What is online analytical processing?

Online analytical processing (OLAP) is software technology you can use to analyze business data from different points of view. Organizations collect and store data from multiple data sources, such as websites, applications, smart meters, and internal systems. OLAP combines and groups this data into categories to provide actionable insights for strategic planning. For example, a retailer stores data about all the products it sells, such as color, size, cost, and location. The retailer also collects customer purchase data, such as the name of the items ordered and total sales value, in a different system. OLAP combines the datasets to answer questions such as which color products are more popular or how product placement impacts sales.

Why is OLAP important?

Online analytical processing (OLAP) helps organizations process and benefit from a growing amount of digital information. Some benefits of OLAP include the following.

Faster decision making

Businesses use OLAP to make quick and accurate decisions to remain competitive in a fast-paced economy. Performing analytical queries on multiple relational databases is time

consuming because the computer system searches through multiple data tables. On the other hand, OLAP systems precalculate and integrate data so business analysts can generate reports faster when needed.

Non-technical user support

OLAP systems make complex data analysis easier for non-technical business users. Business users can create complex analytical calculations and generate reports instead of learning how to operate databases.

Integrated data view

OLAP provides a unified platform for marketing, finance, production, and other business units. Managers and decision makers can see the bigger picture and effectively solve problems. They can perform what-if analysis, which shows the impact of decisions taken by one department on other areas of the business.

What is OLAP architecture?

Online analytical processing (OLAP) systems store multidimensional data by representing information in more than two dimensions, or categories. Two-dimensional data involves columns and rows, but multidimensional data has multiple characteristics. For example, multidimensional data for product sales might consist of the following dimensions:

- Product type
- Location
- Time

Data engineers build a multidimensional OLAP system that consists of the following elements.

Data warehouse

A data warehouse collects information from different sources, including applications, files, and databases. It processes the information using various tools so that the data is ready for analytical purposes. For example, the data warehouse might collect information from a relational database that stores data in tables of rows and columns.

ETL tools

Extract, transform, and load (ETL) tools are database processes that automatically retrieve, change, and prepare the data to a format fit for analytical purposes. Data warehouses use ETL to convert and standardize information from various sources before making it available to OLAP tools.

OLAP server

An OLAP server is the underlying machine that powers the OLAP system. It uses ETL tools to transform information in

the relational databases and prepare them for OLAP operations.

OLAP database

An OLAP database is a separate database that connects to the data warehouse. Data engineers sometimes use an OLAP database to prevent the data warehouse from being burdened by OLAP analysis. They also use an OLAP database to make it easier to create OLAP data models.

OLAP cubes

A data cube is a model representing a multidimensional array of information. While it’s easier to visualize it as a three-dimensional data model, most data cubes have more than three dimensions. An OLAP cube, or hypercube, is the term for data cubes in an OLAP system. OLAP cubes are rigid because you can't change the dimensions and underlying data once you model it. For example, if you add the warehouse dimension to a cube with product, location, and time dimensions, you have to remodel the entire cube.

OLAP analytic tools

Business analysts use OLAP tools to interact with the OLAP cube. They perform operations such as slicing, dicing, and pivoting to gain deeper insights into specific information within the OLAP cube.

How does OLAP work?

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An online analytical processing (OLAP) system works by collecting, organizing, aggregating, and analyzing data using the following steps:

1. The OLAP server collects data from multiple data sources, including relational databases and data warehouses.
2. Then, the extract, transform, and load (ETL) tools clean, aggregate, precalculate, and store data in an OLAP cube according to the number of dimensions specified.
3. Business analysts use OLAP tools to query and generate reports from the multidimensional data in the OLAP cube.

OLAP uses Multidimensional Expressions (MDX) to query the OLAP cube. MDX is a query, like SQL, that provides a set of instructions for manipulating databases.

What are the types of OLAP?

Online analytical processing (OLAP) systems operate in three main ways.

MOLAP

Multidimensional online analytical processing (MOLAP) involves creating a data cube that represents

multidimensional data from a data warehouse. The MOLAP system stores precalculated data in the hypercube. Data engineers use MOLAP because this type of OLAP technology provides fast analysis.

ROLAP

Instead of using a data cube, relational online analytical processing (ROLAP) allows data engineers to perform multidimensional data analysis on a relational database. In other words, data engineers use SQL queries to search for and retrieve specific information based on the required dimensions. ROLAP is suitable for analyzing extensive and detailed data. However, ROLAP has slow query performance compared to MOLAP.

HOLAP

Hybrid online analytical processing (HOLAP) combines MOLAP and ROLAP to provide the best of both architectures. HOLAP allows data engineers to quickly retrieve analytical results from a data cube and extract detailed information from relational databases.