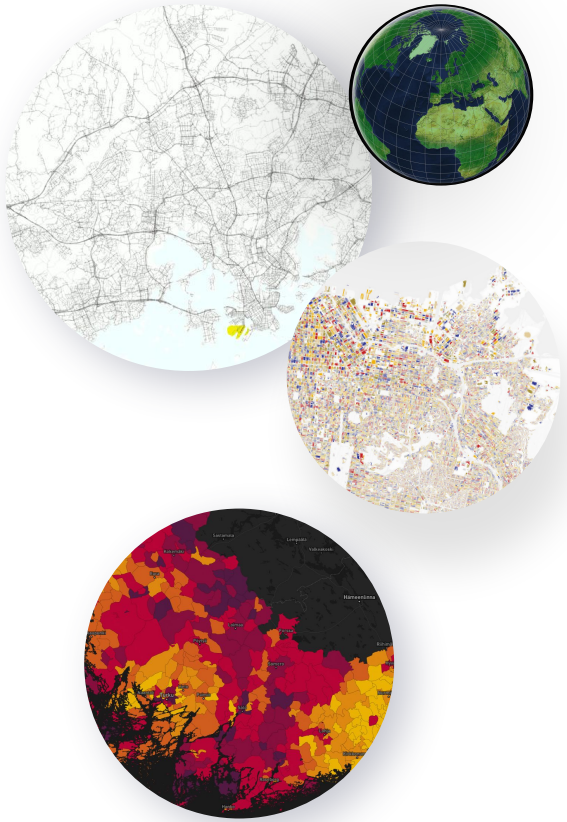
Building an Enterprise GIS workflow with QGIS and PostGIS

Kartdagar 2024, 17.4.2024

Pekka Sarkola - Gispo Sverige AB

Gispo

- **Founded** in 2012
  - 25+ employees
- **We consult** our customers on how to utilize FOSS4G solutions and open data efficiently
- **We develop** software
  - QGIS plugins and QGIS core
- **We train** our customers in GIS – 100+ organizations and 1000+ people
- **We support** our customers who use FOSS4G
- **Open source advocate** and capacity building with open source



We **support our customers** so that they can gain competitive advantage **with FOSS4G** (Free and Open Source Software for Geospatial) **and Open Data**.

We **support the development** and usage of open source and open data and act as an open source advocate.

Enterprise GIS

Enterprise GIS

__BIG__ thing to sold
by __KEY__ account managers
to __BIG__ customers
with __BIG__ amount of €£$'s

By unidentified head of BIG GIS company

Enterprise system

***Enterprise software**, also known as enterprise application software (EAS), is computer software used to **satisfy the needs of an organization rather than individual users**.*

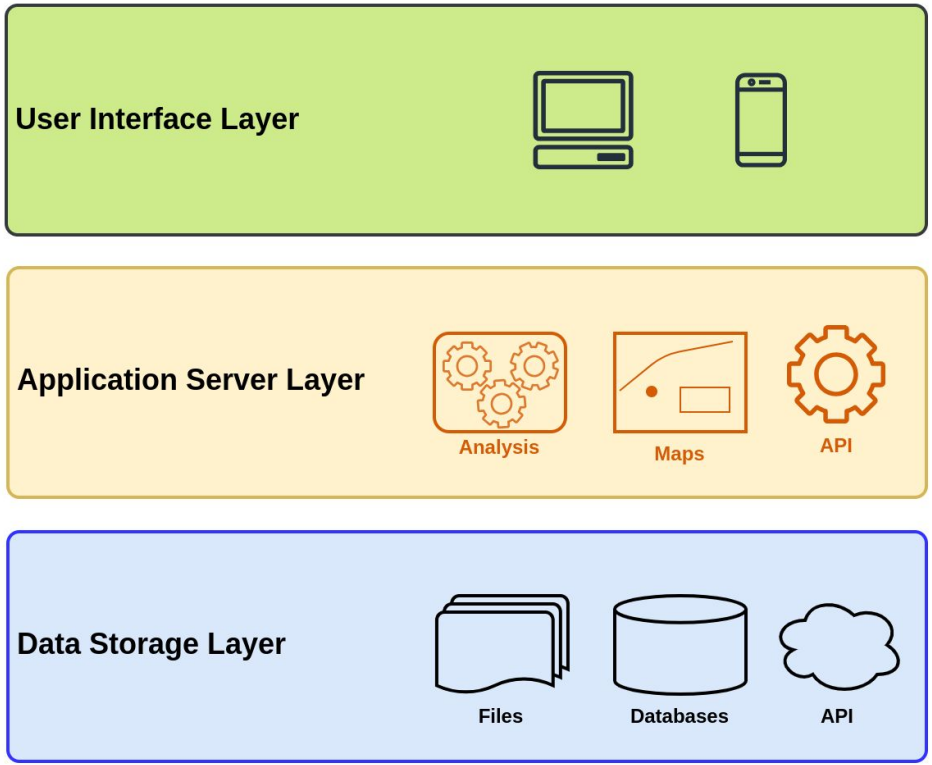
Enterprise software** is an integral part of a (computer-based) information system; a collection of such software is called an **enterprise system.

Enterprise software by Wikipedia

Enterprise GIS

- Organisation wide collection of interoperable GIS softwares to manage and process geospatial information
- Not one desktop
- If one person is leaving, process won’t stop
- Focusing rather to organizations process than projects
    - Project will start and end, have limited resources (time, money, people)
    - Processes are vital to organizations to fulfill their commitments

Architecture of Enterprise GIS

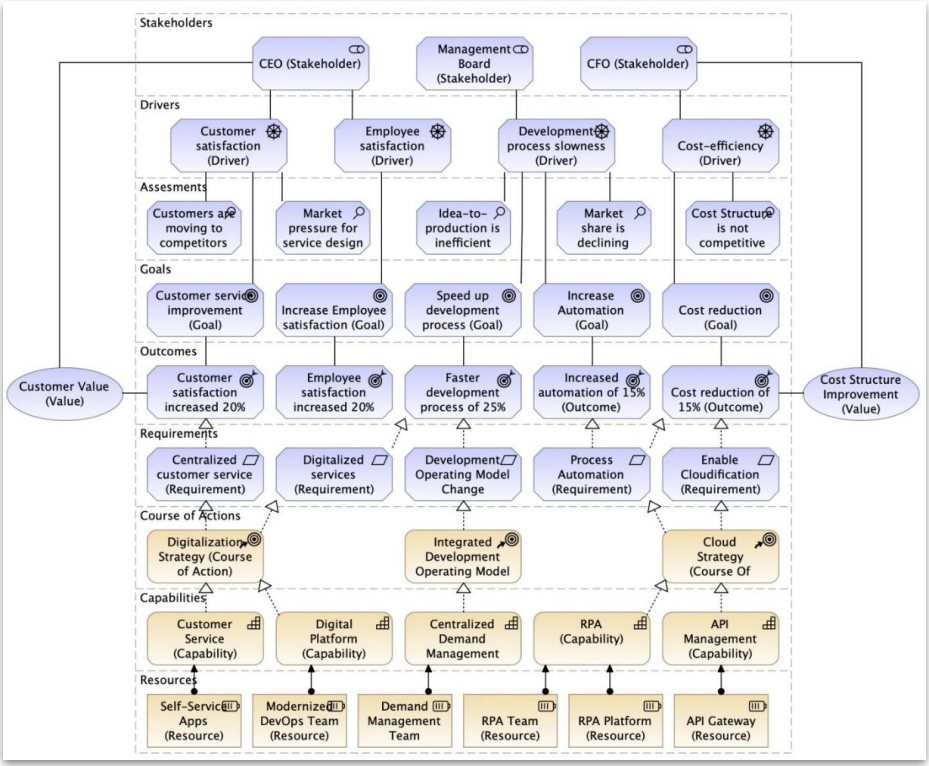


How to build Enterprise GIS?

- Start with principles of the Enterprise architecture
- First step
  - Check if your organisation has already defined Enterprise architecture
  - If yes or no, you will have a long path to go
- Enterprise GIS architecture is part of organisation’s Enterprise architecture.
- However, sometimes GIS people should show the path

Enterprise architecture

- Very complex concept to cover in this presentation
- Not technology design tool
- Discussion “tool” between business owners and IT people
- Documentation tool
- Tools
  - Archimate (open source)
  - Also commercial tools available

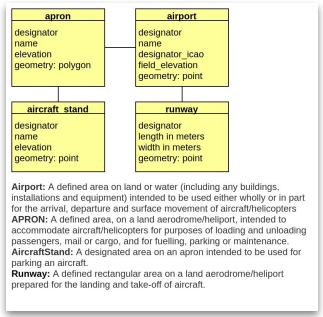


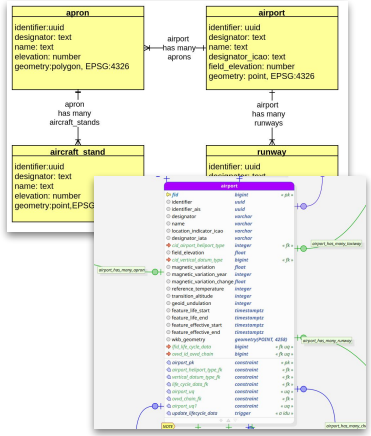
Archimate Cookbook: https://www.hosiaisluoma.fi/blog/archimate/

Where to start Enterprise GIS architecture?

- Description of the current processes
  - Process owners and actors
  - Goals of the processes
  - Outcome of the processes
- After describing the processes
  - Are processes good enough? Should we simplify them?
  - Does current IT (GIS) systems support our processes?
- Who will describe the processes?
  - You: internal actor has strengths and weaknesses
  - Consultant: “Fire is a good farmhand, but a bad master”

Data Architecture in Enterprise GIS





- Define and document the followings:
  - Conceptual data model
  - Logical data model
  - Physical data model
- Data architecture description should include also external datasets
  - Very few GIS systems does not include any external datasets
  - Are you using external dataset via API or do you download copy of the dataset?
  - How often you update dataset?

Application Server Architecture in Enterprise GIS

- Typical GIS Application servers services are:
  - Map APIs (WMS, WMTS)
  - Data APIs (WFS, WFS-T, WCS, OGC API Features)
  - Geoprocessing services (like routing, geocoding)
  - Web Map applications
- Describe internal services to implement
- Describe external services to use
  - Make also vulnerability analysis of external services: how long we can continue our processes without external services?

User Interface Layer in Enterprise GIS

- This is what end-users will see, all other parts will serving this layer
- Different solutions for different use cases:
  - Desktop Application
  - Web application (both desktop and mobile usage)
  - Mobile Application (online and offline usage)
- If you have only one (1) user interface, your system is **not** Enterprise GIS

Fast lane for Enterprise GIS

1. Describe processes
2. Design data layer
    a. Create data models (conceptual, logical, physical)
    b. Define external data sources
3. Design application server layer
    a. Design internal services
    b. Define external API services
4. Design User Interface layer
    a. What tool to whom to do what?

Then iterate through 2-3 times!

FOSS4G software

FOSS4G software

- Free and Open Source software for Geospatial
  - Wide definition: “Any GIS software with Open Source license”
- OSGeo Project software
  - FOSS4G software which has pass Open Source Geospatial Foundation Incubation process
  - OSGeo standards for professional governance and development
  - OSGeo donations and annual budget
- Choosing right software is always tricky task
  - Learn, test and analyse in your environment and for your processes
  - Communicate with other FOSS4G users: local or industry
  - Deploy PoC (Proof-of-Concept) system

Open Source GIS Stack

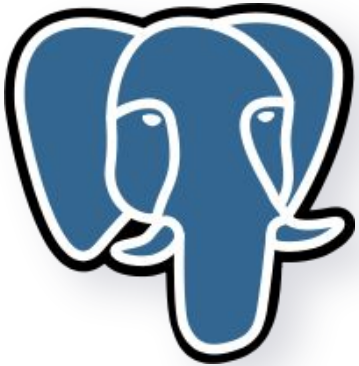
Desktop Mobile	GIS Server	Database	Front End and Libraries
QGIS	GeoServer	PostGIS	OpenLayers
GRASS GIS	MapStore 2	PostgreSQL	Leaflet
gvSIG	GeoNode	GeoPackage	CESIUM
	QGIS SERVER	Spatialite	GDAL
merginmaps	Liz map		GeoTools
	MapServer open source web mapping		ORFEO ToolBox cnes

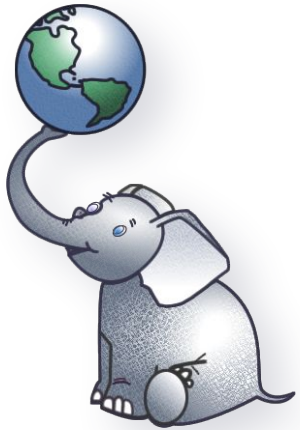
FOSS4G: Free Open Source Software for Geospatial

PostGIS

PostgreSQL with PostGIS

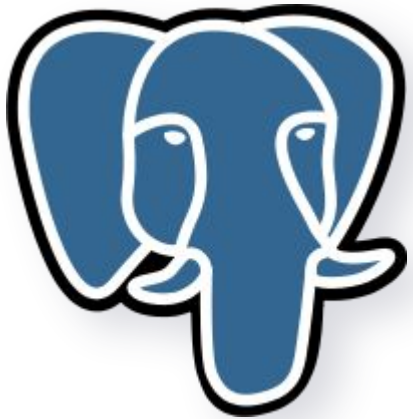
- Database management system: **PostgreSQL**
- Database management system spatial extension: **PostGIS**





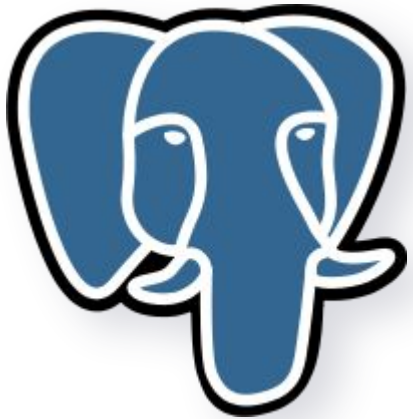
PostgreSQL

- Object-relational management system (ORDBMS)
- Transactional RDBMS
- Developed in University of California, Berkeley
- License: BSD/MIT
- www.postgresql.org



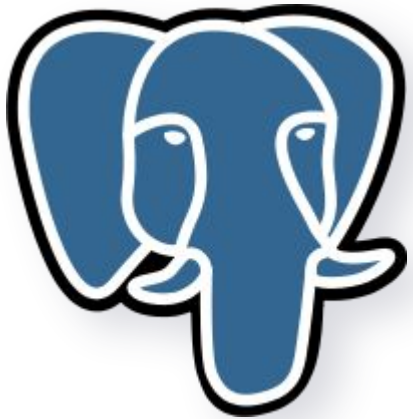
History of PostgreSQL

- Berkeley’s POSTGRES project
  - 1986 - 1994 - POSTGRES 4.2
- Postgres95
  - 1994 - 1996
  - Support for SQL, ANSI C
- PostgreSQL
  - 1996 →



Why Postgres?

- Openness
- Freedom of action
- Multiple platforms
- Designed for heavy use
  - Multiversion Concurrency Control, MVCC
- Extensibility
- Less maintenance
- Costs



Why not Postgres?

- PostgreSQL is a server software
  - SQLite, Firebird are better embedded databases
- If a key-value-store solution is required
  - NoSQL vs. YesSQL
- If only data archival is required

Proprietary and cloud versions

- Amazon RDS & Amazon Aurora
- Azure Database for PostgreSQL
- Google Cloud SQL for PostgreSQL
- EuroDB
- FUJITSU Enterprise Postgres
- Postgres Plus Advanced Server
- Aiven.io

PostGIS extension

- Refractions Research, first version 2001
- Implementation of the *Open Geospatial Consortium (OGC) Simple Features for SQL* –standard
- Why PostgreSQL?
  - Careful support for SQL standards (full SQL92)
  - Pluggable type extension and function extension
  - No limit on column sizes
  - Generic index structure (GiST) to allow R-Tree index
  - Community-oriented development model

Features of PostGIS

- Around 300 spatial functions - possibility for GIS analysis
- Support for raster and vector data
- Linear referencing
- 3D-data
- Extensions
  - pg_routing: Route/network optimization
  - pointcloud: Point cloud management
  - ogr_fdw: Reading spatial data directly

QGIS

QGIS

- QGIS (originally Quantum GIS) is an open source desktop software
- Quantum GIS 1.0 was published in January 2009
- QGIS has currently 30+ core developers
- Funding directs the development
- Various extensions
- More information: www.qgis.org

Technical information

- C++ and Qt
- Python API
- QGIS works with almost all operating systems
  - Windows, macOS, Linux, Docker, Conda, Android…
- Integrated software
  - GRASS GIS
  - PDAL
- New versions every 4 months, long-term releases (LTR) yearly
  - Point release (patches) every month

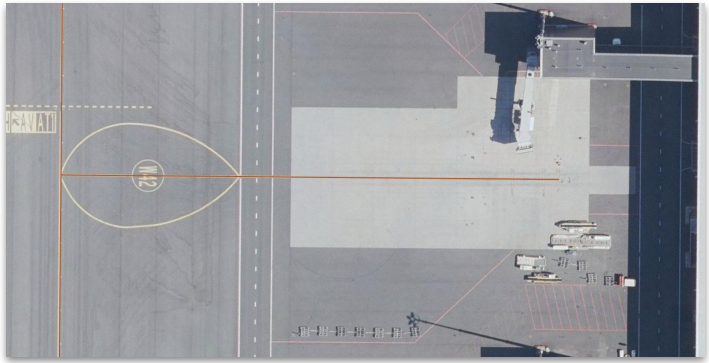
Enterprise GIS with FOSS4G

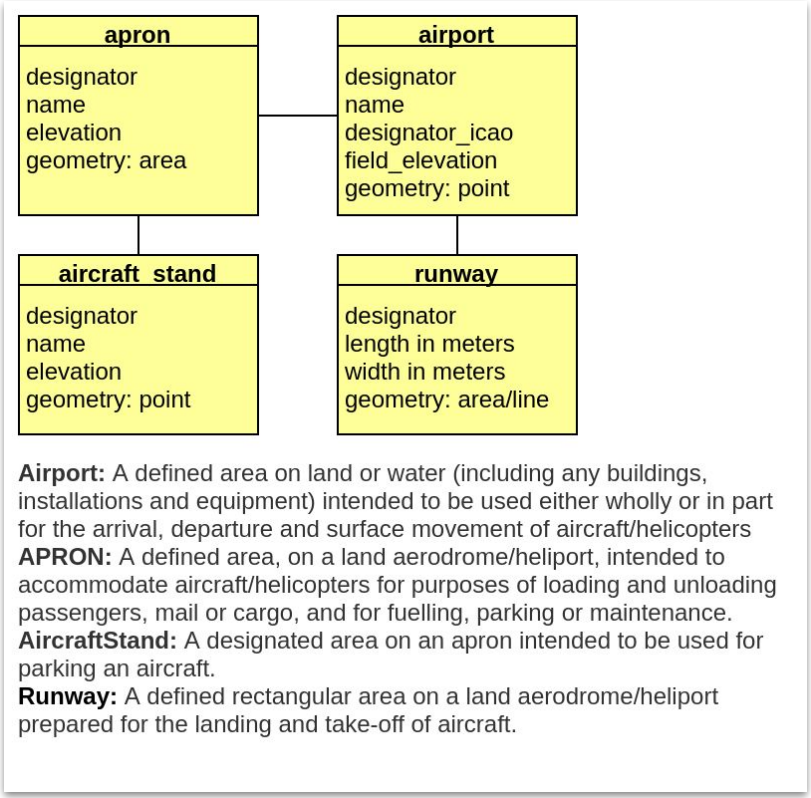
Steps to create Enterprise GIS with FOSS4G

- Describe processes
  - Not technology dependant
- Design data model for your own data
  - Only physical data model is technology dependent
  - PostgreSQL/PostGIS is your database selection
- Choose FOSS4G software
  - Application server
  - Desktop application
  - Mobile application

Conceptual data model

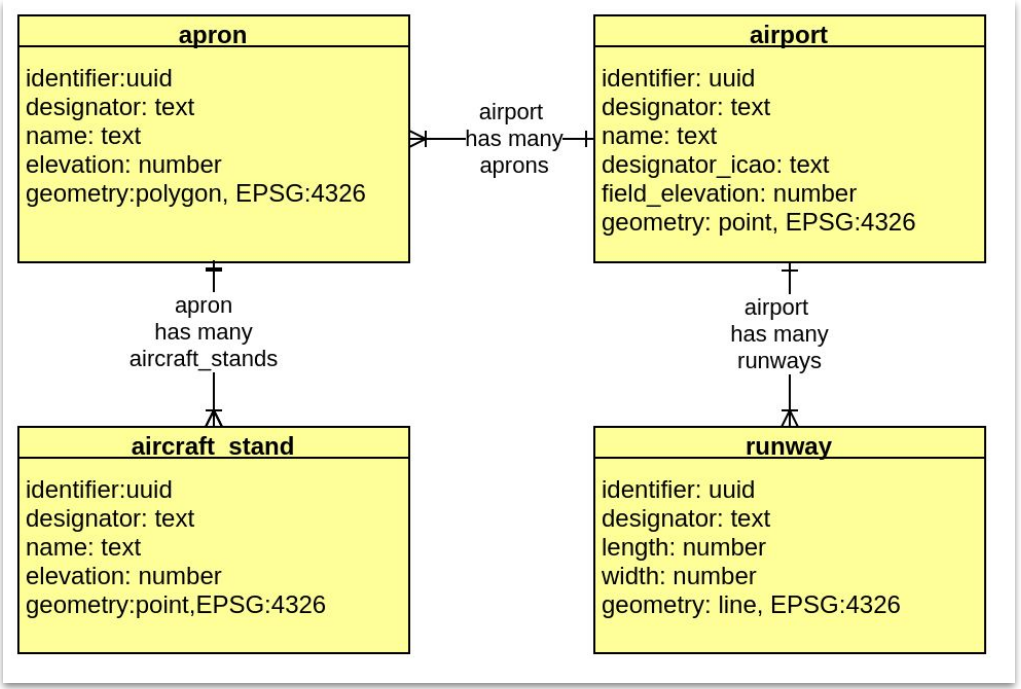
- Basic information
- Terminology
- Made with domain experts
- Tools
  - Your selected tool





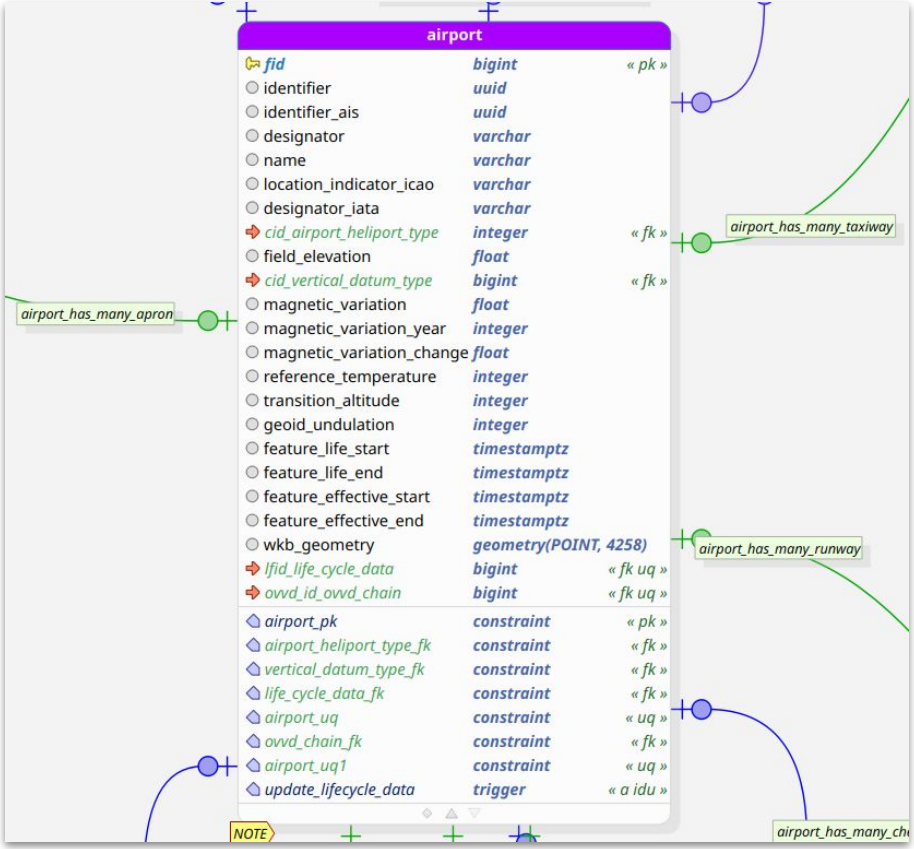
Logical data model

- More information
- Include already information about data types and relations
- Tools
  - Archimate
  - DB design tool



Physical data model

- Technical implementation
- Technology dependant
- Remember also data access rules!
- Tools
  - pgModeler (PostgreSQL, open source)
  - Commercial tools



Application server selection

- What is your IT infrastructure?
  - Operating systems: Windows, Linux
  - On-premises or cloud (AWS, Azure, Google)
- What features do you need?
  - Only API's or full WebGIS capabilities?
  - Viewing services (aka Web Map?)
  - Editing geospatial information?
  - Dashboards, geostories?

Desktop application

- What is your supported operating system?
  - Windows, iOS, Linux (Ubuntu, Arch)
- What features you need?
  - Editing environment
  - Analysis tools
- Does your users know already some GIS desktop applications?

Mobile applications

- What do you want to do with Mobile app?
  - Viewing data in the field
  - Edit data in the field
  - Data collection in the field
- Is usage ad-hoc or part of the process?
- Can you install software or just using the browser?
- Online or offline usage?
  - What is mobile network coverage in your area?

Some FOSS4G architectures

Small municipality

User Interface Layer

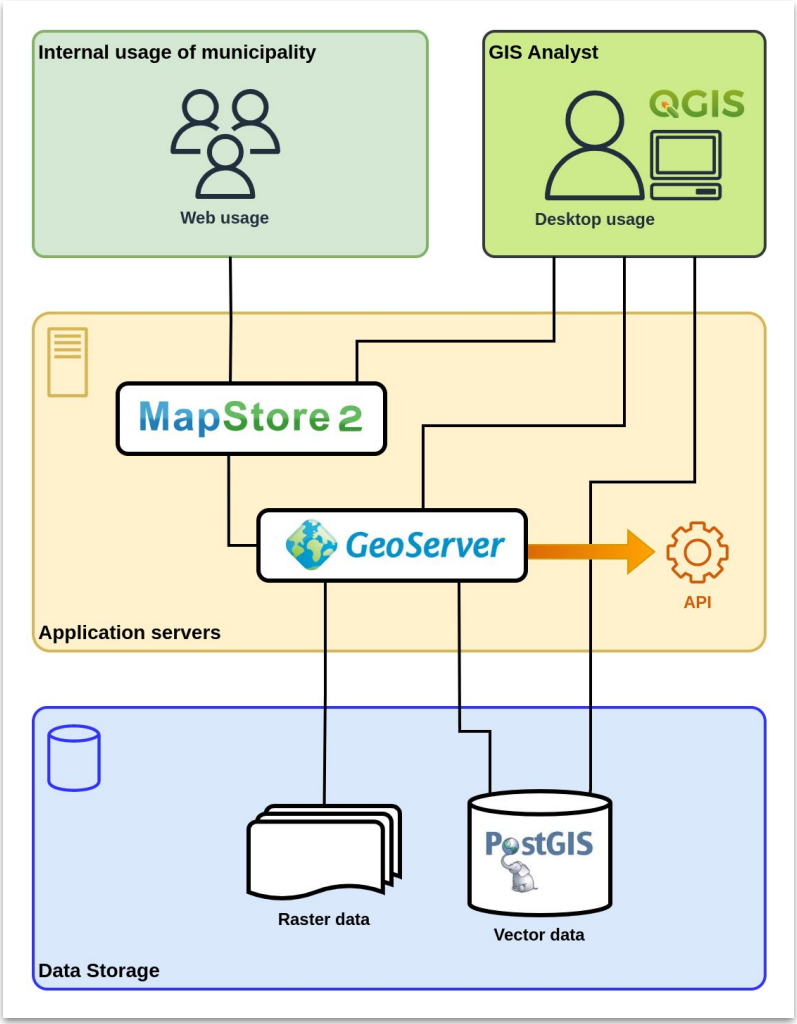
- Web Map for all
- QGIS desktop for GIS analysts

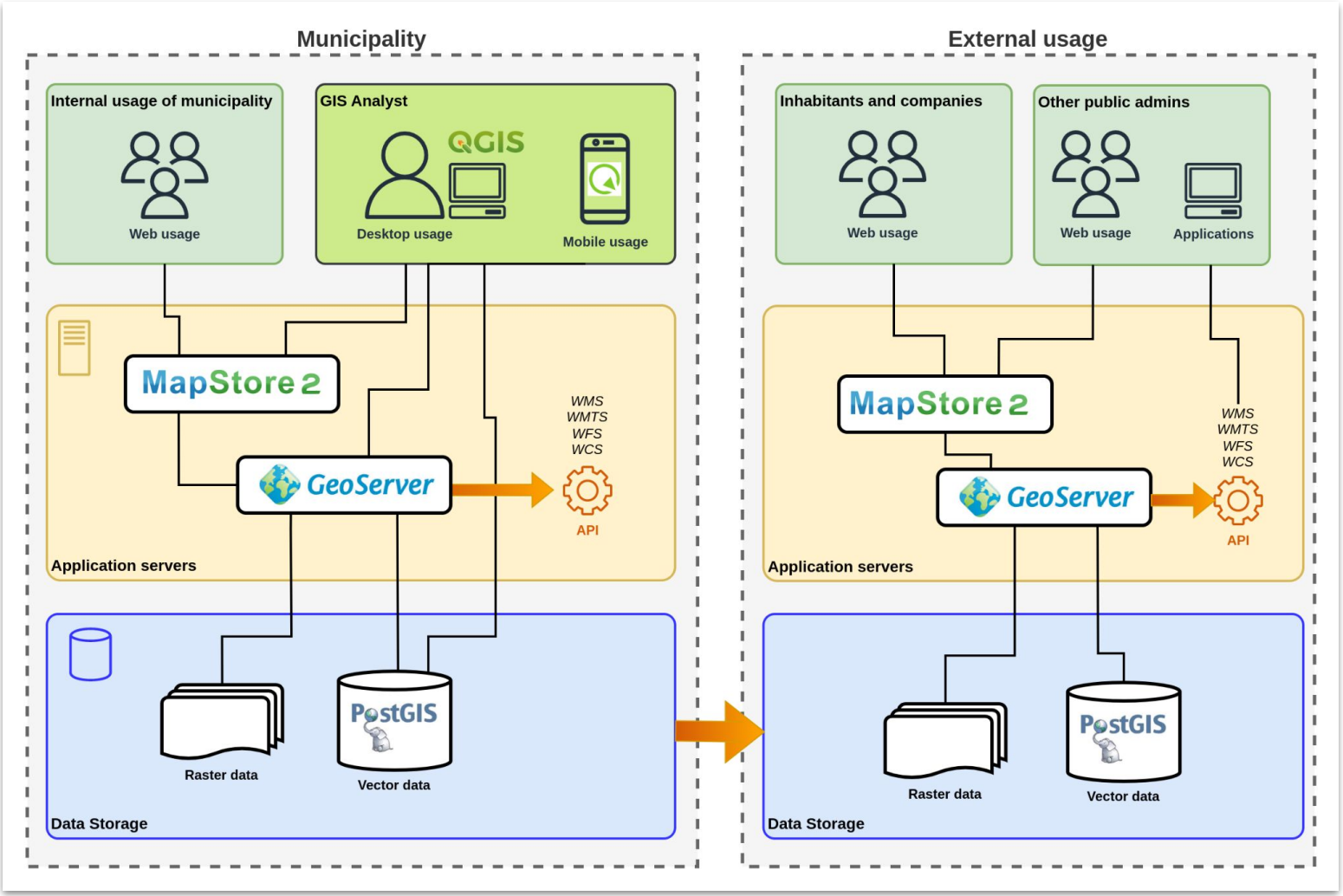
Application Server Layer

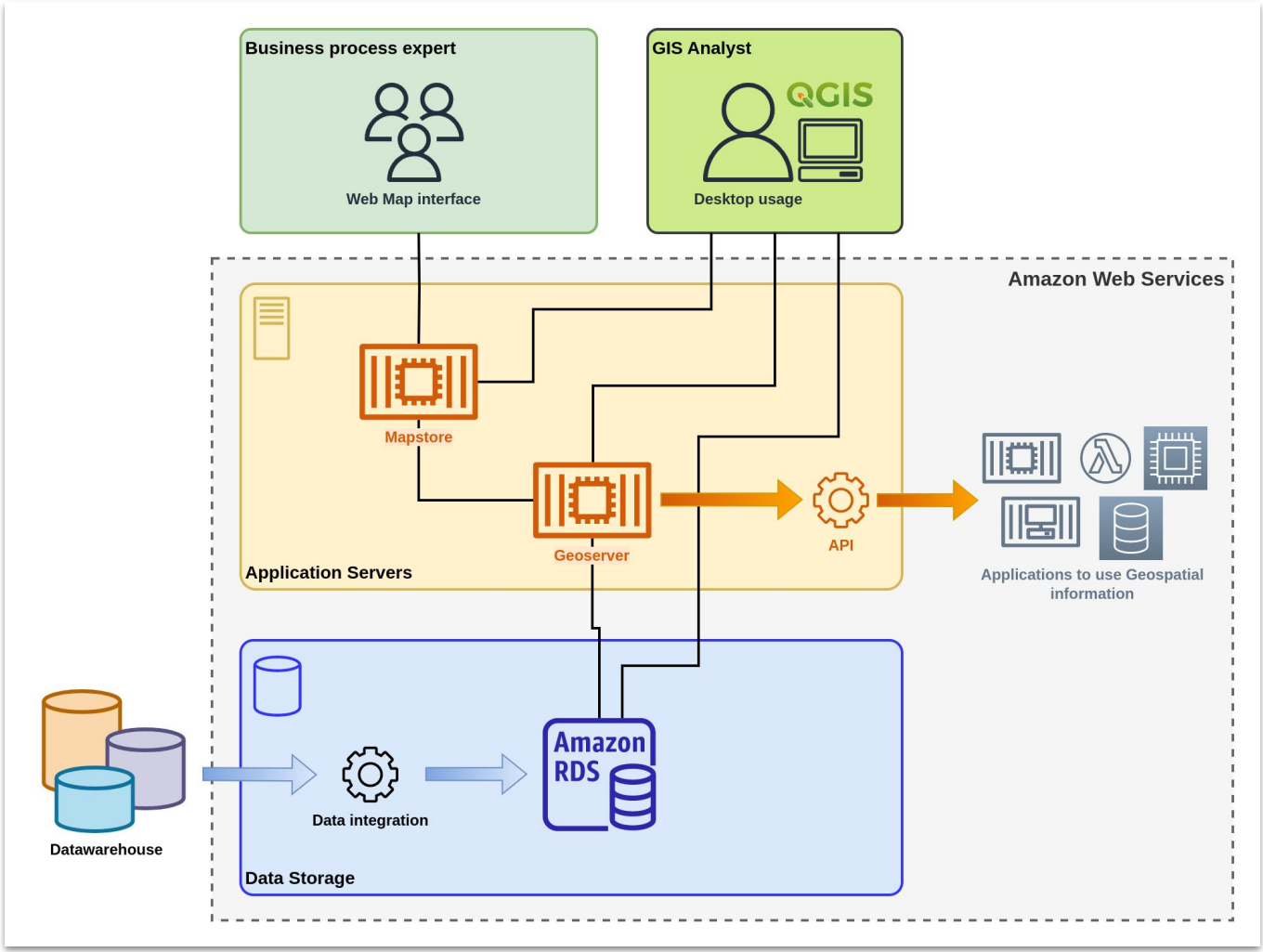
- Mapstore2 for web mapping
- Geoserver for GIS APIs

Data Storage Layer

- Raster data as files (imagery and raster maps)
- Vector data to PostGIS




Municipality
External usage
Internal usage of municipality
Web usage
GIS Analyst
QGIS
Desktop usage
Mobile usage
Inhabitants and companies
Web usage
Other public admins
Web usage
Applications
MapStore 2
GeoServer
WMS
WMTS
WFS
WCS
API
Application servers
Raster data
PostGIS
Vector data
Data Storage


Business process expert
Web Map interface
GIS Analyst
QGIS
Desktop usage
Amazon Web Services
Mapstore
Geoserver
API
Application Servers
Applications to use Geospatial information
Datawarehouse
Data integration
Amazon RDS
Data Storage

Part II - hands-on

Preparations for the next part

- Two options:
  - Do-it-Yourself (DIY)
  - Follow demonstration and learn

Workshop material

- Do-it-Yourself (DIY)
  - Follow workshop material:

    https://gispocoding.github.io/foss4g_kosovo_2023_workshop/
  - If any problems, please raise your hand
- Others
  - You can follow the screen, make notes and ask questions
  - You can check workshop materials later on

Wrap-up

Need more information?

- Gispo Sverige AB booth in exhibition
- Årsmöte för QGIS Sverige - 25.4.2024 - Sundsvall
- FOSS4G Europe 2024 - 1.-7.7.2024 - Tartu, Estonia
  - https://2024.europe.foss4g.org/
- QGIS User Conference - 9.-10.9.2024 - Bratislava, Slovakia
  - https://uc2024.qgis.sk/
- FOSS4G 2024 - early Dec 2024 - Belém, Brazil
- QGIS User Conference - May-June 2025 - Sweden

Some blog posts

- PostGIS and ArcGIS: are they compatible?
- GeoPackage vs. PostGIS
- Vector tiles with React, MapLibre and pg_tileserv
- On the rising importance of SQL for geospatial data experts
- Getting started with QGIS plugin development

Enterprise GIS with FOSS4G

- Affordable solution for all size of organizations
- Freedom of action, digital sovereignty
  - You make decision, how you use the software
  - Avoid vendor lock
    - By whom you can buy related services: training, consultation, development
  - Cost management
    - How much you will pay next year? And year after?
- “Code is law”
- Have fun and join the FOSS4G community!

Questions?

Contact information

- **Pekka Sarkola:** Pekka.Sarkola@gispo.se
- **Gispo Sverige AB:** info@gispo.se