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FINNISH METEOROLOGICAL INSTITUTE

Implementing an INSPIRE Compliant WFS

Roope Tervo
Finnish Meteorological Institute

4th Workshop on the use of GIS/OGC standards in meteorology

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What?

Finnish Meteorological Institute (FMI) is opening weather data it owns.

- The data is delivered (mostly) as INSPIRE harmonized data sets
- The same service (WFS 2.0) will work as INSPIRE and FMI Open Data Download Service

In the first stage only Simple Profile with INSPIRE requirements

- Stored queries
- Language support
- Possibility to fetch INSPIRE data sets

Next step is to implement Filter Encoding

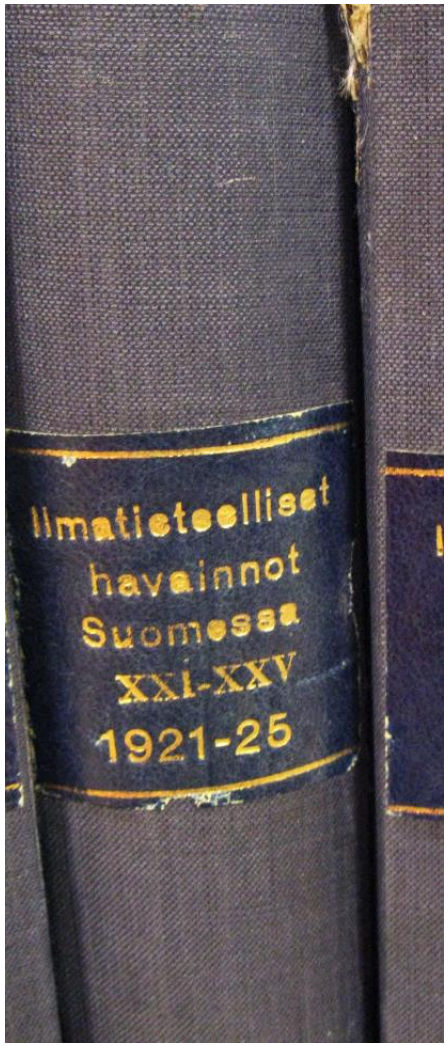
Open Data

Data in Short:

- Weather and marine observations
- Lightning
- Radar
- Hirlam
- Marine forecast models

Data is opened in phases:

- First sets available by summer 2013
- New sets will be added during 2013-2014



Example of Data Sets - Real Time Observations

Data set	Description	Time Interval	Estimated publish date
Weather Observations	Temperature, Wind, Humidity, Ground Temperature…	10 min	Summer 2013
Sun Radiation	UV, Short and Long Term Radiation…	1 min	Summer 2013
Marine Observations	Waves, Sea Temperature, Sea Level…	1 h	Summer 2013
Weather Radars	Precipitation Rate, Precipitation Amount…	5 min	Summer 2013
Lightning	Thunder Strikes in Finland	5 min	Summer 2013
Soundings	Temperature, Humidity, Pressure, Wind from ground to 25 km height	2 times a day	2014

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Example of Data Sets - Observation Time Series

Data set	Description	Time Interval	Estimated publish date
Real Time Observations	Real Time Observations from specific location(s)	AWS 2013 – Soundings 1959 – Flashes 1998 – Sea Level 1971 – Waves 2005 –	Summer 2013
Climatological Observations	Daily and monthly temperature mean and extreme values from weather stations	1959 -	Summer 2013
Climatological Observations	Monthly temperature and precipitation rate mean values interpolated to grid	1961 -	2013
Climatological Reference	Climatological Reference. Temperature, humidity, pressure, precipitation amount and snow depth.	Reference seasons: 1971-2000 1981-2010	2013
Historical Observations	Long time series of temperature and precipitation	End of 19th century -	2013

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Example of Data Sets - Forecast Models

Data set	Description	Time Interval	Estimated publish date
Weather forecast model HIRLAM RCR	Point forecasts and grid data	Latest model run (4 times a day) 0…54 h	Summer 2013
Sea level model OAAS HIRLAM	Point forecast to 13 locations	Latest model run (4 times a day) 0...54 h	Summer 2013
Other Sea forecast models	Wave (WAM), current (HBM) and ice forecast models as grid data	Latest model run (4 times a day) 0...54 h	Summer 2013

Other

Data set	Description	Estimated publish date
Environmental Monitoring Facilities	Weather observation stations, radars…	Summer 2013

Access Control

Registration will be required for open data portal.

- The user will get an API Key.
- Transactions will be limited based on the API Key.
  - Catalog (CSW) will be open
  - Download Service (WFS) have loose limits
  - View Service (WMS) have quite strict limits

Access Control

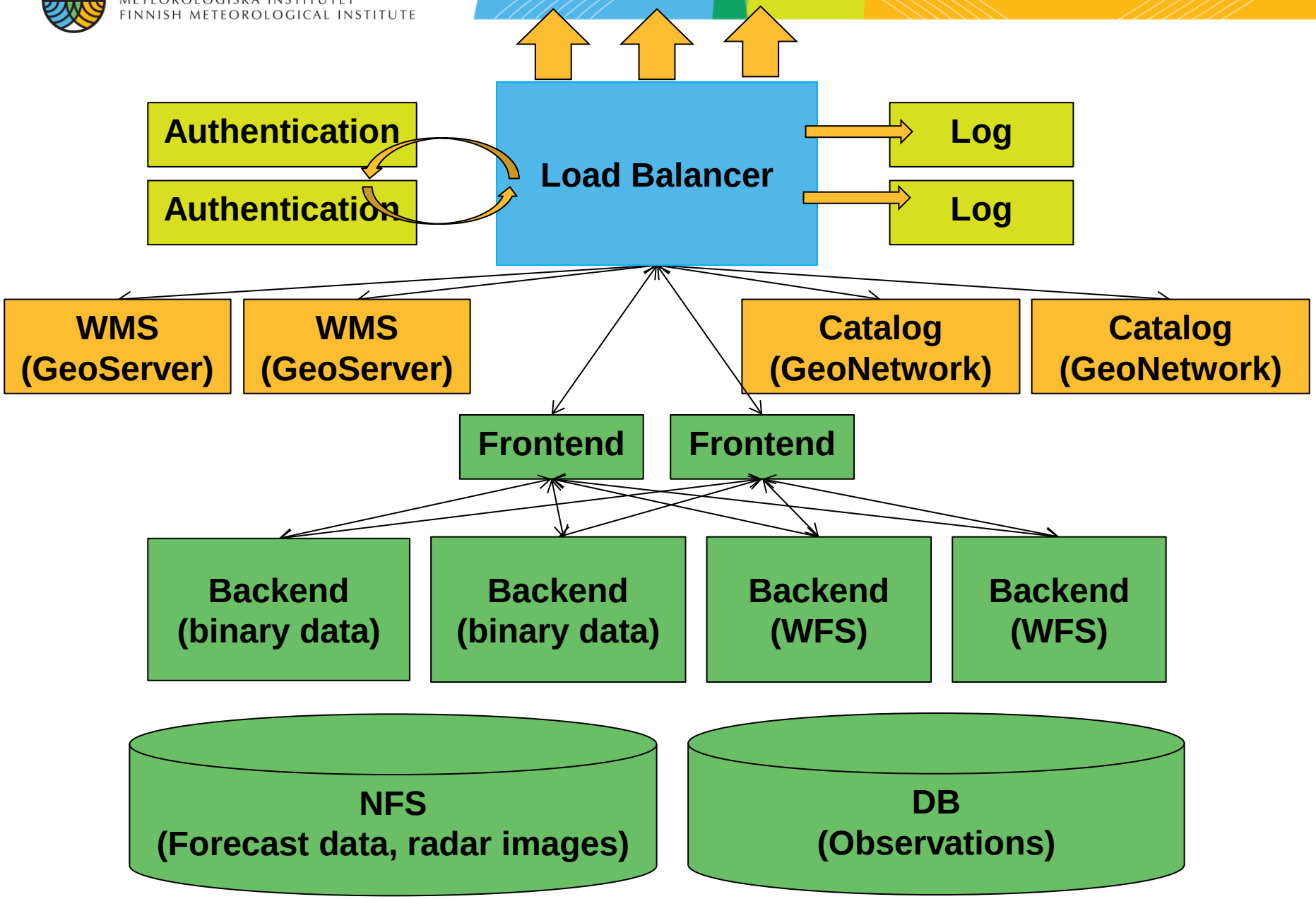
So.. WMS is just for browsing the data.

- If you want provide maps in your applications, you have to download the data and create your own WMS.

WFS transaction limits are designed so that

- You should be able to download almost as much data as you want into your server.
- But applications with lots of end users can not rely directly on FMI WFS.

Possibility to purchase unlimited access to the data.


Authentication
Authentication
Load Balancer
Log
Log
WMS (GeoServer)
WMS (GeoServer)
Catalog (GeoNetwork)
Catalog (GeoNetwork)
Frontend
Frontend
Backend (binary data)
Backend (binary data)
Backend (WFS)
Backend (WFS)
NFS (Forecast data, radar images)
DB (Observations)

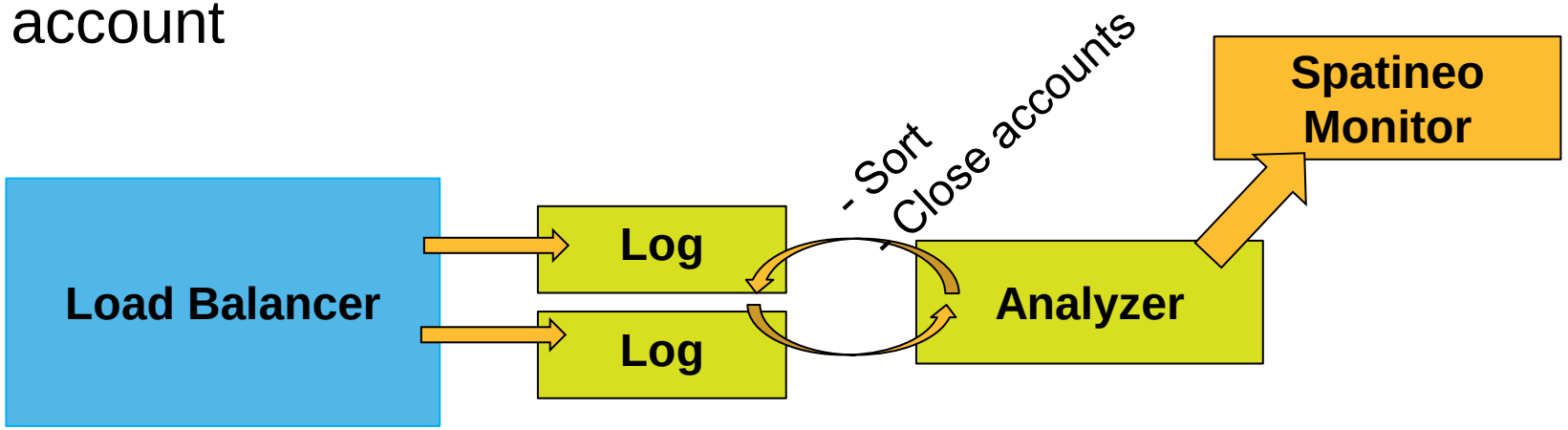
Logging and Monitoring

Logging is done by a load balancer

- Possibility to log to several servers

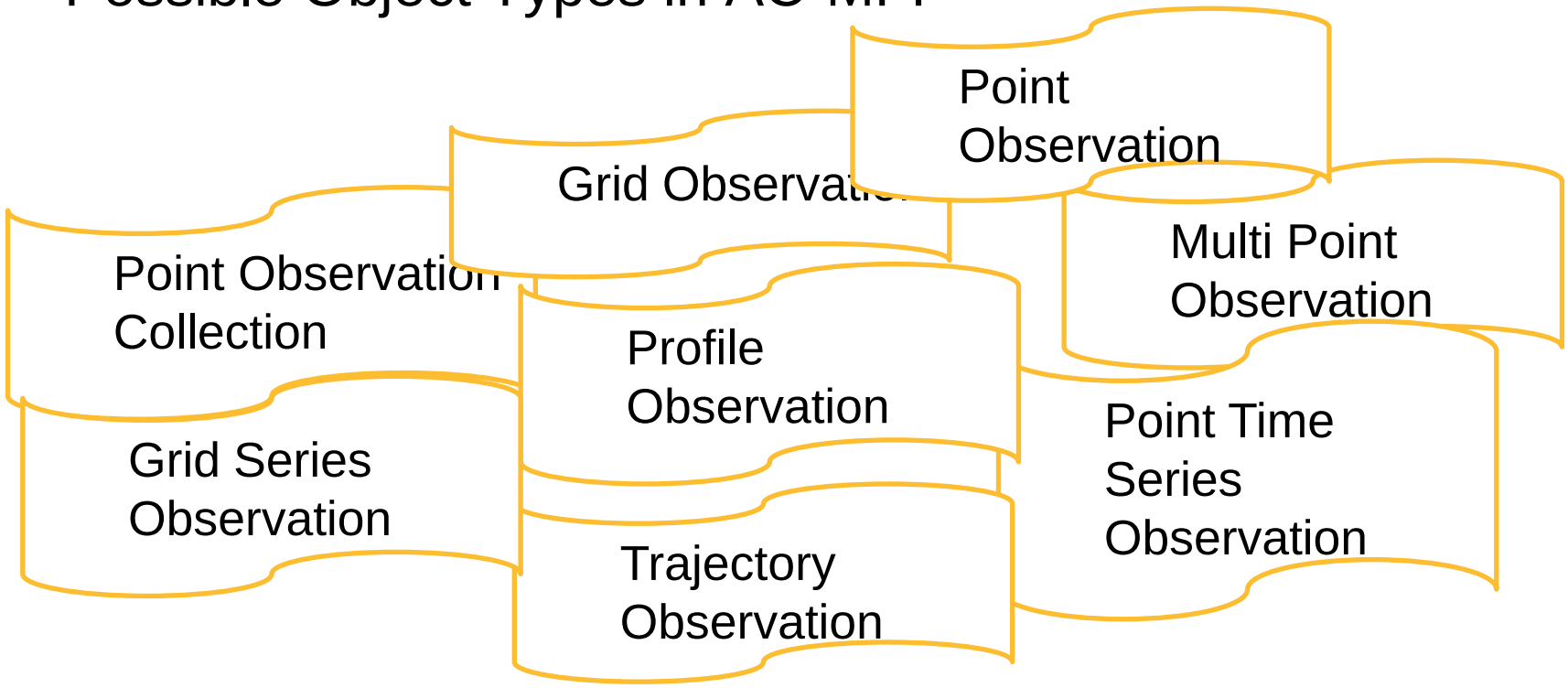
Separate process to analyze logs

- Spatineo Monitor is used for analyzing
- If someone exceeds the transaction limits, close the account

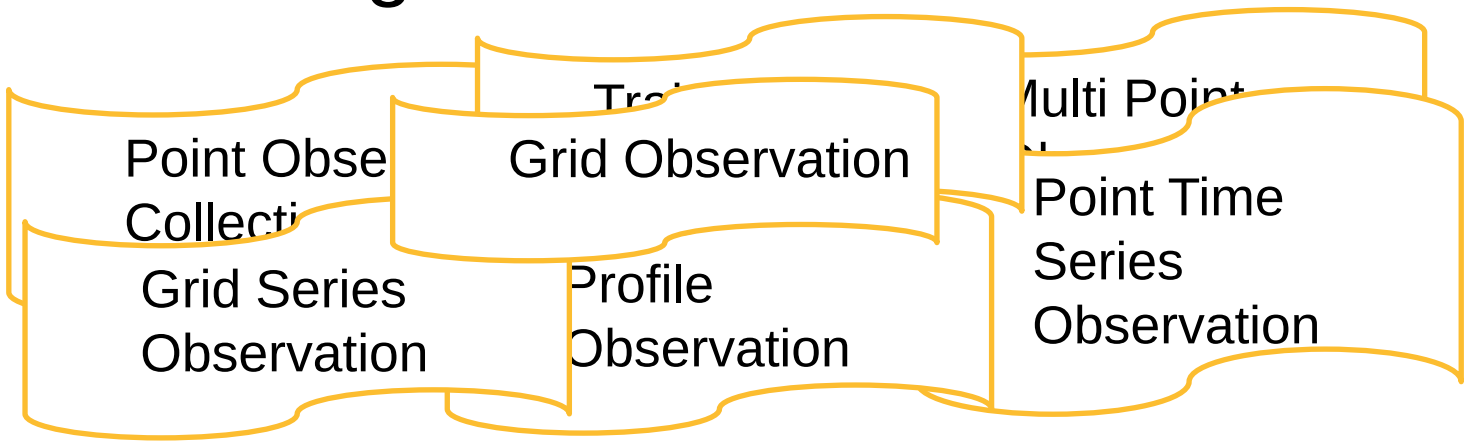


Choosing Data Formats

Possible Object Types in AC-MF:



Choosing Data Formats



Typical data query in meteorological domain:

- Several parameters from the area from last x hours
  - Many parameters, many locations, many time steps

It would be nice to be able to provide all the data in the same format.

Data Formats – Possibilities

1. Use Point Time Series Observations with WaterML 2.0 time series
   - Verbose
   - Could schema be extended to support multiple parameters?
2. Use Grid Series Observations with a irregular grid composed of observation stations
   - Quite complicated to use for none expert users
   - XPath and DOM can’t be used to fetch a single value
3. ‘Misuse’ Point Time Series Observations with a Domain Range Set
   - Compact
   - Quite complicated to use for none expert users
   - Against schema annotation, against INSPIRE requirements

Data Formats – WaterML2 Example

```
<om:result>
  <wml2:MeasurementTimeseries gml:id="for-obs-101196-t2m">
    <wml2:point>
      <wml2:MeasurementTVP>
        <wml2:time>2013-03-01T23:00:00Z</wml2:time>
        <wml2:value>-13.1</wml2:value>
      </wml2:MeasurementTVP>
    </wml2:point>
    <wml2:point>
      <wml2:MeasurementTVP>
        <wml2:time>2013-03-01T23:30:00Z</wml2:time>
        <wml2:value>-13.8</wml2:value>
      </wml2:MeasurementTVP>
    </wml2:point>
    <wml2:point>
      <wml2:MeasurementTVP>
        <wml2:time>2013-03-02T00:00:00Z</wml2:time>
        <wml2:value>-14.2</wml2:value>
      </wml2:MeasurementTVP>
    </wml2:point>
  </wml2:MeasurementTimeseries>
</om:result>
```

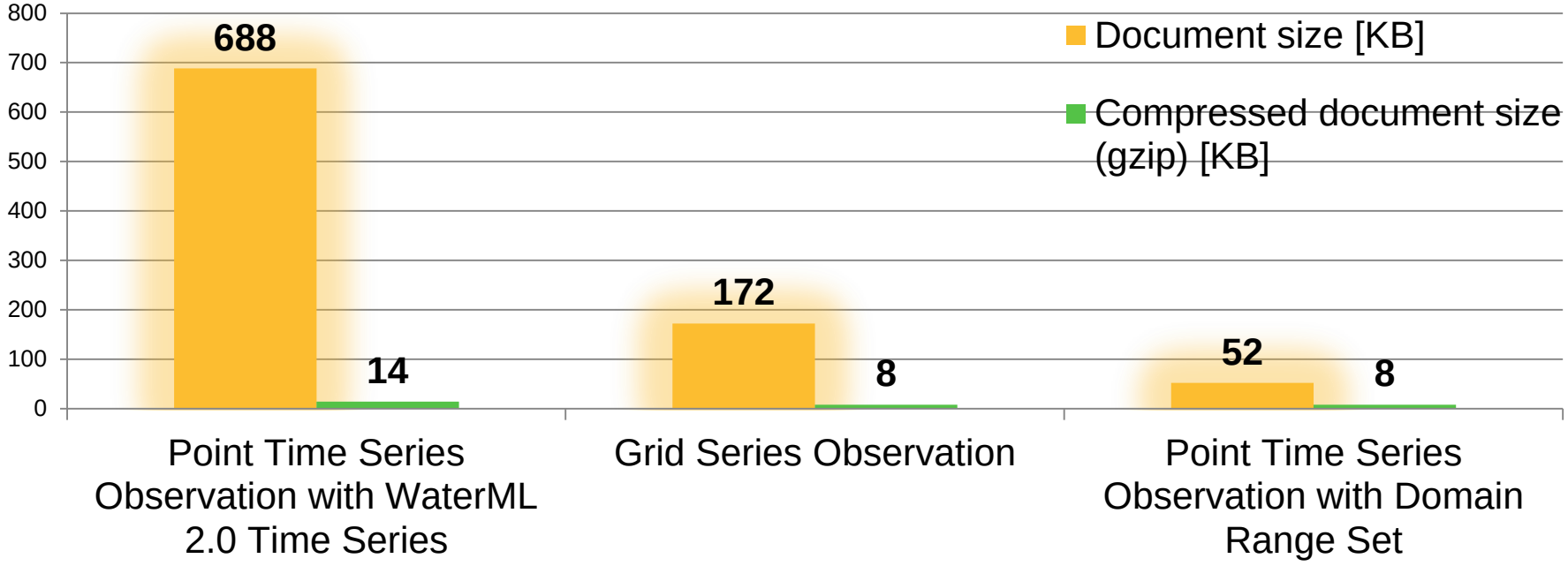
Data Formats – Grid Series Observations

```
<om:result>
  <gmlcov:MultiPointCoverage gml:id="mpcv1">
    <gml:domainSet>
      <gmlcov:SimpleMultiPoint gml:id="mp1" srsName="http://xml.fmi.fi/gml/crs/wgs84.xml" srsDimension="3">
        <gmlcov:positions>
          60.11160 21.70270
          60.11160 21.70270
          60.11160 21.70270
        </gmlcov:positions>
      </gmlcov:SimpleMultiPoint>
    </gml:domainSet>
    <gml:rangeSet>
      <gml:DataBlock>
        <gml:rangeParameters/>
        <gml:doubleOrNilReasonTupleList>
          1.0 4.2 182.0
          1.0 4.1 182.0
          1.0 4.3 184.0
        </gml:doubleOrNilReasonTupleList>
      </gml:DataBlock>
    </gml:rangeSet>
    <gml:coverageFunction>
      <gml:CoverageMappingRule>
        <gml:ruleDefinition>Linear</gml:ruleDefinition>
      </gml:CoverageMappingRule>
    </gml:coverageFunction>
    <gmlcov:rangeType>
      <swe:DataRecord>
        <swe:field name="t2m" xlink:href="http://catalog.fmi.fi/hav/observable-property?t2m"/>
        <swe:field name="ws_10min" xlink:href="http://catalog.fmi.fi/hav/observable-property?ws_10min"/>
        <swe:field name="wd_10min" xlink:href="http://catalog.fmi.fi/hav/observable-property?wd_10min"/>
      </swe:DataRecord>
    </gmlcov:rangeType>
  </gmlcov:MultiPointCoverage>
</om:result>
```

Point Time Series Observations with a DRS

```
<om:result>
  <gmlcov:MultiPointCoverage gml:id="mpcv-1">
    <gml:domainSet>
      <gmlcov:SimpleMultiPoint gml:id="mp-1" srsName="http://xml.fmi.fi/gml/crs/etrs89-and-epoch-time.xml" srsDimension="3">
        <gmlcov:positions>
          61.05000 26.48330  1362222000
          61.05000 26.48330  1362225600
          61.05000 26.48330  1362229200
        </gmlcov:positions>
      </gmlcov:SimpleMultiPoint>
    </gml:domainSet>
    <gml:rangeSet>
      <gml:DataBlock>
        <gml:rangeParameters/>
        <gml:doubleOrNilReasonTupleList>
          -8.257659 2.149565
          -7.319952 2.384935
          -6.884493 2.857687
        </gml:doubleOrNilReasonTupleList>
      </gml:DataBlock>
    </gml:rangeSet>
    <gml:coverageFunction>
      <gml:CoverageMappingRule>
        <gml:ruleDefinition>Linear</gml:ruleDefinition>
      </gml:CoverageMappingRule>
    </gml:coverageFunction>
    <gmlcov:rangeType>
      <swe:DataRecord>
        <swe:field name="temperature" xlink:href="http://catalog.fmi.fi/hav/observable-property?temperature"/>
        <swe:field name="WindSpeedMS" xlink:href="http://catalog.fmi.fi/hav/observable-property?WindSpeedMS"/>
      </swe:DataRecord>
    </gmlcov:rangeType>
  </gmlcov:MultiPointCoverage>
</om:result>
```

Data Formats – Comparison



- Test set contained ~100 weather stations, 6 time steps and 10 parameters.
- FMI test server returned WML2 time value pair only about 10 % slower than others.

Data Formats

Our choice is **Point Time Series Observation** for:

- Weather and marine observations including lightning
- Point Forecasts

…and **Grid Series Observations** for:

- Grid data

At the moment we provide data in both Domain Range Set and WaterML 2.0 time series

Data Formats – Grid Data

Grid data can’t be encoded in GML due to its volume

- Grid Series Observations with a link to binary data is used
- GeoServer WMS with black and white GeoTiffs are used for radar images
- Forecast models are returned by FMI data server as grib (1 or 2) or NetCDF (classic 4) depending on data
- Data can be fetched with bbox, level and parameter

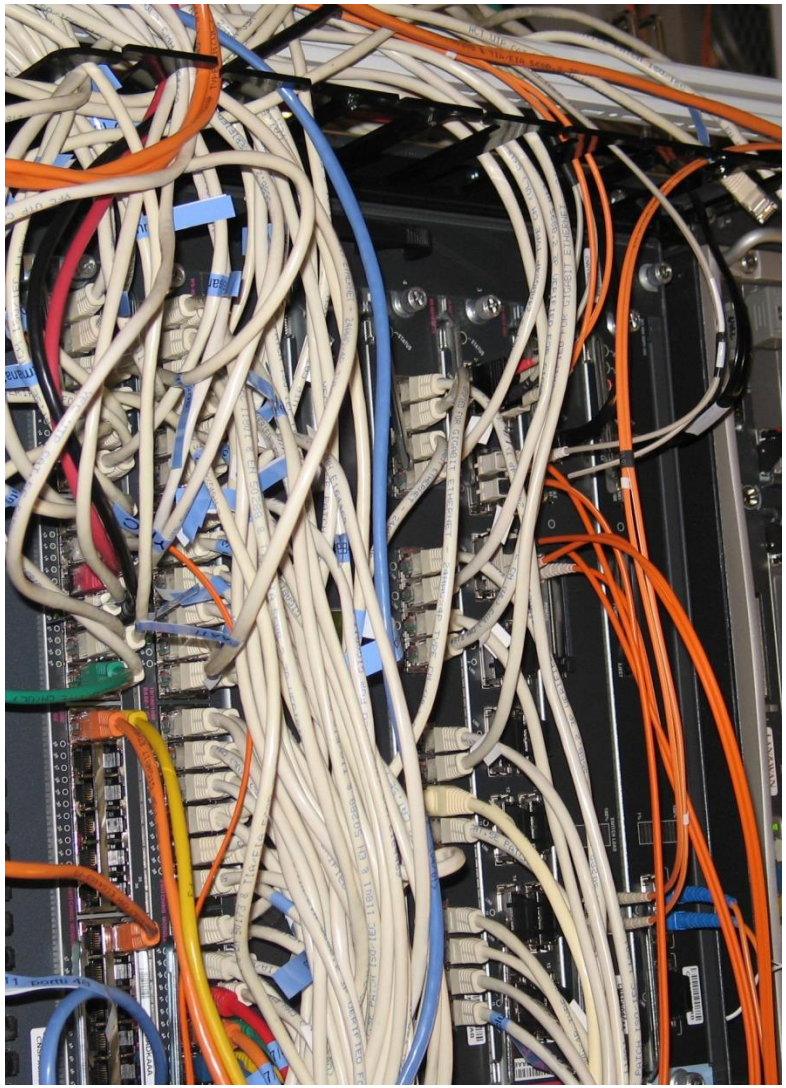
Challenges

- How to describe coordinate systems for pressure and hybrid levels?
- How to encode radar scanning angle?
- Paradigm of continuous data flow and data sets
  - How to define INSPIRE data sets?

Libraries

FMI is also going to publish an open source library *'MetO Lib'* to help loading and handling data.

- First JavaScript
- Next some scripting language, but what?
  - Python?
  - PHP?
- Going to be published in GitHub by summer



Beta

The portal is published 15.5.2013.

- Beta version is open at data.fmi.fi/wfs
- Add fmi-apikey into all requests
  - *&fmi-apikey=b37f3e99-cdb8-4858-b850-bfffea6542f9*
  - corresponding header in post requests

GetCapabilities:

- http://data.fmi.fi/wfs?request=getCapabilities&fmi-apikey=b37f3e99-cdb8-4858-b850-bfffea6542f9

ListStoredQueries:

- http://data.fmi.fi/wfs?request=describeStoredQueries&fmi-apikey=b37f3e99-cdb8-4858-b850-bfffea6542f9

Observations as Domain Range Set:

- http://data.fmi.fi/wfs?request=getFeature&storedquery_id=fmi::forecast::hirlam::ground::point::multipointcoverage&fmi-apikey=b37f3e99-cdb8-4858-b850-bfffea6542f9&place=jaala&parameter=temperatue

Observations as Time Value Pair:

- http://data.fmi.fi/wfs?request=getFeature&storedquery_id=fmi::forecast::hirlam::ground::point::timevaluepair&fmi-apikey=b37f3e99-cdb8-4858-b850-bfffea6542f9&place=jaala&parameter=temperatue

Thank You

roope.tervo@fmi.fi