

GIS supports urban planning in Prague

Jiří ČTYROKÝ & Jana IROVÁ

Mgr. Jiří Čtyroký & Mgr. Jana Irová, City Development Authority, Prague, Hradčanské nám. 8, 118 54 Prague 1, CZ,;
e-mail: ctyrokj@urm.mepnet.cz, irova@urm.mepnet.cz

1 INTRODUCTION

The City Development Authority (URM)- the municipal planning department - has first integrated GIS into the common planning process 10 years ago. Since then, GIS becomes the powerful tool for exploration, analyses and presentations. Although in the core of GIS application at URM is the maintenance of the well structured and detailed City Master Plan 1:10000, the attention has been also drawn to development of the tools designed for more efficient and wider use of spatial information: intranet and internet map applications, metadata catalogue and other tools.

The paper sets the focus mainly on the technological systems and solutions towards supporting the various planning activities by delivering the customised and pre-processed land information and supporting metadata services.

2 INTRANET MAP SERVICES

GIS was traditionally used as a powerful tool for creating maps which served as the source of immediate information both in office daily routine and the 'outdoor' urban survey activities. However the reliable information on the land has always been the midpoint of the planners interest, the built up environment is at the same time the most dynamically changing type of Earth's surface. The necessity of production of up-to-date maps was the key reason for introducing the GIS into the planning sector.

It has been already stated, that simple map information look is the most frequent task people in the urban planning must go through when they deal with some practical question. What is the parcel number, which address, what is the zoning regulation, which type of ownership? Also, urban planning decision process need complex evaluation of various antagonistic aspects, moreover, aspects changing in time. To provide the information in the traditional way is therefore complicated and time consuming question even with use of desktop GIS.

The question of immediate delivery of the basic up-to-date land information and map to the wide range of users has been answered by the launch of the intranet map applications based on Map Server technologies (Map Services).

The philosophy of the Map Services implementation in the City Development Authority stands on three pillars: Simplicity, Flexibility and Reliability.

2.1 Simplicity

To compete the paper map information, the Map Services must be fast and as simple as possible. While desktop GIS application are mostly used by the trained professionals, Map Services must look friendly and attractive for also people for whose the computer is not the best friend. To achieve this, all the Map Services must be of the very similar GUI (design), must be based on the same map background datasets and must share the same limited set of important tools. The requested information must be possible to get by the minimum of steps, the 'intelligent' find and info tools are the key requirements. If searching by the zooming, the scale limit for switching the map layers is set in the way which gives the users the most typical and practical map composition (picture) for the particular scale. Also, the delivery time mostly for raster layers is optimised by use of pyramid layers architecture.

Talking about simplicity, the simplicity for the end-users is only the one side of the coin. Maintenance of the Map Services system must be also easy-to-perform in order to be able to provide flexible reaction to the comments and new requests. The clear development environment is essential also in respect of the maximal independence on the concrete developer staff.

2.2 Flexibility

The Map Services are designed in the way which enables to perform easily adjustments in the map and tools contents as well as the additional design or other changes in order to improve the functionality and intuitivity towards the most common users. Also, source data storage and administration system is designed in order to provide as easy as possible update of all the geographic or related tabular datasets. In terms of administration, each Map Service application is being developed and maintained by the person responsible also for the regular update of the data contents. Despite it, the administrators must follow the agreed common design and functionality as well as the interoperability with other services.

2.3 Reliability

The bottleneck of every information system is the content and functional reliability. The practical experience clearly proved that if the information system should be really used by the non-IT specialists, it must behave according the user expectations (i.e. normally, without any occasional exceptional and confusing dialog messages) and must provide as up-to-date information as possible. Thanks to the previous good experience with the desktop GIS performance and its requirements and outputs, the majority of users has learned at least a glimpse of the various land data availability, limitation and the update cycles, so they are able to distinguish between system functionality and the data quality. The apprehension of two system components (data and the application) is, from the administrative point of view, very helpful when users requests the new functionality, new data or refers to the failure of the interface.

3 MAP SERVICES ARCHITECTURE

To be able to achieve all the above mentioned requirements, the architecture of the Map Services is based on the division of the core map server (image server) and the application system nutshell which serves as the interface between the user and the map server. The interface application system translate and deliver the requests from the user to the map server, which perform the map image generation and send it back to the application interface. Such division enables to tune use independent software systems for both different parts of the task and tune them to the maximum performance.

3.1 Software and Hardware

The core map server is the ESRI ArcIMS 4.0.1, which deliver the 8 and 24 bit PNG images. Running on the Internet Servers Apache Tomcat 4.1.12 and MS IIS 5.0. The application interface is the PHP 1.3.7 based system T-wist by T-mapy Hradec Králové. System runs on PIII 1,26 GHz, 1GB RAM.

Database agendas are stored in the MySQL 4.0.8 and the ORACLE database system (experimental). GIS data storage uses the ESRI shapefile system, the migration into the ESRI ArcSDE 8.2 (8.3), and Oracle 9i database is currently in preparation, installed on the 2xP4 Xeon 2GHz, 1GB RAM. The web browser software used for the client stations is MS IE 5.0 (the graphics is optimised for resolution 1024x768).

3.2 ArcIMS map services

As the T-wist system enables to combine the map images delivered by the map server, the ArcIMS map services are designed as the basic thematic map components which are combined according to the specific requirements of each Map service application. The main map services are the basic map background (ortophoto, parcels, address points) and the zoning regulation from the Master plan. In addition to this, other thematic map services are prepared (building permit service, price map service, some environmental data services, urban studies services, etc.). The configuration of the services functionality (AXL setting) is focused to the map content and the symbolisation only in order to minimise the map server delivery time and also because specific layer visibility setting (including the scale depending visibility) is better controlled by the T-wist application.

3.3 T-wist application system

T-wist system is composed by the set of PHP scripts and definition files which controls the GUI design and functionality, the communication with Map Server(s) and the communication with the external database systems. The GUI is, in T-wist terminology, called Map Client, derived from the fact that normally several types of GUI varying in the complexity of the tool and the specific design can be required for the different user classes working with the same Map Service (scalable architecture). The Map Client serves as a sort of GUI template for the application controlling the main common design features as the colour scheme, location and the size of the interface components (map frame, overview frame, toolbar, legend frame, query result frame, etc.). Common Map Client specification is the key tool for the ensuring the common look of all Map Services application.

However Map Client controls the design features of GUI, the functionality is set by the definition files specific independently for each Map Service application. These settings controls the availability and performance of each tool and command as well as the its GUI design properties as icon on the button, location in the toolbar, etc. Given that, maintenance of the same basic functionality of all Map Services Application, as e.g. navigation, finding places, basic info tool, etc. is not that easy as in case of the Map Client design specification. On the other hand, possibility to alter the common tools gives the chance to adjust the generally known tools for the specific needs of various thematic datasets, which increases the intuitive command and user acceptance. In fact, new Map Services are developed by copying and altering the verified and popular ones.

Third area which is controlled by the T-wist system is the connection to the database agendas. T-wist enables to store in the GIS source files only the information necessary for the spatial identification while the rest of the descriptive data is stored in the relational databases. Such approach is again effective in terms of use of system resources and resulted in best request delivery time. By analogy with the ArcIMS map services, T-wist enable to define basic connectors to the database agendas which are then used by the various Map Services. Thus, one Map Service normally uses several ArcIMS map services and also more database agendas. T-wist does not require to collect all the information into the huge source data warehouse, which lets the room for effective distribution of administration and content maintenance of the particular databases.

4 SHORT INTRODUCTION TO EXISTING MAP SERVICES

4.1 Common features

The standard environment consists of main map frame, active overview with zooming functionality, legend frame with map layer check boxes and the toolbar. Tools and functions used across all applications are mostly connected with navigation and database search. The core ones are: zoom in & zoom out, pan, measure and print tool, together with two tools for easy info and search. Both latter tools consist of a combo box with predefined roll-down menu and a button for performing the task. The menu offers the basic options as information on parcels, zoning regulation and the address.

4.2 Ortophoto

The oldest and most frequently used Map Service which combines the elegance and simplicity. The application was designed in order to provide quickly first essential information on the area: Cadastral boundaries, Parcel+parcel numbers, Street+addresses, Ortophoto aerial image, zoning regulation from the Master Plan and after the flood in August 2002 also extent of the Q 500 flood area.

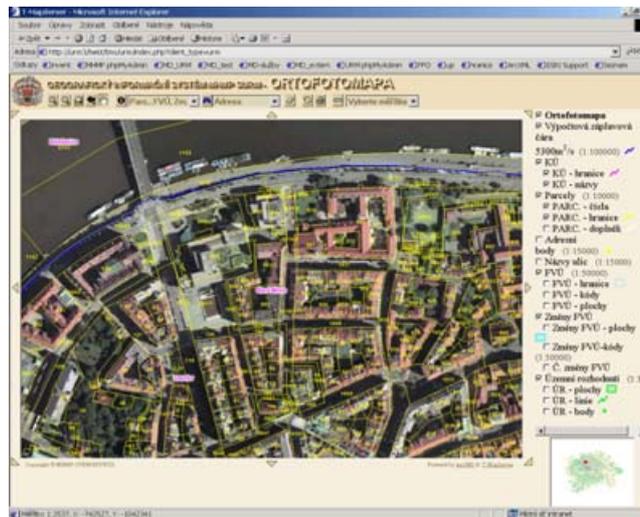


Fig. 1 Ortophoto Map service

4.3 Master Plan

The basic and essential application for exploring the map and textual information from the all 21 drawings of the Master Plan. The individual drawings are converted into the raster datasets and completed with the basic “navigation” layers as ortophoto, address points, etc. The description information on the selected map features (i.e. zoning regulation, etc.) are accessible through the hyperlink tools. Even though the map itself originates in the vector data model, there are many good reasons for using the raster image in the same resolution (scale) as the approved paper document is. First, the zoning regulation was prepared with some precision (1:10000) which determines the maximal detail which can be taken into consideration when working with some small area. Second, legal. According to the Czech legislation, the only legally binding document is the paper one, so that Map Service was designed in order to combine the official content with the strength of the search and related info functionality. Each drawing dataset is followed by the original image of the colour legend from the approved documentation.

4.4 Building Permits

Monitoring the interest in development activities in the area is easy to perform through use of the Building Regulation process monitoring. Every building activity since 1996 has been located into the map layers by point, polyline or polygon features and has been identified by the unique identifier. The identifier is then used for database referencing to the particular types of legal documents of Building Permits. From the administrative point of view the Map Service is the first which uses the interlink with the large database administered by the institutional body independent from the City Development Authority.

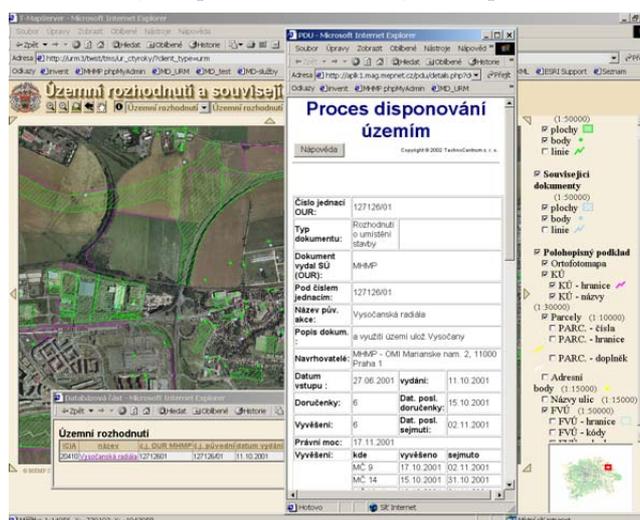


Fig. 2 Building Permit Map Service

4.5 Environmental applications

Information on various aspects of environment are accessible through two applications - Terrestrial System of Ecological Stability and Noise map. Terrestrial System of Ecological Stability (landscape network of green) is the important environmental limit for the land use anchored in the Czech law. The map of such landscape green patches and corridors followed by the database information of specific requirements on the type of the vegetation and other limits is the main information value of the Map Service.

Noise map displays the outputs from the noise model of Prague, the regularly updated source. Apart from isophone map representing the daily average noise levels in the whole Prague area, application contains also the layer of noise reception points – the points in the roadside location at the house facades with precisely calculated and calibrated daily average noise levels.

4.6 Urban development monitoring databases

Monitoring of development is provided individually for each segment of development according to its urban function – housing, retail, office, sport, etc. Currently, map applications for housing and sport are available, the application for retail facilities is under development.

All applications of such type are designed for detail description of development areas and larger development schemes. Thus the map presentation is simple and straightforward in order to show the extent and type of development, while the wealth of database, textual and image (photo, plans, etc.) are accessible through the hyperlink. All application are linked with the building permit database in order to be able to track the development from plan to realisation.

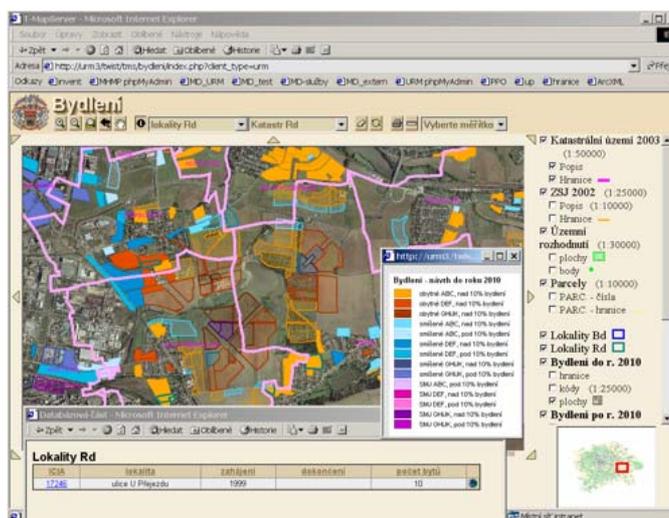


Fig. 3 Map application for housing

4.7 Floods 2003

Shortly after August 2003 floods orthofoto mosaic covering the whole flooded area in Prague was available. Together with calculated and calibrated flood contour line and 'normal' orthofoto and standard map background, the Map Service is valued tool for discussion on the building regulation within the flood zones.

5 DAILY ROUTINE USE AND PROSPECTS TO THE FUTURE

When the first Orthofoto Map Service was launched in November 2002 it attracted soon attention of all planners as well as technical staff due to the comfortable and friendly option for obtaining fast the needed map information. Since then the majority of the staff use some Map Service every day, however, it was proved that the success of basic Orthofoto application can not be probably overcome in the close future. The log file analysis shows, that from some 100 employees which could potentially use the Map Services around 50 different access addresses connects to the Services. Normally there is roughly 20 clients running simultaneously.

The launch of Map Services meant also hard examination of the stability and performance of the office network system, which had to be tuned and adjusted for the increased data loads. On the other hands, the adjustments did not require to exchange the existing hardware and they were targeted mainly on the client internet access refinement.

In the near future new map services are to be developed, the Noise Map service and the Land Price Map service will be the next additions. Also, fine tuning of the current applications and changes towards increase of data store and speed of the system are expected as well.

In the same time, big step is going to happen, the opening the selected Map Services for the internet access. The project, named WebGIS Prague, brings together the leading GIS departments of Prague municipality in order to prepare new common municipal internet mapping and geoinformational website. City Development Authority will, within the framework of the project, develop on own internet map server technology the applications concerning Master plan and the urban planning documentation, as well as it will participate in the development of the other applications using cross-departmentally shared data administration, e.g. already mentioned Building Permit database system. According to the project plan, existing map services will be verified in terms of functionality and the legal conditions for the datasets use (contractual conditions for the presenting on the internet, etc.) and than refined in the necessary way. Technically, before website is officially open, hard stability and performance testing of the servers will be undertaken within the Authority.

6 METADATA SYSTEMS

6.1 Internal metadata system

Opening of the geodata to the broader audience and increasing need to provide and exchange the datasets led to the decision to establish the metadata system based on the valid and currently negotiated metadata standards in order to stay compatible with the most possible numbers of the geodata providers and consumers. The starting point for the metadata architecture was Czech standard for the structure and exchange format of the geographic information sources metadata issued by the predecessor institute to the current Ministry of Informatics and based on the EU CEN P 12657. The implementation of the Standard was consulted with the authors of the standard and the GIS laboratory of the Technical University Ostrava where the national GIS metadata system MIDAS based on the Standard has been developed.

The Standard uses the well defined XML as the exchange metadata format. XML structures and the meaning and conditionality of each metadata field was the good base to build the own implementation. The main stress was put on the enabling the description of the dataset attributes and its domains, the tree hierarchical organisation of the Master Plan datasets as well as description of the use of the dataset layers in the particular drawing, colour legend symbolisation and other specific properties. Of course, such detail goes far beyond the Standard specification. On the other hand, many of that extended information are intended as internal, which allowed to design such database architecture which fully respects the requirements of the XML export format and is also capable to store the additional dataset characteristics. Thanks to the flexible architecture of the Standard, major part of extension was connected mostly by definition of new data classes in the class definition table and additions to the table of association types (definition of the possible relations between object classes). General metadata system architecture within the City Development Authority is based on the central database system accessed purely by the intranet application scalable system allowing to perform all operations connected to all administration of the system, database content maintenance and the end-user requirements.

Development of the metadata system started in October 2002. The system architecture was finished in November and the development of PHP application for the system administration has begun. Concurrently, the database was filled in the testing phase with the first set of Master plan data. Due to non-existing interface the database feeding was provided through direct database access using by MS Access standard application interface.

Up to now, the basic interface has been developed and the important part of the Master Plan dataset has been already entered into the system.

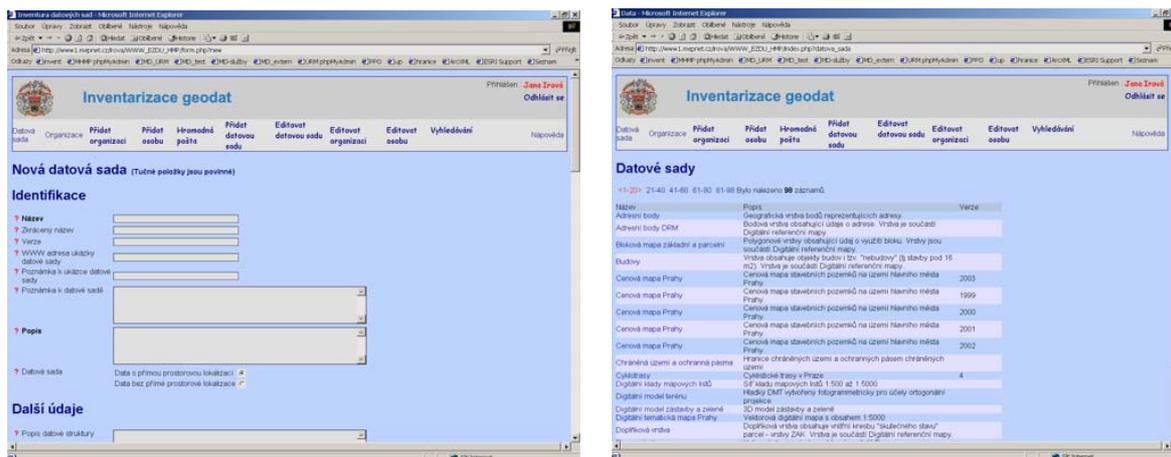


Fig. 4 Municipal geodata inventory interface

6.2 Municipal metadata project

Together with development of the municipal WebGIS project mentioned in the paragraph dedicated to the Map Services, the need to share the description metadata to the first presented datasets and all reliable geodatasets in the future appeared. The municipal metadata system must respect the distributed administration of the geographic data across the municipal departments and organisations as well as must take into account the different internal traditions and methods of dataset organisation and maintenance. The correspondence of the system to the national and international standards was also clearly expressed as essential.

Having that, the development of the system was designed in two steps. First, fast and lightweight inventory of the municipal datasets will be provided based on the simplified Czech metadata standard. The aim of the inventory is to raise the basic information on the geodata existence, quality and administration in Prague in order to be able to tailor the main metadata system in the most effective and productive way. The main co-ordinator of the geodata inventory phase, responsible for development of the inventory system, data input management and raised data exploitation is the City Development Authority.

After the inventory is evaluated, the main metadata system architecture will be developed. Even if detail technical solution is not ready now, the main features of the system has been already drafted. The system will be based on the principle of one central thin internet portal which will contain the basic list of dataset identification and the connection parameters to the metadata servers of each dataset administrator parties. The main task of the central portal is to serve as the 'single address' interface for the end users which will communicate with the local metadata servers. Local servers will wait for the request and return the complex information to display in the portal interface. Distribution of the main metadata content into the interlinked databases will allow all parties to maintain its metadata in internal well managed system and will avoid the ineffective dual metadata maintenance which will be the

case if one central municipal metadatabase would be implemented. The communication between local metadatabase system and the portal will be based on Metadata Services principle and XML protocol, which assumes all parties equipped by the Internet Map Server will run the Internet Metadata Server within the system as well. The XML protocol must be compatible with the national and international metadata standards in order to be able to communicate in the future national geodata clearinghouse infrastructure.

6.3 Standards

As it has been stated above, proper definition of the rules for the metadata information content and exchange is the essential for any database architecture and the XML exchange format discussions. In this respect the development of both internal and municipal metadatabases is being disturbed by the unfinished Standard preparation in the Czech republic. In spite of publication of referred Standard based on CEN 12657 which is so far the only existing Czech official metadata document there is still missing standard which is expected to survive without considerable changes for more than two years. The reason is in the final stage of preparation new international ISO 19115 Standard, which is expected to serve as the base for new EU metadata standard as well as for the general redesign of the Czech document. The differences between current Czech and draft ISO standards are not only of the cosmetics nature. Even if comparison of the item (metadata entities) list and related mandatory/compulsory properties do not show too much real differences, the general database logic of both documentations can not be marked as compatible.

Unsettled situation in the field of standards has, of course, negative impact to the metadata systems preparation in Prague. It is clear, that after new Czech standard is published, existing metadata infrastructures will have to be adjusted to the new requirements. Therefore, development of some database parts (namely of internal City Development Authority system) was practically stopped until at least the draft of new standard is known. In order to be as close as possible to the process, the developers of both referred Prague metadata systems take the chance to participate in the discussions on the new ISO based standard.

7 CONCLUSION

GIS has become the essential part of the urban planners daily routine in Prague in the last decade. Implementation of internet information systems and namely Map Services into the common working environment brought positive change of perception of GIS among end users who no more see the GIS as the mysterious system for experts but as the common tool for everybody willing to learn and know. Positive feedback after launch of the first Map Service application was the impulse for boom of follower applications based on the common design and core functionality. Opening selected services for the internet user within the municipal WebGIS Prague project will be the next milestone on the way to the fulfilling the idea of the information society.