



Autodesk Topobase Technical Architecture

The Technical Components of Autodesk Topobase

Integrating design and data management, Autodesk® Topobase™ software provides centralized, flexible, and secure access to spatial information for departmental interactions between design and business teams. Organizations can use Topobase to efficiently exchange information among legacy systems such as enterprise resource planning (ERP), geographic information systems (GIS), or outage management systems.

Benefits of Topobase

Using Topobase, organizations improve decision making by gaining a comprehensive view of infrastructure assets and geospatially enabling all asset management processes. Organizations enhance efficiency and data quality by using the same applications to create and manage spatial information across departments. When all departments can use the same set of business rules to access and analyze data, an organization reduces manual and duplicate data entry and minimizes data conversion processes. Topobase also streamlines data editing and creation, making those processes more efficient with rule-based data entry and process automation. Perhaps most important, Topobase enables organizations to securely share spatial information with field staff, business decision makers, and other employees who have traditionally lacked access to this kind of information.

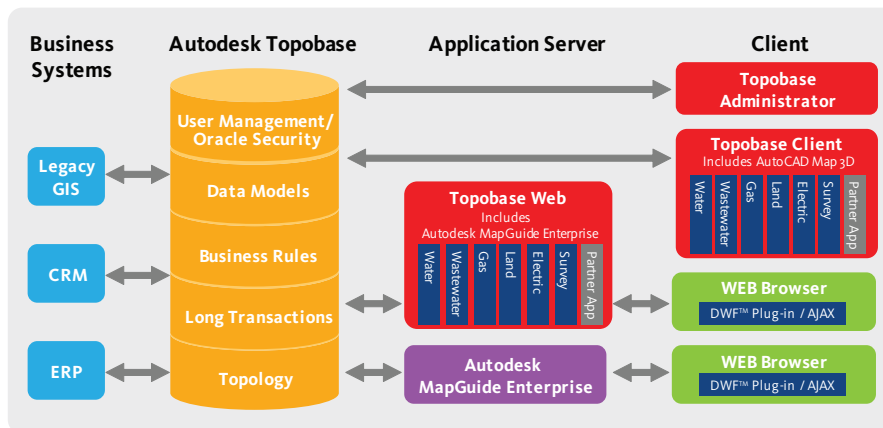


Figure 1: Overview of Topobase Technical Components

Overview of the Topobase Technical Components

Autodesk Topobase is an open and flexible system that can support efficient exchanges of information, departmental interactions, and integration with other IT systems. Topobase stores spatial information in a relational database in native Oracle® format (no BLOBs), so other systems can access it without expensive or proprietary middleware. The Topobase technical components are divided into a server tier, which includes data management capabilities and the spatial engine, and the client tier, which supports data creation, management, and sharing. Topobase is also fully customizable and can be enhanced to suit your specific needs.

Topobase can be used as

1. A departmental solution for managing design and asset information
2. An integration platform to provide up-to-date design and asset information for
 - a. Computerized maintenance management systems (CMMS)
 - b. Customer relationship management (CRM)
 - c. Enterprise resource planning (ERP)
 - d. Geographic information systems (GIS)
 - e. Outage management
 - f. Work order management

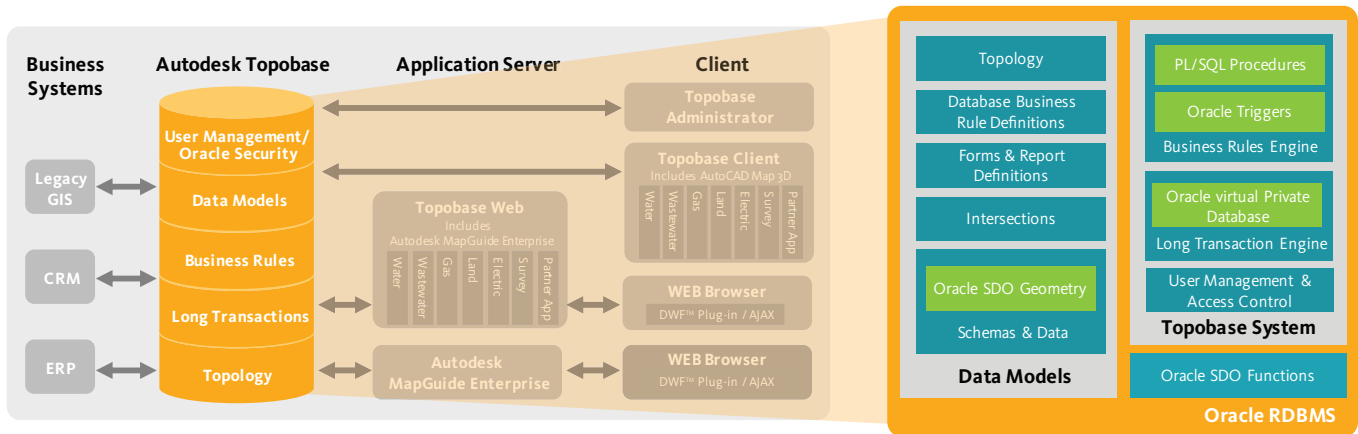


Figure 2: Oracle RDBMS

Components of the Server Tier: Data Management Capabilities and the Spatial Engine

Data management capabilities and the spatial engine form the server tier of the Topobase architecture. Organizations can use any server operating system Oracle supports, including Microsoft® Windows® and Linux® operating systems.

Oracle RDBMS

The Autodesk Topobase architecture is designed to facilitate flexible application and data distribution throughout the enterprise. It consists of the Oracle® Spatial relational database management system (RDBMS), an application server, and a client—which may be either desktop or web based. In addition to storing, organizing, and managing massive amounts of geospatial data, the Oracle Spatial database is used to implement workflow and business rules, long transactions, and topology, as shown in Figure 2.

Topobase System

The Topobase System stores metadata, procedures, and special functionality for Autodesk Topobase and manages data for Topobase users, workspaces, and documents.

Topology Engine

Autodesk Topobase uses topologies to model objects and phenomena of the real world. Typically, a GIS user needs information about relationships between objects with topological characteristics. Area topology easily handles modeling of land and other flat surfaces. Network topology is appropriate wherever real-world objects are connected to each other in networks. This can include geometrically connected objects and logically connected objects—that is, objects that do not need geometric connections to be connected.

For intersections, users can work with area topologies to build polygons from a set of lines for the primary feature class. An intersection can be performed with polygons as the primary feature class and polygons, line strings, and points as secondary feature classes. The topology engine enables the analysis of specially related features such as network traces. Topologies are maintained on the server side by the Java® and PL/SQL stored procedures and triggers.

Business Rules Engines

Business rules define the structure and help control operations, governing the creation and maintenance of data and helping ensure high-quality data sets. Business rules are identified during the data gathering and analysis phases of a project.

PL/SQL Procedures

Feature rules are provided by Autodesk Topobase; however, users with some experience with PL/SQL triggers can define their own server-side feature rules or create their own client-side feature rule in .NET.

Oracle Triggers

Users can define their own server-side feature rules if they know Oracle triggers and the Topobase application programming interface (API).

Long Transactions Engine

Autodesk Topobase uses Oracle's Virtual Private Database technology to perform "Long Term Transactions" by maintaining multiple-versioned states of data. For example, a user can manage design information in the design, approved, construction, or live (as built) states over the lifecycle of the data. These are collectively called "Jobs" within the Topobase application framework.

Forms and Reports

Topobase has a form and report engine that enables the custom definition of user dialog boxes for attribute data entry. These forms are customizable using the visual (WYSIWYG) tool in Topobase Administrator. The report engine enables the user to define custom queries to extract and generate reports. Both forms and reports can be configured to be made available for use on the Topobase Client (on the desktop) as well as on Topobase Web.

User Management and Access Control

Topobase includes the capability to manage user security based on user groups, which can be configured to control access to workspaces, the database schemas, or workflows. Controls can extend to user interfaces, including form elements that provide read-only or update access to the Topobase system.

Data Models

A data model includes topics, feature classes, topologies, and intersections. The user can create data models with the Topobase data model administrator. The Topobase data models use the Oracle SDO geometry format to maintain geometric information. Data models can be created, edited, and updated on the fly using the Topobase Administrator tool.

The data models also include a series of Oracle triggers and PL/SQL procedures and functions that can be customized using the Topobase Administrator tool.

Oracle SDO Functions

Autodesk Topobase makes use of Oracle's native SDO functions to perform spatial queries on the server.

Components of the Client Tier: Data Creation, Management, and Sharing

The client tier has two implementations: as a desktop client (Topobase Client) and as a web client (Topobase Web).

Both clients have industry-specific utility modules such as water and wastewater, as well as additional industry-specific partner applications. These modules are accessible from Topobase Client and Topobase Web, as they reside on the client tier. Thus, organizations can administer and maintain modules in a centralized location without having to update or modify multiple individual clients.

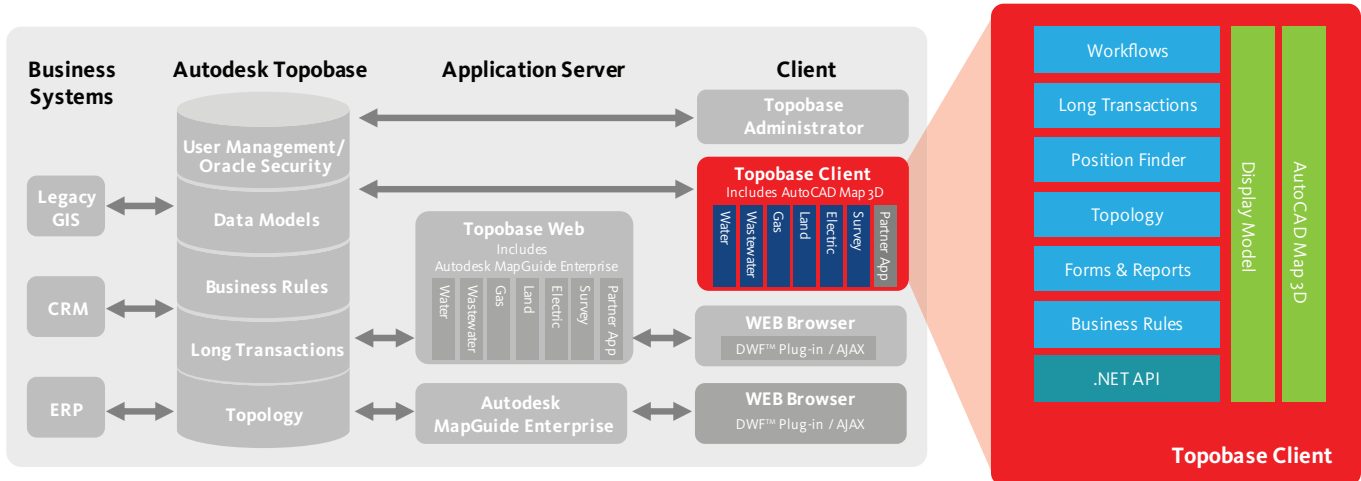


Figure 3: Topobase Client

Topobase Client

Topobase Client is the Autodesk Topobase desktop client that manages geometric and attribute data stored in an Oracle Spatial database. It provides the tools to create, modify, and delete geometric data, and to process attribute data using Topobase forms, as shown in Figure 3. The Topobase product contains the full functionality of AutoCAD® Map 3D and AutoCAD® software products.

Topobase Client makes use of a predefined display model to dynamically render data. These display models can be defined using the AutoCAD Map 3D display manager component and transferred for use on Topobase Web using the “publish to” Autodesk MapGuide® Enterprise software tool.

In addition, Topobase Client layers user-interface elements on top of AutoCAD Map 3D. These include a feature explorer to navigate the data model, a workflow explorer to expose workflows to the end user, a job manager to change version state, enter and edit feature attributes for the end user, and report generation utilities. It also exposes the business rules to the client, thereby validating user interactions with the database.

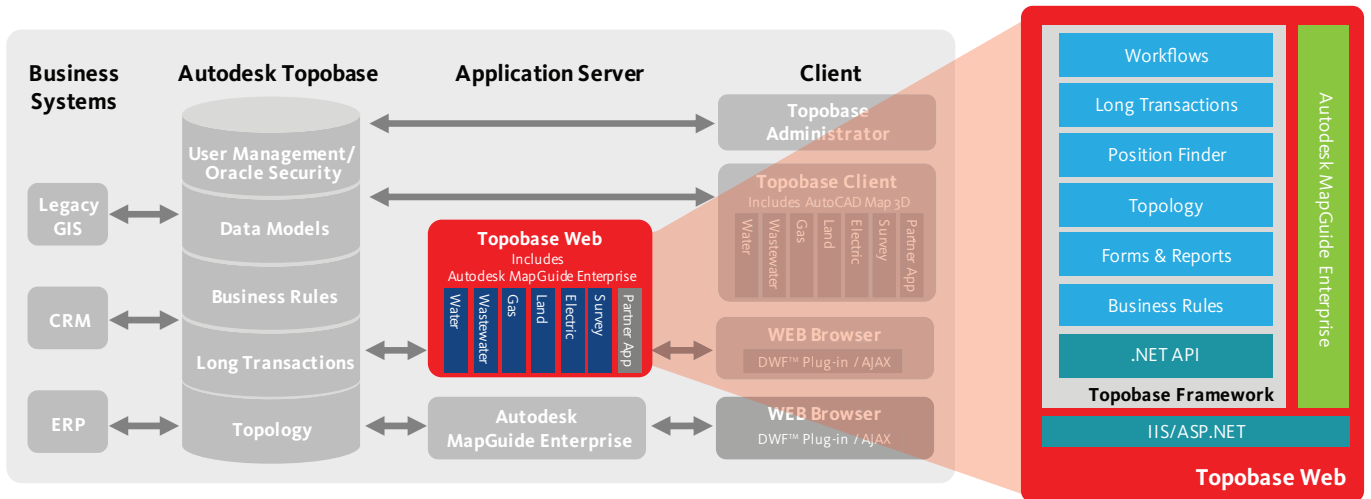


Figure 4: Topobase Web

Topobase Web

Topobase Web, as shown in Figure 4, is a web-based system that enables users to share data across the enterprise. It lets users view and edit data in the Autodesk Topobase database through a browser-based interface based on Autodesk MapGuide Enterprise software. This interface helps distribute data across the organization intranet by reading data directly from Autodesk Topobase, so that all users see the most current data.

User interface elements are available to both desktop users and web users thanks to the Topobase framework on both platforms. Users can directly access Autodesk MapGuide Enterprise to provide view-only applications that utilize the information stored in Autodesk Topobase software.

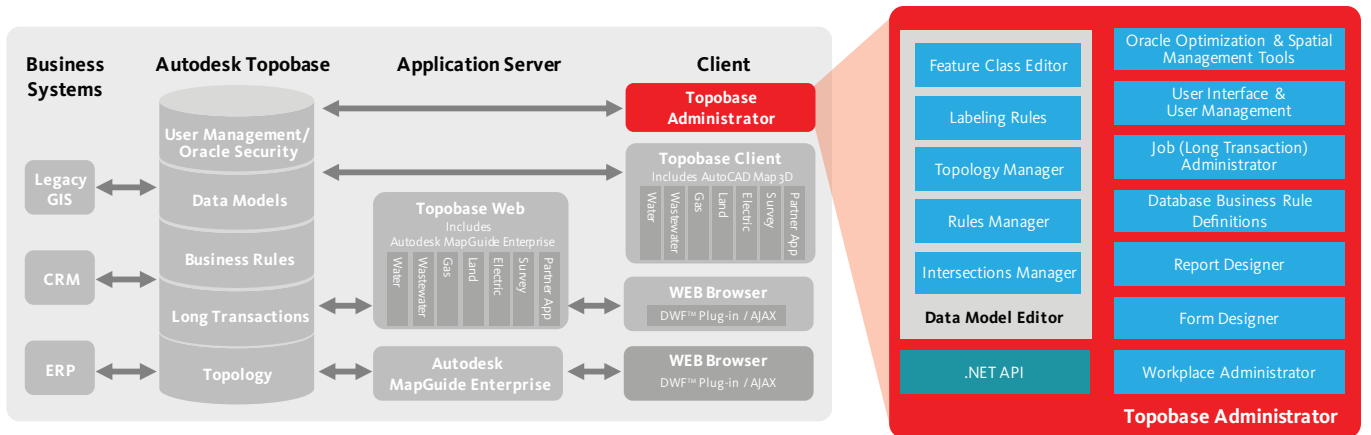


Figure 5: Topobase Administrator

Topobase Administrator

The client tier also includes the Topobase Administrator, shown in Figure 5, which manages various administrative tasks that enable a user to

- Specify workspace, document, and configuration settings
- Design custom data models that address organizational business needs
- Define and edit data models by establishing new feature classes, attributes, domains, and the relationships among them
- Establish an organization's security level and setting permissions for users

Form Designer

Topobase Form Designer is a tool to design forms for processing feature data. For example, a user can hide or show text boxes, create controls, check boxes, or create radio buttons in the forms. Users can even arrange elements to create a custom form for specific needs.

Report Designer

Using Topobase Report Designer, users can design unique reports and assign them to any Topobase feature class form.

User Interface and User Management

Topobase application users are grouped into user groups that have rights to access the database. A user can create or remove as many users or user groups as necessary and define their rights in detail. In addition to data access rights, a user group has access to specific workspaces. Use the Topobase Administrator setup options to create user groups, add users, and assign workspaces.

Job (Long Transactions) Administrator

Based on the Oracle database, Autodesk delivers a long transaction and versioning framework that meets the specific needs of the cadastral applications, Topobase Jobs. Topobase Jobs is based on Oracle's VPD technology, which makes it possible to have multiple states for an object in the database, such as live, pending, and open. The state definitions are customizable. Data may change only within a job, whereas data outside a job is read-only.

Workflow Administrator

Topobase workflows provide basic functionalities for workflows used in Topobase applications, such as water, wastewater, and gas. Workflows guide users through acquisition, analysis, reporting, and other tasks. For each workflow that has been started, a separate workflow area is displayed. The workflow area contains embedded information about the procedures, display options, and check boxes that control the execution of the workflow.

Oracle Optimization and Spatial Management Tools

Topobase Administrator uses built-in functions to manage, tune, and optimize both the Oracle database as well as the spatial data stored within Oracle. This includes the generation of Oracle statistics for faster query performance and management of spatial indexes.

Position Finder

Using the Topobase Position Finder, users can quickly discern the location of any building, parcel, or other feature that has geometry. The detected geometry becomes the center of a graphic generation or a zoom GoTo.

Topobase Position Finder is based on search definitions that the user defines. The definitions are stored in the document in the system table, which means a user can define special search definitions for each document. Both Topobase Client and Topobase Web use the position finder to generate graphics using geographical selection.

Workspace Administrator

A user can access documents by opening a workspace. To create a new document, the user must create a new workspace or select an existing workspace. Users can process documents only if they are assigned to a workspace. The Workspace Administrator facilitates adding or removing documents from a workspace.

Label Rules Manager

With the Topobase Label Rules Manager, users can define label rules that allow the automatic generation of labels. Label rules can use multiple tables based on custom query definitions. For example, a label rule might define the position and placement of text for an overhead conductor from a materials table, phase, and operating voltage table.

Topology Manager

The Topology Manager enables the administrator to define and manage the topologies used in Topobase.

Feature Class Editor

The Feature Class Editor lets users maintain and modify the data model schemas.

Rules Manager

With the Rules Manager, the administrator can define custom business rules on the server using Oracle PL/SQL or enable client-side rules written in .NET.

Intersections

Use the Topobase intersection routines to calculate intersections between two feature classes. Users can define intersections in the Topobase data model administrator and add them to the document explorer in the Topobase task pane. For example, an intersection of the parcel feature class with the land-use feature class determines the surface sections of different land use for each parcel.

Topobase Customization and Integration

Finally, users can customize and enhance Topobase to suit their specific needs. The open architecture of Autodesk Topobase and industry-leading tools lets users integrate Topobase with additional IT systems.

Customization and Development

Topobase provides several tools that enable users to customize the system to suit organizational needs.

Topobase Framework API

Topobase includes a .NET-based framework API used to create custom applications and plug-ins that can be configured for use on both the desktop and the web. The .NET API also enables developers to write client-side business rules and provides a layer of abstraction to manipulate AutoCAD Map 3D.

Geospatial Platform AP

The underlying AutoCAD Map 3D platform used in the Topobase client has a .NET-based API that is shared with the Autodesk MapGuide Enterprise environment and used in Topobase Web. Use the API to customize tools for AutoCAD Map 3D and Autodesk MapGuide Enterprise.

Autodesk MapGuide Enterprise API

Topobase Web runs on the Internet Information Server (IIS) version of Autodesk MapGuide Enterprise using .NET. This enables developers to natively use the Autodesk MapGuide Enterprise .NET API to customize a web-based application for use within Topobase Web. Users can also access Autodesk MapGuide to create view-only applications in the Topobase database and work with ASP, .NET, JSP, PHP, and other supported programs, as well as with web servers such as IIS and Apache.

AutoCAD API

Users can work with standard AutoCAD development tools such as AutoLISP®, ObjectARX®, .NET, and managed API to program and manipulate the application within Topobase.

Integration

Organizations can use standard IT tools along with Oracle's established integration platform tools to integrate Topobase with business and IT systems such as CRM and ERP, work order management systems, primary analysis systems, outage management systems, and legacy GIS systems.

Integration using Feature Data Objects

If the IT systems contain geometric information that needs to be rendered graphically, it is possible to do so in the Topobase desktop and web clients. For example, a user can overlay cadastral data from an ESRI® ArcSDE® system using Feature Data Objects (FDO) technology—an Open Source interface specification for manipulating, defining, and analyzing geospatial information.

Direct Integration with Topobase Forms or .NET

Using the Topobase forms environment, it is possible to use .NET and ActiveX® controls to connect with other IT systems and provide a form interface within the Topobase forms environment. Alternatively, by using the Framework API and .NET, users can create plug-ins and application add-ons that integrate with the external IT system. This form of integration works on both the desktop and on the web.

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Using the Web/SOA with Topobase Framework API

Using the .NET Framework API, users can expose Topobase to an interface based on Services Oriented Architecture (SOA). Alternatively, they can use the Topobase Framework API within Topobase Web to expose web services that can interface and interact with the data in Topobase. This includes updating requests for data entry into the Topobase system as well as listing attribute-based consumption in the external IT system.

Using Server-Side Business Rules, Oracle Triggers, and External APIs

Using the server-side business rules that process triggers, users can fork external shell processes that call the external system API. For example, users can update an external GIS system each time a newly designed asset is entered into Topobase.

Using Enterprise Service Bus Architecture Natively with the Oracle Database

Because of the native use of Oracle database software within Topobase, users can use database-to-database synchronization or Enterprise Service Bus Architecture to mediate and orchestrate transactions between disparate systems. For example, a user can apply Oracle fusion to integrate the Topobase data in Oracle directly with an external IT system.

Conclusion

Autodesk Topobase includes all the components needed to provide centralized access to spatial and design data. Topobase includes a server and client tier that together facilitate data creation, management, and sharing. Fully customizable, Topobase can be enhanced to suit the specific needs of an organization. Because it is an open and flexible system, Topobase can integrate with legacy GIS, ERP, CRM, outage management, or other external systems. Topobase enables departments to more easily manage and share spatial and design data throughout the organization.