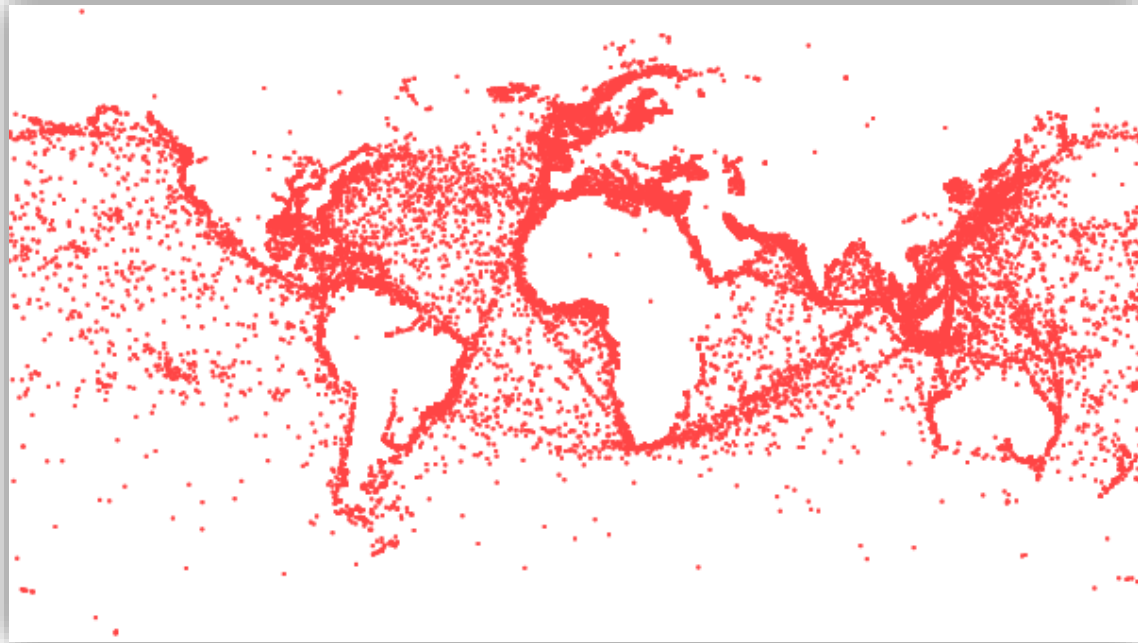
User Authentication Support

GWS allows users to authenticate access to the services using either a token or basic authentication. exactEarth provides both a unique token and user name and password for each user. The [authKey] query string parameter of a WMS/WFS request provides the interface to enter a token to access the services using the following notation, “authKey=[TOKEN]”. For basic authentication, users are required to enter user name and password credentials to access the services, for example, a web browser, OGC-compliant client, or application-level requestor.

Web Map Service (WMS) Example

GWS allows users to request images of geospatial data in a variety of formats. A sample WMS request for the latest vessel information data set as an image (PNG) is included below.

<https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI&styles=&bbox=-180.0,-90.0,180.0,90.0&width=640&height=480&crs=CRS:84&format=image/png>



Web Feature Service (WFS) Example

GWS allows users to request data sets of geospatial data. A sample WFS GML request for the latest vessel information data set is included below.

<https://gws.exactearth.com/wfs?service=WFS&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI&maxFeatures=50&outputFormat=text/xml;subtype=gml/3.2>

```
<wfs:member>
  <exactAIS:LVI gml:id="LVI.fid-754b764c_150ec96f768_57d9">
    <gml:boundedBy>
      <gml:Envelope srsDimension="2" srsName="urn:ogc:def:crs:EPSG::4326">
        <gml:lowerCorner>19.12328333333333 37.35279666666667</gml:lowerCorner>
        <gml:upperCorner>19.12328333333333 37.35279666666667</gml:upperCorner>
      </gml:Envelope>
    </gml:boundedBy>
    <exactAIS:mmsi>214181810</exactAIS:mmsi>
    <exactAIS:imo>6728159</exactAIS:imo>
    <exactAIS:vessel_name>ALBARAKA 7</exactAIS:vessel_name>
    <exactAIS:callsign>ERRJ</exactAIS:callsign>
    <exactAIS:vessel_type>Cargo</exactAIS:vessel_type>
    <exactAIS:vessel_type_code>70</exactAIS:vessel_type_code>
    <exactAIS:vessel_type_cargo/>
    <exactAIS:vessel_class>A</exactAIS:vessel_class>
    <exactAIS:length>78</exactAIS:length>
    <exactAIS:width>11</exactAIS:width>
    <exactAIS:flag_country>Moldova</exactAIS:flag_country>
    <exactAIS:flag_code>214</exactAIS:flag_code>
    <exactAIS:destination>JEDDAH</exactAIS:destination>
    <exactAIS:eta>11032330</exactAIS:eta>
    <exactAIS:draught>4.0</exactAIS:draught>
    <exactAIS:position>
      <gml:Point srsDimension="2" srsName="urn:ogc:def:crs:EPSG::4326">
        <gml:pos>19.12328333333333 37.35279666666667</gml:pos>
      </gml:Point>
    </exactAIS:position>
    <exactAIS:longitude>37.35279666666667</exactAIS:longitude>
    <exactAIS:latitude>19.12328333333333</exactAIS:latitude>
    <exactAIS:sog>0.0</exactAIS:sog>
    <exactAIS:cog>209.9</exactAIS:cog>
    <exactAIS:rot>0.0</exactAIS:rot>
    <exactAIS:heading>0.0</exactAIS:heading>
    <exactAIS:nav_status>Under Way Using Engine</exactAIS:nav_status>
    <exactAIS:nav_status_code>0</exactAIS:nav_status_code>
    <exactAIS:source>S-AIS</exactAIS:source>
    <exactAIS:ts_pos_utc>20151109121554</exactAIS:ts_pos_utc>
    <exactAIS:ts_static_utc>20151106113853</exactAIS:ts_static_utc>
    <exactAIS:ts_insert_utc>20151109124935</exactAIS:ts_insert_utc>
    <exactAIS:dt_pos_utc>2015-11-09 12:15:54</exactAIS:dt_pos_utc>
    <exactAIS:dt_static_utc>2015-11-06 11:38:53</exactAIS:dt_static_utc>
    <exactAIS:dt_insert_utc>2015-11-09 12:49:35</exactAIS:dt_insert_utc>
    <exactAIS:vessel_type_main>Specialized Cargo Ship</exactAIS:vessel_type_main>
    <exactAIS:vessel_type_sub>Livestock Carrier</exactAIS:vessel_type_sub>
  </exactAIS:LVI>
</wfs:member>
```

Web Feature Service (WFS) Data Schema Example

GWS allows users to request the schema of the geospatial data services. A sample WFS request, *DescribeFeatureType*, for the latest vessel information data set is included below.

<https://gws.exactearth.com/ows?request=DescribeFeatureType&service=wfs&version=1.1.0&typeName=exactAIS:LVI>

```
<xsd:extension base="gml:AbstractFeatureType">
  <xsd:sequence>
    <xsd:element maxOccurs="1" minOccurs="0" name="mmsi" nillable="true" type="xsd:long"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="imo" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_name" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="callsign" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_type" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_type_code" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_type_cargo" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_class" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="length" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="width" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="flag_country" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="flag_code" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="destination" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="eta" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="draught" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="position" nillable="true" type="gml:PointPropertyType"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="longitude" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="latitude" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="sog" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="cog" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="rot" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="heading" nillable="true" type="xsd:double"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="nav_status" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="nav_status_code" nillable="true" type="xsd:int"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="source" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="ts_pos_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="ts_static_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="ts_insert_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="dt_pos_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="dt_static_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="dt_insert_utc" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_type_main" nillable="true" type="xsd:string"/>
    <xsd:element maxOccurs="1" minOccurs="0" name="vessel_type_sub" nillable="true" type="xsd:string"/>
  </xsd:sequence>
</xsd:extension>
```

Web Services Filtering

GWS supports OGC Filtering to allow for dynamic/ad-hoc customization of data responses based on geography, time, and AIS message attributes. The below table provides a set of examples using OGC XML-based Filtering.

Filter Example	Filter Example Syntax
Equal To (MMSI: AIS Message Attribute)	&FILTER=<Filter><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>MMSI#</Literal></PropertyIsEqualTo></Filter>
Between (SOG: AIS Message Attribute)	&FILTER=<Filter><PropertyIsBetween><PropertyName>sog</PropertyName><LowerBoundary><Literal>10</Literal></LowerBoundary><UpperBoundary><Literal>20</Literal></UpperBoundary></PropertyIsBetween></Filter>
Geography	&FILTER= <Filter xmlns:gml="http://www.opengis.net/gml"><Within><PropertyName>position</PropertyName><gml:Polygon><gml:exterior><gml:LinearRing><gml:posList>-55.1 45 55.1 -5.4 60.0 -5.4 60.0 -8.0 -55.1 45</gml:posList></gml:LinearRing></gml:exterior></gml:Polygon></Within></Filter>
Latest Insert Update (Fetch Delta Updates)	&FILTER=<Filter><PropertyIsGreaterThanOrEqualTo><PropertyName>ts_insert_utc</PropertyName><Literal>20130724134900</Literal></PropertyIsGreaterThanOrEqualTo></Filter>
Latest Position Update (Fetch Position Updates)	&FILTER=<Filter><PropertyIsGreaterThanOrEqualTo><PropertyName>ts_pos_utc</PropertyName><Function name="eeMaxAgoUTC"><Literal>1</Literal></Function></PropertyIsGreaterThanOrEqualTo></Filter>
Function [eeMaxAgoUTC] Returns Formatted Timestamp in UTC based on Hours [Number] in the Past	

Web Services Filtering Examples

The below WMS 1.3.0 request provides a PNG image for a specific MMSI from the latest vessel information data set.

```
https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI&styles=&bbox=-180.0,-90.0,180.0,90.0&width=640&height=480&crs=crs:84&format=image/png&filter=<Filter><PropertyIsEqualTo><PropertyName>mmsi</PropertyName></PropertyIsEqualTo></Filter>
```

The below WMS 1.3.0 request provides a PNG image for all vessels with Speed over Ground (SOG) reported between 10 and 20 knots within a specific area of interest using the BBOX parameter from the latest vessel information data set.

```
https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI&styles=&bbox=-83,-23,32,34&width=660&height=330&crs=crs:84&format=image/png&filter=<Filter><PropertyIsBetween><PropertyName>sog</PropertyName><LowerBoundary><Literal>10</Literal></LowerBoundary><UpperBoundary><Literal>20</Literal></UpperBoundary></PropertyIsBetween></Filter>
```

The below WMS 1.3.0 request provides a PNG image for all vessels with a specific area of interest from the latest vessel information data set.

```
https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI&styles=&bbox=-180.0,-90.0,180.0,90.0&width=660&height=330&crs=crs:84&format=image/png&FILTER= <Filter>
xmlns:gml="http://www.opengis.net/gml"><Within><PropertyName>position</PropertyName><gml:Polygon><gml:exterior><gml:LinearRing><gml:posList>-55 45 55 -5 60 -5 60 -8 -55 45</gml:posList></gml:LinearRing></gml:exterior></gml:Polygon></Within></Filter>
```

The below WMS 1.3.0 request provides a PNG image for a historical track for a specific vessel (MMSI: 235068025) and duration (number of days between 1 and 90) within a specific area of interest from the historical vessel tracks data set.

```
https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:HVT&styles=&bbox=-70,-45,10,90&width=660&height=330&crs=crs:84&format=image/png
&filter=<Filter><And><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068025</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>duration</PropertyName><Literal>15</Literal></PropertyIsEqualTo></And></Filter>
```

The below WFS 1.1.0 request provides an example GML 3.2 output for historical vessel tracks for a specific vessel (MMSI: 235068025) and time span (anytime in the last 90 days; start and end timestamps defined as YYYYMMDDHHmmss).

```
https://gws.exactearth.com/ows?service=WFS&version=1.1.0&request=GetFeature&typenames=exactAIS:HVT&crs=crs:84&outputformat=gml32&filter=<Filter><And><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068025</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>start</PropertyName><Literal>20150903113000</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>end</PropertyName><Literal>20151020183530</Literal></PropertyIsEqualTo></And></Filter>
```

Layer Style and Symbolization Support

GWS allows users to request styles (symbolization) to be applied to Web Map Service (WMS) GetMap (image) responses. exactEarth provides a variety of styles that can be used to customize the look and feel of rendered maps. The [styles] query string parameter of a WMS request provides the interface to enter a style to define the symbology to apply to the map output, “styles=[STYLE]”.

Legend Support

GWS allows users to generate legends based on supported styles (symbolization). The [request] query string parameter, GetLegendGraphic, of a WMS request provides the interface to generate legends. The [scale], [style], and [layer] query string parameters control the appearance of the legend. The below WMS 1.3.0 request provides a PNG image (legend) for the latest vessel information data set using the [style] and [scale] parameters to generate a legend based on the VesselByTypeSpeed style at a map scale of 1:80,000.

https://gws.exactearth.com/wms?request=GetLegendGraphic&service=WMS&format=image/png&version=1.3.0&style=VesselByTypeSpeed&layer=exactAIS:LVI&scale=80000&legend_options=fontStyle:bold;forceLabels:on;fontName:Helvetica;fontAntiAliasing:true;fontColor:0x000000;fontSize:9;background-color:0xFFFFFFFF;dpi:120;

Web Services WMS Custom Symbolization

GWS supports custom symbology to allow for dynamic/ad-hoc rendering of vessels. The [env] query string parameter of a WMS request provides the interface to change the vessel symbols using the following notation, “env=[PARAM]:[VALUE]”. [env] query string parameters are delimited by “;”, for example, “env=[PARAM1]:[VALUE1];[PARAM2]:[VALUE2]”.

Custom Color

To adjust the rendering of vessels by color, add the [color] parameters to the [env] query string parameter of a WMS request using the following notation, “env=color:hexadecimal”. The hexadecimal is an RGB color code, defined as RRGGBB. The below WMS 1.3.0 request provides a PNG image for all global vessels from the latest vessel information data set using the [env] parameter specifying all vessel be rendered as magenta (FF3366).

<https://gws.exactearth.com/wms?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI&styles=&bbox=-180.0,-90.0,180.0,90.0&width=640&height=480&crs=crs:84&format=image/png&env=color:FF3366>

Custom Point Size

To adjust the rendering of vessels location symbol size for HVT/HVP, add the [psize] parameters to the [env] query string parameter of a WMS request using the following notation, “env=psize:Value”. [env] query string parameters are delimited by “;”. The value is a numeric integer. The below WMS 1.3.0 request provides a PNG image for a vessels’ 30 day historical track using the [env] parameter specifying all line segments be rendered as green (78AB46) with location symbol sizes of 7 pixels.

<https://gws.exactearth.com/ows?service=WMS&version=1.1.0&request=GetMap&layers=exactAIS:HVT&styles=&bbox=-180.0,40.0,-160.0,60.0&width=660&height=330&srs=EPSG:4326&format=image/png&env=color:78AB46;psize:7&filter=<Filter><And><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068025</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>duration</PropertyName><Literal>30</Literal></PropertyIsEqualTo></And></Filter>>

Web Services Optional Parameters

GWS supports optional parameters and capabilities to enhance the usability of the service.

Optional Parameters	Description
Maximum Features (maxFeatures)	<p>Overview: Provides an ability to limit the number of features by request to the WFS services.</p> <p>https://gws.exactearth.com/ows?service=wfs&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI&outputFormat=gml32&maxFeatures=10</p>
Sorting (sortBy)	<p>Overview: Provides an ability to sort the values in a column in ascending or descending order by request to the WFS services. Sorting by ascending order is the default setting, using “+D” will change the response to sorting by descending order.</p> <p>https://gws.exactearth.com/ows?service=wfs&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI&maxFeatures=1&outputFormat=gml32&sortBy=ts_pos_utc+D</p>
Feature Counts (resultType)	<p>Overview: Provides an ability to retrieve the number of features by request to the WFS services.</p> <p>https://gws.exactearth.com/ows?service=wfs&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI&format=gml32&resultType=hits</p>
Multiple Layers	<p>Overview: Provides an ability to specify multiple layers per request. The [layers] and [typeName] query string parameter of a WMS and WFS request, respectively, provides the interface to add multiple layers by using a “,” as the delimiter, for example, “layers=exactAIS:LVI,exactAIS:LVI” or “typeName=exactAIS:LVI,exactAIS:HVT”.</p> <p>Note: The number of layers needs to correspond to the number of styles and filters for WMS and filters for WFS.</p> <p>https://gws.exactearth.com/ows?service=WMS&version=1.1.0&request=GetMap&layers=exactAIS:LVI,exactAIS:LVI&styles=VesselSpeedVector,VesselByType&bbox=-5.0,-5.0,5.0,5.0&width=660&height=330&srs=EPSG:4326&format=image/png</p> <p>https://gws.exactearth.com/ows?service=wfs&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI,exactAIS:LVI&maxFeatures=15</p>
Multiple Styles	<p>Overview: Provides an ability to specify multiple styles per request. The [styles] query string parameter of a WMS request provides the interface to add multiple styles by using a “,” as the delimiter, for example, “styles=VesselByType,VesselLabelOverlay”.</p> <p>Note: The number of styles needs to correspond to the number of layers and filters for WMS.</p> <p>https://gws.exactearth.com/exactAIS/wms?service=WMS&version=1.1.0&request=GetMap&layers=exactAIS:LVI,exactAIS:LVI&styles=VesselByType,VesselLabelOverlay&bbox=-5.0,-5.0,5.0,5.0&width=660&height=330&srs=EPSG:4326&format=image/png</p>



Optional Parameters	Description
Multiple Filters	<p>Overview: Provides an ability to specify multiple filters per request. The [filter] query string parameter of a WMS and WFS request, respectively, provides the interface to add multiple filters by using “()” as the delimiter, for example, “filter=([Filter 1])([Filter 2])”.</p> <p>Note: The number of filters needs to correspond to the number of layers and styles for WMS and typeName(s) for WFS.</p> <p><i>https://gws.exactearth.com/ows?service=WMS&version=1.3.0&request=GetMap&layers=exactAIS:LVI,exactAIS:HVT&styles=&bbox=-180.0,-90.0,180.0,90.0&width=660&height=330&crs=crs:84&format=image/png&filter=(<i><Filter><PropertyIsGreaterThanOrEqualTo><PropertyName>mmsi</PropertyName><Literal>316000000</Literal></PropertyIsGreaterThanOrEqualTo></Filter>)(<i><Filter><And><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068025</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>duration</PropertyName><Literal>30</Literal></PropertyIsEqualTo></And></Filter></i></i></i></p> <p><i>https://gws.exactearth.com/ows?service=wfs&version=1.1.0&request=GetFeature&typeName=exactAIS:LVI,exactAIS:HVT&maxFeatures=50&filter=(<i><Filter><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068031</Literal></PropertyIsEqualTo></Filter>)(<i><Filter><And><PropertyIsEqualTo><PropertyName>mmsi</PropertyName><Literal>235068025</Literal></PropertyIsEqualTo><PropertyIsEqualTo><PropertyName>duration</PropertyName><Literal>15</Literal></PropertyIsEqualTo></And></Filter></i></i></i></p>
Fields / Columns (propertyName)	<p>Overview: Provides an ability to specify the output fields / columns per request. The [propertyName] query string parameter of a WFS request provides the interface to limit the fields / columns returned in the GetFeature request, for example, “propertyName=mmsi,vessel_name,ts_pos_utc”.</p> <p><i>https://gws.exactearth.com/ows?typenames=exactAIS:LVI&service=wfs&version=1.1.0&request=getfeature&propertyName=mmsi,vessel_name,ts_pos_utc&outputFormat=gml32</i></p>