OLAP (Online Analytical Processing) was introduced into the business intelligence (BI) space over 20 years ago, in a time where computer hardware and software technology weren't nearly as powerful as they are today. OLAP introduced a groundbreaking way for business users (typically analysts) to easily perform multidimensional analysis of large volumes of business data.

Aggregating, grouping, and joining data are the most difficult types of queries for a relational database to process. The magic behind OLAP derives from its ability to pre-calculate and pre-aggregate data. Otherwise, end users would be spending most of their time waiting for query results to be returned by the database. However, it is also what causes OLAP-based solutions to be extremely rigid and IT-intensive.

Limitations of OLAP cubes

- OLAP requires restructuring of data into a star/snowflake schema
- There is a limited number of dimensions (fields) a single OLAP cube
- It is nearly impossible to access transactional data in the OLAP cube
- Changes to an OLAP cube requires a full update of the cube – a lengthy process

Vendors offer a variety of OLAP products that can be grouped into three categories: multidimensional OLAP (MOLAP), relational OLAP (ROLAP), and hybrid OLAP (HOLAP).

1. Relational Online Analytical Processing (ROLAP):

ROLAP servers are placed between relational backend server and client front-end tools. It uses relational or extended DBMS to store and manage warehouse data. ROLAP has basically 3 main components: Database Server, ROLAP server, and Front-end tool.

Advantages of ROLAP –
- ROLAP is used for handle the large amount of data.
- ROLAP tools don't use pre-calculated data cubes.
- Data can be stored efficiently.
- ROLAP can leverage functionalities inherent in the relational database.

Disadvantages of ROLAP –

- Performance of ROLAP can be slow.
- In ROALP, difficult to maintain aggregate tables.
- Limited by SQL functionalities.

2. Multidimensional Online Analytical Processing (MOLAP):

MOLAP does not uses relational database to storage. It stores in optimized multidimensional array storage. The storage utilization may be low With multidimensional data stores. Many MOLAP server handle dense and sparse data sets by using two levels of data storage representation. MOLAP has 3 components : Database Server, MOLAP server, and Front-end tool.

Advantages of MOLAP –
- MOLAP is basically used for complex calculations.
- MOLAP is optimal for operation such as slice and dice.
- MOLAP allows fastest indexing to the pre-computed summarized data.

Disadvantages of MOLAP –
- MOLAP can't handle large amount of data.
- In MOLAP, Requires additional investment.
- Without re-aggregation, difficult to change dimension.

3. Hybrid Online Analytical Processing (HOLAP) :

Hybrid is a combination of both ROLAP and MOLAP.It offers functionalities of both ROLAP and as well as MOLAP like faster computation of MOLAP and higher scalability of ROLAP. The aggregations are stored separately in MOLAP store. Its server allows storing the large data volumes of detailed information.

Advantages of HOLAP –
- HOLAP provides the functionalities of both MOLAP and ROLAP.
- HOLAP provides fast access at all levels of aggregation.

Disadvantages of HOLAP –
HOLAP architecture is very complex to understand because it supports both MOLAP and ROLAP.

Difference between ROLAP, MOLAP and HOLAP :

Basis	ROLAP	MOLAP	HOLAP
Storage	Relational	Multidimensional	Multidimensional

location for summary aggregation	Database is used as storage location for summary aggregation.	Database is used as storage location for summary aggregation.	Database is used as storage location for summary aggregation.
Processing time	Processing time of ROLAP is very slow.	Processing time of MOLAP is fast.	Processing time of HOLAP is fast.
Storage space requirement	Large storage space requirement in ROLAP as compare to MOLAP and HOLAP.	Medium storage space requirement in MOLAP as compare to ROLAP and HOLAP.	Small storage space requirement in HOLAP as compare to MOLAP and ROLAP.
Storage location for detail data	Relational database is used as storage location for detail data.	Multidimensional database is used as storage location for detail data.	Relational database is used as storage location for detail data.
Latency	Low latency in ROLAP as compare to MOLAP nad HOLAP.	High latency in MOLAP as compare to ROLAP and HOLAP.	Medium latency in HOLAP as compare to MOLAP and ROLAP.
Query response time	Slow query response time in ROLAP as compare to MOLAP and HOLAP.	Fast query response time in MOLAP as compare to ROLAP and HOLAP.	Medium query response time in HOLAP as compare to MOLAP and ROLAP.

Difference between ROLAP and MOLAP

ROLAP	MOLAP
ROLAP stands for Relational Online Analytical Processing.	MOLAP stands for Multidimensional Online Analytical Pr
It usually used when data warehouse contains relational data.	It used when data warehouse contains relational as we data.

It contains Analytical server.	It contains the MDDB server.
It creates a multidimensional view of data dynamically.	It contains prefabricated data cubes.
It is very easy to implement	It is difficult to implement.
It has a high response time	It has less response time due to prefabricated cubes.
It requires less amount of memory.	It requires a large amount of memory.