

# Carmenta Server Product Description

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*This document is a general introduction to Carmenta Server from Carmenta. It also provides more in-depth information about the most important aspects of the product.*

# Contents

1.	Introduction to Carmenta Server .....	4
1.1	Key Features .....	4
2.	Architecture Overview .....	5
3.	Carmenta Geospatial Technology Benefits .....	6
4.	Carmenta Server Map Server .....	7
4.1	The Rich Web Client .....	7
4.2	Layer Types.....	9
4.3	Functionality for Searching and Filtering.....	9
4.4	Rich Web Client vector editing .....	10
4.5	Web-based administration.....	10
4.6	JavaScript API .....	10
4.7	Web-based Rich Web Client Editor.....	10
5.	Carmenta Server Geocoding Server .....	10
5.1	Web Interface .....	10
5.2	Integration with other parts of Carmenta Server .....	10
6.	Carmenta Server Routing Server .....	11
6.1	Web Interface .....	11
6.2	Integration with other parts of Carmenta Server .....	11
7.	Methods for accessing Carmenta Server.....	11
7.1	Web Service Interface .....	11
7.2	OGC Interfaces.....	11
7.3	Carmenta Server Catalogue Services .....	12
8.	Using Carmenta Server for High-Traffic Sites .....	13
8.1	Integration with HTTP Proxy Cache Servers .....	13
8.2	Pre-rendering of high quality cartographic maps .....	14
9.	System Requirements.....	15
10.	Further Information.....	15

# 1. Introduction to Carmenta Server

The Carmenta Server Product is for using Carmenta Geospatial Technology in a network environment. The flexibility of Carmenta Server technology makes it suitable for use in a wide variety of purposes, such as:

- hosting feature-rich, highly interactive web based maps and integrating them into web sites.
- securing fast and reliable geodata in high-capacity map sites, such as large enterprise intranets or public Yellow Pages solutions.
- managing all aspects of setting up and maintaining Spatial Data Infrastructures (SDIs)
- providing maps and geospatial calculations in a SOA-based (Service Oriented Architecture) system.
- adding maps, metadata and other geospatial information to GIS solutions via standard interfaces such as those specified by the Open Geospatial Consortium, Inc (OGC).
- providing integrated, as well as standalone geocoding and reverse geocoding search functionality through a fully integrated Geocoding Server.
- enabling fast route and shortest path searches via an integrated Routing Server component as well as a standalone web service.
- supplying maps for mobile devices using platforms such as Java 2, Micro Edition (J2ME) or the Microsoft .NET Compact Framework.

## 1.1 Key Features

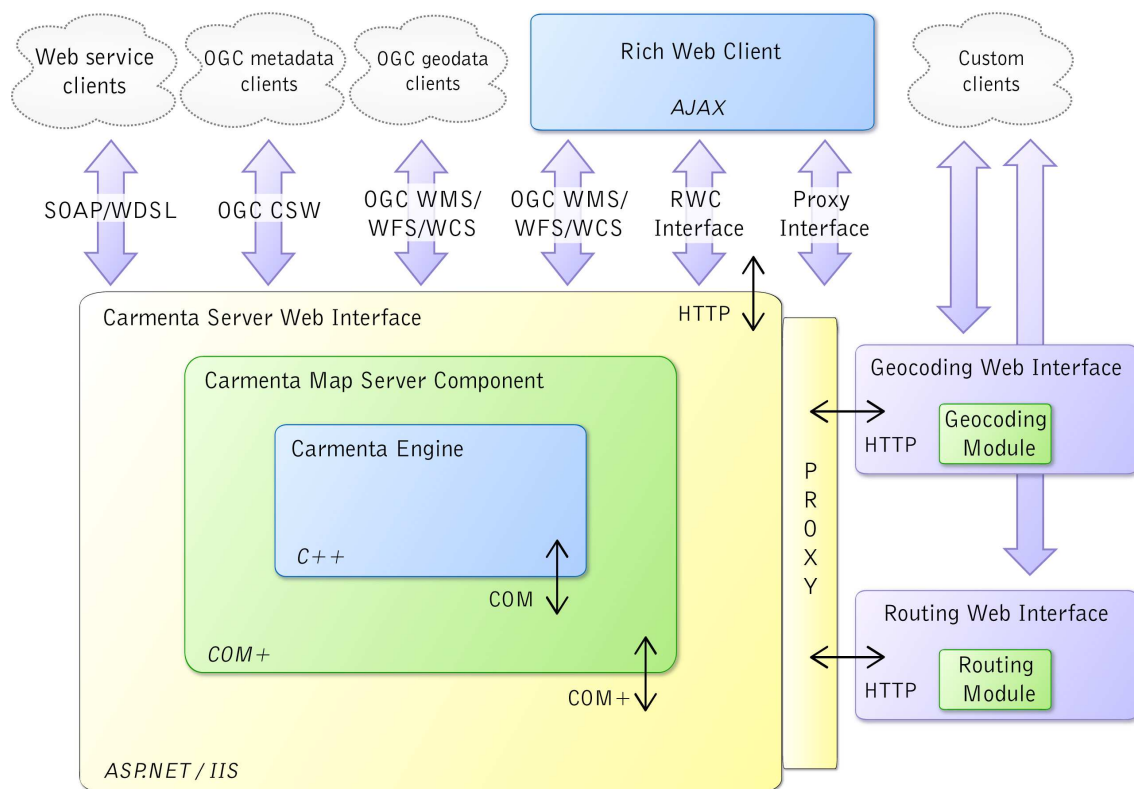
This is a summary of the most important features of the product. Refer to later chapters for more in-depth information.

- The product is based on Carmenta Geospatial Technology, used in many 24/7/365 environments with high demands on performance and reliability.
- Over 70 geographical data formats and geospatial databases are supported, and the list can be extended to access custom data sources.
- Carmenta Server comes with a configurable AJAX-based web client that can be embedded into existing web pages.
- It automatically provides web server interfaces based on industry de-facto standards as well those based on OGC specifications.
- An advanced Catalogue Service keeps track on metadata and services through an OGC compliant CSW interface. It allows quick searches and sorting of information.
- A web based server administration page provides easy remote administration for hosted map server solutions.
- The server is designed with high-traffic sites in mind. It integrates seamlessly with third party HTTP cache servers such as Squid.
- The product comes with a complete set of geospatial functions in one integrated package.

- A Geocoding Server module is integrated that provides a well defined interface for geocoding and reverse geocoding searches. Can run on a separate server HW.
- Advanced route and shortest path functions are integrated via a Routing Server module. Can run on a separate server HW.

## 2. Architecture Overview

The picture below shows a schematic overview of the Carmenta Server architecture.



The core of Carmenta Server is a map server component which encapsulates Carmenta Engine. The Map Server uses COM+, a proven Microsoft technology, to provide enterprise services such as pooling, transactions and fault tolerance.

The COM+ server component provides a rich, entirely stateless API which contains all functionality required by server-based GIS solutions. For example, it is possible to:

- retrieve maps as bitmaps, vector features or coverages by specifying the geographic area, layers, image format, etc.
- perform geographic queries which return geographical objects with attributes.
- access metadata about available maps, layers etc.
- run geographic calculations such as reprojections.

The mapping functionality is exposed through different HTTP interfaces:

- **The Web Service interface** exposes the Carmenta Map Server API via a **SOAP/WSDL** interface.
- **The OGC Web Map Service (WMS) interface** exposes the Carmenta Map Server functionality according to the OGC Web Map Server specification. This is part of the standard Carmenta Map Server.
- **The OGC Web Feature Service (WFS) interface** makes it possible to publish feature (vector) data as GML or geoJSON objects. This is available through the Carmenta Server Web Features Extension module.
- **The OGC Web Coverage Service (WCS) interface** adds capability to expose objects such as elevation grids and raw image data as, in OGC called coverages, in a standardized way using a service interface.
- **The OGC Catalogue Service/Web (CSW) interface** adds capability to handle metadata in a standardized way using a certified service interface.
- **The Rich Web Client (RWC) interface** is used by an AJAX-based web component described in chapter four. The light weight data interchange format geoJSON is used.

Carmenta Server also has functions for route calculations and address search. This functionality is added by two separate web servers. The Routing Server is built around a third party route search component and all communication to and from this component is handled by the **Routing Web Interface**. The Geocoding Server uses a standard RDBMS, optimized to provide fast address searches and retrieval of geographical objects from input positions. A **Geocoding Web Interface** handles the communication with the Map server or with custom clients.

Each additional server shares a common HTTP interface and the communication with the Map Server is via a Proxy. An **RWC Proxy interface** is used to link the AJAX-client to the geocoding and routing services on the same machine or a different server.

### 3. Carmenta Geospatial Technology Benefits

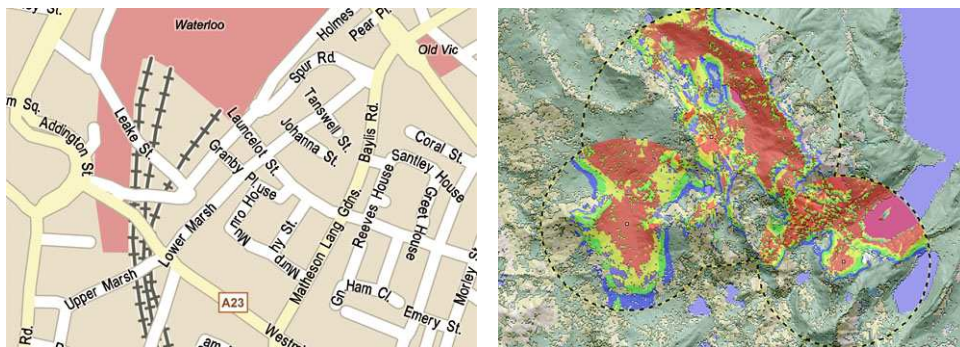
Carmenta Engine, which forms part of the core of Carmenta Map Server, was designed to meet the demanding GIS requirements of high-performance applications.

The use of Carmenta Engine renders Carmenta Server a number of advantages:

- **Top-of-the-line 2D cartographic features.**  
Notable features include anti-aliased drawing of vector objects, automatic label placement, semi-transparency and smoothing of raster data. Custom drawing routines can also be integrated into the map rendering process.

- **Support for reading geographical data directly from major GIS data sources.**  
Time-consuming and expensive off-line work to prepare the data can be greatly reduced or even eliminated entirely.  
Carmenta Engine can read over 70 of the most common data formats – for a complete list; refer to the Carmenta Engine Summary of Features document.
- **Unlimited support for combining different data types in a single map presentation.**  
Both raster and vector data can be reprojected on the fly between any projection or reference system. Any number of layers can be combined in a presentation. Each layer can be read from different files, geographic databases or web services such as OGC WMS.
- **Ability to create custom data readers.**  
Developers can easily extend Carmenta Engine to enable it to access data from application-specific sources such as databases or proprietary data formats.

The pictures below give a few examples of the type of maps Carmenta Engine can produce on-the-fly.



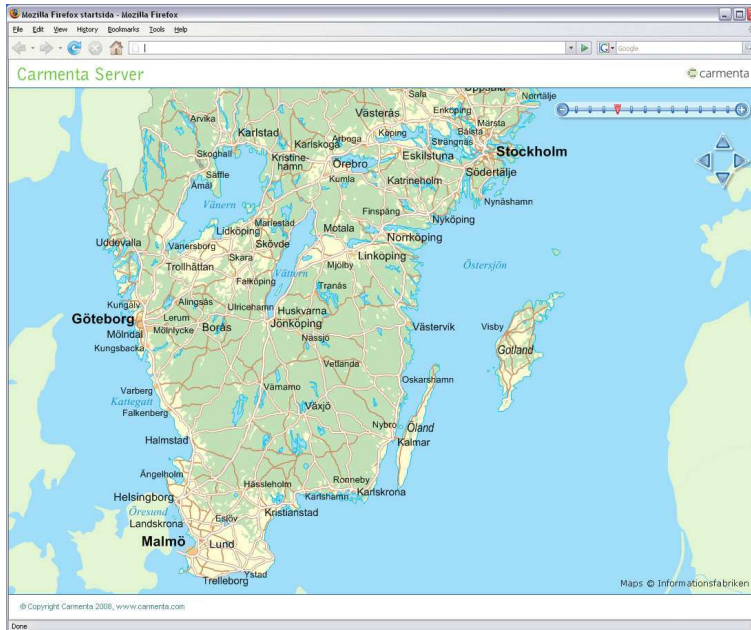
For more information about Carmenta Engine features, please refer to the Carmenta Engine Product Description document.

## 4. Carmenta Server Map Server

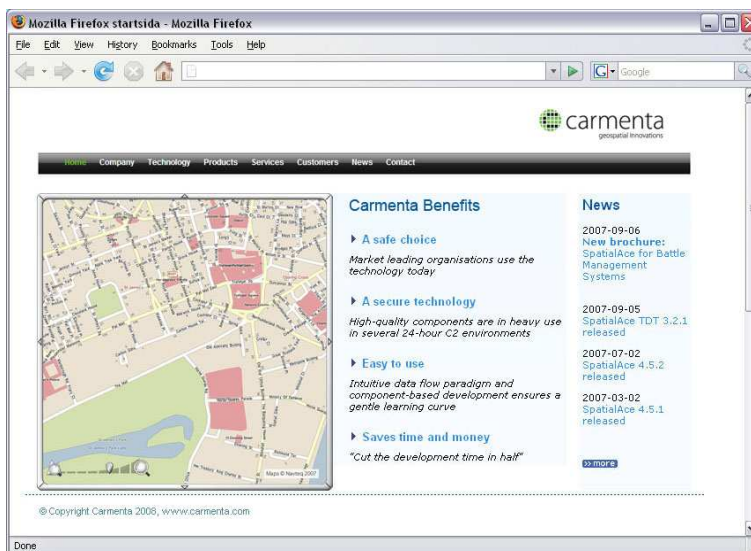
### 4.1 The Rich Web Client

The Carmenta Server Rich Web Client is an HTML/JavaScript-based component which uses AJAX technology to communicate with a Carmenta Server. It provides a highly interactive map interface which includes a number of predefined GUI components.

The picture below gives an example of how the Rich Web Client can be used to create a simple full-page map viewer in a web browser.



It is also possible to use it for smaller map views which are integrated into existing sites, as shown in the picture below:



The Rich Web Client uses a JSON-based configuration file, together with a standard CSS style sheet, to control both its appearance and behavior. This means that it can be easily customized to fit the look and feel of your web site.



## 4.2 Layer Types

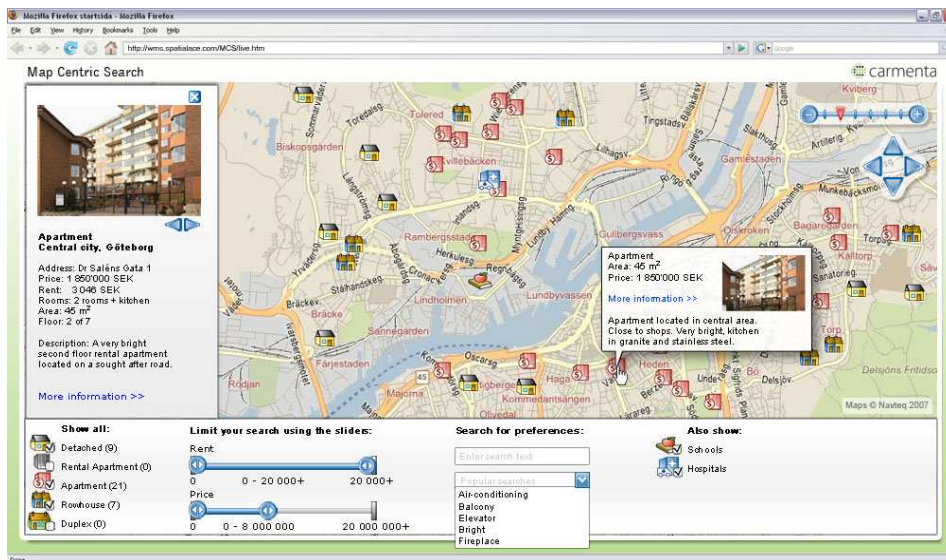
The Rich Web Client can handle maps which are composed of multiple layers. Layers can be handled in different ways:

- **Server layers** are composed of bitmaps which have been rendered by the Carmenta Server. The Rich Web Client by default requests the images in a “tiled” fashion, which improves the user experience when panning the map.
- **Client layers** contain individual objects which are rendered in the web browser. This enables a richer interaction, such as automatically displaying information boxes when the mouse moves over objects. The objects may also be accessed as features from a OGC WFS server.

## 4.3 Functionality for Searching and Filtering

The Rich Web Client contains a number of predefined user interface elements for searching and filtering client layers. All these elements are easily configured in the RWC configuration file.

The user interface elements include simple components such as text boxes and radio buttons, as well as more advanced widgets such as ‘range sliders’. The picture below provides an example of how the search controls can be used in a real estate search site.



The actual searching and filtering can be done in two ways: either by Carmenta Server or directly in the web browser. The latter option makes it possible to create very dynamic interfaces, where objects in the map appear and disappear immediately when the user interacts with the page.

## 4.4 Rich Web Client vector editing

Carmenta Server supports editing of vector objects on the client. The Rich Web Client has an integrated object editor that allows adding, removing and modifying objects graphically directly in the map by using a simple point and click interface. The editor also lets the user modify object attributes. The geoJSON format specification are used for communicating the objects to other geoJSON compatible services.

## 4.5 Web-based administration

A Web Administration Tool is used for setting up and managing the Map Server from a web page without direct access to the server. The tool also contains extended functionality to manage logging and create RWC configurations.

## 4.6 JavaScript API

The Rich Web Client exposes a rich JavaScript API which allows it to be controlled from the web page in which it is embedded. It is for example possible to change the center point of the map and turn layers on and off via this API.

In addition, it is possible to both add and interact with geographical objects in client layers via the JavaScript API. This makes it easy to build sites which display dynamic information in the map, e.g. for fleet management or tracking purposes.

## 4.7 Web-based Rich Web Client Editor

Included in the SDK version of Carmenta Server is a powerful web-based editor that may be used to build and maintain RWC web pages. This makes it possible to create web pages with advanced user interaction and full control over layout and design.

# 5. Carmenta Server Geocoding Server

## 5.1 Web Interface

The Geocoding Server provides a web interface for fast and accurate geocoding and reverse geocoding searches using a spatially indexed RDBMS. The server uses the geoJSON format for easy integration with 3<sup>rd</sup>-party clients. Various types of map data can be imported into the database and also combined with data from other sources to create a good coverage of geocoding data.

## 5.2 Integration with other parts of Carmenta Server

The geocoding server is integrated with the Rich Web Client for easy implementation of on-map geocoding functionality with text based searches as well as point and click tools.

## 6. Carmenta Server Routing Server

### 6.1 Web Interface

The Routing Server provides fast route and shortest path search functionality that can be easily setup to work with existing web sites and web clients. The routing server also uses geoJSON for integration with other compatible services as well as the Carmenta Server Rich Web Client.

The Routing Server is based on RW Net - a routing component from the Danish company RouteWare. The routing server can be populated with preprocessed data from major suppliers of digital map databases such as Navteq or TeleAtlas as well as more specialized road data.

### 6.2 Integration with other parts of Carmenta Server

Just like the Geocoding Server, the routing component is integrated with the Rich Web Client to allow route search in any Rich Web Client based web map with a minimum of setup required.

## 7. Methods for accessing Carmenta Server

### 7.1 Web Service Interface

The Web Service interface exposes the entire Carmenta Map Server functionality via the SOAP/WSDL protocols. Web Services are easy to consume from all major programming environments (e.g. the .NET Framework, Java and C++). They form a fundamental part of the Service Oriented Architecture (SOA) approach to building systems.

To help you get started, the Carmenta Server SDK includes samples which demonstrate how to use the Web Service interface from various different platforms. This picture shows one of these samples running on an emulated Windows Mobile-based Smartphone.



### 7.2 OGC Interfaces

The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, was established in 1994. The OGC brings together more than 370 commercial, governmental, non-profit and research organizations worldwide to collaborate in an open consensus process, encouraging the development and implementation of standards for geospatial content and services, GIS data processing and data sharing.

Carmenta is an active member of the OGC, and Carmenta Server has certified support for a number of OGC specifications. The OGC support is an integral part of the product: all loaded maps are automatically exposed via the OGC interfaces – no special configuration is needed.



Bundled in the standard Carmenta Server package is support for the OGC Web Map Service (WMS) implementation 1.1.1 and 1.3.0. This allows Carmenta Server to provide map images in a standardized way as bitmaps to OGC WMS compliant clients.

The Web Feature Extension is an add-on to Carmenta Server that provides compliant support for the OGC WFS 1.0.0 and 1.1.0 implementation specifications. The following benefits comes out-of-the-box with this add-on:

- Easy set-up and administration of the feature service.
- High performance publishing of feature/vector data.
- On-the-fly conversion of vector data stored in various file formats or databases.
- OGC WMS integration and proxy functionality through SLD/FPS.
- Tested with several WFS clients such as OpenLayers, ArcMap, Gaia and more.
- Support for GML and GeoJSON as transport formats.

The Web Coverage Extension is an add-on to support the OGC WCS 1.1.0 implementation specifications. This service is used for publishing grid and/or matrix data in raw format such as elevation data and image pixel data for further analysis on the client side. The following features come with the WCS add-on:

- Easy set-up and administration of the coverage service.
- High performance coverage generation and publishing.
- Reads a large number of raster formats supported by Carmenta Engine.
- Raster output as the commonly available GeoTiff format with 1-, 2-, 4-, 8-, 16-, 24- and 32-byte bit depth. Also 32-bit floating point raster data is supported.
- Supports advanced functionality for on-the-fly processing and usage of several data sources at the same time.

### 7.3 Carmenta Server Catalogue Services

The Carmenta Server Catalogue Services Extension adds support for the OGC Catalogue Service/Web (CSW) 2.0.1 and 2.0.2 implementation specifications. The extension provides the following support:

- Easy set-up and administration of the catalogue service.
- CS/W to CS/W cascading catalogue look-up.
- Easy plug-in of OGC data services with auto-generation of metadata.
- Quick search of metadata fields.
- Geodata centric catalogue integration through online metadata look-up from WFS.
- Displays metadata in multiple standard output formats, including ISO19139/19119 and Dublin Core.

- Reading of file-based metadata in multiple formats, including the EU INSPIRE-portal format, National geodata-portal formats and more.
- Fast metadata retrieval through advanced server-based caching.

## 8. Using Carmenta Server for High-Traffic Sites

Carmenta Geospatial Technology has been designed to provide very high performance. As a result, a single stand-alone Carmenta Server Map Server is typically capable of delivering more than a hundred map images per second.

For many applications, this is clearly more than enough. But for public web sites which experience very high volumes of traffic, the map server is occasionally called upon to deliver thousands of map images per second.

The Map Server handles these situations by integrating seamlessly with industry-standard HTTP proxy caches, as described in the following section.

### 8.1 Integration with HTTP Proxy Cache Servers

A HTTP proxy cache server acts as an intermediary between the client (web browser) and the underlying web server (in this case Carmenta Server).

The first time it receives a particular request from a client, it asks the underlying web server for a response. In addition to returning this information to the client, it also stores it in a cache. The next time it receives the same request, it can simply return it from the cache.

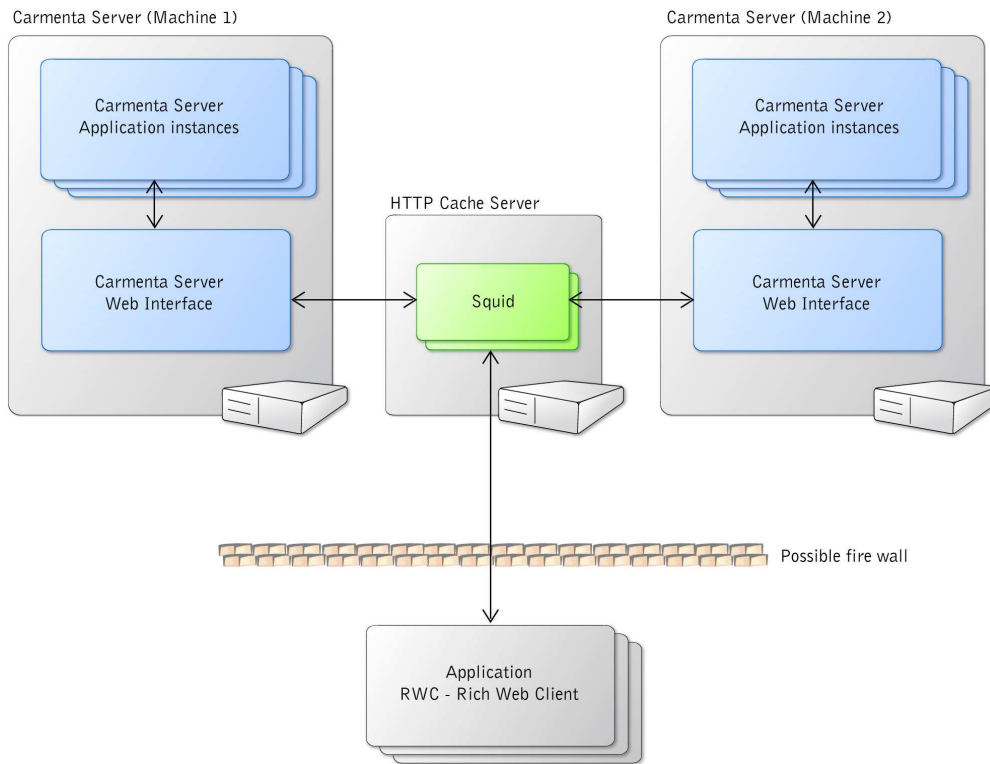
The proxy cache server uses certain properties from the 'actual' server response to determine how long it can keep this information in its cache. For map server responses, these properties can be very hard to specify; you may want the background map to remain in the cache for several days, whereas other layers may need to be updated every minute.

To solve this problem, Carmenta Server has a built-in function for handling these 'expiry values' all the way down to the individual map layer level.

In addition to these advanced server configuration possibilities, the Rich Web Client has been carefully designed to ensure a very high hit rate in HTTP proxy cache servers.

A well-known and very flexible HTTP proxy cache server is Squid, <http://www.squid-cache.org>. It is an open source (GNU GPL) application with an active user community. Squid is used in many existing Carmenta Server installations with very good results.

The following picture illustrates a typical setup when using Carmenta Server together with Squid or another HTTP proxy cache server.

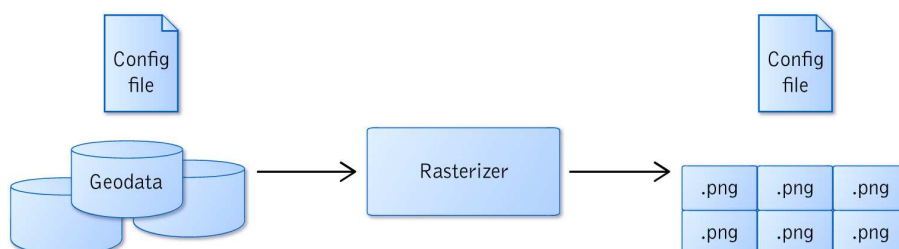


## 8.2 Pre-rendering of high quality cartographic maps

Although Carmenta Engine has a very high performance, some vector map configurations are not suitable for direct use in Carmenta Map Server, due to their complex rendering pipeline.

Configurations using the automatic label placement are an example of this. Although the label placement algorithm usually produces a reasonable result in a very short period of time, achieving the highest quality cartographic output may require allowing it to work a bit longer.

In this case it is more efficient to use Carmenta Engine to pre-render geodata into image 'tiles', as illustrated in the picture below. This is part of the map preparation and optimization process when building a map storage solution capable of serving high-traffic sites. The stored raster tiles is then read by the Map Server, resulting in a map with very high performance



Carmenta has developed tools for efficient geodata management in server environments. A rasterizing system has been specifically designed for rapidly building multi-scale raster tile structures. Carmenta offers professional services helping customers design and build efficient map storage solutions.

## 9. System Requirements

For the most part, these are recommended system requirements; Carmenta Server will run on more modest hardware than this, but performance may not be optimal.

For desktop computers used to develop Carmenta Server solutions:

- Windows XP and Windows 7
- Pentium III-class processor or later, at least 1 GHz
- At least 512 MB RAM (2 GB RAM recommended for Windows 7)
- At least 10 GB free disk space

For servers used to host Carmenta Server sites or to perform load testing:

- Windows Server 2003 and 2008
- Xeon-class processor or later, at least 2 GHz.
- Multi-core CPU and/or multi-CPU systems. A Quad-core processor is typically used as follows:
  - Two cores running one Map Server instance each
  - One core for the IIS working process
  - One core for the Squid or web-cache process
- Additional CPUs needed for optimal performance when running Routing and/or Geocoding Servers
- At least 2 GB RAM
- More than 64 MB memory on the graphics card
- At least 100 GB free disk space
- Fast disks such as hardware RAID or similar will increase the server performance significantly

## 10. Further Information

Further information about Carmenta Server, as well as a live demo installation showcasing the latest features can be found on the Carmenta web site: <http://www.carmenta.com>.

If you have other questions, feel free to contact:

Mikael Gråsjö  
Vice President, Spatial Data Infrastructure Program  
[mikael.grasjo@carmenta.com](mailto:mikael.grasjo@carmenta.com)  
+46 31 775 57 22