



Education, research and development in an institutional cooperation towards the establishment of an open source GIS platform

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Geoinformatics education module

- In 2004 the *Geoinformatics* educational module started as part of the Software Engineering Master Education at *Eötvös Loránd University, Faculty of Informatics (ELTE IK)* with five courses:
 - Introduction to Cartography,*
 - Geoinformatics,*
 - Spatial Databases,*
 - Remote Sensing Image Analysis,*
 - GIS Application Development.*
- Up to now, more than 400 students have completed the module. The number of masters' theses has significantly grown in this area.
- Geoinformatics has appeared in papers presented in Scientific Students' Association, and it is also included in PhD courses.

Research is GIS

- The informal research association called *Creative University GIS Workshop (TEAM)* was established in 2004.
- Research topics include:
 - Automatic raster-vector conversion of maps using knowledge based approach (*IRIS*),
 - The development of University Digital Map Library (*EDIT*),
 - The development of a library of image filtering procedures (*GEO FilterBank*),
 - Three dimensional viewing of globes via web (*Virtual Globes Museum*).

Cooperation between ELTE and FÖMI

- Continuous improvement of image analysis methods has always been an important part of operational projects, in which *Institute of Geodesy, Cartography and Remote Sensing (FÖMI)* works together with ELTE since the early 80's.
- Common fields include segment-based processing of satellite images and data fusion methods.
- Students with interest in this field may complete their professional practice at FÖMI in the frame of Cooperative Education.

Segment-based classification

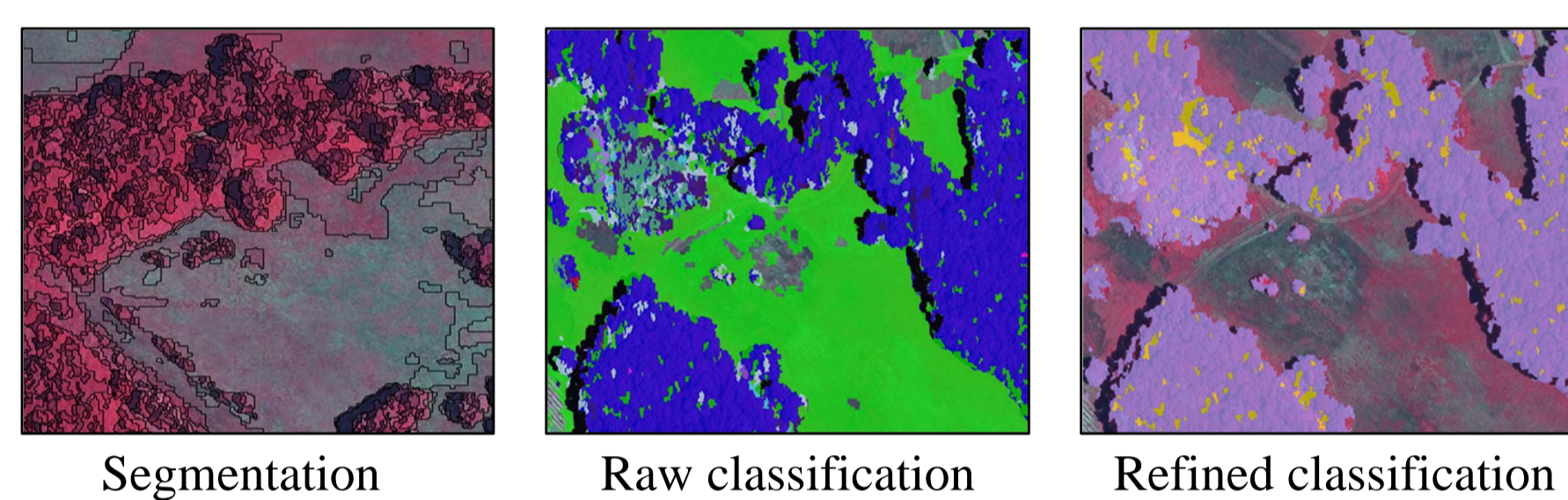
- Traditional pixel-based classification methods completely disregard spatial relations. To overcome this drawback, segmentation was introduced with the aim of extracting neighborhood information and preserving natural homogeneity.
- The following methods were implemented and analyzed.
 - Merge-based, "bottom-up" methods:* sequential linking, best merge and graph based merge,
 - Cut-based, "top-down" methods:* minimum mean cut, minimum ratio cut, normalized cut.
- With the introduction of fully segment-based classification, the thematic accuracy grew to 91-95%, about 2-3% more than that of pixel-based method.

Object-based case studies

- The following three case studies were performed with the *Definiens/eCognition* software suite using segment-based classification methods.

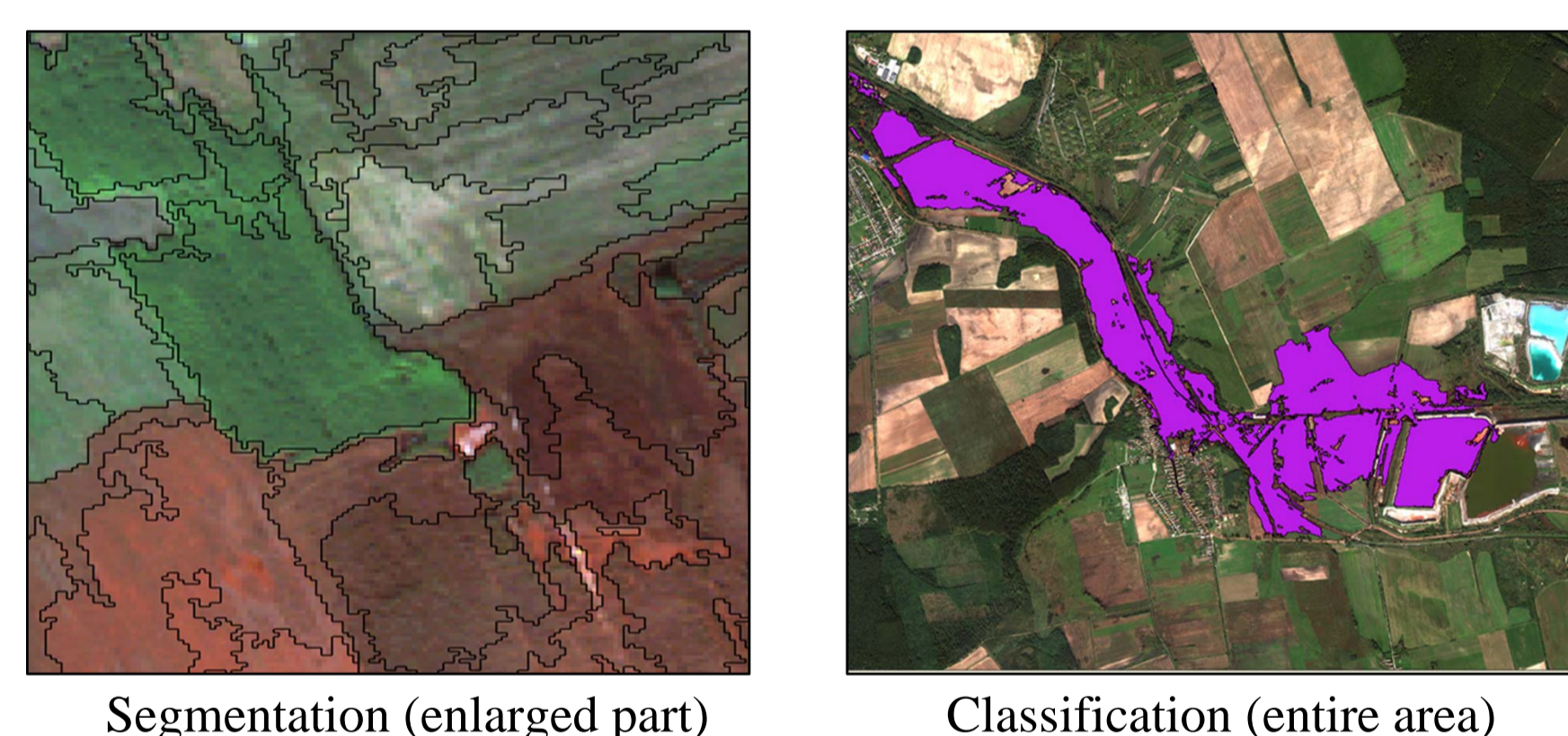
Identification of ineligible land

- In *Land Parcel Identification System (LPIS)*, an important property of areas is whether they are subsidized (eligible for agricultural payments). The goal of application is to automatically delineate (ineligible) scattered trees and bushes appearing on (otherwise eligible) pastures.
- In some cases the question cannot be decided even by visual interpretation. Segment-based classification was proven to be appropriate in the majority of cases examined.



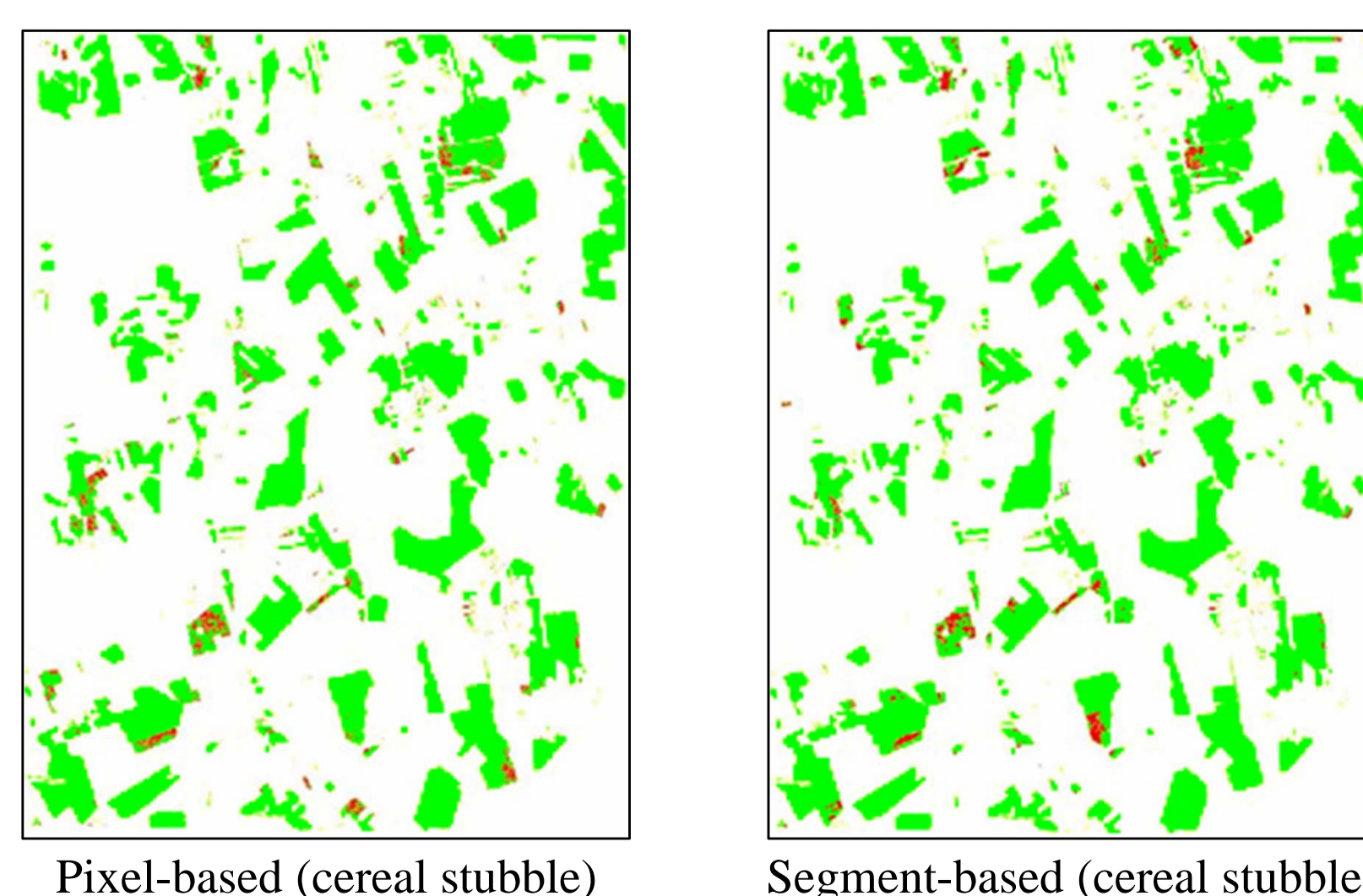
Observation of red mud spill

- On 4 October 2010, industrial red sludge spill caused serious environmental damage in the surrounding of Ajka town (North-Western Hungary).
- It was important to urgently deliver map information of spilt areas to help the assessment of damage and salvage.
- Original band values, vegetation indices and their standard deviation were used in the classification, taking into account red, red-edge and near infrared bands.



Ragweed monitoring

- Among invasive alien species, ragweed causes serious problems in Hungary, because of the allergenic effect of its pollen. Since 2005, remote sensing highly supports its exemption.
- As an experimental research project, very high resolution (VHR) satellite images were processed with a segment-based method. The matching between results of segment-based and pixel-based processing is about 90%.

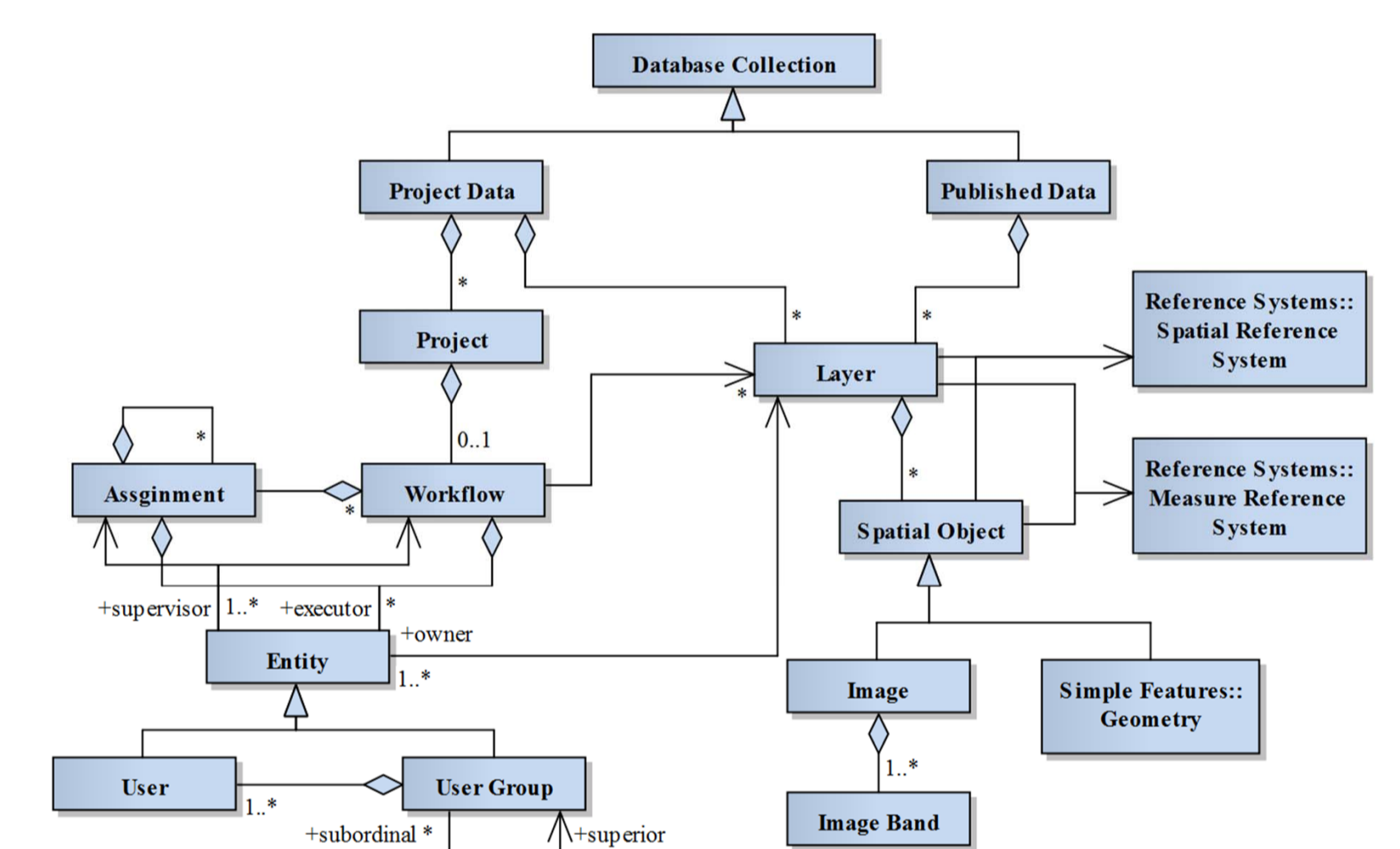


Development of the AEGIS system

- The purpose of *AEGIS* is developing a multi-platform, open source, client-server architecture geographic information system with broad functionality and efficient data processing capabilities.

Main features

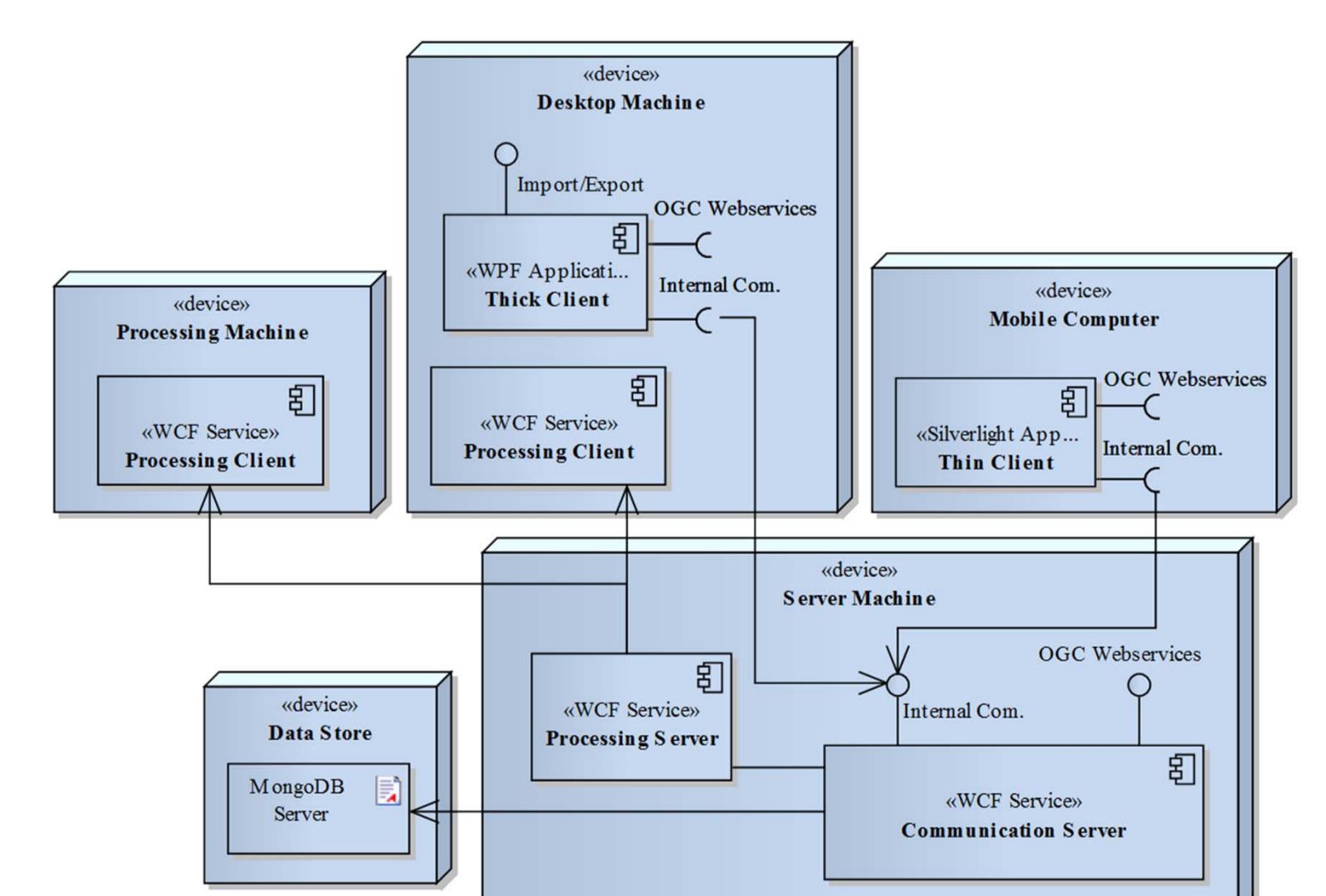
- Desktop and mobile graphical user interfaces.
- Project based and revision controlled storage of spatio-temporal data.
- Import and export of data in any standard GIS format and OGC web services.
- Extendible processing library with scripting support. Resource demanding operations carried out in computational cloud.
- Online, services based communication of subsystems via encrypted channels.
- Data analysis, process modeling and simulation. production of spatial and temporal statistics.
- Comprehensive user rights control with task scheduling and activity management.



AEGIS database and project management architecture

System components

- Thick Client:* A fully functional desktop GIS browser and editor application. It features 3 dimensional graphics view (implemented in XNA) with editing, analysis and simulation possibilities.
- Thin Client:* A simplified application for desktop, browser and mobile platforms built in Silverlight with reduced operating possibilities.
- Processing Services:* Realizes the computational cloud. The server side aims to distribute operations and data among running clients that execute them and return results to the server.
- Server Services:* The server provides connection between client machines using encrypted channels through WCF and also provides OGC web services.



AEGIS system components

Acknowledgements

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