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Plan4all

Data Sharing Requirements

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[1] OJ L 79, 24.3.2005, p. 1.

Contents

1. Introduction to data sharing requirements

1.1 Purpose of document

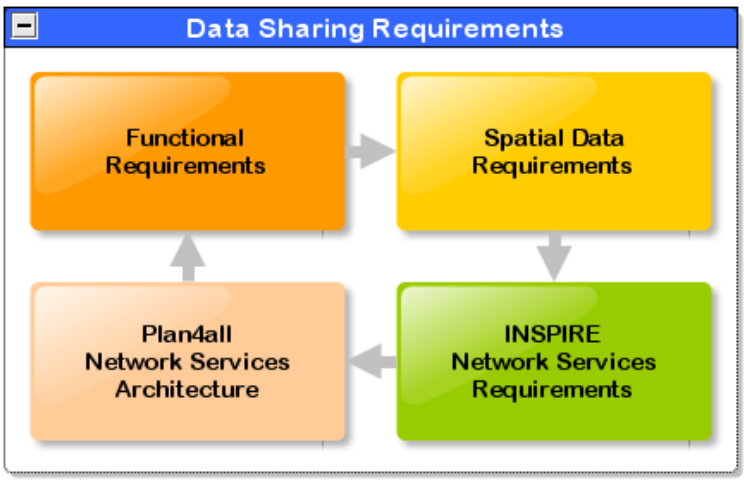

Figure 1: The different sets of requirements which define the Plan4All network service architecture

Document purpose is to formalize Plan4all networking and data sharing requirements as well to make recommendations for architecture and suggest possible used components. This work will be based on the analysis of INSPIRE networking requirements and previous work package (WP) collected data and survey results.

This document mainly is intended for technical partners in charge of networking design architecture. In addition, this deliverable is relevant to any person inside the Plan4all project interested in learning about the Plan4all architecture.

1.2 Document notation and conventions

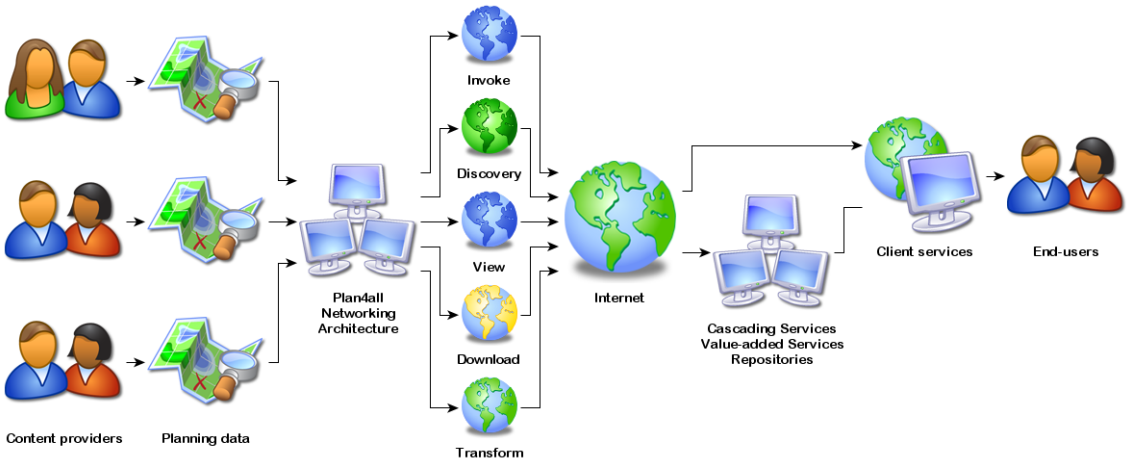

Figure 2: Simplified overview of networking service architecture

Roughly structured as a Software Requirement Specification (SRS) document adapted to the task of describing an INSPIRE compliant data sharing requirements specification.

How specific subsections are written:

- Section "Overall requirements" contains basic requirements for Plan4all networking architecture respecting INSPIRE requirements and gives overall overview of networking architecture.
- Section "Functional Requirements" contains requirements for Plan4all network architecture identify services and they functional and technical requirements.
- Section "External Interface Requirements" describes basic requirements for user interface and software, protocol interfaces used for external communication.
- Section "Non-functional Requirements" describes non-functional aspects of the software requirements such as performance, security and safety, software quality and internationalization.
- Section "Implementation Recommendations" contains basic recommendations based on deliverable D2.4 (user requirement) and also software examples.

Scope of document

- Recognize technical user requirements for data sharing;
- Analyze and formalize input data from WPs 2, 3 and 4;
- Provide software requirements for use in software design specification development and is direct input to T5.2.

1.3 Methodology

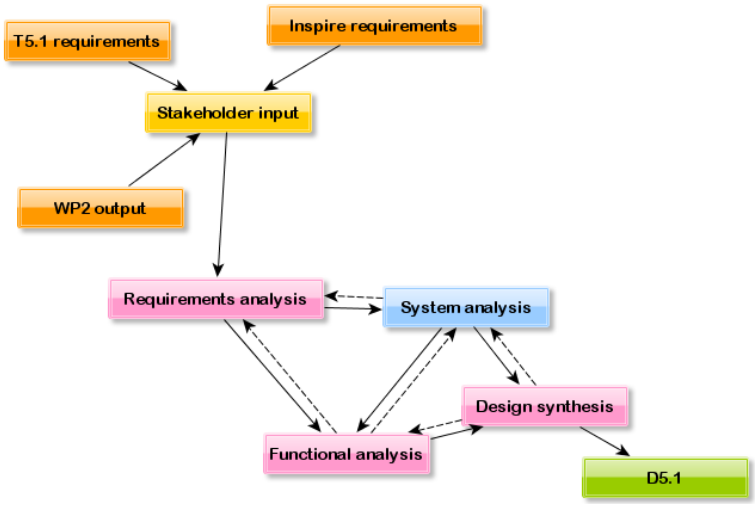

Figure 3: Methodology steps involved in defining the data sharing requirements in this document

System specification methodology To define requirements for system requirement specification is analyzed the previous work which was mainly done in WP2. The main knowledge from this work suitable for the defining of the PLAN4ALL Data Sharing Requirements was taken into account, as well in requirement defining is taken into account partners existing infrastructure and as possible individuality. Furthermore, we had to extend this knowledge to be able to describe requirements on data sharing and networking coming mainly from best experience form partner countries and other European projects experience. Also INSPIRE requirements related to networking are taken as main guideline in requirement definition.

1.4 Terms and Definitions

Term	Definition
INSPIRE	Infrastructure for Spatial Information in the European Community. http://inspire.jrc.ec.europa.eu/
WP	Work Package
Inspire Transformation Service	Web service used for data transformation from one schema to another [1]
KML	Keyhole Markup Language [7]
GML	Geography Markup Language [8]
WMS	OGC Web Map Service standard [9]
WCS	OGC Web Coverage Service standard [10]
WFS	OGC Web Feature Service standard [11]

WPS	OGC Web Processing Service standard. [14]
CSW	OGC Web Catalog Service standard [13]
ISO	International Standardization Organisation
OASIS	Organization for the Advancement of Structured Information Standards. http://www.oasis-open.org/who/
W3C	World Wide Web Consortium
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
CAD	Computer Aided Design
UDDI	Universal Description, Discovery and Integration
OGC	Open Geospatial Consortium
NGO	Non-governmental Organisation
GIS	Geographic Information System
CAD	Computer-aided design
XML	Extensible Markup Language
SLD	Styled Layer Descriptor http://www.opengeospatial.org/standards/sld
CRS	Coordinate Reference Systems
WKT	Well-known text
GML	Geography Markup Language http://www.opengeospatial.org/standards/gml
KML	Keyhole Markup Language http://www.opengeospatial.org/standards/kml/
REST	Representational state transfer

2. Overall requirements

In this section, basic requirements for Plan4all networking architecture are described. The architecture respects Inspire set of services, for discovering, publishing and transforming geodata.

2.1 Overview

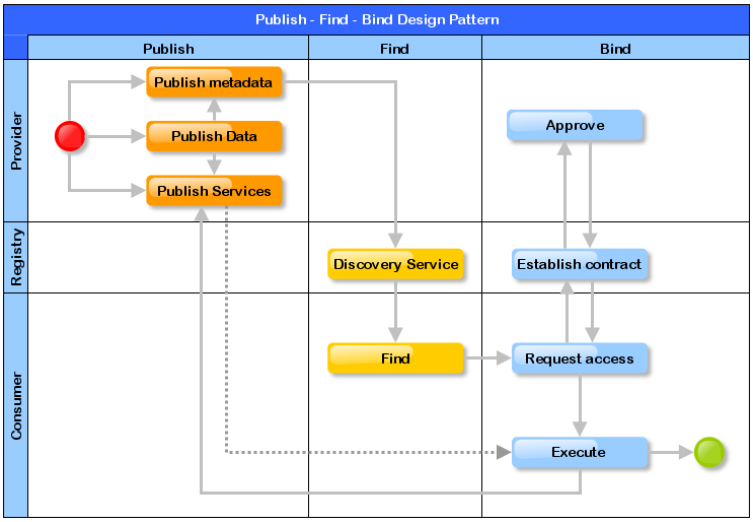

Figure 4: Publish - find - bind design pattern

The basic taxonomy of geospatial services is given by ISO 19119. This taxonomy is organised in categories, the subcategories defining the value domain of the classification of spatial data services. There are bais services given by ISO taxonomy [18]:

100 Geographic human interaction services (humanInteractionService)

This category comprises the following subcategories:

101 Catalogue viewer (humanCatalogueViewer) – Client service that allows a user to interact with a catalogue to locate, browse, and manage metadata about geographic data or geographic services.

102 Geographic viewer (humanGeographicViewer) – Client service that allows a user to view one or more feature collections or coverages.

103 Geographic spreadsheet viewer (humanGeographicSpreadsheetViewer) – Client service that allows a user to interact with multiple data objects and to request calculations similar to an arithmetic spreadsheet but extended to geographic data.

104 Service editor (humanServiceEditor) – Client service that allows a user to control geographic processing services.

105 Chain definition editor (humanChainDefinitionEditor) – Provides user interaction with a chain definition service.

106 Workflow enactment manager (humanWorkflowEnactmentManager) – Provides user interaction with a workflow enactment service.

107 Geographic feature editor (humanGeographicFeatureEditor) – Geographic viewer that allows a user to interact with feature data.

108 Geographic symbol editor (humanGeographicSymbolEditor) – Client service that allows a human to select and manage symbol libraries.

109 Feature generalisation editor (humanFeatureGeneralizationEditor) – Client service that allows a user to modify the cartographic characteristics of a feature or feature collection by simplifying its visualisation, while maintaining its salient elements – the spatial equivalent of simplification.

110 Geographic data-structure viewer (humanGeographicDataStructureViewer) – Client service that allows a user to access part of data set to see its internal structure.

200 Geographic model/information management service (infoManagementService)

This category comprises the following subcategories:

201 Feature access service (infoFeatureAccessService) – Service that provides a client access to and management of a feature store.

202 Map access service (infoMapAccessService) – Service that provides a client access to a geographic graphics, i.e. pictures of geographic data.

203 Coverage access service (infoCoverageAccessService) – Service that provides a client access to and management of a coverage store.

204 Sensor description service (infoSensorDescriptionService) – Service that provides the description of a coverage sensor, including sensor location and orientation, as well as the sensor's geometric, dynamic, and radiometric characteristics for geoprocessing purposes.

205 Product access service (infoProductAccessService) – Service that provides access to and management of a geographic product store.

206 Feature type service (infoFeatureTypeService) – Service that provides a client to access to and management of a store of feature type definitions.

207 Catalogue service (infoCatalogueService) – Service that provides discovery and management services on a store of metadata about instances.

208 Registry Service (infoRegistryService) – Service that provides access to store of metadata about types.

209 Gazetteer service (infoGazetteerService) – Service that provides access to a directory of instances of a class or classes of real-world phenomena containing some information regarding position.

210 Order handling service (infoOrderHandlingService) – Service that provides a client with the ability to order products from a provider.

211 Standing order service (infoStandingOrderService) – Order handling service that allows a user to request that a product over a geographic area be disseminated when it becomes available.

300 Geographic workflow/task management services (taskManagementService)

This category comprises the following subcategories:

301 Chain definition service (chainDefinitionService) – Service to define a chain and to enable it to be executed by the workflow enactment service.

302 Workflow enactment service (workflowEnactmentService) – The workflow enactment service interprets a chain and controls the instantiation of services and sequencing of activities.

303 Subscription service (subscriptionService) – Service to allow clients to register for notification about events.

400 Geographic processing services – spatial (spatialProcessingService)

This category comprises the following subcategories:

401 Coordinate conversion service (spatialCoordinateConversionService) – Service to change coordinates from one coordinate system to another coordinate system that is related to the same datum.

402 Coordinate transformation service (spatialCoordinateTransformationService) – Service to change coordinates from a coordinate reference system based on one datum to a coordinate reference system based on a second datum.

403 Coverage/vector conversion service (spatialCoverageVectorConversionService) – Service to change the spatial representation from a coverage schema to a vector schema, or vice versa.

404 Image coordinate conversion service (spatialImageCoordinateConversionService) – A coordinate transformation or coordinate conversion service to change the coordinate reference system for an image.

405 Rectification service (spatialRectificationService) Service for transforming an image into a perpendicular parallel projection and therefore a constant scale.

406 Orthorectification service (spatialOrthorectificationService) – A rectification service that removes image tilt and displacement due to terrain elevation.

407 Sensor geometry model adjustment service (spatialSensorGeometryModelAdjustmentService) – Service that adjusts sensor geometry models to improve the match of the image with other images and/or known ground positions.

408 Image geometry model conversion service (spatialImageGeometryModelConversionService) – Service that converts sensor geometry models into a different but equivalent sensor geometry model.

409 Subsetting service (spatialSubsettingService) – Service that extracts data from an input in a continuous spatial region either by geographic location or by grid coordinates.

410 Sampling service (spatialSamplingService) -Service that extracts data from an input using a consistent sampling scheme either by geographic location or by grid coordinates.

411 Tiling change service (spatialTilingChangeService) – Service that changes the tiling of geographic data.

412 Dimension measurement service (spatialDimensionMeasurementService) – Service to compute dimensions of objects visible in an image or other geodata.

413 Feature manipulation services (spatialFeatureManipulationService) ,Register one feature to another, an image, or another data set or coordinate set; correcting for relative translation shifts, rotational differences, scale differences, and perspective differences. Verify that all features in the Feature Collection are topologically consistent according to the topology rules of the Feature Collection, and identifies and/or corrects any inconsistencies that are discovered.

414 Feature matching service (spatialFeatureMatchingService) – Service that determines which features and portions of features represent the same real world entity from multiple data sources, e.g., edge matching and limited conflation.

415 Feature generalisation service (spatialFeatureGeneralizationService) -Service that reduces spatial variation in a feature collection to increase the effectiveness of communication by counteracting the undesirable effects of data reduction.

416 Route determination service (spatialRouteDeterminationService) Service to determine the optimal path between two specified points based on the input parameters and properties contained in the Feature Collection.

417 Positioning service (spatialPositioningService) – Service provided by a position-providing device to use, obtain and unambiguously interpret position information, and determines whether the results meet the requirements of the use.

418 Proximity analysis service (spatialProximityAnalysisService) – Given a position or geographic feature, finds all objects with a given set of attributes that are located within a user-specified distance of the position or feature.

500 Geographic processing services – thematic (thematicProcessingService)

This category comprises the following subcategories:

501 Geoparameter calculation service (thematicGoparameterCalculationService) – Service to derive application-oriented quantitative results that are not available from the raw data itself.

502 Thematic classification service (thematicClassificationService) – Service to classify regions of geographic data based on thematic attributes.

503 Feature generalisation service (thematicFeatureGeneralizationService) – Service that generalises feature types in a feature collection to increase the effectiveness of communication by counteracting the undesirable effects of data reduction.

504 Subsetting service (thematicSubsettingService) – Service that extracts data from an input based on parameter values.

505 Spatial counting service (thematicSpatialCountingService) – Service that counts geographic features.

506 Change detection service (thematicChangeDetectionService) – Service to find differences between two data sets that represent the same geographical area at different times.

507 Geographic information extraction services (thematicGeographicInformationExtractionService) – Services supporting the extraction of feature and terrain information from remotely sensed and scanned images.

508 Image processing service (thematicImageProcessingService) – Service to change the values of thematic attributes of an image using a mathematical function.

509 Reduced resolution generation service (thematicReducedResolutionGenerationService) – Service that reduces the resolution of an image.

510 Image Manipulation Services (thematicImageManipulationService) – Services for manipulating data values in images: changing colour and contrast values, applying various filters, manipulating image resolution, noise removal, "striping", systematic-radiometric corrections, atmospheric attenuation, changes in scene illumination, etc.

511 Image understanding services (thematicImageUnderstandingService) – Services that provide automated image change detection, registered image differencing, significance-of-difference analysis and display, and area-based and model-based differencing.

512 Image synthesis services (thematicImageSynthesisService) – Services for creating or transforming images using computer-based spatial models, perspective transformations, and manipulations of image characteristics to improve visibility, sharpen resolution, and/or reduce the effects of cloud cover or haze.

513 Multiband image manipulation (thematicMultibandImageManipulationService) – Services that modify an image using the multiple bands of the image.

514 Object detection service (thematicObjectDetectionService) – Service to detect real-world objects in an image.

515 Geoparsing service (thematicGeoparsingService) – Service to scan text documents for location-based references, such as a place names, addresses, postal codes, etc., in preparation for passage to a geocoding service.

516 Geocoding service (thematicGeocodingService) – Service to augment location-based text references with geographic coordinates (or some other spatial reference).

600 Geographic processing services – temporal (temporalProcessingService)

This category comprises the following subcategories:

601 Temporal reference system transformation service (temporalReferenceSystemTransformationService) – Service to change the values of temporal instances from one temporal reference system to another temporal reference system.

602 Subsetting service (temporalSubsettingService) – Service that extracts data from an input in a continuous interval based on temporal position values.

603 Sampling service (temporalSamplingService) – Service that extracts data from an input using a consistent sampling scheme based on temporal position values.

604 Temporal proximity analysis service (temporalProximityAnalysisService) – Given a temporal interval or event, find all objects with a given set of attributes that are located within a user-specified interval from the interval or event.

700 Geographic processing services – metadata (metadataProcessingService)

This category comprises the following subcategories:

701 Statistical calculation service (metadataStatisticalCalculationService) – Service to calculate the statistics of a data set.

702 Geographic annotation services (metadataGeographicAnnotationService) Services to add ancillary information to an image or a feature in a feature collection.

800 Geographic communication services (comService)

This category comprises the following subcategories:

801 Encoding service (comEncodingService) – Service that provides implementation of an encoding rule and provides an interface to encoding and decoding functionality.

802 Transfer service (comTransferService) – Service that provides implementation of one or more transfer protocols, which allows data transfer between distributed information systems over offline or online communication media.

803 Geographic compression service (comGeographicCompressionService) – Service that converts spatial portions of a feature collection to and from compressed form.

804 Geographic format conversion service (comGeographicFormatConversionService) – Service that converts from one geographic data format to another.

805 Messaging service (comMessagingService) – Service that allows multiple users to simultaneously view, comment about, and request edits of feature collections.

806 Remote file and executable management (comRemoteFileAndExecutableManagement) – Service that provides access to secondary storage of geographic features as if it were local to the client.

This full list represented basic services, which could be used in management, visualization and analysis of spatial data. There it is necessary taken into account, that in many cases, these services are for users not accessible as single services, but that there are part of user applications. There is important question, for which users is important the accessibility of single services and their eventual user chaining and for which users is better to use already combination of applications based on single services. Not all services are also relevant for spatial planning. This classification of special data services is adopted in INSPIRE Metadata regulation (EC No 1205/2008).

2.2 INSPIRE Networking Architecture Components

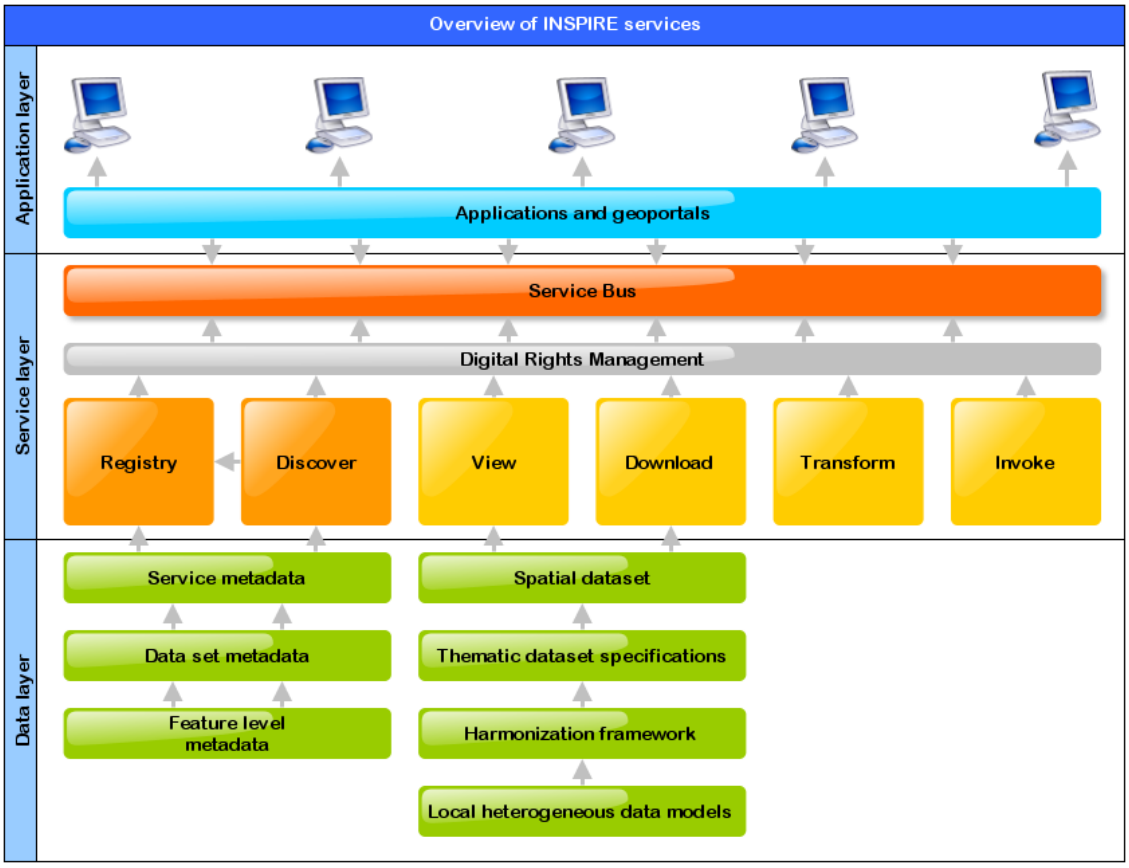

Figure 5: The above diagram provides a simplified overview of key elements in the technical architecture of INSPIRE.

Important aspect is, that INSPIRE Network Services expose services for machine-to-machine communication (publish-find-bind or direct invocation. The INSPIRE Network Services Infrastructure is understood as a Services Oriented Architecture (SOA) and INSPIRE Services are defined as web services and as communication-protocol and binding technology for INSPIRE services SOAP is recommended.

Due the tasks expected from Plan4all implementation, the INSPIRE list of networking services has limited scope and usually the single INSPIRE services will require interaction of more than one single service. Also there will be necessary to implement list of Geographic human interaction services and Geographic model/information management, which will help to switch parameters for running of other networking services.

The INSPIRE Directives defines standards for next five types of services:

- Discovery Service [5]
- View Service [6]
- Download Service [4, 3]

- Transformation Service (partly) [1]
- Services allowing spatial data services to be invoked (Invoke Service) (no standard yet)

It is clear, that INSPIRE networking architecture doesn't cover all required functionality for spatial planning and we have to extend the Plan4all networking architecture for additional services exactly focused on Spatial Planning task.

The key question is on which level we have to be focused on: SOA services (machine machine communication), how to organize orchestration of services and which services will be necessary to implement Plan4all solution.

2.3 Users and User Groups

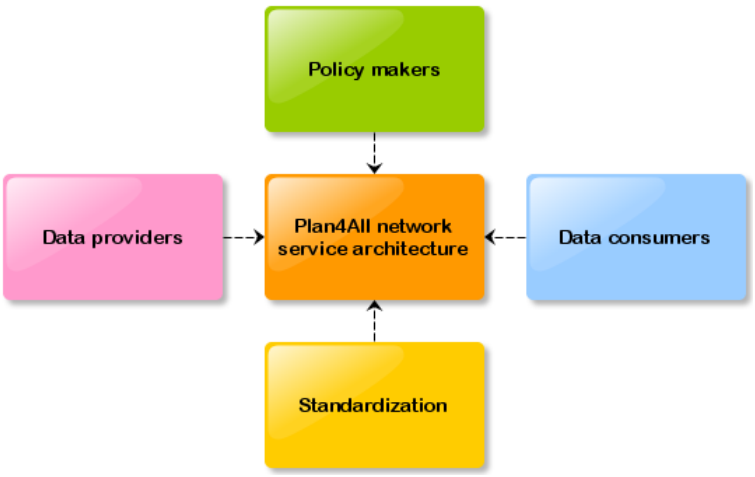

Figure 6: Generalized representation of main stakeholders having an impact on the definition of the Plan4all networking architecture

The requirements on data are different from data providers and data consumers' points of view. Main types of data providers and consumers are as follow:

- Government sector (e.g. municipalities, provinces, states, fedral states)
- Private sector (e.g. investors, consultancy companies, contractors and development companies)
- NGOs and "the Third Sector" (e.g. ideal organisations, non-profit organisations, aid organisations, environmental organisations)
- Research and Education sector (e.g. universities, research institutes, scientists, students)
- Citizens (e.g. people who are accessing systems without affiliation to associations, NGOs or similar)

A more comprehensive and specialized typology of actors within planning has been described in WP2. For the purpose of identifying user requirements for Plan4all data sharing networking services it is however not necessary to know what dataset users are after, but rather what formats the data are in, what volume of data exists, what bandwidth may be expected to be available etc. For this reason D5.1, this document, does not distinguish between different types of government organisations based on their thematic focus. From the perspective of services – a utility dataset is the same as a land use dataset, provided they share the characteristics described above.

2.3.1 The temporal aspects of a plan versus its users

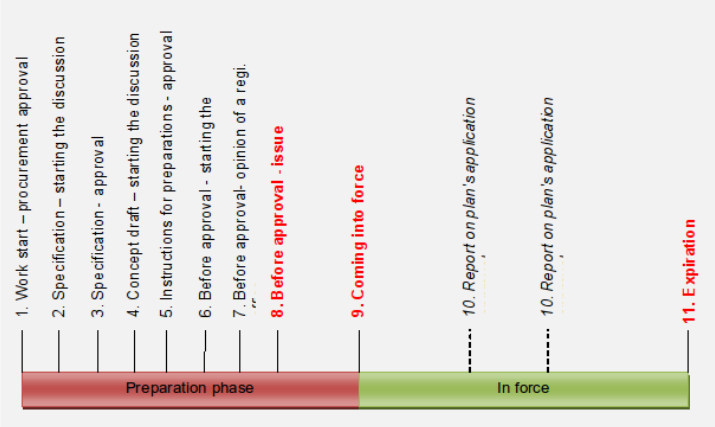

Figure 7: Planning life cycle

The role of each of these user types and their requirements for access to planning data varies throughout the life-cycle of the plan.

Traditionally, individuals and NGOs have been urged to participate in the development phase of plans as part of e-Democracy initiatives. At this stage it is not important that the data should be harmonized – as the users who are eligible to give feedback to a plan under development typically share the same judicial system for planning and hence don't need to relate to more abstract concepts.

After a plan has been approved, it will govern what type of activities citizens and private sector will be allowed to execute within the spatial areas covered by the plan. In a world increasingly affected by globalization, this is where harmonized data may be useful, e.g. to foreign investors looking for prime real-estate for location of new services, retail, outlets etc.

2.3.2 The impact of standardization and policies

In addition to the roles above, two key stakeholders have an impact on the definition of requirements for the Plan4all data sharing network architecture, namely: standardization organisations and policy makers.

Firstly, establishing stand-alone networking architectures which are specific to a narrow domain are not likely to succeed. The utilization of and conformance to common open standards as defined by the Open Geospatial Consortium, the International Standardisation Organisation and similar are therefore key to the success of the endeavor.

Second, the usefulness of a comprehensive service framework depends entirely on the availability of high quality underlying data. This is where the impact of the policy makers becomes critical to the successful implementation of the work.

2.4 Operating Environment

The operational environment will be given by service oriented architecture interconnecting:

- Web servers running required (OGC) Web Services
- Web based clients
- Server-deployed clients
- Desktop clients

The environment is heterogeneous.: Various operating systems (especially MS Windows, GNU/Linux) will be used, with various platforms installed (Java, PHP, C, etc.). There is no unique standard for input data, file transformation to common GIS formats is usually issue.

2.5 Design and Implementation Constraints

Implementation of all required services on particular node, can be constrained by several conditions, among others

- Data access policies (licensing, price)
- Data security issues
- Realistically available bandwidth (for view and especially download service)
- Heterogeneous software platforms (Java vs. "others")
- Heterogeneous server platforms (MS Windows vs. UNIX platforms)
- Heterogeneous GIS/CAD software – especially data formats
- Experience in running of distributed infrastructures
- Cost of running and maintaining plan4all node
- Cost of running maintaining repository

2.6 User Documentation

Several documents will have to be put together, so users could be able to setup the node infrastructure, those are:

- Technical documentation related to setup of node on pilot application
- Technical documentation related to setup transformation services
- Technical documentation related to setup for central portal
- Developer documentation for consuming data

2.7 Assumptions and Dependencies

- INSPIRE specifications and drafts
- ESPON initiative
- ISO standards – ISO 19119
- W3C and OASIS standard
- RFCs
- Bandwidth

3. Functional Requirements

3.1 Registry Services

INSPIRE registry services are unclearly defined. In SOA word the registry is metadata repository. In the scope of INSPIRE registry is rather repository for dictionaries, glossaries etc. (see http://inspire-registry.jrc.ec.europa.eu/registers) In the scope of this project these registries should be defined:

- Plan4all glossary (compatible with INSPIRE glossary).
- Plan4all Feature catalogue (compliant to ISO 19109/19110)

These elements should be integrated with metadata catalogue.
No additional requirements for infrastructure are defined.

3.2 Discovery Services

Discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata. The goal of discovery services is to support discovery of data, evaluation and use of spatial data and services through their metadata properties.

REQ	Description	Notes
REQ1	Compliant to OGC CSW 2.0.2	
REQ2	Compliant to OGC CSW 2.0.2 ISO AP 1.0	
REQ3	Compliant to INSPIRE requirements	INSPIRE technical guidance is still in discussion in IOF-TC, final version is not available yet.
REQ4	Will support Pla4all metadata profile	Will be defined in D 3.2
REQ5	Should support SOAP binding	
REQ6	Should support multilinguality	
REQ7	Cross-links between dataset metadata and services metadata should be maintained	

3.3 View Services

View services make it possible, to display, navigate, zoom in/out, pan or overlay viewable spatial data sets and to display legend information and any relevant content of metadata.

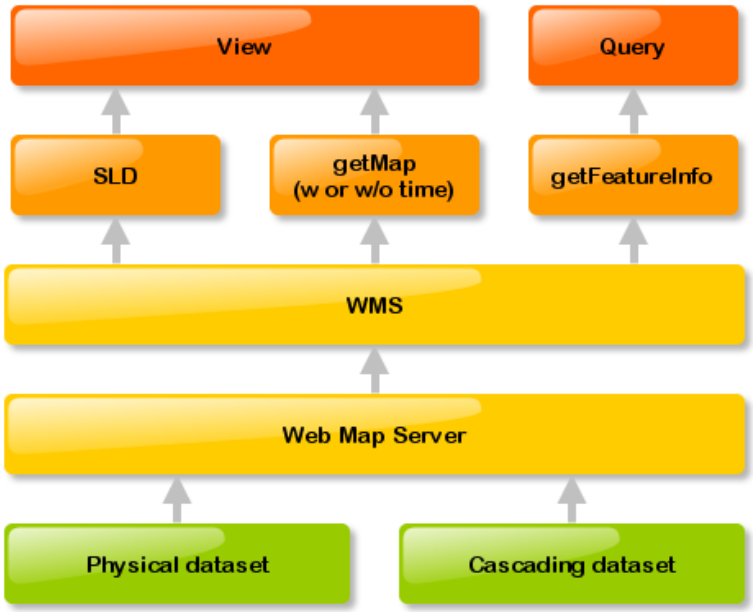

Figure 8: Schematic overview of "View" type services

REQ#	Description	User group
REQ1	INSPIRE defined CRS	
REQ2	Support for transformation-defined WKT Proj4 CRS definition.	
REQ3	Support for web-mapping CRS for compatibility with web portals.	
REQ4	Must be SLD-capable. This brings visual harmonization from different sources. Each data themes should introduce default portrayal rules.	
REQ5	GetFeatureInfo operation support with allowed formats: GML, text	
REQ6	Layer metadata should include datased Identifier, metadataURL and dataURL respectively	
REQ7	Transparent background coveraging only minimal bounding box of the data.	
REQ8	Plan layers should be accessable separately and as an group as well.	
REQ9	Where ever aplicable, implement WMS timescale support.	

3.4 Download Services

Ddownload services are enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly.

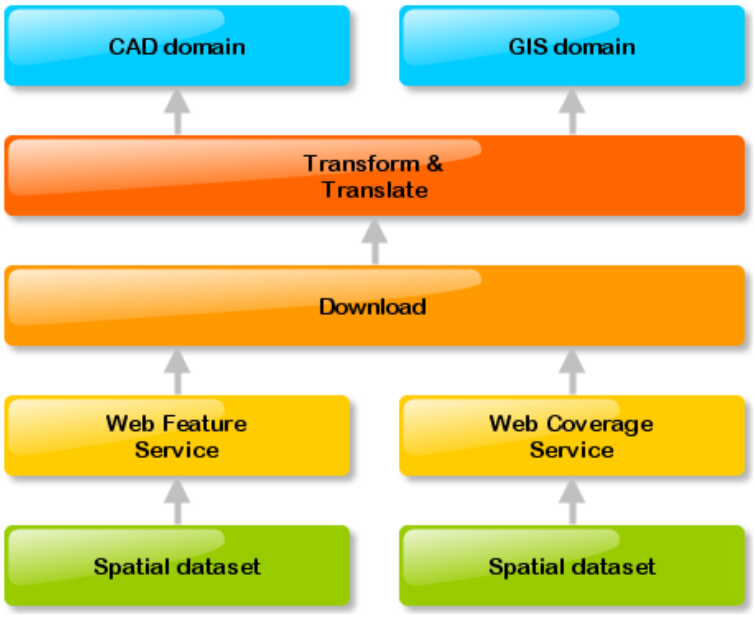

Figure 9: Schematic overview of "Download" type services

REQ#	Description	Notes
REQ1	Most recent version of WFS.	Currently, this is 1.1.0. INSPIRE requires 2.0.0, however it was not implemented yet in any known software.
REQ2	Most recent version of GML	Currently, 3.1.x is wildly supported in used software.
REQ3	Support for SOAP envelope	While the WFS standard currently mainly supports the GET and POST methods of the HTTP protocol, it is required to provide support for SOAP in order to embed the functionality of download services into complex business processes and execution languages such as BPEL.
REQ4	Complex models embeding	If plan4all themes has complex GML, it should be supported
REQ5	Paging support	For big amount of data paging is reasonable also for WFS result paging and filtering.
REQ6	Spatial queries	
REQ7	Spatial processing ? (e.g.) clip etc ...	Not mandatory – may be realized thru processing services

3.5 Invoke Services

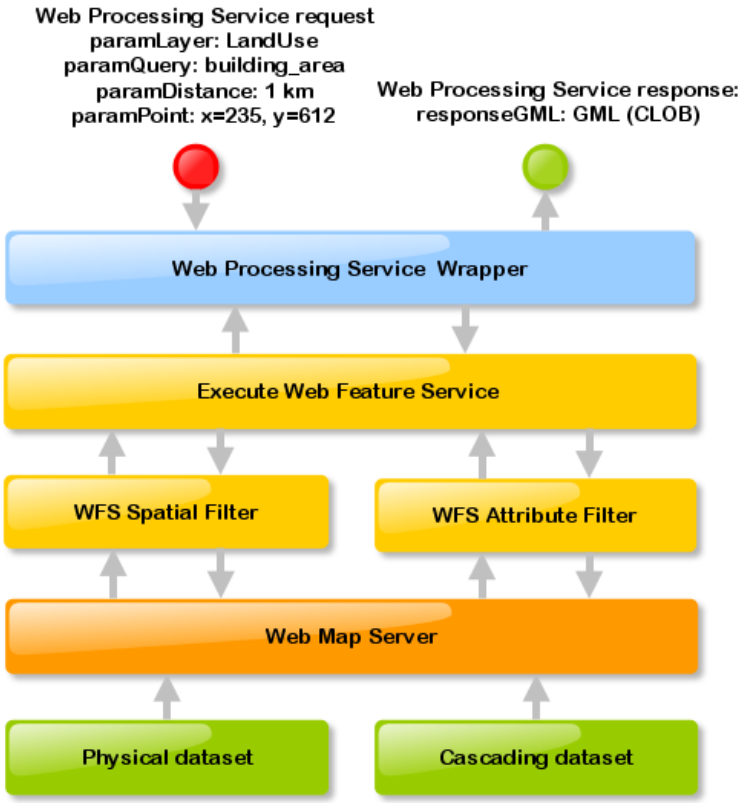

Figure 10: Example of an "Invoke" type service. Several services are to be invoked (Filter, Intersect, Distance) in chain definition service.

Service that allows defining both the data inputs and data outputs expected by the spatial service (GIS Analysis, usually referred as "Process") and a workflow or service chain combining multiple services. In- and Outputs can be raster or vector data (where in Plan4all project, we expect, mostly vector data, but in some more complex types of analysis, raster data will be taken into account as well). It also allows defining the external web service interface of the workflow or service chain.

Typical analysis of vector data can be buffer, network analysis (routing, etc.), overlays of several vector layers, proximity and others. Visibility, temperature, friction costs and similar are usually performed on the raster data inputs. Results can be visualized via View Service or downloaded via Download Service.

In Plan4all, it is assumed, that set of Invoke services will be defined, together with client implementations, which will enable the users to perform basic analysis over various plans. This services should be accessable from Plan4all portal, as well as from desktop GIS packages.

REQ#	Description
REQ1	Must use OGC WPS 1.0.0 or later
REQ2	Must be well described. This assumes properly filling of all optional describe parameters for Process itself, as well as for data in- and outputs. (e.g. Abstract, MimeType, Schema, UOMs, Metadata, ...)
REQ3	Should be of well-known WPS Profile.
REQ4	Must support asynchronous process invoking.

3.6 Transformation Services

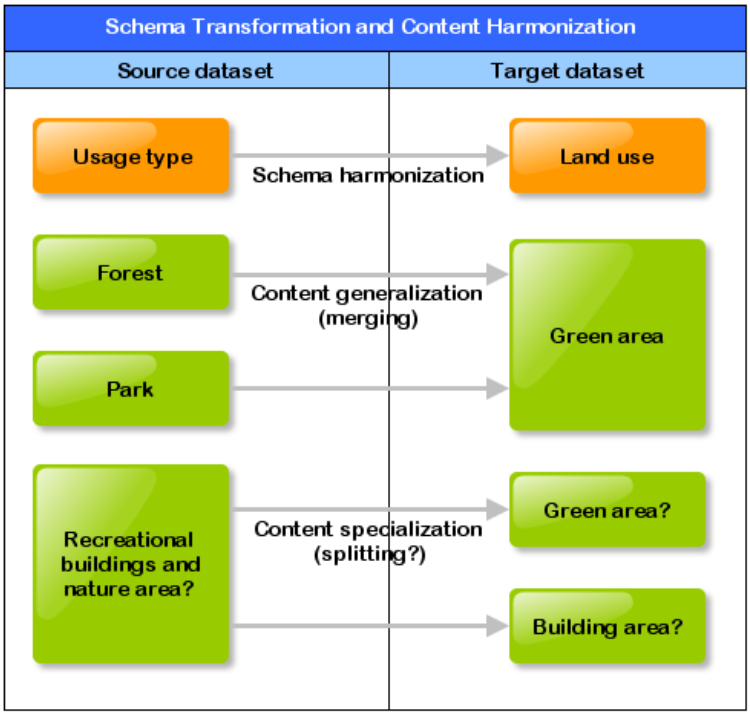

Figure 11: Example of a "Transformation" type schema transformation and content harmonization service.

This type of service is mainly relevant when chained with other services; particularly view and download (and upload) services. It can be viewed as subset of Invoke services. Transformation services can be of three different kinds:

- Coordinate transformation
- File format transformation (translation)
- Schema transformation

Transformation service can be configured as a stand-alone service, but usually it is explicitly bound to a fixed data source. Currently, there is INSPIRE implementation rule defined only for Coordinate transformation. For other types of transformation services, Plan4all profile will have to be defined.

3.6.1 Coordinate transformation service

Coordinate transformation service is designed to transform raster or vector data between various coordinate systems. As all data within INSPIRE should be available in defined set of coordinate reference system (namely ETRS) or coordinate transformation service should be made available for them, it is important service of each node.

REQ#	Description
REQ1	Coordinate Transformation Service will have to follow Inspire Coordinate transformation implementation rule.
REQ2	Transformation services will communicate according to OGC WPS 1.0.0 or later.
REQ3	Coordinate systems listing

3.6.2 Format translation service

Format translation service was not standardized yet. It is assumed, that it will be similar to coordinate transforation.

REQ#	Description	Note
REQ1	Must support input/output of following formats DWG, DGN, DXF ESRI Shapefile, TAB, SFS/WKT, WKB, GML, GeoRSS, KML	
REQ2	Must adopt current/existing protocol and formats where applicable	Currently, GML 3.2 is required by INSPIRE, but it is not supported by commonly available software. GML 3.1.x, and 2.x will be probably used.
REQ3	Where applicable, use open libraries	GDAL, OGR, Open Design (Open DWG, Open DGN), GeoTools

3.6.3 Schema transformation service

Schema transformation service provides transformation from one dataset to another using rules difined in transformation mapping files. Input and Output files are encoded as XML files with defined and accessable schema. Transformation rules are stored in XML mapping file.

REQ#	Description	Note
REQ1	Must adopt existing protocols and standards where applicable	This is for example Humboldt HALE

3.7 Rights Management Services

Non-standard – often dependent on metadata exposed through registry and discovery services.

The Plan4all project should give guidelines or basic requirements for establishing business models on regional or local level in accordance with INSPIRE direction. On the other hands, the conclusion from the last INSPIRE meeting specified that because of differences in individual European countries, no other special requirements regarding Digital Rights Management will be requested.

IPR questions related to digital content are not usually taken as problem to be solved by special legislation.

The main requirements regarding IPR have been specified on the basis of Case studies form partners, the report D2.4 elaborated within task 2.4 and updated in task5.1 as follow:

- Mainly general Copyright Acts should be applied for digital rights management.
- The national Law system decides what data, information or documents can be disclosed to a particular user. Its specified especially by the legislative framework and the corresponding IPR.National Copyright LAW should be kept
- Shared ownership of digital version of planning documents betwen owners (e.g. municipalities), and organizations that have funded the digitization process.
- Output of the Plan4all system (data, services) should be free accesible for public and paid accordance to agreement with data providers in the case of commercial usage.
- Metadata should be acquired together with data sets creation and shoul be standardized and free accessible

Availability of the data should be devided into main groups as follow:

- Free access without registration
- Registration is required
- Limited access
- Access for a fee

DRM tools are related to the outputs mentioned below. By each of them, only the options of DRM tools (Rights, Restrictions, Obligations Rights owners) that should be applied, are listed.

3.8 Upload Services

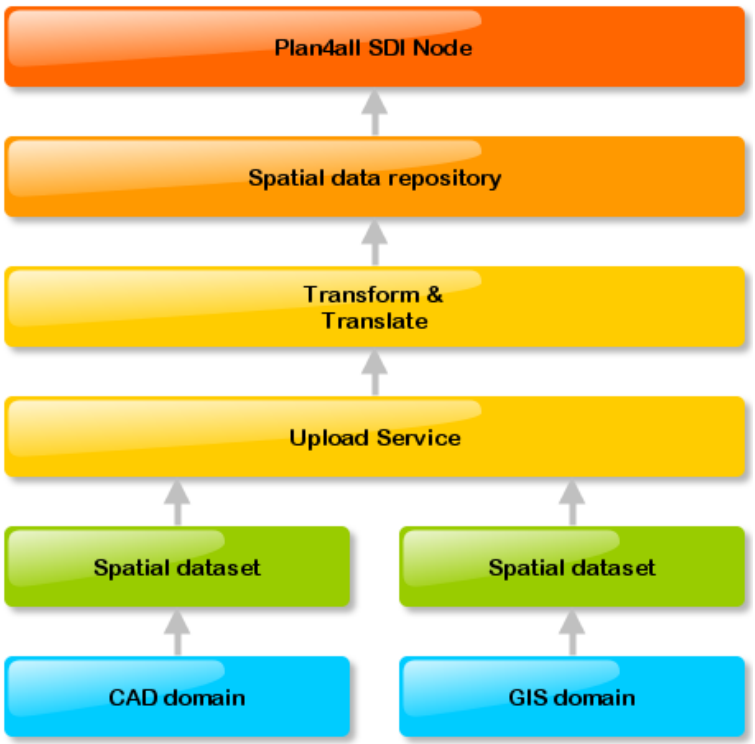

Figure 12: Example of a "Upload" type schema transformation and content harmonization service.

INSPIRE does not define any standard for upload services as part of their networking service architecture nor are they meant to be. The creation of a potentially vast decentralized infrastructure of services targeting the local government level across Europe does however imply a requirement for establishing cooperations among smaller administratinos which are not financially or technically capable of handling the requirements for running an SDI node.

This means that we can look at three different types of actors when it comes to data and service provision in Plan4all:

- Data and service providers – providing access to their own data and services
- Pure data providers – providing access to their own data through a "mediator"
- Pure service providers – publishing services on behalf of data providers, acting as data "mediators".

A pure service provider will offer storage space for spatial data to pure data providers. In order for this process to be smooth, the Plan4all data sharing network services architecture will include a data upload service as shown in the diagram.

This service will however exclusively be accessible through restricted access and will not be exposed through the registry layer for inclusion into publish-find-bind-execute chains.

REQ#	Description	Note
REQ1	Ability to upload spatial data files from an electronic form to a remote location using either HTTP, FTP or LAN protocols for data transfer.	Data providers (as consumers), data mediators and service providers (as providers)
REQ2	Ability to chain upload processes with coordinate system, format and schema translation services on the server-end.	Data providers (as consumers), data mediators and service providers (as providers)
REQ3	Ability to accept as input formats commonly used CAD or GIS formats.	Data providers (as consumers)
REQ4	Ability to accept as input format WFS.	Data providers (as consumers)

3.9 Spatial Data Requirements

3.9.1 Input file formats (Formats provided be data providers)

According to WP2 document – User Analysis Report system should support these formats:

- **Raster formats:** TIFF, JPEG, GIF, PNG, BMP, PDF, ECW, LIB ArcInfo-GRID, IMG, PCX, GeoTIFF,
- **Vector formats:** DGN, DWG, DXF, SHP, CAD4, ZEM, GML, MWF, PMF
- **Databse connection:** Oracle Spatial 10g SDO-Geometry, MDB, ArcSDEon, PostgreSQL/PostGIS, MS SQL 2008, SQL Server, MS Access
- **Web Services:** WMS, WFS

It probably not necessary that the system will be able to handle all these formats directly but we have to specify and test best practices how to transform unusual file formats to those that will be supported (for example how to convert DXF to GML). We should consider capabilities of libraries such as ogr2ogr for such propose.

3.9.2 Output formats:

System should provide standard interface for data sharing – WMS and WFS. For WFS data should be transformed to target GML schema that should be specified by wp4. According to WP2 document "User Analysis Report" Plan4all data model should be based on this schema:

3.9.3 Software for harmonization

The main issue of harmonization of different datasets that are available by data providers are not in file formats but more in different conceptual data models. To be able to transform the data it is necessary to provide and test software tools that should be used for such propose.

Some of currently available open osurce software tools suitable for data harmonization are:

- ogr2ogr (http://www.gdal.org/ogr2ogr.html) – file formats and simple data harmonization (filtering, attribute renaming etc. . .)
- Spatial data integrator (http://www.spatialdataintegrator.com/)
- Humboldt Alignment Editor (http://community.esdi-humboldt.eu/)
- GeoKettle (http://www.geokettle.org/)

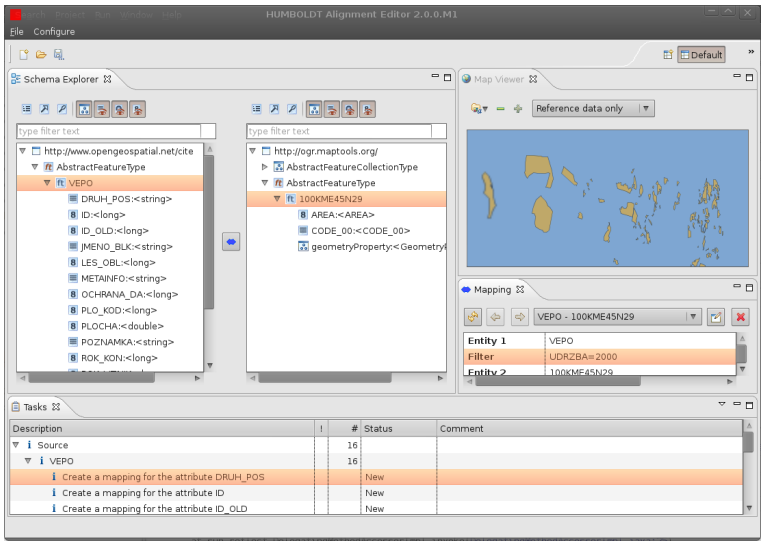

Figure 13: Humboldt alignment editor

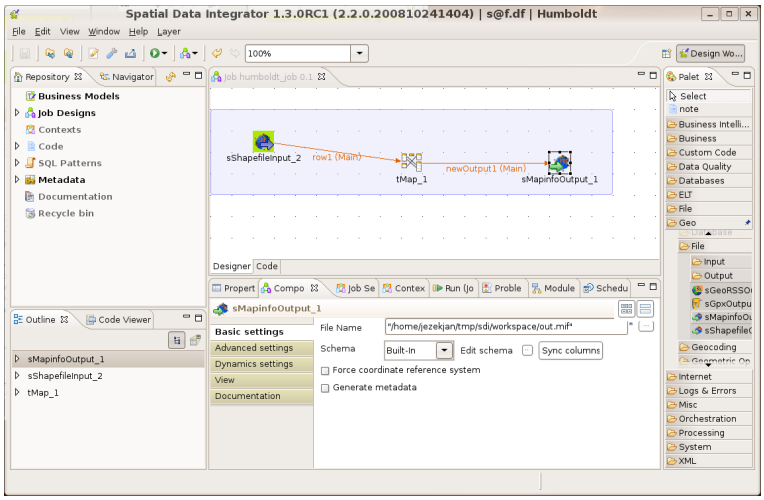

Figure 14: Spatial Data Integrator

3.10 INSPIRE Network Services Requirements

References and extracts from the central resources on INSPIRE network services

According to Inspire document (D3.5 – INSPIRE Network Services Architecture) the services should provide:

- Discovery Services – Mainly Matadata catalogs. Related standard: OGC WCS
- View Services – User friendly Map viewer that allows common capability to view and browse portrayed geographical data.
- Performance (according to (Regulation on INSPIRE Network Services 19.10.2009):
  1. The normal situation represents periods out of peak load. It is set at 90% of the time.
  2. The response time for sending the initial response to a discovery service request shall be maximum 3 seconds in normal situation.
  3. For a 470 Kilobytes image (e.g. 800x600 pixels with a colour depth of 8 bits), the response time for sending the initial response to a Get Map Request to a view service shall be maximum 5 seconds in normal situation.
- For the Get Download Service -Metadata operation, the response time for sending the initial response shall be maximum 10 seconds in normal situation.

For the Get Spatial Data Set operation and for the Get Spatial Object operation, and for a query consisting exclusively of a bounding box, the response time for sending the initial response shall be maximum 30 seconds in normal situation then, and still in normal situation, the download service supports:

- 1. download of a complete dataset shall maintain a sustained response greater than 0.5 Megabytes per second or datasets, orgreater than 500 Spatial Objects per second.
  2. a part of a dataset or datasets, and
  3. where, practicable, provide direct access to complete datasets or parts of datasets.
  4. Gazetteer like services are also covered by a type of download service.

- Transformation Services – services that should provide functions to achieve interoperability. Related standard: OGC WPS.

- Invoke Spatial Service Services – services that allows defining both the data inputs and data outputs expected by the spatial service and define a workflow or service chain combining multiple services. It also allows defining the external web service interface of the workflow or service chain.

These services should be based on OGC OWS standards (where possible). If there is possibility to use also SOAP interface then it is recommended to use that.

1. For the Describe Spatial Data Set operation and for the Describe Spatial Object Type operation, the response time for sending the initial response shall be maximum 10 seconds in normal situation then, and still in normal situation, the download service shall maintain a sustained response greater than 0.5 Megabytes per second or greater than 500 descriptions of Spatial Objects per second.

3.10.1 Capacity

1. The minimum number of simultaneous requests to a discovery service to be served in accordance with the quality of service performance criteria shall be 30 per second.

2. The minimum number of simultaneous service requests to a view service to be served in accordance with the quality of service performance criteria shall be 20 per second.

3. The minimum number of served simultaneous requests to a download service to be served in accordance with the quality of service performance criteria shall be 10 requests per second. The number of requests processed in parallel may be limited to 50.

4. The minimum number of simultaneous requests to a transformation service to be served in accordance with the quality of service performance criteria shall be 5 requests per second.

3.10.2 Availability

- The probability of a network service to be available shall be 99% of the time.

3.10.3 Support of INSPIRE Spatial Reference Systems

1. Lambert Azimuthal Equal Area (ETRS89-LAEA) for pan-European spatial analysis and reporting, where true area representation is required;
2. Lambert Conformal Conic (ETRS89-LCC) for conformal pan-European mapping at scales smaller than or equal to 1:500,000;
3. Transverse Mercator (ETRS89-TMzn) for conformal pan-European mapping at scales larger than 1:500,000.

3.10.4 Standard versions

Newest versions of OWS should be used:

- WMS 1.3
- CSW 2.0.2
- WFS 2.0
- GML 3.2

It is not mandatory requirement, but should be implemented in future.

3.10.5 Multilinguality

Additional LANGUAGE parameter will be introduced for WMS and CSW to enable multilingual requests (later will be asked to include to OGC services). The interpretation is not precisely clarified yet.

GetCapabilities documents will be extended to support different language versions

Protocol binding: Currently KVP for WMS, POST/SOAP for CSW. In future some additional requirements may be formulated

GeoRM is out of scope INSPIRE currently, so no special requirements are not formulated

Meaning of "Linked service" parameter mentioned in directive is under discussion. There are some interpretations leading to enabling user to located cascaded (or harvested) catalogues from selected service. It imples some additional parameters in CSW GetCapabilities operation

Cross – linking between WMS layer metadata , corresponding service and dataset metadata in catalogue should be defined.

4. External Interface Requirements

4.1 User Interfaces

4.1.1 Discovery services

The INSPIRE Directive asks Member States in article 11(1) (a) to establish and operate a network of services for the discovery of spatial data sets and services "for which metadata have been created". "Discovery services making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata." Within the geographic community various names have been assigned to instruments for discovering spatial data and services through the metadata properties; examples are Catalogue Services, Spatial Data Directory, Clearinghouse, Geographic Catalogue and Geodata Discovery Service. In INSPIRE these services are referred to as Discovery Services. The goal of discovery services is to support discovery of data, evaluation and use of spatial data and services through their metadata properties. Metadata is the information and documentation, which makes these resources understandable and sharable for users over time. Indexed and searchable metadata provide a controlled vocabulary against which discovery can be performed. INSPIRE Discovery Services shall provide the functionality for users both to manage and search catalogues for the purpose of discovery and evaluation within the context of the INSPIRE Directive. The network of services should also include the technical possibility to enable public authorities to make their spatial datasets and services available. The INSPIRE Directive specifies that Member States shall ensure that public authorities are given the technical possibility to link their spatial datasets and services to the network. This 'linking' service is also offered in the context of a discovery service as a capability of the discovery service.

User Interface for discovery services should allow users to easily perform these operations (flowing INPIRE directive):

- GetDiscoveryService Metadata
- DiscoverMetadata
- GetMetadata
- INSPIRE.PublishMetadata

- INSPIRE.CollectMetadata

Figure: Example of user interface of discovery service – metadata catalog Micka:

View Service View services should make possible, as a minimum, to display, navigate, zoom in/out, pan or overlay viewable spatial data sets and to display legend information and any relevant content of metadata". Where public authorities levy charges for view services, the Member States shall ensure that e-commerce services (including rights management services) are available (article 14(4)). The process of laying down implementing rules for the directive highlights the following aspects of a view service: Nature of the Metadata Common coordinate reference system Temporal data dimension View geometry selection Multiple datasets view output format Styling Rights Management Legend availability and handling Correspondence between layers and INSPIRE themes Multilingualism relationship with client applications

View Service user interface should allow users to perform these operations:

- Get Service Metadata
- Get Map
- Get Feature Information – User interface for View Service should naturally include well known functionality of popular map applications like zoom, pan, etc...

Download Service Download services are enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly". In addition, where public authorities levy charges for the download services, Member States shall ensure that e-commerce services (including rights management services) are available (arcticle 14(4)). A download service supports

- download of a complete dataset or datasets, or
- a part of a dataset or datasets, and where, practicable,
- provides direct access to complete datasets or parts of datasets.

Gazetteer like services are also covered by a type of download service.

In the context of INSPIRE and the scope of the Implementing Rules, datasets are restricted to the categories defined by the Annexes I-III (see Article 4), and for which metadata exist and are updated according to Article 5, and that spatial datasets are interoperable and harmonised according to Article 7-10. It is worth to note that the conceptual or application schema of the local or national spatial data set may and will often differ from the INSPIRE harmonised specification of the spatial object types in the data specification. In this case a download service may transform between the application schema of the spatial dataset and the harmonised schema on-the-fly, if possible, or a transformation service (see 6.4) may be invoked. Alternatively, a member state may provide a

download service based on derived datasets converted in advance of receiving the query. Search criteria need to support a variety of criteria, including spatial and temporal extents, metadata elements, and feature propreties. INSPIRE services are restricted to INSPIRE IR and INSPIRE themes, but obviously the same type of services can be used much more general. The architecture and the IRs are focusing on INSPIRE requirements, but does not restrict MS to operate other services and services on other data – on the contrary, such data services may be registered in the metadata.

Download servise UI should allow users to perform these operations:

- Get Download Service Metadata
- Get Spatial Objects
- Describe Spatial Object Types (conditionally)
- Define Query (conditionally)
- Link Download Service

4.2 Rights-management services

INSPIRE rights management services are introduced to manage different kinds of rights (legal, business contracts, access keys) between an application (e.g. a Geoportal) and the INSPIRE infrastructure if needed.

4.3 Hardware Interfaces

Participants in the plan4all networking architecture are referred to as nodes, there are three types of nodes which will have different hardware interface requirements:

- The Plan4all registry node (one node)
- Plan4all data and service provider nodes (unlimited number of nodes)
- Plan4all service providers (mediators) (unlimited numbef of nodes)

Examples of recommended hardware configurations are given in the table below:

Data and service provider node		Service provider node (mediator)	Registry layer node
Minimum configuration	Recommended configuration	Recommended configuration	Recommended configuration
$\geq 1 \times 2,4GHzCPU$	$\geq 2 \times 2,6GHzCPU$	$\geq 2 \times 2,6GHzCPU$	Not applicable
$\geq 4GB\ RAM$	$\geq 3 \times 500GBHDD(RAID)$	$\geq 12GBRAM$	
$\geq 3 \times 250GBHDD(RAID)$	$\geq 8GB\ RAM$	$\geq 3 \times 1TBHDD(RAID)orSAN$	

The specifications above are not binding requirements for participation in the plan4all data sharing networking service architecture but indications of hardware interface configurations which are likely to satisfy the accessibility, availability and capacity of individual nodes.

4.4 Software Interfaces

To achieve interoperability the main software interface between each particular component have to be based on ISO standards and OGC specifications following Inspire directive. These specifications are:

- OGC CSW
- OGC WFS
- OGC WMS
- OGC WPS

Other relevant standards are:

- ISO 19115
- ISO 19110
- Metadata Dublin Core

4.5 Communications Interfaces

Communication interfaces should be based on well known approaches used generally in SOA (Service-oriented architecture). These communication protocols are mainly:

- Key-Value-Pairs sent via HTTP/GET,
- Key-Value-Pairs and/or XML sent via HTTP/POST,
- SOAP sent via HTTP/POST
- REST communication via HTTP/GET/POST

Most of off-the-shelf GIS software products are based on HTTP POST based on OGC XML encoding, but it would be useful if SOAP specific encoding where possible (WSDL). Using SOAP can be benefit for other tasks like chaining of services using BEPL.

5. Non-functional Requirements

This subsection describes the non-functional requirements of the Plan4all data sharing networking architecture. Non-functional requirements are requirements which affect the networking architecture and its implementation but which is not linked to a specific function to be exposed either as a service or as a client interface.

5.1 Performance Requirements

Taking as a starting point that the data sharing network services will be distributed across the Internet it is essential that performance is considered in the design of the networking architecture. This subsection lists requirements and considerations related to performance as seen from both provider and consumer user's perspectives.

REQ#	**Requirement**	**Comment**
REQ1	Ability to handle large file-uploads	The architecture must take into account that files to be uploaded into repositories and data clearinghouses to serve as data mediators will be large. Planning data are typically very detailed and as a consequence large. It is essential that any upload services are designed to allow for stable upload of data without breaking due to session time-outs, (predictable) network latency or other foreseeable factors. A resume function is desirable in case of broken downloads due to third-party network issues..

REQ2	Ability to handle large file-downloads	The architecture must similarly allow for download of large files bearing in mind the same considerations. A resume function is desirable in case of broken downloads due to third-party network issues.
REQ3	Provide (intermediate) storage for large amounts of data	For Plan4all nodes acting as mediators of data, i.e. offering a repository where content providers may upload and "host" their content into the Plan4all virtual data space must be dimensioned to handle large quantities of data and measures must be implemented to avoid application breaking due to running low or short of physical storage space.
REQ4	Acceptable response time for services	Any invoked service within the five categories must provide a response time of no more than two-four seconds (measured as time from request is issued till the first byte of response data is received). The sum of execution time for services may accumulate beyond what is a reasonable expectation for end-users.
REQ5	Sufficient session timeout for persistent connections	Sessions must be configured not to time-out during large scale data operations.
REQ6	Fail-over mechanisms in case of unavailable nodes	Architecture must implement error handling for non-available nodes due to third party networking issues.
REQ7	Suitable bandwidth for service provider	Plan4all service providers should have a bandwidth of minimum 5 Mbps
REQ8	Suitable bandwidth for service/data mediator node	Plan4all service/data mediators should have a bandwidth of minimum 10 Mbps

REQ9	Suitable bandwidth for service consumer	Plan4all service consumers may scale bandwidth based on needs but should have a minimum of 512 Kbps to enjoy an efficient user experience.
REQ10	Minimize amount of data returned by web services	The returned data from the various Plan4all service types will be either XML or binary data such as images. It must be an implementation goal to return as small amount of data as possible from the web services.

5.2 Security and Safety Requirements

This subsection outlines networking architecture requirements related to securing access to data and/or integrity of data once made available through the networking infrastructure. Planning data, in many European judicial systems, have a "legal" meaning which must be observed in communicating planning data out of their original context.

REQ#	**Description**	**Comment**
REQ1	Must prevent data loss	The Plan4all and INSPIRE networking architecture mainly implements "read-only" services. For this reason, data loss is not at the outset a big issue. For actors intending to run data repositories or acting as data clearinghouses for underlying content providers, measures must be taken to prevent data loss after data have been uploaded to the storage host.

REQ2	Must prevent unauthorized access to sensitive data	Planning data are for the greater part abstract data with limited sensitivity – in certain cases planning regulations may convey military and safety related information which is classified and highly sensitive. Datasets such as restriction areas, utilities and similar may be considered sensitive out of concern to public safety and civil defense. Steps must be taken both at content provider, service provider and data/service mediator levels to avoid that such content is propagated into the "cloud" and made available for service chaining for unauthorized users.
REQ3	Must secure privacy concerns	In certain legal systems, planning data may convey personal information. Content providers must make sure that no data served are in breach of national data protection acts and that data may freely be re-used in a detached, transnational geographical context.
REQ4	Must provide appropriate system security	Where authentication mechanisms are enforced to distinguish between access levels to information served through the Plan4all networking architecture, proper security mechanism must be in place to prevent data break-ins and hacking.

REQ5	Must Intellectual property rights	The system must give room for supplying rich information about IPR in the interest of clarifying what is the re-use potential of the planning data. Metadata must be clear and unambiguous in conveying the intellectual property rights associated with data accessed through Plan4all.
REQ6	Must secure integrity of copyrights	Any copyrights associated with content and regulations thereabouts must be embedded within the metadata. No copyrights must be infringed by serving data through the Plan4all networking infrastructure.
REQ7	Must enable "fair use" of data and services published	A re-use policy stating what is considered as "fair use" must be elaborated and made available throughout the discovery service in order to support the uptake and building of value-added services based on the networking services and data contained therein.

5.3 Software Quality Requirements

This subsection provides requirements regarding the overall quality of software to be applied in implementing nodes in the networking architecture. These requirements are generic and applies to all types of software, applications and components required to provide discovery, view, download, transform and invoke services in accordance with INSPIRE and the Plan4all networking architecture.

REQ#	**Description**	**Comment**

REQ1	Must be adaptable	Software applied to realize the Plan4all networking architecture must be adaptable to changing requirements and standards.
REQ2	Must be highly available	The software must be highly available in terms of up-time and allow for large scale concurrent use without "breaking", causing disruption of external dependant processes. Nodes participating in the Plan4all networking architecture should sign-up for a Service Level Agreement (SLA) regulating their rights and duties in partaking in the infrastructure.
REQ3	Must be highly reliable	Software should be reliable and properly tested before being implemented into the networking architecture.
REQ4	Must have high capacity	Software must not put artificial constraints on the ability to serve and access data.
REQ5	Must be easy to maintain	Many of the envisaged nodes of the Plan4all networking architecture are local and regional planning professional authorities which are not specialized in the running and maintenance of SDIs. Any systems implemented in such a context must demonstrate low maintenance in terms of time and expenses.
REQ6	Must be robust	The software will be exposed to third parties across the Internet and will be vulnerable to external hacking attacks. The software must implement proper security and measures to prevent such attacks from being successful.

REQ7	Must prove good ROI	Any software applied should demonstrate a profitable return on the investment in terms of quality and capacity gained versus the financial and time costs associated with acquiring, configuring and learning the software.

5.4 Internationalization requirements

The Plan4all networking architecture is going to be operated in a multi-lingual, multi character-set, multi-cultural user environment. Planning data are for the greater part created according to national or regional standards and invariably in national languages. Most classification systems and legal planning purposes are custom made for each country and have legal meanings and definitions which makes it difficult to map between them 1:1. The networking architecture needs to take into consideration certain minimum requirements to secure fidelity of data once consumed by third parties across the Internet.

REQ#	**Description**	**Comment**
REQ1	Must support extended character sets	Data, encoded in various code pages should be retained after passing through server software while being consumed across the Internet. The output and interchange format should be UTF-8. All typical code pages used throughout Europe including Cyrillic as used in e.g. Bulgaria and Greece must be supported. Also, code pages giving access to particular extended characters prevalent in Scandinavian and Latin languages must be supported.
REQ2	Must support multiple languages	Applications and services must support multiple language configurations.

6. Implementation Recommendations

6.1 Recommendation of services

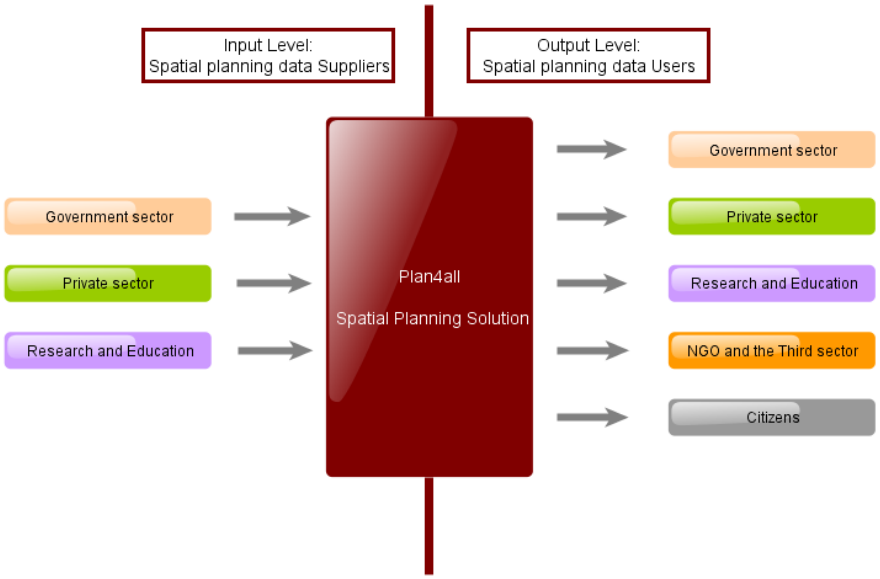

Figure 15: Spatial planning data suppliers

Recommendations	Spatial planning authorities	Other civil service authorities	Public owners infrastructure	Public agencies	Policy makers	Private Owners of	Planning engineers, city	Business Companies	Investors	NGO, the third sector	Universities	Students	Public
Data input services	X		X			X	X				X		
Data visualization	X	X	X	X	X	X	X	X	X	X	X	X	X
Data access through web services	X	X	X	X	X	X	X	X	X	X	X	X	X
Direct Access to own data sources	X		X			X	X				X		

Figure 16: Recommendation on data services accessibility table

Recommendation on services are elaborated on the basis of user requirements specified in the deliverable D2.4 and extended in the task 6.1.

If we take into account a data-flow of the proposed Plan4all system, requirements of user groups may be displayed from two points of view:

- spatial planning data supply
- spatial planning data usage

The requirements on data are different from data suppliers and data users points of view. On each of these two sides, the different requirements can be raised by main user groups. According to report D2.4 and the Chapter 2.3. of this report, we have declared main user groups for sectors as follow:

- Government sector
  1. Spatial planning authorities
  2. Other civil service authorities
  3. Public owners of transport and technical infrastructure
  4. Public agencies
  5. Policy makers
- Private sector
  1. Private Owners of transport and technical infrastructure
  2. Planning engineers, city planners
  3. Business Companies
  4. Investors
- NGO, the Third sector
- Research and Education sector
  1. Universities
  2. Students
- Citizens

6.1.1 Recommendations on input level (data/services suppliers)

With respect to the requirements described deeply in previous sections, we recommend to elaborate a design of the the Plan4all networking architecture that will cover recommendations on data sharing functionality as follow:

1. Data input into file repository on the server
2. Data import into database on the server
3. A possibility to offer data as web service (a system have to accept web services, mainly WMS and WFS)
4. Mandatory metadata when data are supplied from data suppliers
5. In case of access to data providers through web services, metadata of these WS have to be accessible
6. Standardized data exchange format
7. Standardized metadata
8. Data preview – suppliers need a possibility check, which data are in the system and if their own data is correct
9. Authorization access is mandatory
10. Possibility to offer data from different SW systems (transformation services)
11. Possibility to offer data from different coordinate systems and geographical projections
12. Possibility of dynamic conversion of the data models (import) of geospatial data of the technical infrastructure providers into the planning data model. The goal is to implement the technological processes for the most automatic processing of the entry data from various, but known sources. Still, there is a risk of DM instability for data output on the part of providers – it is not clear on which level the service should be implement (input or output), will be clarified
13. Possibility to offer data in non-graphical format (pdf, text, images)
14. Possibility data up-date, revisions, data synchronizing

6.1.2 Recommendation on output level (data/services users)

1. Standardized data exchange format for horizontal (intermunicipal) and vertical (planner – municipality – county – federal state) process of coordination of planning
2. Data views of spatial plans of different administrative units, to compare different areas and different planning scales
3. Data preview within their administrative territory and "border zone" at local and regional level (as for the plan, the data preview means also the interconnection of attributes of individual elements with the text part of the plan – regulations related to individual areas with different way of usage)
4. Access to different thematic projects and time stage of the same thematic project (for example a Concept of the Municipal plan and a final version of the Municipal plan)
5. Access to data via web visualization client
6. Access to data through standardized web services
    - WMS including Get feature info
    - WFS
    - WFS-T
7. Access to data via download service (data export)
8. Access to non-geographical data (pdf, text, images)
9. Data printing (maps and non-geographical information as well)
10. Data accessible in pre-defined formats and geographical projections
11. Authorization service depended on a type of users and requests
    - Free access
    - Restricted access (registration, limited access, paid access)
12. Metadata search for:
    - Name and number of urban land use plans
    - Information to the date of establishment, public display period, notification of permission of urban land use plans
    - Legal foundation of urban land use plans
    - Main designation of land use purpose

13. Data preview in metadata catalogue
14. Data and metadata catalogue listing and grouping data under different classifications
15. Possibility to manage composition in web map clients
    - Add data layers into view (from database, file repository, web services)
    - Access to attributes (descriptive data of geographical objects)
    - Draw information symbols (not edit data!)
    - Measuring
    - Printing
    - Analyses – buffering, interlayer
    - Data editing for authorized user
    - Implementation of email client – possibility to send comments or requests bound with geographical position
16. eShop – for data or web services commercialization

6.1.3 Other recommendation (mainly common recommendation on the Plan4all system, not mentioned above, regarding data management)

- Posibility of data management on the server
- Data editing – need to be discussed, probably not efficient on the server side
- Semantic description of planning data as a basis for the establishment of services (query, monitoring, reporting) and interwork with different software applications of existing infrastructures (for example the GeoDirectory, EDEN (Environmental Data Exchange Network) and specific widely used applications such as the LGCSB's gPlan system)
- Central storage of urban land-use plans / other plans of special urban planning legislation (e.g. formally designated redevelopment area) in a uniform semantic structure as a data base for different software applications and information systems
- The implementation at national level of standards regarding data collection (also applying to metadata)
- Language translation functionality

6.1.4 Minimus set of required services

- Which minimum set of services is required (reference to section 3)
- Will be done after Chapter 3 elaborating

6.2 Recommendations by type of services

A Summary of recommendations on services has been elaborated according to requirements defined in the sections 3,4,5.

Services	Recommendation
Discovery	To implement specification for CSW 2.0.2 and CSW 2.0.2 AP ISO
	To implement CSW protocol harvesting verbs
	To define Pla4all metadata profile
	Support of INSPIRE and OGC AP ISO queryables
	Support of Plan4All queryables defined in D 3.2
	To include previews of contents functionality
View	To use Coordinate Reference Systems (CRS) defined by INSPIRE
	To use transformation-defined WKT Proj4 CRS definition
	To implement web-mapping CRS for compatibility with web portals
	To allow SLD profile capability for WMS
	To implement GetFeatureInfo operation support with allowed formats: GML, text
	To include datased Identifier, metadataURL and dataURL into layer metadata
	To use transparent background covering only minimal bounding box of the data.
	To implement functionality for visualization of plan layers separately and in groups as wellPlan layers should be accessable separately and as an group as well.
	Where ever applicable, to implement WMS time-scale support

Download	To implement the most recent versions of WFS and GML
	To implement the support for SOAP envelope
	To allow complex models embedding
	Paging support
Invoke	To implement OGC WPS 1.0.0 or later
	To describe optional parameters for data inputs, outputs and the processes themselves
Transformation	To implement Coordinate Transformation Service according Inspire Coordinate transformation implementation rule
	To provide Transformation services communication according to OGC WPS 1.0.0 or later.
	To elaborate a list of often used Coordinate systems
	To provide a input/output of following formats DWG, DGN, DXFSHP, TAB, SFS/WKT, PostgreSQL, GML
	To adopt current/existing standards, protocol and formats where applicable
	To use libraries GDAL, OGR, Open Design (Open DWG, Open DGN) where it is applicable
Right management	To apply general Copyright for digital rights management
	To keep IPR.National Copyright LAW
	To provide outputs of the Plan4all system (data, services) free accessible for public or paid accordance to agreement with data providers
	To provide standardized and free accessible metadata acquired together with data sets
Upload	To ensure data upload together with metadata, if exist
	To implement upload functionality supporting FTP and HTP
	To provide upload geospatial, graphical (images) and textual data

Spatial data	To support raster formats: TIFF, JPEG, GIF, PNG, BMP, PDF, ECW, LIB ArcInfo-GRID, IMG, PCX, GeoTIFF
	To support vector formats:DGN, DWG, DXF, SHP, CAD4, ZEM, GML, MWF, PMF
	To provide databse connection: Oracle Spatial 10g SDO-Geometry, MDB, ArcSDEon, PostgreSQL/PostGIS, MS SQL 2008, SQL Server, MS Access
	Web Services: WMS 1.3, WFS 2.0, CSW 2.0.2, GML 3.2
INSPIRE Network	To provide technical parameters of web services according INSPIRE rules. The detail of parameters recommended within Plan4all project is described in the section Inspire Network Service requirements
Performance	To provide ability to handle large file uploads and downloads
	To provide (intermediate) storage for large amounts of data
	To provide acceptable response time for services and sufficient session timeout for persistent connections
	To implement fail-over mechanisms in case of unavailable nodes
	To ensure suitable bandwidth for service provider, service/data mediator node and for service consumer
	To minimize amount of data returned by web services
Security and Safety	To prevent data loss
	To prevent unauthorized access to sensitive data
	To secure privacy concerns
	To provide appropriate system security
	Intellectual property rights
	To secure integrity of copyrights
	To enable “fair use policy” of data and services published
SW quality	Adaptability for changes of requirements and standards
	Availability

	Reliability
	High capacity
	Easy maintenance
	Robustness
	Good return on investment
Internationalization	A support of extended character sets
	A support multiple languages

Recommendations by type of services

6.3 Centralized versus distributed infrastructure

The Plan4all networking architecture is targeting to establish a set of interoperable services which may be accessed and invoked independently but which also should be capable of taking part in complex "chains" of events controlled and executed by means of BPML.

Execution of processes through chaining of services existing in the Internet "cloud" has a significantly higher time-cost compared to executing the same processes in a local system and on local data. The factors causing the increased time-cost is the need for transport of data, network latency as well as different capacity of hardware/software platforms utilized by the network nodes.

- Transport of data requires high bandwidth on account of the protocols being applied for data sharing. OGC-WFS is for an example entirely text based and leads to massive data transfers for relatively simple data.
- The distribution of services across the Internet leads to network latency issues due to different bandwidth, stability and packet-loss.
- Different software vendors implement standard protocols with custom extension or modified behavior in order to stay ahead of the development. These extensions solve issues of "current interest" and become essential to the users – whereby effectively breaking the standards.
- Finally, different hardware configurations will deliver different processing capabilities and response time.

The paradigm "network service architecture" would break if all data and services should be centralized. The factors which are weighed against each other is therefore the pros and cons of promoting regional and/or national aggregations versus gaining direct access to original data from their production databases in real-time in a fully distributed network service architecture.

	Aggregated data and services	Distributed data and services
Pro	Allows generalization of content to take place at a higher level, whereby making the Plan4all infrastructure Integration of data allows complex queries, analysis with high speed and performance. Fewer points to implement and maintain services and (custom) protocols	All services will be working directly towards authoritative data sources without any time-lag Allows for local autonomy and institutional involvement
Con	Requires a solid server platform from the perspective of the aggregator Might lead to issues related to intellectual property rights.	Content and schema will have to be generalized at the local level Requires skills, experience and resources in running distributed trusted infrastructures.

It is recommended that the Plan4all networking architecture should allow the coexistence of content providers, aggregators and service providers in a heterogeneous structure in order to cater for the different legal systems and jurisdictions in which planning data resides.

Due to cost and/or efficiency concerns, sensible levels of aggregation should be promoted to provide either cascading access to underlying data or offer data repositories which may serve national and pan-European purposes.

6.4 Examples of software which is envisaged to support preliminary requirements

This subsection indicates a minimum set of open source software capable of providing the envisaged services and protocols in accordance with the (preliminary) requirements of the Plan4all networking architecture.

Element	Open Source
Platform	Linux
Web server	Apache + PHP
	Apache + Python
Database	PostgreSQL + PostGIS (geodatabase)
	MySQL
Discove (CSW)	Geonetwork
	Micka
View (WMS)	UMN MapServer
	OpenLayers, HSLayers
Download (WFS, WCS)	UMN MapServer (WCS)
	Geohosting (Admin (upload/configure etc.) tool based on PostgreSQL and UMN MapServer)
	GeoServer (WFS)
Transform	Proj4
	GDAL/OGR tools (FWtools)
	HALE
	Spatial Data Integrator http://sourceforge.net/projects/sdispatialetl/
Invoke (WPS)	PyWPS

6.5 Recommendation on compliance levels

Once a set of independent services are envisaged to be used as if they were "one" by issuing simultaneous requests to seven decentralized services instead of one centralized, it is critical that the seven services are capable of responding to the same arguments over the same protocol and yield results which are formatted according to the same standard.

Enforcing and absolutely requiring a wide range of services in a decentralized service infrastructure raises the threshold for partaking in the Plan4all network architecture. For this reason, it is recommended that the architecture should allow for differentiation of service compliance levels in order for the system to provide access to a critical mass of content.

It is recommended to establish compliance level A and B:

A = required services + some or no optional services

B = required services + all optional services

The concept of compliance levels allows data contributors to participate in the plan4all virtual data store with varying levels of ambition (and initial investment). This might be required in order to achieve quick results.

Type of service	**SCL A** (step 2 of 2)	**SCL B** (step 1 of 2)	**Extra (for aggregators)**
Discover	X	X	
View	X	X	
Download	X	X	
Transform I	X	O	
Invoke	X	O	
Upload			X
Transform II			X

SCL = Service Compliance Level – X = required / O = optional

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