ENGLISH VERSION

cart@net

White Paper

PLANETEK

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About Cart@net

Cart@net$^®$ is a web application designed to publish and share cartographic databases.

The simplicity of use, the high performances and reliability, conjugated to the modular structure, make Cart@net the perfect solution for both small applications and enterprise architectures.

The cartographic navigation is guaranteed through pre-defined maps that allows the user to immediately reach the information of its own interest also inside big-sized files.
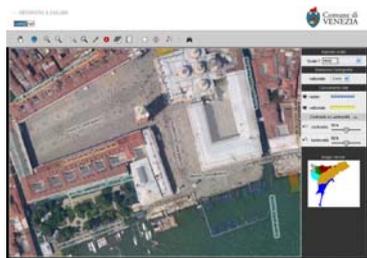
Together with the traditional navigation of maps, a new way of viewing the maps is available with side by side windows and overlapped windows that allow to browse at the same time different thematic maps related to the same area of interest. Cart@net enables immediate comparative analysis also to users without specific competences and therefore it works as a true professional tool.

This high performances derive from an efficient way of accessing the files based on the use of compressed formats like ECW and JPEG2000. At the same time it uses an efficient transmission protocol that optimizes the connection speed via Internet to the client. This way the system offers wide map views that, as a difference with the traditional systems, could reach the size of the whole screen by keeping, at the same time, a low server load and therefore rapid answer times also in presence of several contemporary connections.

In the enterprise configurations Cart@net allows the unique fruition of multiple files, distributed in different corporate locations. Such characteristic can, for instance, allow to a cartographic regional office to publish inside its own web portal the cartographies provided by the cartographic applications of the provinces, thus realizing an unique point of fruition without the need to duplicate the files.

Via Cart@net you can browse and query different cartographic database via Internet, by searching on graphic and alphanumeric criteria, and view the raster cartography (like aerial photos or satellite imagery) related to the area of interest.

The system can connect simultaneously to files published with different types of raster and vector Internet Map Servers (IMS) like Image Web Server, UMN MapServer, OGC WMS, ArcIMS in different SRS, Spatial Reference Systems (UTM, Gauss Boaga and Geographic) as well.

An administration area, accessible via web, permits in a few minutes to publish cartography and update the catalogue of data in a simple and fast way.

Cart@net provides a series of optional tools for the direct access to raster database, for the safety of the datasets, for the management of multiple servers, for the 3D visualization and navigation, and for the interactive geolocation.

The system has been developed in the full respect of the national and international standards, as for instance the specification of the Open Geospatial Consorzium (OGC).

With Cart@net you can:

- Publish and share on-line cartographic databases;

- Create your own modular and customized cartographic Web portal;

- Make raster maps of any size accessible via the Internet;

- View the images on-the-fly and browse in real time, and this happens quickly as it's not needed to download entire heavy data;

- Use the imagery inside GIS and CAD applications;

- Allow the access to multiple archives and connect to different Internet Map Servers (IMS) and different SRS;

- Update continuously the catalogue of data available in a fast and easy way.

Why publishing the cartography on the Web?

In the very last years the importance of geographical information has arisen both in the traditional market of cartography users and in emergent markets, today the new consumers of geospatial information. This change has produced on one side, for the companies, a remarkable increase in the file size (from Gigabytes to Terabytes of data) and from the other side a progressive growth in the size of the single image as a consequence of the higher resolution of the sensors which acquires such data (as for instance the images acquired from the satellites of last generation).

Together with a wider use of the geographical data there is at the same time the need to integrate raster images with the traditional vector data managed from the GIS (Geographical Information Systems) in order to get better results both in viewing and analyzing the geographical data.

The WebGIS systems answer this demand. They enable web publishing of cartography, thus producing a higher value for the investment made inside an organization to realize a Geographical Information System, in order to let the information be available to anybody in any moment and anywhere. Thanks to the powerful

technologies today available, it is possible share the information using new "Open Standard" formats, that allow accessing to the data without big technical limitations.

Every single organization using spatial analysis applications has different hardware environments in fact. A web oriented application in these cases is the perfect solution for data management and sharing, avoiding the need to install the same application on different client computer, and minimizing the quantity of data that circulate on the net.

This approach enables a centralized management of the application, the protection of the data, the viewing and the access from the outside and also, thanks to the palmtop computers and wireless communication technologies, the direct use by those operators involved in the reliefs on the field, strongly increasing the communication and the productivity.

When planning and developing a systems that allows, to any client connected on the Web, accessing to the territorial data through the typical tools of a GIS (WebGIS, as they are commonly called) various aspects should be considered:

- integration and publication of different cartographic datasets;

- development of simple procedures in the website, that may be used by not experienced consumers too;

- optimization of the answer-times during the maps browsing;

- immediate up-to-date of the cartography published on Internet through automatic tools;

- safety of the data published;

- need of customization of GUI (Graphic User Interface) and tools;

- possibility to expand, in different steps, the database and the features of the application.

Why Cart@net

Cart@net answers all the demands listed above, in order to satisfy the requirements of most part of the consumers that need to publish cartographic data and integrate the information provided from heterogeneous servers.

The product is the result of an accurate analysis of the requirements of several users. It improves itself by enriching always of new features, developed as a concrete answer to the request and needs of real customers.

With Cart@net anybody can count on a system for the publication of cartography on Web that, thanks to its flexibility and modularity, can fit

the demands of any kind of user, from the small Municipality to the Public Regional or Central Administration, from the tourist firms to big territorial corporate agencies.

System architecture

Cart@net is based on a Windows architecture. In details:
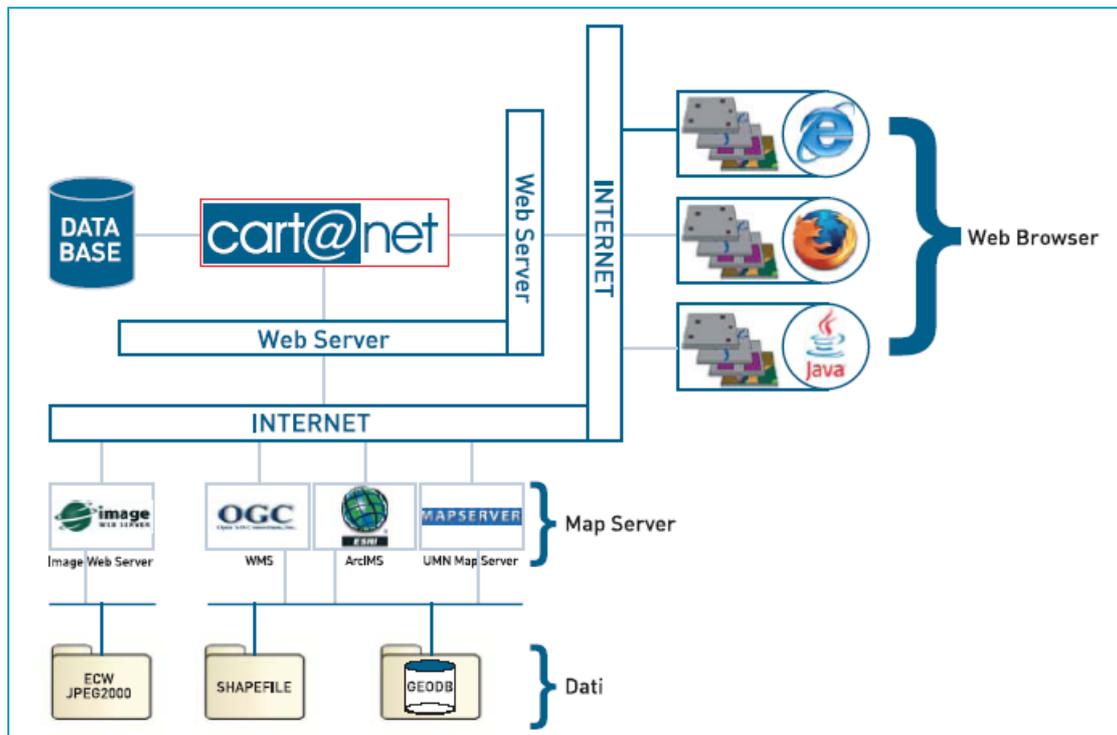
- The software Internet Information Server is used to publish the website;

- Image Web Server® allows the distribution on the Intranet or Internet of the cartographic database in ECW or JPEG2000 format via the *ECWP* protocol;

- ESRI's ArcIMS®, UMN MapServer and any OGC WMS Server are the environments supported for the publishing of vector cartography on the Web;

- the browsers Internet Explorer (IE) or Mozilla Firefox, and generally speaking any browser who supports the Java Virtual Machine, may constitute the application that the users will use to view and work with the geographic data;

- Alphanumeric data related to toponyms and for the management of the cartographic information are stored in the database. Cart@net is designed to work with the most common databases available on the market like Oracle, MS Access, SQL Server, MySQL, PostgreSQL.

The formats of cartography commonly used in the web system are SHAPEFILE and Geodatabase, therefore the preparation of the archives does not require any intervention on the structure and format of data. The format ECW and JPG2000 are used for the management of raster data for the big advantages offered by the quick access to the visual information.

ECW

Cart@net uses the ECW compression format developed by ER Mapper (http://www.ermapper.com) for the management of raster data. ECW allows to remarkably reduce the size of raster images, and permits at the same time the multi-resolution access to the data. The compression technique used generates a sort of pyramid image (where the information is stored at different resolutions) without the waste of space due to the storage of additional data. The time of direct read of the data and of extraction of a portion of the raster data to the needed resolution for a correct visualization are substantially independent from the total size of the image.

ECW is the acronym of Enhanced Compressed Wavelet. It's a common standard for the compression of images of big size, widely used in the field of geomatics.

The Wavelet is up to day the most efficient technology of image compression, based on the image encoding. The Wavelet compression analyzes and decompresses the images in a recursive way. This analysis produces a sequential series of images with more and more high resolution, each of them increasing the quantity of information present in the image with a lower resolution. The Wavelet compression is very efficient in preserving the accuracy of the data inside highly compressed files. As a difference to the traditional JPG format, that uses a Discreet Cosine Transform (DCT) to blocks, the modern techniques of Wavelet compression allows compression rates of 20:1 or higher without a visible degradation of the original image. The Wavelet compression could be used also to produce a compressed images without loss of information (lossless) with rates around 2:1.

The Raster cartography is transferred between the server and the client using the *ECWP* protocol. The ECWP protocol on the server side is managed from the software Image Web Server developed by Earth Resource Mapping. The access to the server can be made through both the web interface, by using a plug-in inside a common Internet browser, and directly within a GIS software, using the ad-hoc plug-in freely available.

JPEG 2000

JPEG 2000 is an international standard, developed by the Joint Photographic Expert Group (JPEG). The JPEG standard has been used widely in the field of the applications of digital graphics like for instance digital cameras, scanner and Internet.

JPEG 2000 is substantially a revision of the previous JPEG format. JPEG 2000 provides to the actual and future applications important features and support, together with a better compression of images. Between the characteristics of JPEG 2000 it must be highlighted the capability to make compression of Lossy type (with loss of information) and Lossless (without loss of information). The lossless compression doesn't involve any change of data and this permits therefore to recover all the information and exactly reconstruct the original datum starting from the compressed data.

Such characteristic is essential in all those applications where it's important not to modify the values of the pixels of the images (for instance to preserve the radiometry of the data).

The use of Image Web Server optimizes the times of response and the band load, allowing through the *ECWP* protocol the transfer of the solely data needed. Only the information with the right resolution will be extracted on demand and then transferred from the server to the client, in compressed format. During the *pan* and *zoom* actions only the new data requested are transferred, thus avoiding the regeneration of the whole view on the screen. Image Web Server and the *ECWP* protocol, beyond the efficiency of use of the web band, they guarantee an effective use of the hardware resources of the server, thus allowing the management of several clients and related interactive sessions, without requiring any heavy elaborations on the server side, that could create bottle necks.

ECW or JPEG 2000?

There are several aspects to consider when creating a compressed image, in order to choose the compression format to be ECW or JPEG 2000. These aspects include the size, the performances, the radiometric resolution (bit depth), the loss of information and the compatibility.

 Size: Datasets larger than 1,000 gigabytes should be compressed with ECW

 Performance: Compression and decompression will generally be quicker with ECW images.

 Bit Depth: ECW only support 8-bits data per band (24-bit RGB) where as JPEG 2000 supports 28-bit precisions per band.

> Compatibility: ECW is more widely supported in GIS applications than the new JPEG 2000 format. JPEG 2000 support is growing rapidly.
>
> Lossy or Lossless: ECW only supports lossy compression. JPEG 2000 supports lossy and lossless compression.
>
> Further details for Image Web Server, the ECW and JPEG 2000 compression and the *ECWP* protocol, together with sample application, are available at the website http://www.earthetc.com and http://www.planetek.it.

The access to vector data

The servers for the publication of the vector data are designed for the management of the cartography in different thematic maps, that may be overlayed each other in an integrated way. The graphics and colour layout (colors, outlines, symbols) may be defined through a programming interface accessible by the administrator of the system.

The system grants a complete visibility via web of the information tables related to each single vector object.

The vector datasets are organised in types, and the attributes correspond to the data stored inside the shapefile provided by the customer.

The displaying of the alphanumeric information allows the consultation on-line via Intranet-Internet of the information tables of all the cartographic elements. The information tables can host different kinds of data (images, photos collected by scanner, videos, etc.)
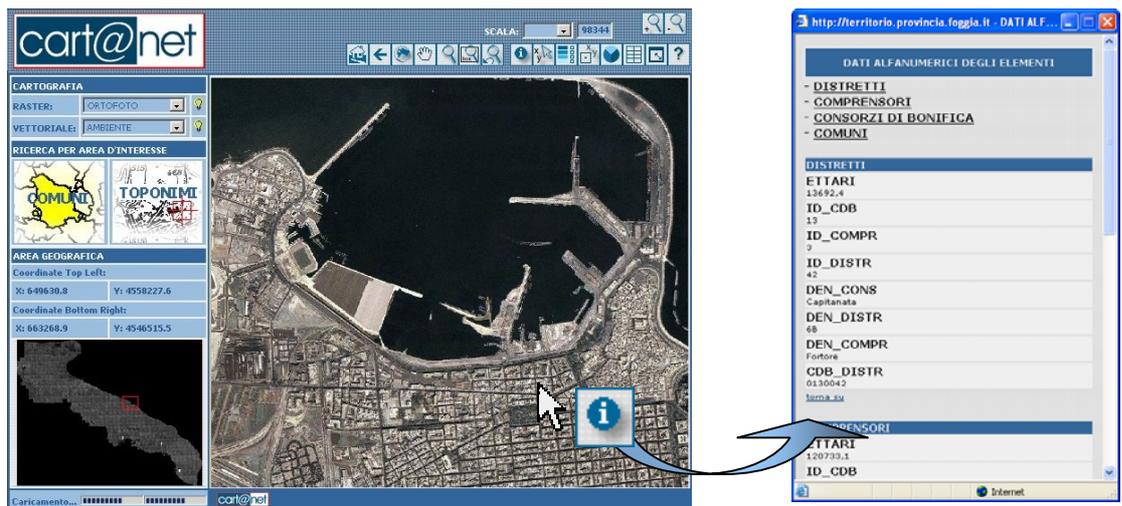
Viewing area

Cart@net is a web application accessible through a traditional browser as Internet Explorer or Mozilla Firefox, on Microsoft Windows, and generally speaking on whichever computer with a Java Virtual Machine platform (version 1.4.x or advanced). The application moreover offers an user friendly interface.

The Cart@net system offers the consultation of maps through a driven navigation. When viewing the maps, the user can choose within a series of thematic areas of interest (e.g.: land use, hydrogeology, forests and landscape, etc.).

Example of Thematic Areas of Interest

Inside each thematic area, a potentially limitless number of "cartographic tables" can be loaded. Every *cartographic table* corresponds to a vector service (a set of cartographic layers in shape-file format) associated to a raster theme in background.

Example of Cartographic Tables related to a Thematic Area

For each *cartographic table* is showed a text description (e.g. the characteristics of the vector service published, information on the metadata, institutional references, credits etc.), a preview icon of the published map, created dynamically (it is automatically updated every time that the related vector service is modified), with the possibility to

associate also possible links to other documents. All these information are managed in the Administration Area in a simple and fast way (see §"Administration area").

As an option maps can be organized in different ways, based on the end user requirements. It is possible to give the user free hand to choose the viewing area through a geographic search or by selecting in an interactive map the area of interest (e.g. through the navigation scheme Region → Province → Municipality).

Web Interface

In the organization of the website and the graphic design, priority is given to the ease of navigation and consultation of the maps. The "look" of the website is normally compliant to what represented in the figures of this document.

Planetek Italia carefully consider the customization of the graphical interface. A big effort is carried out every time to adapt the graphical design of the pages to the rest of the web portal where the cartographic section will be inserted.

This effort comes from the belief that the graphical design has an important role towards those who will use the service effectively and, at the same time, accelerating the speed of understanding the several functions provided by the website.

Both the redefinition and the optimization of the menu tunings, as like as the choice of icons, passes from the accurate study made by Planetek Italia staff every time, for every single application realized. The perfect interface does not exist in fact, and the interaction man-machine can instead change, depending on the user requirements.

This job is carried out thanks to the ten-years experience of Planetek Italia made through continuous exchanges with the customer. For this reason Cart@net guarantees an always efficient result from both the functional and the visual point of view. This is the main distinctive feature that confers value added to the whole Web Site, thus demonstrating the effectiveness of the investment made.

Another aspect that is usually weighted is the level of competences, both cartographic and information mediums, of the users of the system. Being a lot diversified and being the system addressed to a considerable number of customers, a friendly interface is usually designed, giving the less expert customer the opportunity to access the system easily and appreciate the quality of the service offered.

Cartographic navigation

When accessing the website in the cartographic section, the user finds a number of tools and functionalities that allow the visualization and browsing the maps inside the area of interest.

In order to simplify the navigation, the graphical interface provides interactive buttons that, when the mouse passes over, show a short description of its function. This facilitates the customer understanding of the available tools.

An HELP window with a downloadable handbook is also available on-line. It describes the functionalities of the buttons and the search options.

The customer, thanks to drop-down menu, `canm`can use a series of functions in support to the navigation, like the choice of the portion of the territory to visualize or the scale of the cartography.

Inside the reference area the user can move and navigate freely by using the standard tools (pan, zoom).

The scale can moreover be easily modified, with the zoom tool ('zoom in' to pass to a higher detail, or 'zoom out' to pass to a lower detail), or set up, writing the target value.

The user can move and query the cartography by using the following buttons:

- interactive Pan
it shows the different zones of the map by moving the mouse in the different direction (up, down, left, right)

- moving arrows
(up, down, left, right)

- dynamic zoom
It increases the level of detail of the cartography in continuous way (dynamics) `[z3]`

- zoom box;
It increases the level of detail of one specific portion of the cartography, framed from a rectangle (box)

- zoom in (+) and zoom out (-)
It increases the level of detail of the cartography with assigned scale factors

- coordinates of a specific point
by pointing with the mouse cursor on a point this function reveals the geographic coordinates associated

- identify of the vector data and visualization of its attributes
this function makes a query on the geographic database linked to the cartography to show the attributes of the object on which the customer clicks

- Measure of distances and areas
This function let the customer know the distance between two points or the area of a polygon in the following ways:

✓ *Video digitizing a line*

✓ *Video digitizing a polyline*

✓ *Video digitizing a polygon*

The distance is calculated by the system and showed with a measure unit adapted to the size of the of area viewed. During the digitizing of the segments that constitute the polyline, the system supplies also the length of the last segment digitized.

- On-the-fly coordinate conversion
This function converts on-the-fly the coordinates of a known point, or to search a point, knowing the coordinates, in various projection systems.

Moreover during the cartographic navigation the customer always views the map, because the system does not need any refresh that slows the use down.

Displaying modes

The website is designed in order to allow the display of a single database or of two databases, both inside the same viewing window or in two 'side by side' windows.

The website is provided with three sections that allows:

1. **Single view**
2. **Side by side views**
3. **Overlapped views**

The display of the single database (Single View) is the default view. The side by side views is an option to be activated from the user.

Single view

In this display mode the web user chooses the data to display between those available for the selected area.

The selected area is displayed in a single window with scale of representation optimized for display of the entire demanded area. This representation mode is simple and immediate. The advantage of the single view is the opportunity to have a wider display of the cartography, equipped with all the functionalities in order to interact with it (Image: Example of single view).
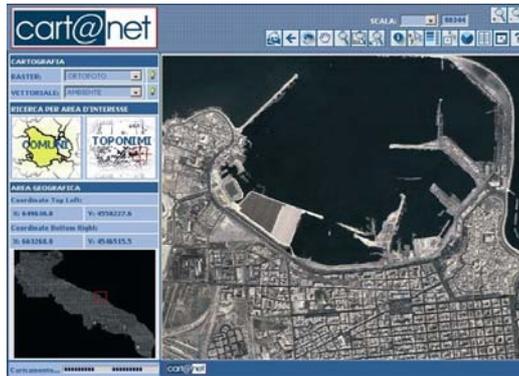

Example of single view

Side by side Views

In this displaying mode is given the possibility to display two different data (raster and/or vector) in contiguous windows. In case more data are available for a same area, the web user can choose which couple of data to display.

The web user has three optional modes:

First option: display in the left area of the window, a couple of data (raster and vector) of the selected territory (e.g. an aerial photo with overlapped the administrative limits) and in the right window another couple of data (e.g. a satellite image with the Land Use Map) of the contiguous portion of the territory (as shown in the picture)
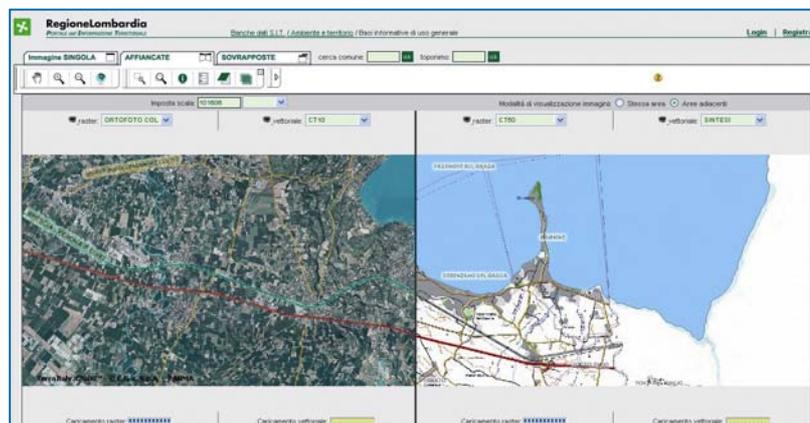
Lombardy Region: side by side view of contiguous areas displayed with a technical cartography and a mosaic of color ortophoto

Second option: display the same portion of the territory both in the left and in the right part of the window, but showing a couple of different data (as in the previous example, see Figure).
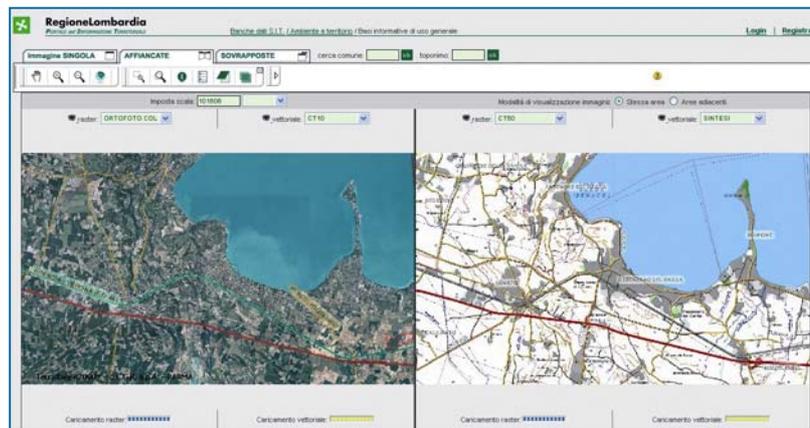
Lombardy Region: displaying the same area both on a technical cartography and on mosaic of ortophoto

Third option: displaying two independent portions of territory in the left and in the right part of the window, and showing a couple of different data. All the mentioned displaying modes maintains the standard navigation tools (pan, zoom, representation scale, search tool, etc.).

Overlapped views

This mode gives the opportunity to display four different data (2 raster and 2 vector) overlapped one to other. This is possible thanks to the management of the data transparency (like represented in the picture).

The system is set up to allow both the synchronized [Pk6] and overlapped display of two raster data and two vector thematic maps. In case more data are available for a same area, the web user can choose, by means of a drop-down menu which data to overlap.

A specific control tool lets the web user choose the transparency degree passing from 0 (foreground data displayed) to 100% (background data displayed). It is possible to pass continuously through all the intermediate degrees of transparency between 0 and 100%. This functionality is managed in real time.

Overlapped view: example of transparency settings

Also in this mode are available all standard navigation functions (pan, zoom, representation scale, search tool, etc.).

Function of localization and search

The web user has the possibility to select the Municipality area, whose cartography is aimed to show, through a list of names organized per Province, or by using the search tool. The area will be automatically evidenced on the cartography with a symbol (for the punctual elements) and the proper viewing scale will be automatically set up on the base of the extension of the selected elements, centering the area in the display window. Here [SS7] follows a schematic example of search.
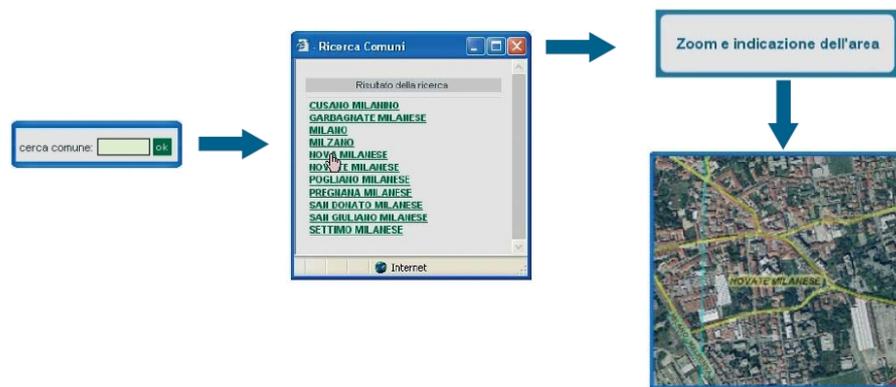
Bookmarking the active display mode

The bookmark tool allows the customer "to save" one or more displayed areas. To save a displayed areas is meant as the possibility to recall later, or in the next access to the system, the territorial area with all the active functions selected from the customer in that moment (see the table of the previous paragraph). Every bookmark can be personalized with a name. The functionality uses the technology of "cookies" related to the browser. The information used for such scope is not therefore saved in the Database of the system but, encrypted, on the *client* of the customer who enters the system.

The bookmark saved from the customer could be recalled and displayed again by using the "bookmark cart".

Search by Toponyms

The functionalities of Cart@net can be enriched with the Toponyms Module. Thanks to an advanced searching environment the customer can search for a specific place name inside of the database, displaying immediately the result on the reference cartography.

The toponyms module enables the research

method by filling in parameters in a text case. The customer will be able to choose the toponyms to display from the listed directory, and the display mode will be the same already seen for the Municipalities areas, with a symbol for the identification and automatic representation scale.

Printing

The cartography printing feature inside Cart@net gives the opportunity to activate the tool for printing the cartographic sights.

The printing function can be enabled by a simple click on the specific icon ( ) that will show in a new page the printing preview, equipped with all the characteristics of the cartography displayed in the sight (as an example the extent, the layers and the vectorial or raster cartography selected).

The printing preview shows also the information inherent the scale, both of projection and datum, the title of the cartography and the coordinates of the map extent. Moreover is displayed the legend and the section of the cartography that is being printed.

The customer by clicking on the key "print cartography" will be able to proceed on to the cartography printing process through the common Microsoft Windows steps. The customer can also ask the system to produce high quality Acrobat PDF files of the cartography. Once produced the PDF file, itself is made available to the customer in two alternative ways:

Delivery by e-mail: the customer is only asked to specify the e-mail address in the proper dialogue window, and PDF file is automatically sent attached in the email message;

Download: the system automatically generates an URL address where the customer will be able to download the file (e.g.: http://server.com/print00156.pdf)

Advanced features

Direct access to raster cartography

The Cart@net system, thanks to integration with Image Web server, let the customers experience an innovative access mode to the raster database. Allowed customers will be able in fact to display inside their own GIS/CAD applications the raster database, made available by every Agency that uses Cart@net to publish its cartographic archive, via the internet using the ECWP protocol (see §"System Architecture"). This access mode allows remote users to add an informative raster layer inside the GIS/CAD software installed on the PC.

This access mode is to the database is already available with following products:

ArcGIS

ArcView

AutoCAD 2000\2000i, 2002

AutoCAD R14

MapInfo

Microsoft Office

Erdas

ER Viewer

For the products that do not support the ECWP protocol directly this function is made available with the installation of a free plug-in.

Once installed the proper plug-in, as an example in ArcGIS, and loaded the extension that displays ECW images, the toolbar will shown a special icon which adds, inside a specific view, a raster theme charged via Web. The last step is to copy from Cart@net the URL of the ECW image, as shown in the following Picture:

and paste the same URL in the dialogue window of the GIS software, in order to promptly display the new geocoded raster theme
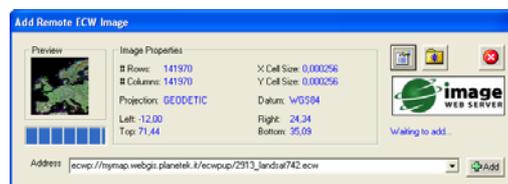
In this way a remote user, as an example the technical office of a Municipality, can overlap to ortofoto any information such as the municipal borders, town plans and other data.

Protecting Data

All the vectorial and raster data published and displayed in the website can be protected from internet "unauthorized download". Furthermore as a guarantee for the complete protection of the system, the html/javascript code of the webpages is encrypted.

IWSES - Advanced protection

Planetek Italia, in order to guarantee the protection of the data published with Cart@net, has designed and developed IWSES - Image Web server Enhanced Security: an innovative instrument dedicated to the protection of the raster cartography published through Image Web Server.

A revolutionary characteristic of Image Web Server is the possibility to use the ECW images published via Internet, not only with the most common browsers (as Internet Explorer and Netscape) but also through direct access from GIS and CAD applications (as ArcGIS or AutoCAD) or Office (as Microsoft Word).

IWSES is however able to recognize who is accessing consultation through Internet browser and who is using the data by inside a professional GIS/CAD application, applying customized levels of protection. In this way it is possible to identify the customers' accesses to the database and admit only the subscribed authorized users.

IWSES can be integrated with the normal procedures of authentication used in the web sites in order to give access to the restricted areas of the website also using old archives of users.

This instrument is considered a good solution for those administrations who plans to publish via Internet raster cartographic databases like ortophotos, satellite images and cartography acquired through scanner, and allow the access, in controlled way, to other Agencies previously authorized safeguarding the copyright of the published images.

IWSES, in its Advanced version, can manage the accesses both via browser and through the other applications allowed.

The level of customization enables :

- to manage the access to the data through the authentication of the customer;

- to manage groups of customers by introducing or deleting restrictions on the base of IP address of the client accessing (useful for the management of Intranet clients);

- to activate access restrictions to specific files of the database;

- allow the access only in prefixed hours or days (as an example during the work hours from monday to friday);

- to readdress the access to a different file relating to the different customer (as an example in order to allow image use at a different resolution);

- to trace log of accesses and attempts of unauthorized accesses.

This version is suggested whenever is needed to manage the access to data for the consultation through the website or for the controlled sharing of the data inside of the local network of the agency (as an example between offices/departments) or when they are shared with other agencies, and data exchange procedures are wanted (regions/municipalities, provinces/municipalities).

More information are available at the following address http://www.planetek.it/iwses

Management of Multiple Servers

Geographic data archives lives, today, a period of great development and one of the main goal is to guarantee the best data sharing environment, in order to answer the needs of different kinds of user. The scenario of data archiving systems for GIS and Earth Observation involves a number of actors, institutional and not, and a number of different systems. The main technologies on the market are ESRI ArcIMS, Autodesk MapGuide, Intergraph Geomedia WebMap, MapInfo MapXtreme, UMN MapServer, etc.

The technology suppliers are involved in increasing their market shares but, nonetheless, are very conscious of customers' integration needs, very often occupied in managing an heterogeneous technological substrate. Every big supplier, in fact, has recently introduced updates to its solutions, in order to be compliant with OGC (Open GeoSpatial Consortium) requirements, identifying in these requirements the answer to the demands for interoperability of GIS systems customers.

A first level of integration of the systems is therefore guaranteed by this architecture choice of the suppliers, thus focusing customer's problems at interoperability of geographic data. A system that wants to answer to such requirements, must analyze and resolve two critical points, typical of the cartographic data:

- The heterogeneity of cartographic data reference systems;

- The lack of a standard for encoding alphanumeric information of geographic data, namely the lack of a shared semantic.

The first critical point has historical and geographical reasons. In Italy, as an example, exist various cartographic projections (UTM, Gauss-Boaga, Geographic) based on different Datum (Roma40, ED50, WGS84), for each of the two fuses in which the Italian territory is divided. Their combination originates nine different ways of representing maps and nearly all currently are used in the various Italian administration areas. If we expand analysis to the European territory, the matter would become much more complex. A system that wants to guarantee integration of such a different data therefore, must be able to convert them in real time (on-the-fly) without a demand for previous alignment to projects requirements, duplicating them through industrious batch procedures, that would carry to remarkable losses of time and money: two well-known resources in short supply. Such conversion must be worth both for vector data (punctual, linear, polygonal themes) and raster (ortophotos, satellite maps, technical papers, DEM, IGM), and the conversion of raster data represents the big challenge. The second critical point represents the ability to understand the meaning of the archived information. Every database has, in fact, a different data model, that results from the analyses and project needs, in this way the term "road" could have different meanings for each database involved in integration: an address, or the entire road complete with width, length, typology, etc. There is the necessity of having a semantic dictionary, that works as a guideline for the interpretation of the information.

Cart@net Multiserver

The Multiserver module is designed to connect Cart@net to WebGIS services served by remote servers without limits in the number of the integrated servers. This module empowers Cart@net with the following additional functionalities:

- ✓ Integration of remote cartographic vectorial servers using the same technology, ESRI ArcIMS®, UMN MapServer or OGC WMS;

  The administrator of Cart@net will be able to publish vectorial cartography hosted on whichever server, also external

- ✓ Integration of remote cartographic raster servers with Image Web Server technology

  The administrator of Cart@net will be able to publish raster cartography hosted on whichever Image Web Server, also external;

- ✓ Not intrusive

  Is not necessary to install software or to make adjustments or updates on the remote server

- ✓ Alignment of the information published in Cart@net.

e.g.: the administrator of Cart@net system will be able anytime to realign the catalogue information archived in the system with those on the remote server, that they could have encountered a misalignment, due to an hypotetical maintenance of the remote system;

✓ Data accesses Report

e.g.: every supplier of cartography will be able to receiving information about the use of its own cartography published through Cart@net.

The vector and raster cartographic data could be given in the projection, datum and fuse that normally are used to produce cartography on Italian national territory. As an example UTM with datum WGS84 or ED50, in Fuse 32 or 33 or Gauss-Boaga projection with datum Roma40, fuse East or West, and so on.

If the GeoHarP module is not present the contemporary consultation of different data is only made for data with same system of reference. The system can to recognize automatically the uncorrelated conditions allowing only the consultation of homogenous data.

Such a mechanism of control is applied to all the consultation modes (simple view, synchronized, overlapped) between raster and raster, vectorial and vectorial, vectorial and raster.

Unavailability and uncorrelated Archives

The shared publication of remote archives embraces the risk that temporary a server could be disconnected to the network and therefore navigation through archives could be impossible. In these cases an error can be encountered during the consultation of the cartography.

The system manages this situation through periodic control procedures that find possible anomalies between cartographic services published and those really available. In this way the system avoids that a customer, when visiting the WebGIS sites, can demand the consultation of unavailable cartographies residents on the server in that moment, or alternatively, it informs of the unavailability of the consultation of the data.

Module Cart@net MultiStandard

The module Cart@net MultiStandard is installed directly on the module Cart@net Multiserver and enables the publication of data served by server based on different technologies.

Following are described the additional functions added by the MultiStandard module skipping those functions already described in the Multiserver section module or already native of Cart@net.

The Driver needed to access the data

The drivers for the remote server access are shown in the following table:

Cartographic Server	Exchange Protocol
ArcIMS (ESRI) from version 3,1 to 9.x	ArcXML
Image Web Server from version 1.7.1	ECWP
WMS version 1.1.1	OGC specifications
UMS MapServer from version 3.x	MapServer

Thanks to the MultiStandard Module the customers of the system can consult cartographic data served by the remote server of the Data Provider who use different solutions.

To the customer will be totally transparent the use of cartography coming from different not homogeneous typologies of server.

The exchange protocols

the growing popularity of Internet and Intranet networks for the distribution of geospatial information from servers to clients has asked time by time the definition of various data transmission protocols, each characterized by a different set of features for diffusion and compatibility. Cart@net can fully support the four transmission protocols here following described.

Open GIS Consortium Web Map Service (OGC WMS)

The Open GIS Consortium (http://www.opengeospatial.org/) is founded by a wide number of companies and organizations that supply indications and develops requirements for the geospatial industry. This Consortium has developed a standard for the Client/Server interaction dedicated to the distribution of geospatial information known as Web Map Service (WMS), that has the advantage of being a Open format Standard designed for the supplying a lists of standard requirements interface for the market.

Cart@net supports the WMS interface. This guarantees the compatibility of the application also for the future evolutions of OGC standards, and represents an optimal guarantee also in terms of protection of the investments made for the development.

ESRI ArcXML

The diffusion of ESRI GIS products wide both in the government agencies and in the industry, that the interface protocol of ArcIMS, called ArcXML, as a fact has become a standard for the industry.

Cart@net supports the ArcXML protocol and this enables our application to publish cartography served from whichever ArcIMS server using this protocol.

The advantage in using ArcXML interface is that the wide installation base of ArcIMS server can be considered as popular interface.

Enhanced Compression Wavelet Protocol (ECWP)

The Enhanced Compression Wavelet Protocol (ECWP) is the solution supplied from Image Web Server (www.earthetc.com) that produces the distribution of the images via web. Complementary to the HTTP, this protocol supplies upon request data from ECW or JPEG2000 images files. In order to enable a web browser using this protocol is necessary to download only once the free ECW plug-in of 960 Kb. Or an alternative JAVA Applet is available that doesn't require plug-in but needs, instead, the support of Sun Java Runtime (JRE). The free plug-ins are available also for a wide range of third parts products, such as ArcGIS and ArcView, and are downloadable on Planetek Italia website

ECWP protocol is recommended for Enterprise tailored systems since it empowers them with a faster answer time to the client applications and remarkably reduces the charge on the server and on the network if compared with what happens when portions of JPG, GIF or PNG images are sent.

The advantage of using ECWP protocol is related to the significant improvements of performances if compared with other protocols, because it is based on a streaming technology with memorization on the local cache and on the real time Pan and Zoom tools. This enables faster answers and network traffic is reduced in substantially.

GeoHarP Module

Cart@net can be enriched also with a module designed for data harmonization, called GeoHarp (Geographic Harmonizing Platform) that enables the integration and the harmonization of geographic data available on-line, through conversion procedures "on-the-fly". GeoHarP includes the previously described features Multiserver and MultiStandard modules, and enables the access to remote cartographic archives, served by different technologies, reference and projection systems, making them available for the consultation in standardized way and in compliance with customers demands. GeoHarP can also standardize the semantic characteristics of the data coming from different sources.

The main characteristics of GeoHarP module are:

• Makes available conversion algorithms on-line and on-the-fly;

- The capacity to enable semantic integration between various database;

- A kind of access considered transparent and not intrusive towards the data publishing systems.

GeoHarP enables interoperability all the systems different for:

a) Reference System of the cartographic data;

b) Semantic Characteristic of the alphanumeric data.

Moreover the system is characterized by two fundamental properties:

1) it is not intrusive towards the integrated server;

2) all the process are made on-the-fly without pre-processing.

Being GeoHarP totally transparent also to the suppliers of cartographic data, and not intrusive towards systems, they do not need to install additional module software for being part of GeoHarP network. This is made possible by the Open architectures that the most popular IMS are implements with and, specifically, those who lead the to choose a driver development inside GeoHarP.

GeoHarP can manage the following combinations Projection, Datum, Fuse:

Projection	Datum	Fuse
UTM	WGS84	32,33
UTM	ED50	32,33
Gauss Boaga	Roma40	East, West
Geographic	WGS84	
Geographic	ED50	
Geographic	Roma40	

The managed technologies, namely the exchange protocols information, are:

- ArcXML: vector cartography served by ESRI ArcIMS;

- WMS (Web Map Server) 1.1.1: vector cartography served by OGC compliant IMS;

- ECWP (Enhanced Compression Wavelet Protocol): cartography raster served by ER Mapper's Image Web Server.

The combination of the choices made for technology and SRS, consider great part of Territorial Information Systems currently existing in Italy. Therefore, using GeoHarP as a platform for interoperability, one is able to integrate great part of the existing cartographic patrimony, without doing a data or technology migration.

The customer does not perceive the interaction with a distributed architecture and must only choose which SRS, between the available ones, to consult the project created, being able to change it in every moment.

A number of procedures, inner to the WebGIS client, processes on-the-fly all the conversions needed. Such procedures, based on the CConvert application, software for the conversion between the systems of coordinates developed by Planetek Italy, are optimized and calibrated on the resolution of the demanded map. A high precision of the conversion algorithms of the data can be too much in respect of the low resolution of the image on screen. Therefore it does not make sense to process data in order to obtain precisions of about 10 meters, if the screen resolution of the image is of about 100 m per pixel.

GeoHarP manages moreover the interrogation of the alphanumeric data associated to the cartographic layer, independently from the used reference system, turning back homogenous data even if the primal data come from different projection systems.

Visualization and navigation 3D

Through this functionality every customer can visualize with a viewer 3D the cartography formed by the cartographic base and the vector base. Such viewer is developed inside the system and needs the download of a VRML plugin. The user while displaying the cartography can change over, by clicking on the 3D button, all the 2D scene in a usable 3D web page.

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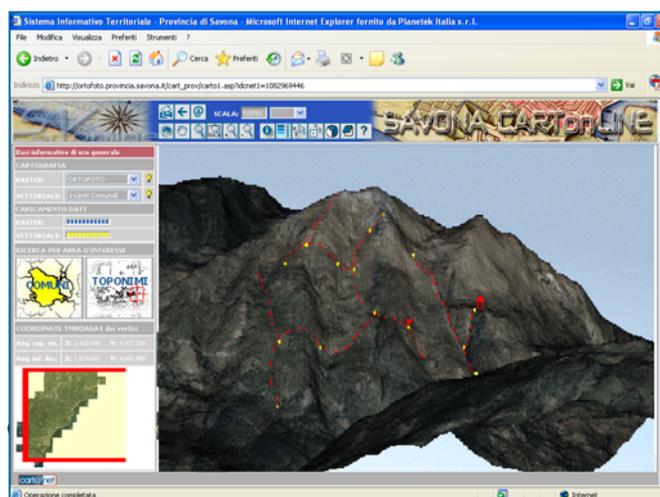
It is possible also the punctual interrogation of the cartographic raster data in order to obtain the quota of each single displayed point on the map.
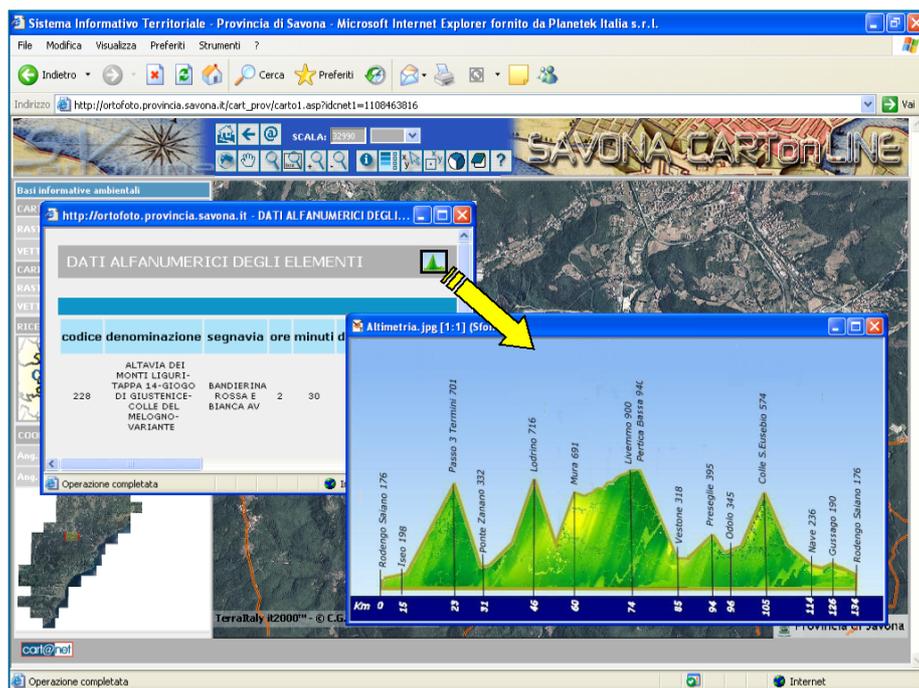
To obtain such information it is necessary to get a DEM (Digital Elevation Model) that can be displayed or not in the cartographic area.

Moreover it is possible to realize interactively an elevation diagram of every object (e.g. a road) on the map. The diagram is obtained from the pixel quota value of the DEM in those coordinates points equal to those related to the correspondents vertex of the polyline (the road) with the distance in meters between the same vertexes.

The step that sets the density of points chosen to manage for being able to display the diagram can be chosen by the customer or be optimized automatically from the system.

Interactive localization

The module for the interactive geocoding of punctual objects enables the end user adding objects on the map, and at the same time managing all the attributes. It is possible to limit the functions of the customers on the base of specific access profiles.

This can be useful in order to activate a geocoding project of the street interruptions and the works in progress, or to geocoding all the school buildings, with all the planimetric characteristics and the buildings related.

It is clearly visible that, since the information is charged by the customers, its research does not constitute an big effort on the managing side, where the remaining task is the verification and validation of the data.

The module enlists a number of administration instruments who makes possible to do:

- Management of the customers

- Searching of the added objects/communications

- Consultation and Modification of the objects/communication properties

- Export of the objects/communications

Cart@net Multiband Module

The "Multiband" module can be integrated inside the WebGIS application to supply functionality of visualization and analysis of multiband data.

This module represents the state of the art in the publication of multiband images and represents an unequalled system in the panorama of the information systems dedicated to the on-line publication of images. This module enables the access to raster cartography ECW or JPEG2000 MULTIBAND through a procedure of selection of the bands to display. The module is specifically dedicated to the online distribution of multiband images like Landsat, SPOT, Ikonos.

The module gives the user the possibility to choose the combination of bands that needs to display and to associate them to the three bands of video displaying (Red-Green-Blue).

In the picture it is represented the interface of Cart@net MultiBand module, and inside it is displayed the same Landsat image with combinations of different bands. On the left the combination 4-3-2 and on the right the combination 3-2-1 for the channels of Red, Green and Blue
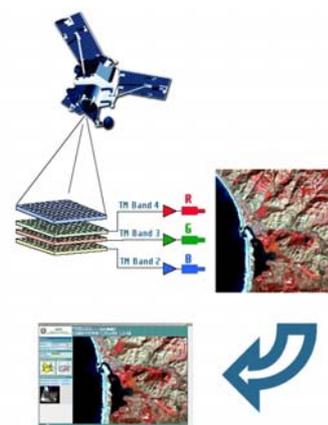
The user is free to modify the combination of bands as it is liked without some tie, therefore as it is possible not to associate some band to one of the channels R, G or B or to two of them together. If the same band for the three channels in output is selected, the information of the band will be represented in scale of greys. Through such module it is moreover possible to display "pre-processed bands" inside of a unique ECW file. As an example it is possible to add a new band to the original ECW file that will contain the NDVI produced from the raw image or to realize relationships between bands and make it available to those who access the archives.

Administration Area

The raster and vector database published in the website can be easily updated by using procedures and private pages inside the system.

By employing this solution updates are available time by time and at the same time they lower remarkably the times of realization. Cart@net is equipped of a private section that guarantees to the administrators the maintenance, management and update of the data published.

Once the login is made, the system shows an index of the several sections of administration.

1) Data Provider Management

2) Customers Management

3) Server Management

4) Publishing and management of the raster database

5) Publishing and management of on-line cartography

6) Report area

Data Provider Management

In this section the administrator of Cart@net, if the system uses the module Multiserver or Multistandard, has the possibility to manage all the suppliers of data that, through Cart@net, makes available its own cartography through the connection with remote server. Specifically the administrator will be able to add, to modify or to eliminate whichever data provider and/or the server associated.

Customers Management

In this section the administrator of Cart@net has the possibility to manage the customers and the levels of access to the system, both to the consultation area and to the administration. In particular it is possible to add, modify or remove a user, or qualifying it or not to the use of a particular functionalities of the system or to the consultation of data.

Server management

In this section the administrator of Cart@net has the possibility to manage the server that serves the cartographic data to the system. In particular it will be able to add, modify or remove the server, both raster and vector.

Cart@net can make available cartographic raster data through server with ER Mapper Image Web Server technology (compressed data in ECW format through the ECWP exchange protocol) and vector data with ESRI ArcIMS technology, if the system uses the module Multiserver or Multistandard, the following technologies will be able to be managed also: Map Server UNM (University of the Minnesota), Web Map Server OGC (Open Geospatial Consortium).

Publication and management of the Raster Database

The administrator of Cart@net can manage the ECW or JPEG2000 database to publish (where for ECW or JPEG2000 database is meant a single file representing a mosaic of a number of images, of whichever size. Both this compression formats, are known for the extreme efficiency in terms of reduction of the size of the image file and for the speed in the decompression and therefore of their visualization). In particular the administrator of the system can add, modify or remove whichever ECW or JPEG2000 raster data. The raster added will be made automatically available to whichever type of cartography chosen from the customer in the consultation of the website.

Publication and management of the Vector Database

The administrator can to manage also the cartography to publish, where for the term "Cartography" is meant a combination of raster and vector data. The publication of a Cartography inside Cart@net needs preparation of a thematic map served by a vector server data as an example ESRI ArcIms®, UMN MapServer or OGC WMS.

Updating the vector database

Planetek Italia supplies a handbook that helps the activity of updating the vector database. Updating the vector database of the website is usually a matter of training activities as it is needed that, the System users, acquire the maximum autonomy and effectiveness during the updating phase.

Reports

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The administration section of Cart@net is set up in order to generate the accesses and errors report, in PDF or CSV formats.

Accesses Report:

The administrator or a single Data Provider can, anytime, generate the report of the accesses where a detailed information is given (access dates, customer, cartography displayed, total accesses to the system, total access number for single cartographic data).

Error Report:

This tool let the administrator create the errors report where is shown which cartographic data and the server have generated an error during the consultation, giving thus the possibility to analyze the efficiency of the server published with Cart@net.
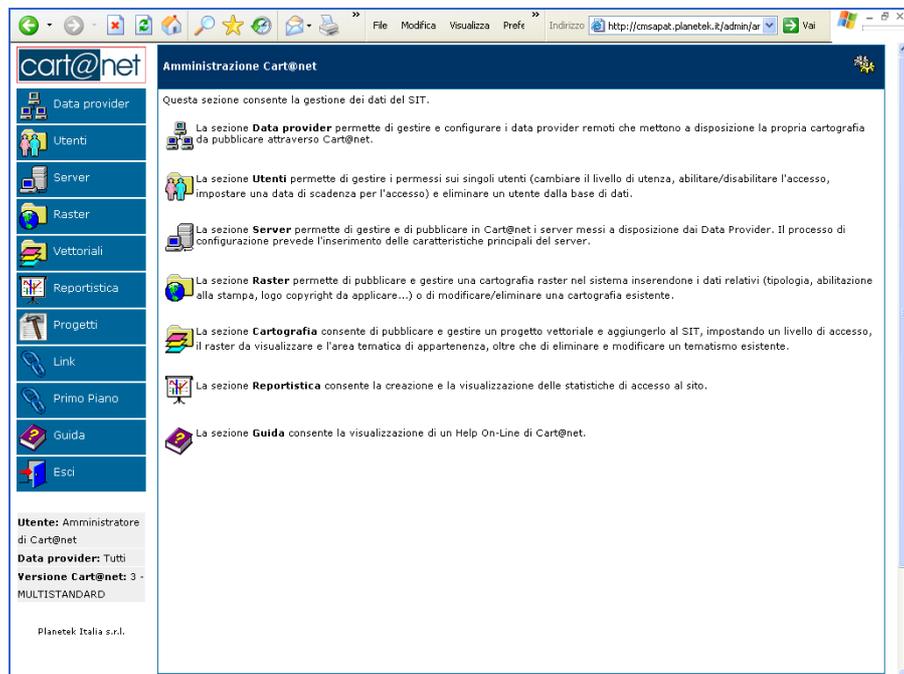
Portfolio

Atlante Italiano: the Italian cartography on the web
The web portal of the Italian Ministry of the Environment where are published the color aerial photo of the entire Italian territory and the geocoded maps of the Benchmarking Cartographic System.
http://www.atlanteitaliano.it

MAIS: the Italian Geospatial Information Access Module
In compliance with the strategy of distribution of territorial data on a national level, APAT (Agency for the Protection of the Environment and for the Technical Services) choose Cart@net to publish and share the cartographic archive and enable the consultation of the data supplied from the PFRs (Regional Focal Points) and from the National Module of the SINAnet network. Through the integration of the modules Multiserver and Multistandard, MAIS is a comprehensive environment where is possible the consultation of data archived on remote servers spread all over the territory and based on different IMS technologies (ESRI, Geomedia, Mapserver) and exchange protocols.
http://www.sinanet.apat.it/mais

Italian Landslides Inventory
The first homogeneous and updated landslide inventory of the entire Italian territory, realized by the APAT Department for Soil Protection – Italian Geological Service.
http://www.mais.sinanet.apat.it/cartanetiffi/

Regione Lombardia Cartographic WebPortal
The entire cartography of the Territorial Information System of Regione Lombardia on line with Cart@net.
http://www.cartografia.regione.lombardia.it
Available Also in English.

Regione Lazio Geographic Information System
On-line the cartography of the Regional Department for Territory and Town Planning of Regione Lazio.
http://www.urbanisticaecasa.regione.lazio.it/cartografia_on_line

Provincia di Roma Geographic Information System
The system enables the management and distribution of cartographic data of Provincia di Roma. More than 100 complex maps and raster data (on-line with Image Web Server) archived with Oracle Spatial database. The user can manage a big number of GIS tools to consult, on-line edit, download cartography and prepare analysis on multiband satellite images.
http://websit.provincia.roma.it/

Provincia di Savona CartOnLine
This web portal publishes the thematic cartography of the territory of Provincia di Savona. The system has been realized integrating and using MapServer, the Open Source cartographic data server.
http://cartonline.provincia.savona.it

PTCP of Provincia di Foggia
The Territorial Information System of Provincia di Foggia with a rich on-line section of thematic cartography publishing the Territorial Plan of Coordination of the Province.
http://www.territorio.provincia.foggia.it

Municipality of Venice Ortophoto 10cm
Inside the Base Territorial Framework of the Municipality of Venice, has been published the vector cartographic database integrated with a very high resolution ortophoto (10cm resolution) with nominal scale 1:2000
http://www.comune.venezia.it/territorio/ortofoto.asp

Territorial Information System of Sangro Aventino
The Territorial Information System of Sangro Aventino has been realized using UMN MapServer, the Open Source cartographic data server and the ortophoto ECW mosaic of the Territorial Pact area.
http://www.sangroaventino.it/sezioni/SIT

Mymap: publish your map with Cart@net
Absolutely free service offered by Planetek Italia to publish ECW images creating your own Web section! Plus you can find technical studies, new links to discover Websites, and a huge of free resources.
http://www.planetek.it/mymap

TO KNOW MORE ABOUT CART@NET

White Paper

To discover and deepen the knowledge of Cart@net with its features, the architecture and used technologies, please refer to the White Paper, available on-line for free download.

http://www.planetek.it/eng/cartanet.asp

Demo On-Line

Cart@net at work. If you wish to discover and use the system directly on the web you can either visit the websites mentioned on the references section or you can surf the web portal of Planetek Italia and find more papers, demo sites and news.

http://www.planetek.it

Note: Cart@net is continuously improving and the mentioned feature can change over time.

Credits and Contact

Since 1994 Planetek Italia designs and develops integrated geographical data management systems. The know-how and the technologies mastered by Planetek Italia make the Company one of the main Italian sources for public institutions, service enterprises and companies that need the best skills in the field of geo-informatics. Thanks to several factors, as the continuous research that combines high reliability with the newest technologies, the continuous update and the qualification of both human resources and company profile, and last but not least its total quality approach, Planetek Italia can create and offer highly innovative and personalized integrated solutions that fit the specific requirements of the customers with the best cost/benefit results.

PLANETEK ITALIA

http://www.planetek.it/eng/cartanet.asp