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FINNISH METEOROLOGICAL INSTITUTE

SmartMet Server

Providing MetOcean Data

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SmartMet Server is data and product server for MetOcean data

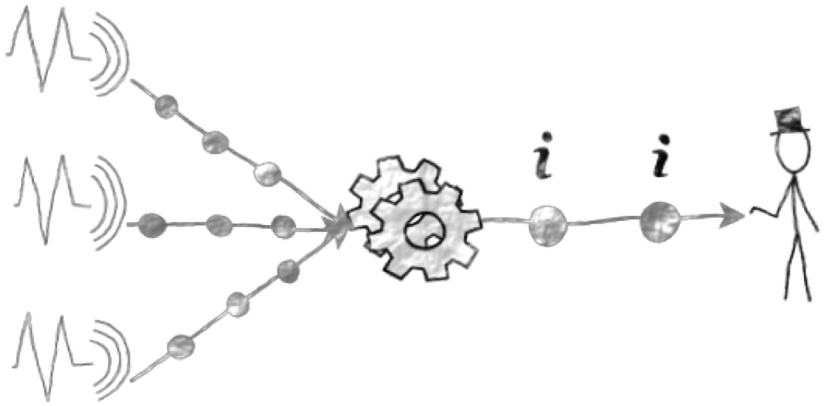
- High capacity & availability
  - FMI installation handles over 30 000 000 requests each day
- Data is extracted and products generated on-demand
- Operative since 2008
  - FMI client services (since 2008)
  - Finnish Meteorological Institute (FMI) Open Data Portal (since 2013)
  - Going to be used at Copernicus C3S Climate Data Store (ECMWF)

Wide range of supported input and output formats and interfaces

Open Source

C++

- Input sources
  - GRIB-, NetCDF-, etc. files (multi-dimensional grid data)
  - PostGIS database (vectors)
  - Point database (point observations)
- Output interfaces and formats
  - WMS, WFS 2.0
  - JSON, XML, ASCII, HTML, SERIAL
  - GRIB1, GRIB2, NetCDF



Basis of FMI product generation

FMI Open Data Portal & FMI INSPIRE Data Services

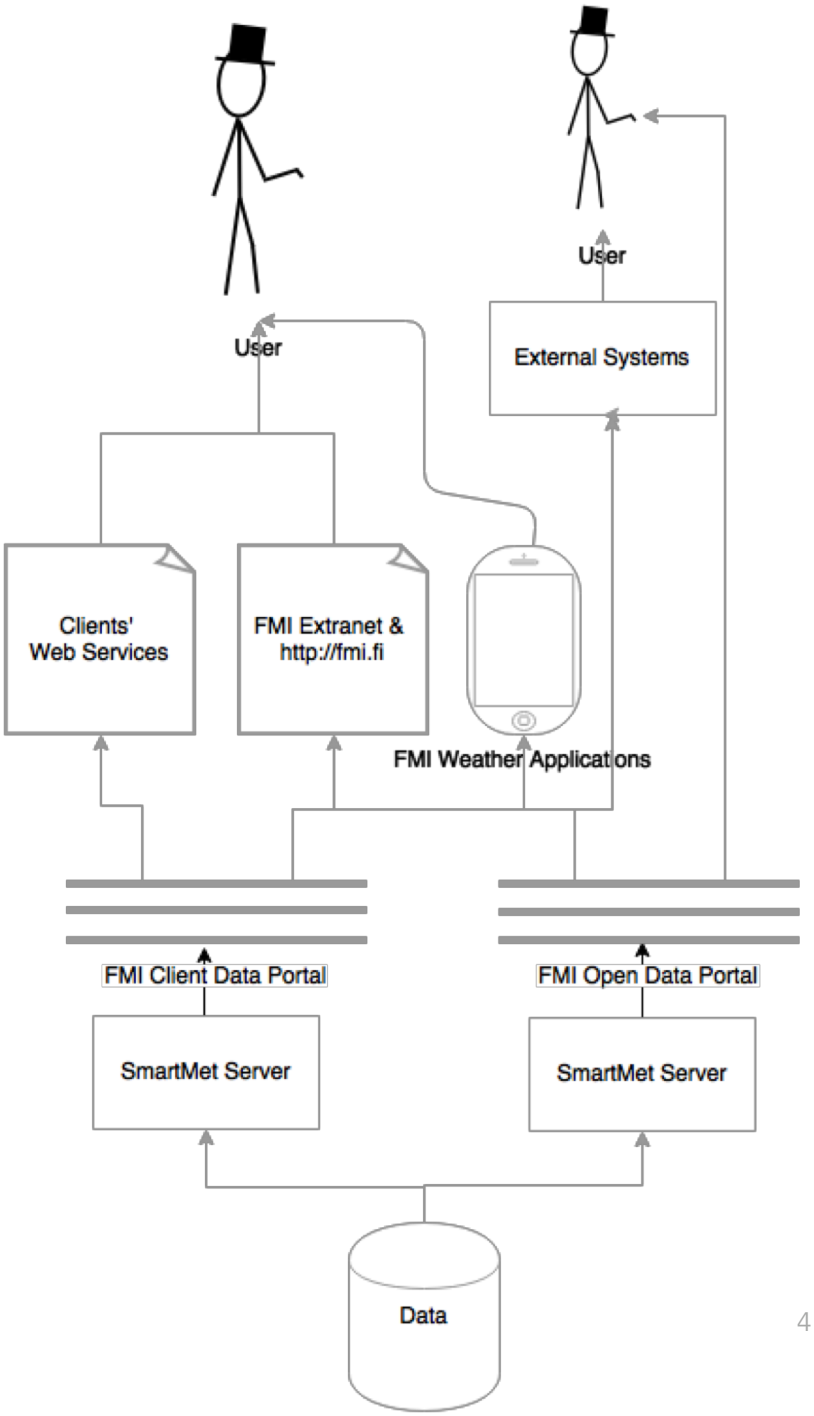
Backend for clients' web services

Integration to clients' systems

Backend for mobile applications

Backend for FMI public pages

Backend for FMI Client Services



Open Source

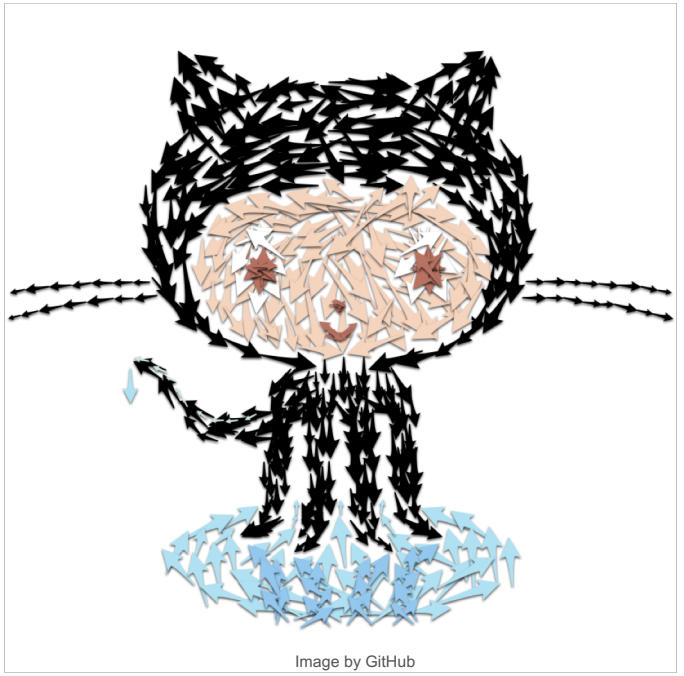
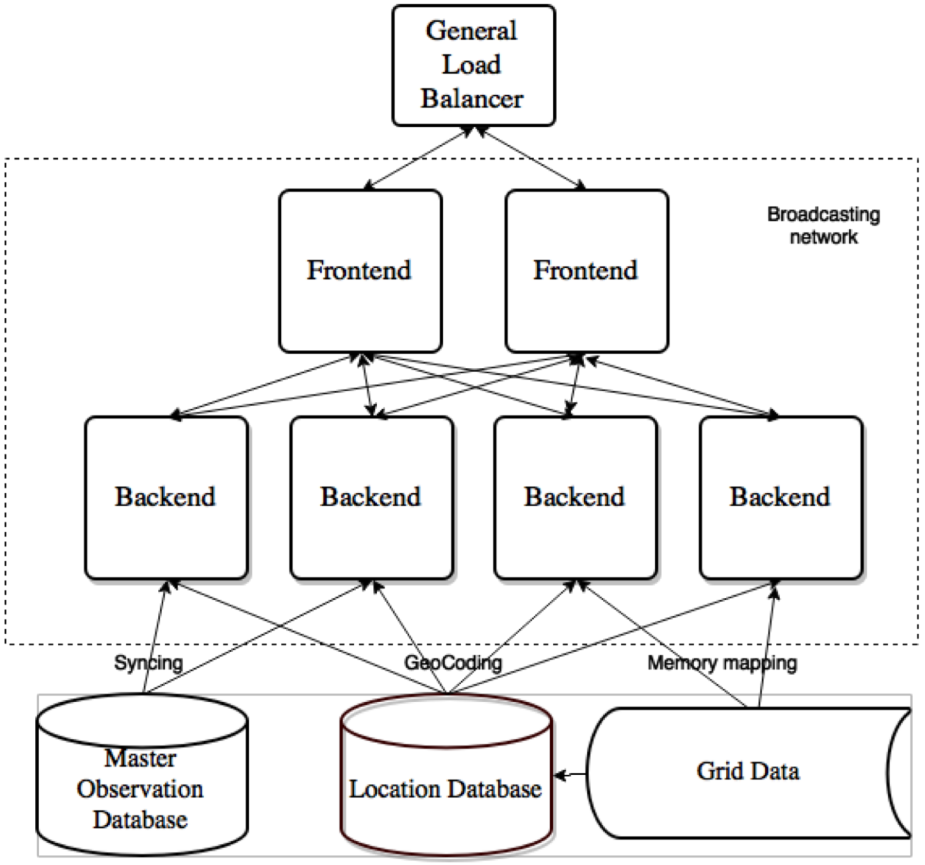


Image by GitHub

- Published in 2016 in GitHub
  - https://github.com/fmidev/smartmet-server
  - MIT License
- FMI will host the development
  - Small contributions with pull requests
  - In larger contributions, implementation plan is recommended (in GitHub wiki)
  - CLA (Contributor Licence Agreement) will be required

Architecture is modular and easily extendable

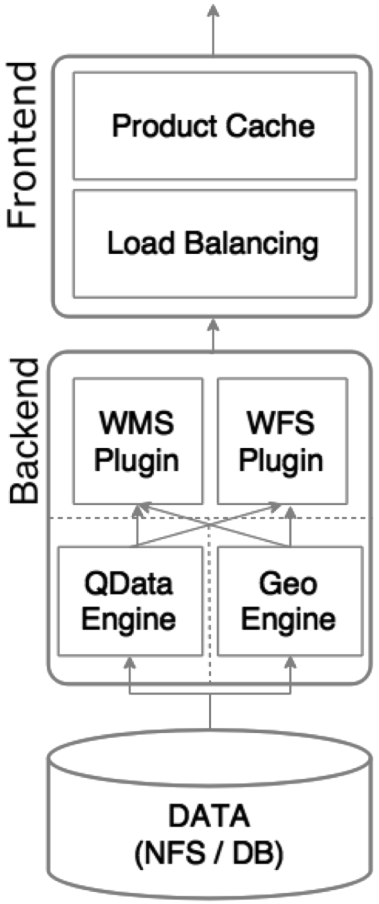
- Frontend
  - Load balancer
  - Cache
  - Knowledge about backend services
- Backend
  - Different backends may contain different services
- Plugin-based architecture
  - *Engines* provide shared access to the data
  - *Plugins* provide services (APIs) built upon engines



WMS and TimeSeries are the most important interfaces

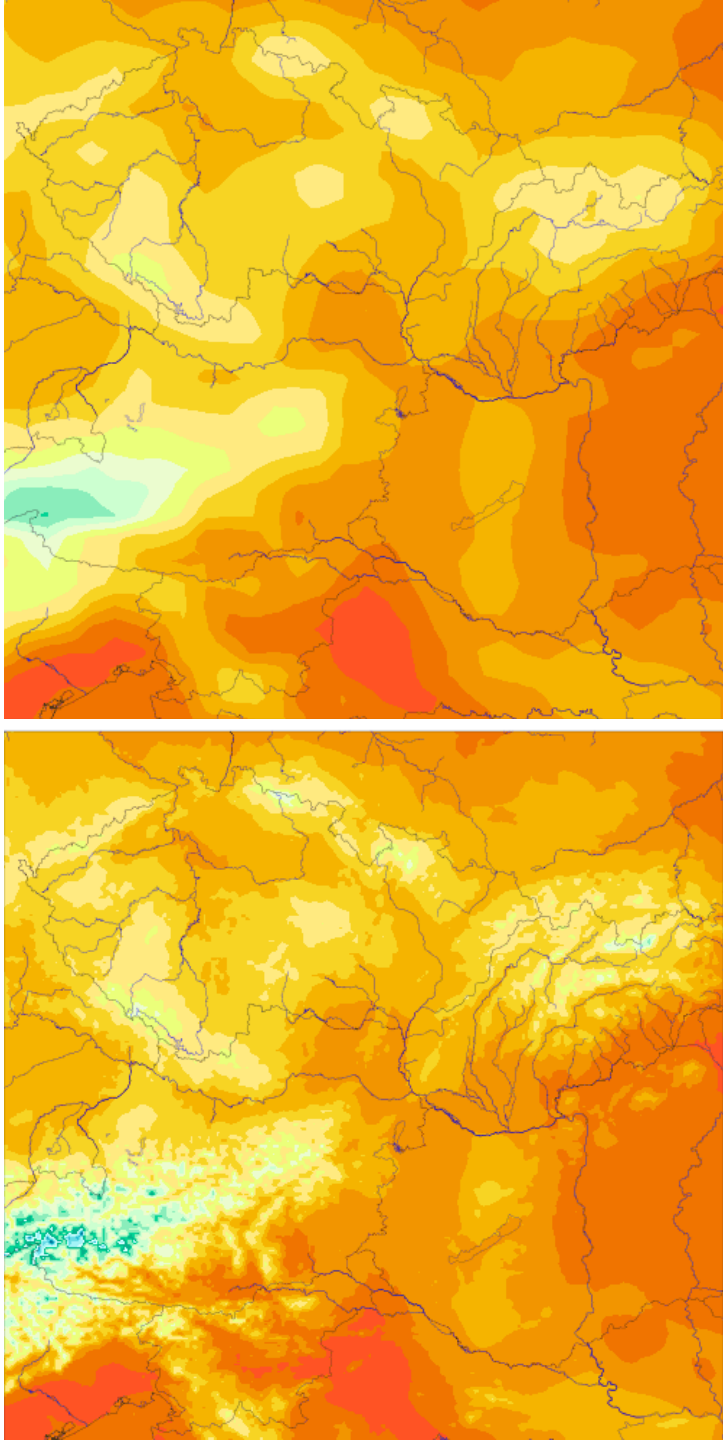
HTTP API provided by different plugins:

- **WMS**: Generates SVG images from grid data on-demand, which are rendered to requested raster format
- **Timeseries:** Custom point data interface with support for aggregate values over time and area
- **WFS**: Point data output for grid data and observations
- **Download / WCS:** Grid data output



Post-Processing Capabilities

- Corrects the data based on accurate DEM (up to 30 meter resolution) and land/water information
- Calculates derivative parameters
- Support for aggregate values over time and area



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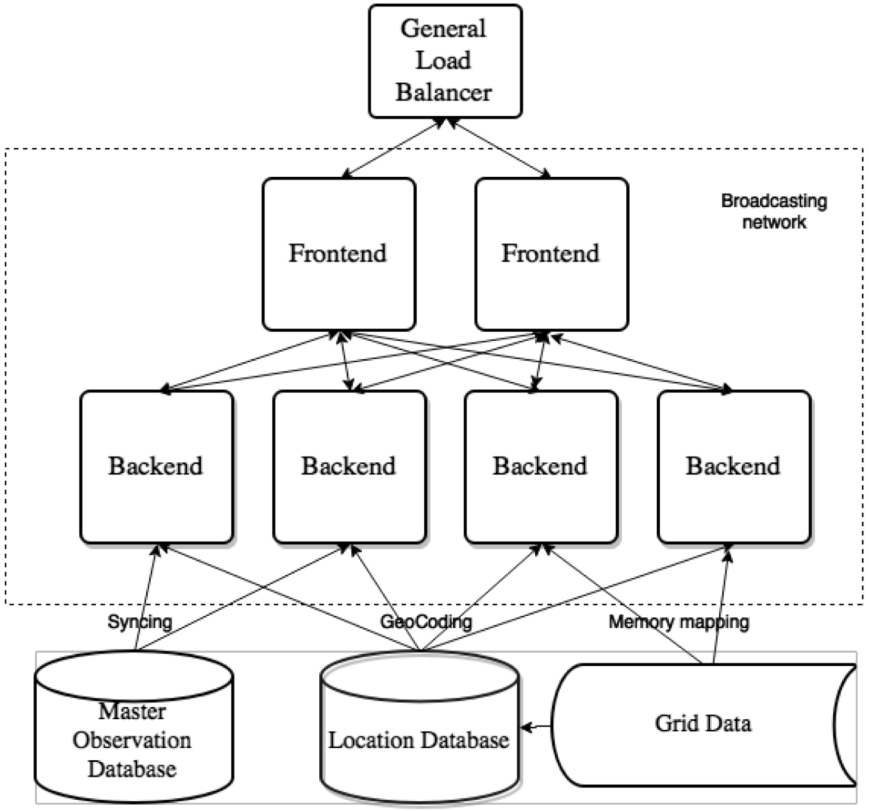
FMI Setup
In 2018

- 2 frontends
    - RAM: 256G
    - CPU: 24x 2.10GHz
    - OS: RHEL7
- 7 backends
    - RAM: 12 - 256 G
    - CPU: 24 x 2.40 GHz
    - OS: RHEL7
- Load Balancer
    - F5 BIG IP 11



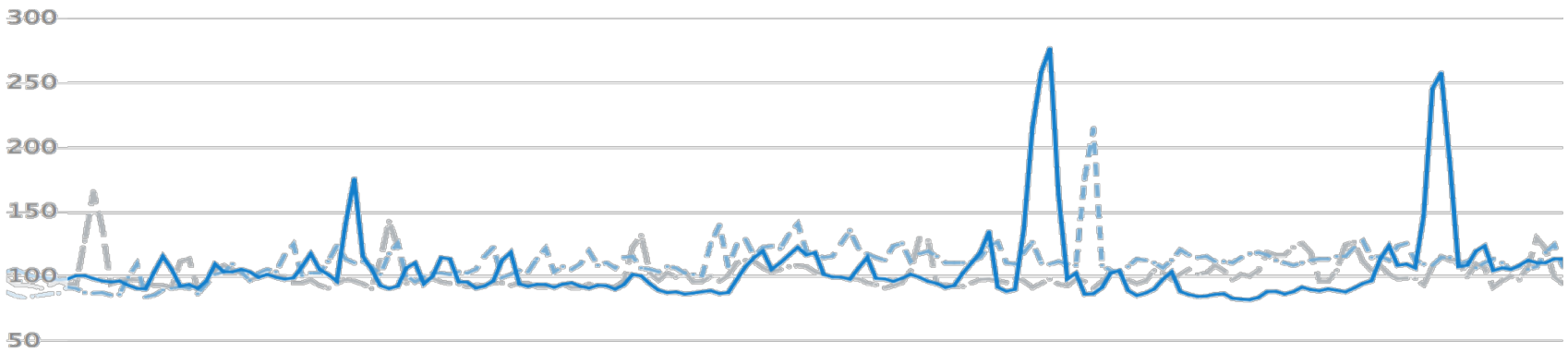
Performance
Production (FMI Setup)

Typical load

- > 30 000 000 req/day
- Baseline 200 req/s
- Peaks over 650 req/s

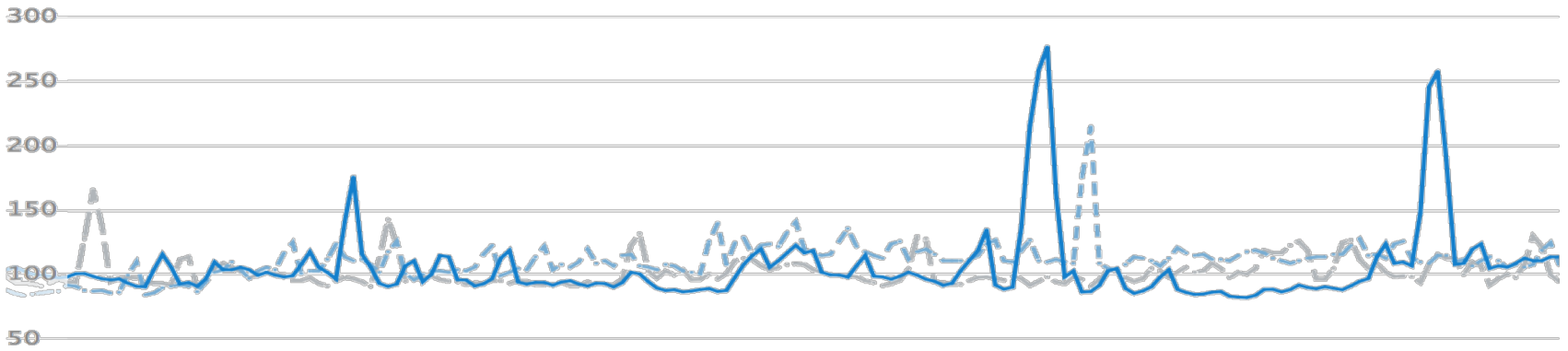
Average response times

WFS	140 ms/req
WMS	130 ms/req
Timeseries	30 ms/req
Autocomplete	4 ms/req



Performance
Load Tests (Production Setup)

- Scenario based on operative use at FMI
- Peaks over 4300 req/s
- Avg 173 ms, 95% of responses in 244 ms, median 54 ms
- Possibly heavy data requests require QoS management
    - Independent queues for slow and fast queries



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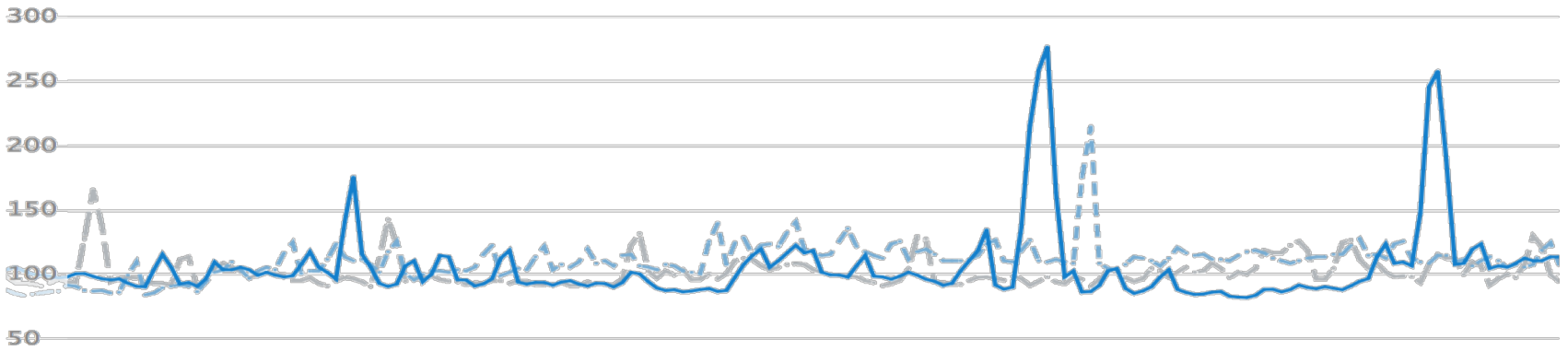
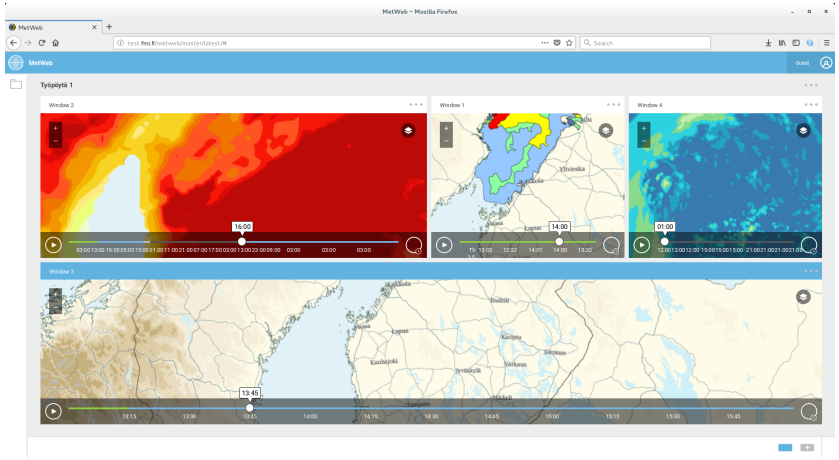
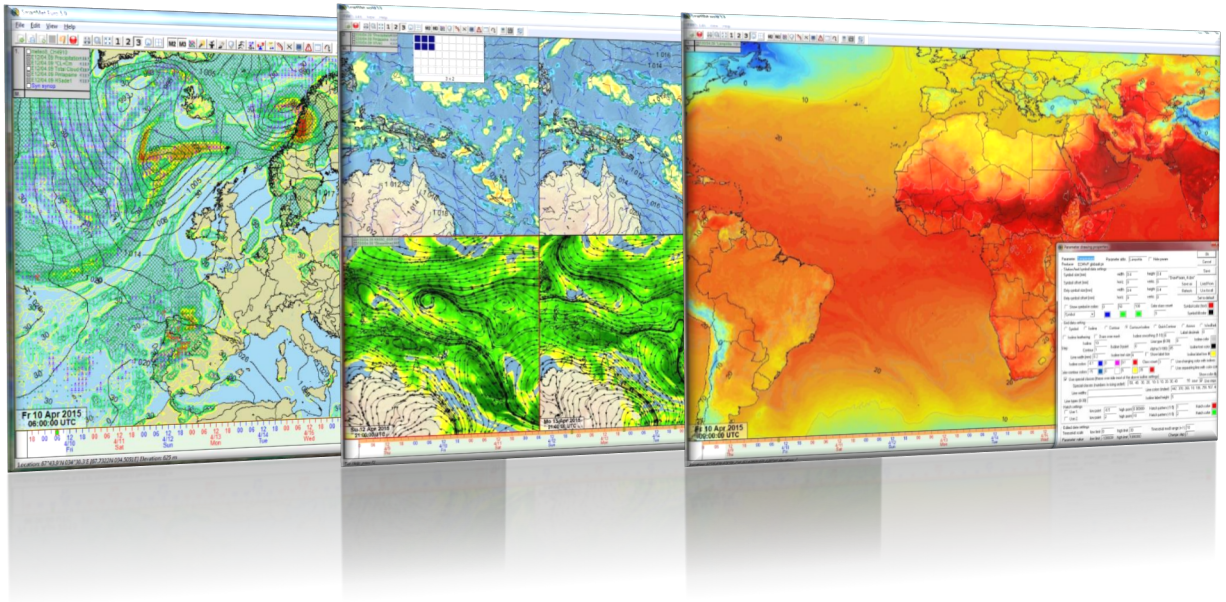


SmartMet Server is used as a backend of meteorological workstations

- Use cases
  - WMS visualisations
  - Server side (on-demand) processing
  - Time series
- Requirements
  - Lots of data
  - Heavy processing

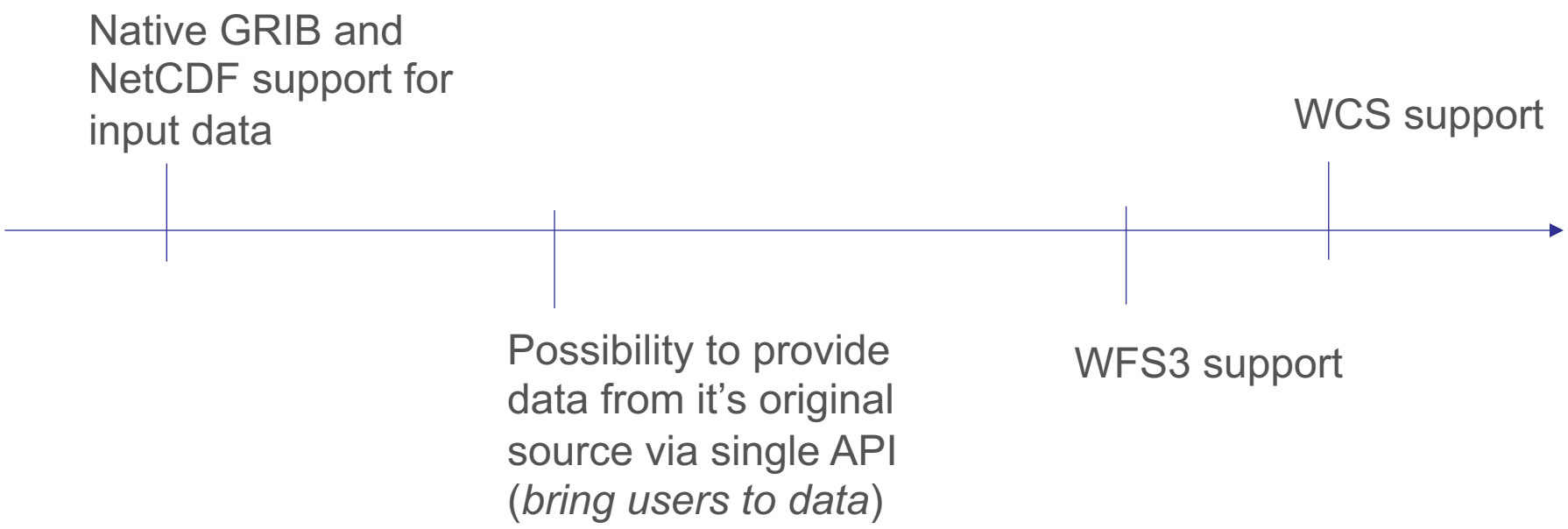




SmartMet Server is used as a backend of FMI services

- Use cases
  - WMS visualisations
  - Time series
- Requirements
  - Lots of requests
  - Fast response time
  - High availability

Roadmap



https://github.com/fmidev
https://en.ilmatieteenlaitos.fi/open-data

http://roopetervo.com
http://www.slideshare.net/tervo