Information System as a Tool for Marine Spatial Planning

The SmartSea Vision and a Prototype

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SYKE

SmartSea

Contents of the talk

- Context and motivation
- Marine Spatial Planning
- Requirements
- Information environment
- Prototype
  - Database
  - Dynamic map service

Context and motivation

- Finland is investing in strategic research with an emphasis on strong societal impact
- Seas and oceans are recognized as drivers for European economy and having great potential for innovation and growth
- ”SmartSea” is a joint effort to take a multi-disciplinary look at the Gulf of Bothnia of the Baltic Sea

Gulf of Bothnia is a shallow, relatively undeveloped sea area that has an area of 117 000 km^2

Maritime Spatial Planning (MSP)

Integrated assessment

Security

Environmental sustainability
- e. health, production, resiliency

Climate change

Public, collaborative process

Long-term perspective

Social needs

Political process

Economic development
- Offshore wind energy
- Seabed mining
- Marine biotechnology
- Aquaculture
- Coastal turism
- Transportation
- ...

Requirements for an information system supporting MSP

- Access to existing spatial data
- Understanding spatial interactions
- Management of multiple objectives
- Collaborative/participatory data collection
- Site selection
- Impact assessment
- Understanding and assessing cumulative impacts
- Environmental valuation
- Conflict assessment
- Collaborative conflict resolution
- Embracing change, learning, and adapting
- ...

=> no one tool satisfies all requirements

Information environment

- A concept for user-centered analysis
- Preferred tools
- Organization policies
- Standards for data access/transfer
- Internet
- Open access to data, Free and open source software

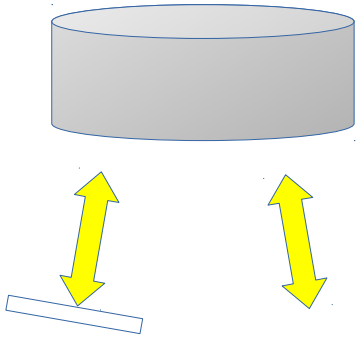
- MSP
  - Communities: Planners, Researchers, Stakeholders, Public
  - Platforms: Collaboration, Participatory Mapping, Decision Support

Characteristics of MSP

- Dynamics
- Multiple levels of planning
- Planning is still unstructured
- Sectoral ambitions are strong
- Spatial focus can be on large areas or local
- Temporal horizon can vary considerably

Prototype

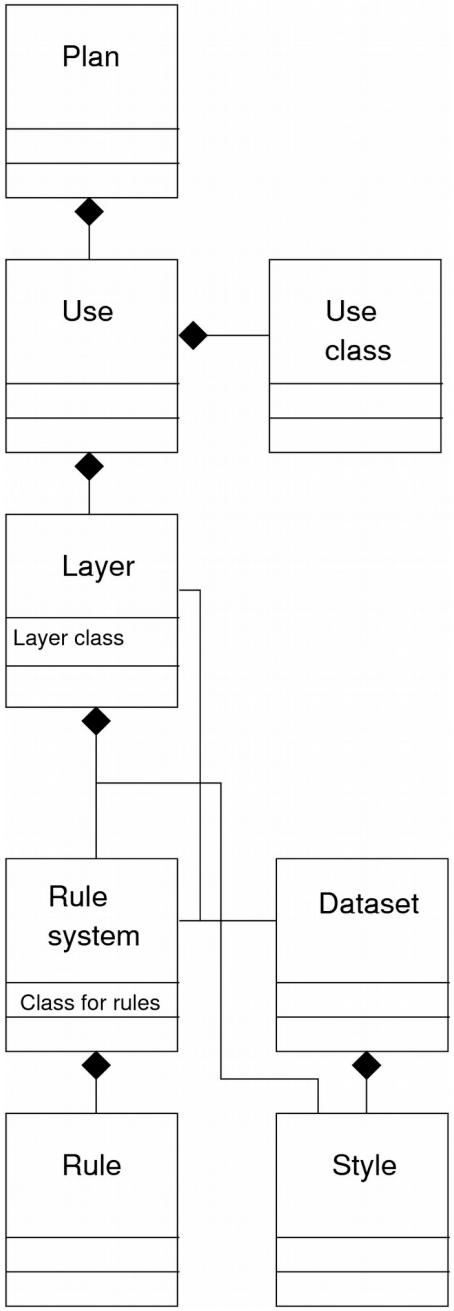
- Integrative database
  - Datasets
  - Planning (spatial modeling)
  - Model for environmental impact
- Dataset development
- Database design
- Services
  - Modeling API
  - WMTS
- Browser client
- Desktop GIS client



Integrative database

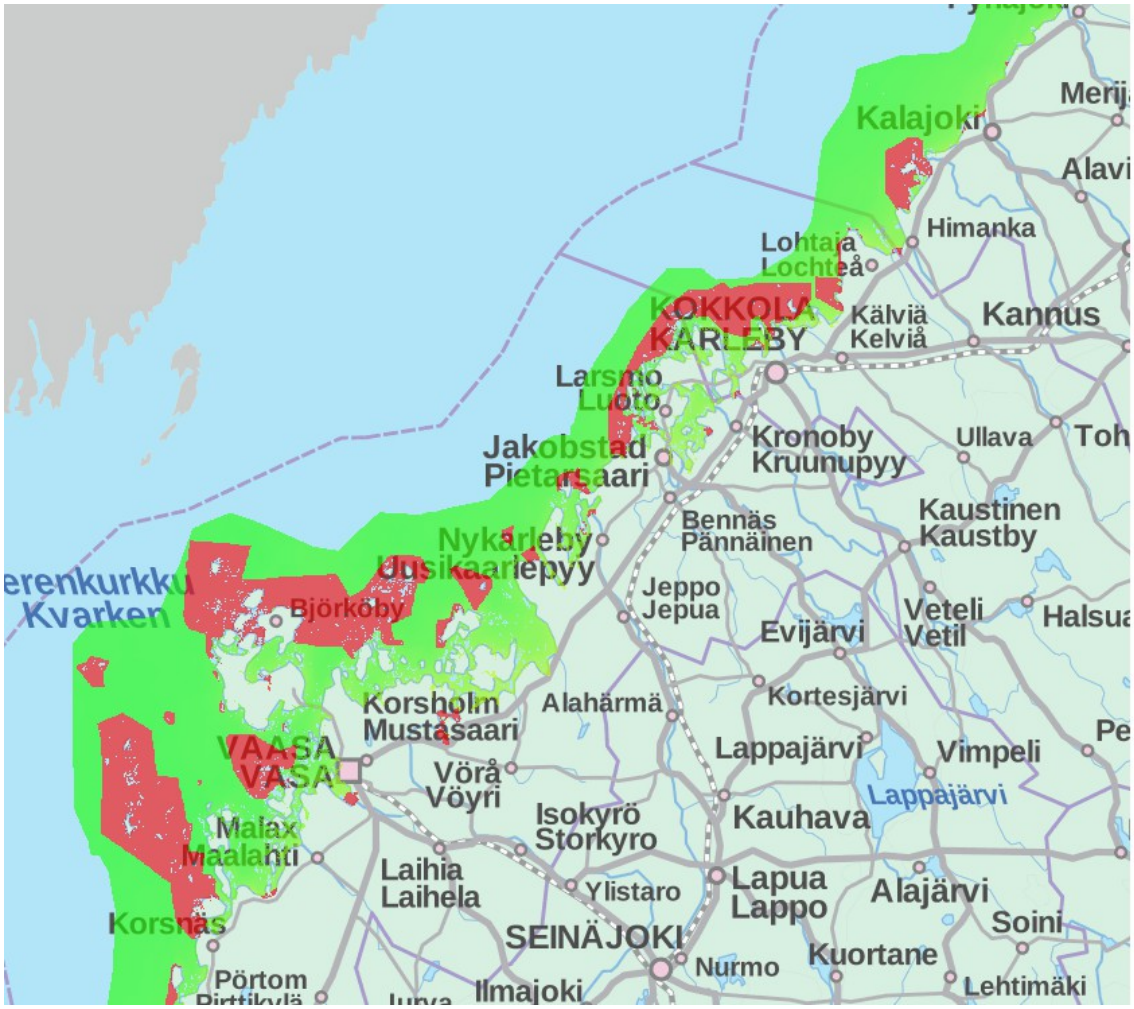
- The planning process: what is being done?
- The input datasets: from where?, how they are produced?
- Presentation styles
- Spatial modeling: where are good locations for this? what is this location good for?
- Activities cause pressures on the environment, pressures cause impacts on ecosystem components

- … work in progress:
- Impact modeling, spatial impacts
- Combination of pressures and impacts
- Risk assessment



Database 1/3

- Two levels of planning:
  1. define types of uses and layers
  2. allocate areas for uses
- Use class = what uses are allowed / disallowed in a zone
- Layer class = ”Suitability”, ”Allocation”, ”Value”, ”Impact”, etc.
- Rule system = how the suitability/value/something else is computed and from what data



SmartSea

MSP tool development

Plan: SmartSea

- ▸ Protected areas
- ▸ Fisheries
- ▾ Offshore wind farms
  - ☐ Allocation
  - ☑ Suitability
  - ☐ Value
- ▸ Fish farming
- ▸ Geoenergy extraction
- ▸ Disposal of dredged material
- ▸ Coastal turism
- ▸ Seabed mining
- ▸ Data

Rules for layer:

Value is a product of rules.

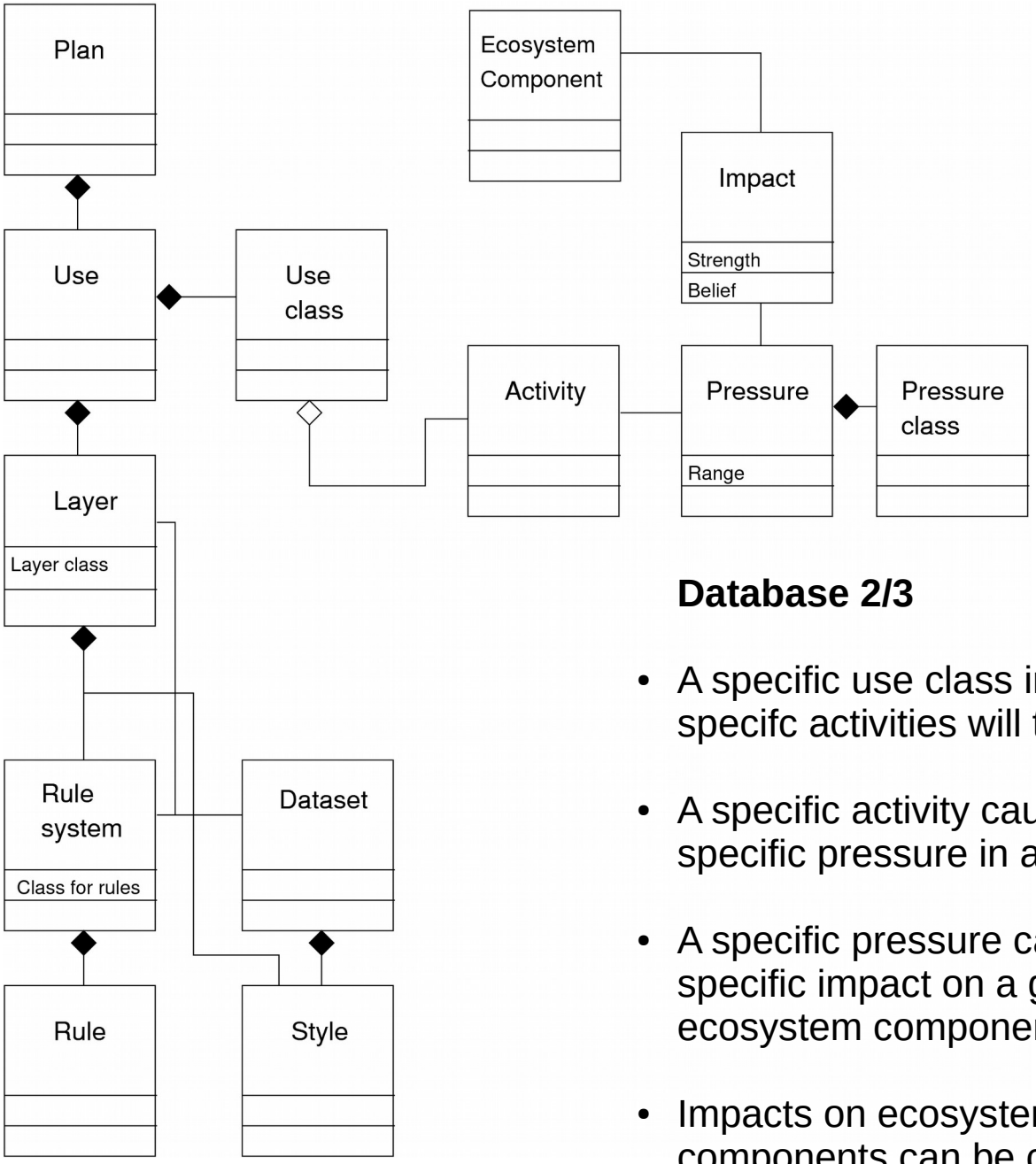
- ☑ WS_75M >= 1
- ☑ Natura 2000 >= 1

Explain site

1

0

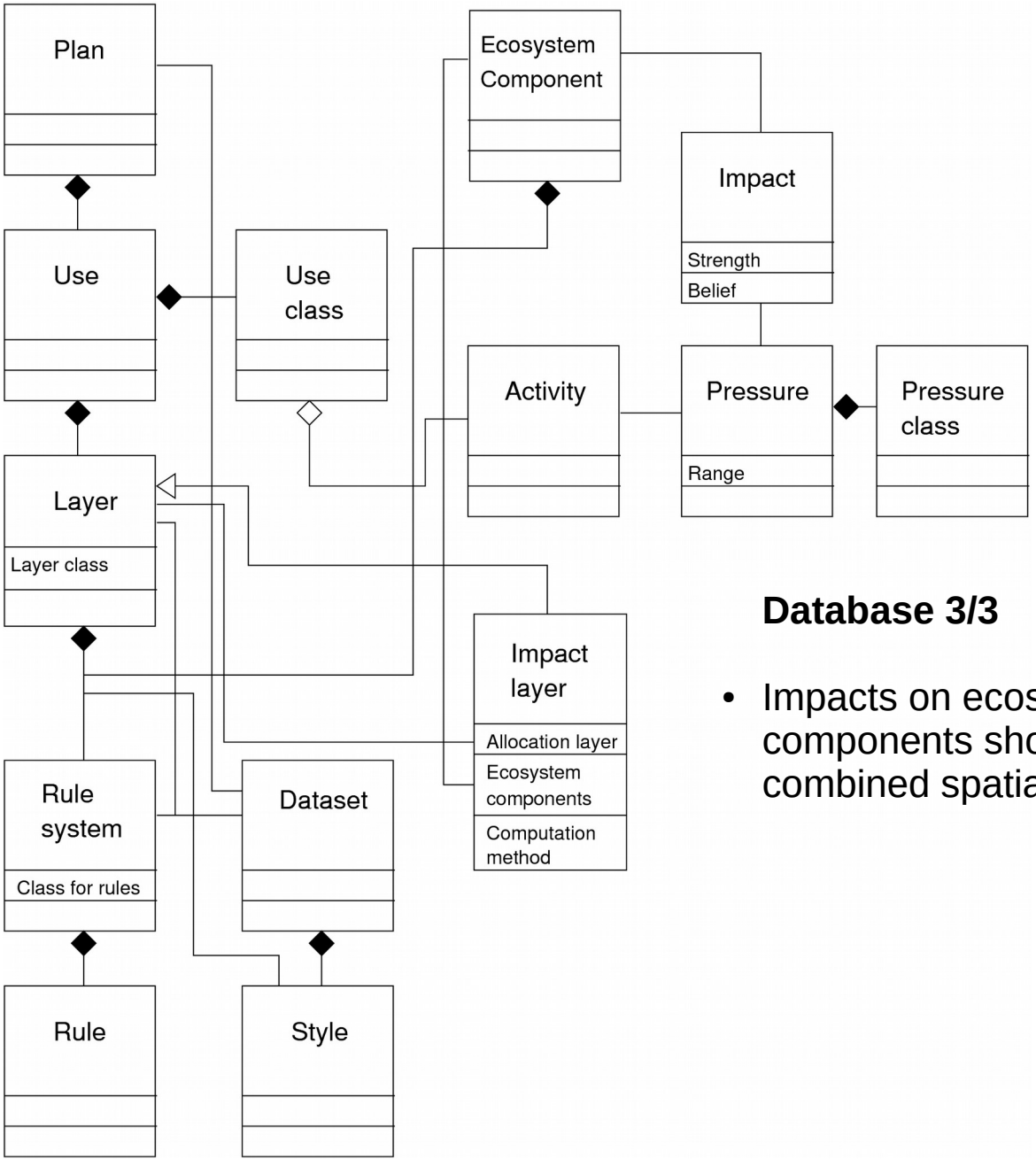
From results
To data



Database 2/3

- A specific use class implies specifc activities will take place
- A specific activity causes a specific pressure in a given range
- A specific pressure causes a specific impact on a given ecosystem component
- Impacts on ecosystem components can be combined


localhost:5000/core_auth/browser/plan:13/use:29
All classes
Show all Plans edit this one
id: 13
name: test
Extra datasets
Lohirysät Remove
Etäisyys asutukseen Remove
Distance to house Add
Show all Uses edit this one
id: 29
name: test.Active recreation
plan: test
use_class: Active recreation
Activities
Vacation homes
Motor sports on water
Fishing, which affects the seafloor
Beach restoration
Boat traffic in shallow water
Buoys, anchoring, seamarks
Motorboating
Atmospheric deposition
Hunting
Climate change
Ecosystem impacts
Coastal fish < 0 m: 2.19 < 500 m: 2.36 < 1 km: 2.33 > 20 km: 2.11
Pelagic fish < 0 m: 1.70 < 500 m: 1.95 < 1 km: 1.89 > 20 km: 1.48
Seabirds < 0 m: 3.07 < 500 m: 3.96 < 1 km: 3.96 > 20 km: 3.05
Seals < 0 m: 3.06 < 500 m: 3.11 < 1 km: 3.11 > 20 km: 3.00
Spawning grounds < 0 m: 3.00 < 500 m: 3.05 < 1 km: 3.05 > 20 km: 3.00
Vegetated muddy bottoms < 0 m: 3.82 < 500 m: 3.97 < 1 km: 3.97 > 20 km: 3.12
Vegetated rocky and stony bottoms < 0 m: 3.96 < 500 m: 3.99 < 1 km: 3.99 > 20 km: 3.80
Vegetated sandy bottoms < 0 m: 3.94 < 500 m: 3.99 < 1 km: 3.99 > 20 km: 3.68
Layers
test.Active recreation.Allocation edit Remove
test.Active recreation.Suitability edit Remove
test.Active recreation.Impact edit Remove
Utility Create



Database 3/3

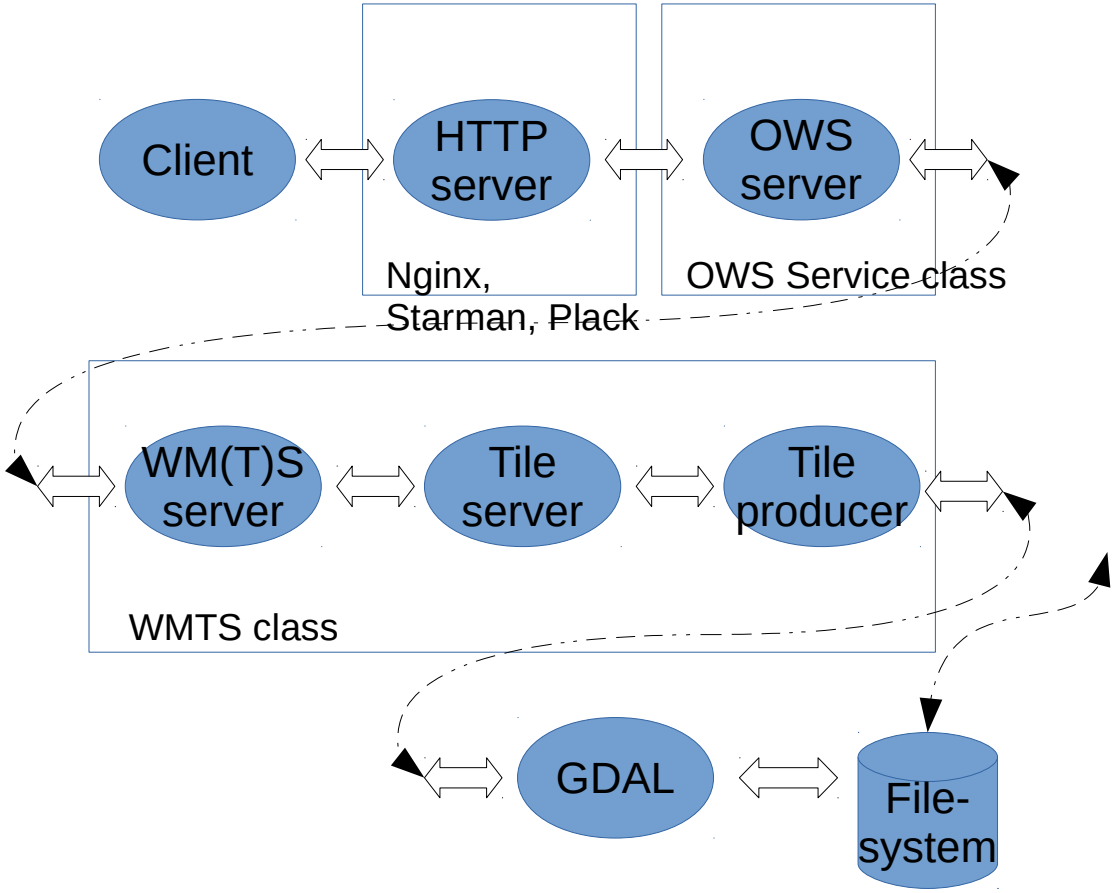
- Impacts on ecosystem components should be combined spatially

Database technology stack

- RDBMS (PostgreSQL) (SQLite for tests)
  - > 30 tables, heavy use of foreign keys
- ORM (DBIx::Class)
  - Classes for each table
  - Objects represent rows in tables or selects on tables
  - Automates references and relationships
- Wrapper class for a ”generic” web-page (HTML) oriented CRUD (create-read-update-delete) API
  - Conceptual ”parent-child” relationship can take many forms in the RDBMS and ORM is not (at least a full) a solution
  - A RESTful API may be what is needed a little further down the line

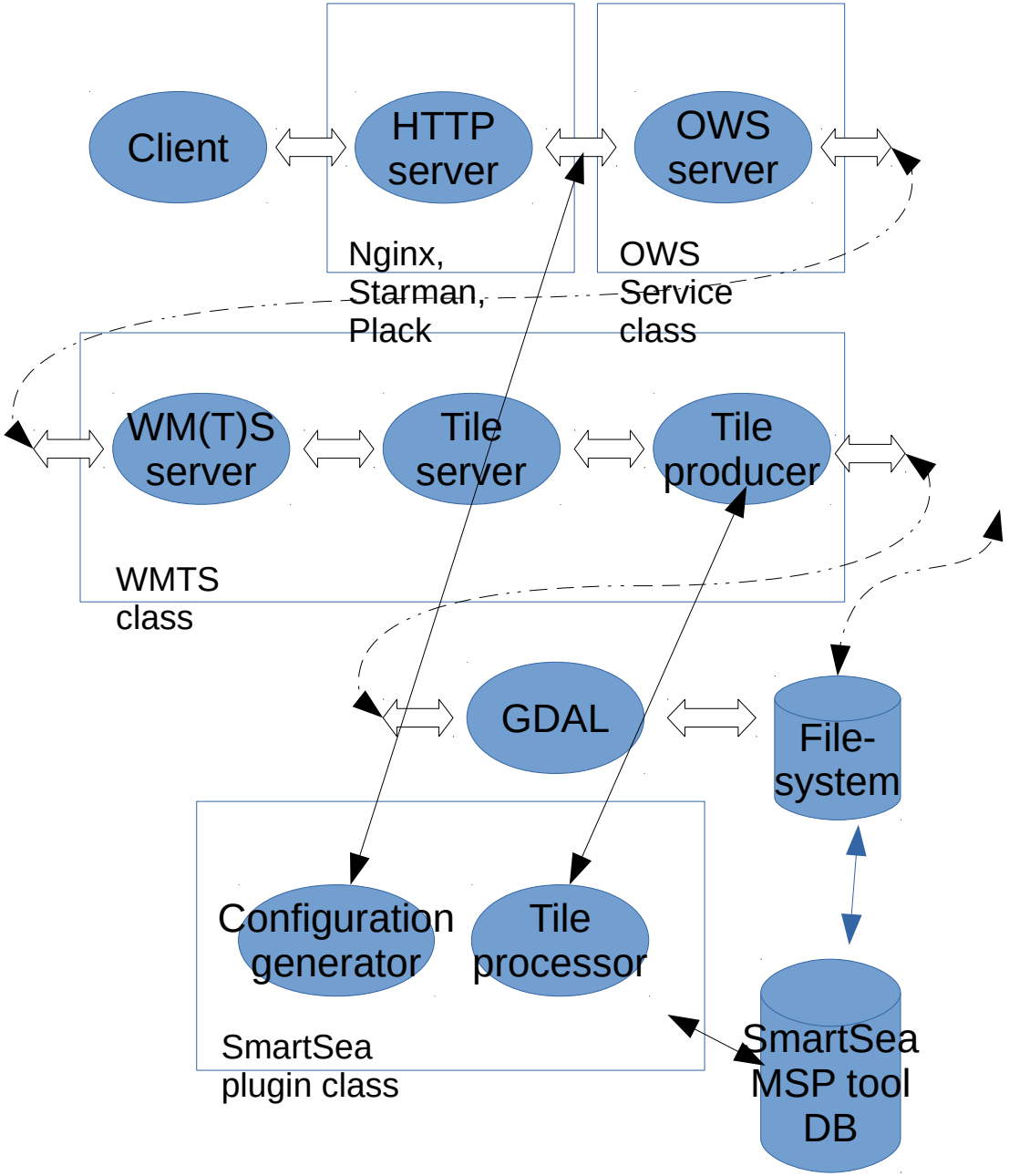
Web Map Tile Service (WMTS)

- Service of map tiles of predefined content, extent, and resolution
- Limited set of resolutions
  - One step finer resolution tile is ¼ of a tile of coarser resolution
- Very good user experience in a browser
- WMTS is commonly viewed as a service of predrawn tiles
  - In this work we implemented a plugin mechanism to modify or create the requested tiles
- Depending on the client library (QGIS: no, OpenLayers: yes) the ”predefined content” rule can be relaxed



WMTS 1/2

- Serving a map tile can happen according to several standards but has a typical pipeline
- Typically tiles are stored as files in a file system
- With some additional code tiles can be generated on-the-fly by, e.g., clipping a single (or virtual) file



WMTS 2/2

- Hooking a plugin into specific locations in the service, it can be turned into a dynamic service
- Even more dynamism can be added to the service by user identification (cookies, user authentication)
- OpenLayers WMTS client does not query capabilities, QGIS does => less flexibility with QGIS

Conclusions, Open Questions

- Is our analysis, and thus the vision (spatial modeling), and thus the software development correct?
-
- The required computing power of dynamic map service?
-
- Impact modeling, integrated risk assessment are complex tasks
-
- The end user community is still emerging/organizing itself
- What will be important:
  - Stakeholder/citizen participation?
  - Spatial design?

Thank you!

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