ABSTRACT
Version 8 of the SAS® System brings powerful new features for managing a Hybrid OLAP (HOLAP) or Distributed Multidimensional Data environment. The HOLAP component of the SAS/MDDB® Server software enables you to include SAS Multidimensional databases (MDDB), SAS files, and relational (RDBMS) databases into a single, powerful OLAP reporting environment. Support for HOLAP data groups is fully integrated into a number of SAS Institute’s OLAP solutions.

INTRODUCTION
In Version 6, the HOLAP extensions to SAS/EIS® software have become a widely implemented back-end for OLAP reporting applications. In Version 8, SAS/MDDB Server software features the ability to access and retrieve multidimensional data stored in a variety of formats on local or remote servers. One logical MDDB can be stored in many different formats and locations. Working with distributed multidimensional data requires two facilities that are part of SAS/MDDB Server software: the Distributed Multidimensional Metadata (DMM) facility and the Multidimensional Data Provider (MDP). The DMM enables you to define logical MDDBs, while the MDP enables you to retrieve the data. These components include and extend the feature set of the Version 6 HOLAP Extensions. In addition, the HOLAP or MDP component is now fully integrated into a number of OLAP solutions offered by SAS Institute.

WHAT IS OLAP?
OLAP (Online Analytical Processing) is a technology that offers high-performance access to large amounts of summarized data for complex multidimensional analysis and easy reporting. With OLAP, managers and analysts can rapidly and easily examine key performance data and perform complex comparisons on large volumes of data. Until recently, companies have implemented OLAP using two different technologies: Relational OLAP (ROLAP) and Multidimensional OLAP (MOLAP). Each technology has its own strengths and weaknesses.

Relational OLAP (ROLAP) uses relational databases (RDBMS) to store the data, sometimes using a star schema or snowflake schema. ROLAP tools offer sophisticated SQL and navigational methods on top of traditional relational databases. Relational OLAP tools offer scalable, manageable technologies for very large data. ROLAP databases can easily handle dimensions with high cardinality. However, the processing required to answer OLAP queries can put a heavy load on the server.

Multidimensional OLAP (MOLAP) uses a specialized data store with pre-aggregated summaries to store the data. The MOLAP data store is built specifically to handle multidimensional queries and offers fast, efficient, and manageable access to multidimensional data. MOLAP databases are one file on the system with indexes built and designed for the best response when doing an OLAP query. The limitation with MOLAP is that it is not as scalable as ROLAP.

HOLAP supports both MOLAP and ROLAP storage formats, enabling you to mix and combine them. By using both ROLAP and MOLAP data stores, Hybrid OLAP encompasses the strengths of both. It gives you full flexibility in dealing with questions of

- Size and scalability
- Access to existing ROLAP databases
- Query performance tuning
- Storage size reduction
- Non-standard aggregations.

A Hybrid OLAP (HOLAP) approach should not be used for every OLAP application. While HOLAP offers flexibility in designing and accessing OLAP data sources, it does add a layer of abstraction, the metadata, which must be maintained. Using a HOLAP approach can be beneficial if any of the following situations exists:

- if the amount of data is too large to handle within one MDDB
- if there is a performance bottleneck when accessing data on a server
- if you want to make use of existing summarized data sources
- if you want to secure your investment in OLAP applications by providing for scalability as data volumes grow and maintaining flexibility in your choice of data storage format and locations.

MULTIPLE STORAGE FORMATS
The HOLAP or MDP component of the Version 8 SAS/MDDB Server software enables you to treat data in different formats and different locations as one logical unit. In detail, the MDP component can access aggregated data stored in

- MDDBs
- PROC SUMMARY output data sets
- Relational data (SAS data sets and SAS views - including SAS/ACCESS® software views)
- Star Schemas

In fact, HOLAP enables OLAP reporting on any data sources that can be surfaced within the SAS System.
Caching is the ability to save the results of a query so that it can be reused at a later time. The MDP automatically caches any data retrieved in a query. This avoids data access on subsequent queries to the same aggregation level. You can control the cache by setting the absolute number and maximum size of the queries to hold in the cache. You can also choose to make your cache permanent to persist it between sessions.

Logging creates a file that contains information about each query that is made against the MDP. This file can then be analyzed to help with optimizing the structure of your HOLAP data group. For instance, you may find that more requests require dynamic roll-up while fewer requests are accessing the stored aggregations. On your next update of the MDDBs, you might choose to create different aggregations for those that are accessed frequently and drop the aggregations that are not requested.

EXTENSIBILITY – A POWERFUL DATA MODEL

The HOLAP component is surfaced as a set of SAS/AF® software classes. This object-oriented implementation provides a convenient way for you to extend and modify the data provider’s behavior programmatically. The data provider, SASHELP.MDDB.HOLAP_DP_CLASS, has public attributes that enable you to control caching, logging, validation, format handling and many other aspects of HOLAP functionality. Methods are provided to support computed columns, sorting, cutting (top/bottom n), and dynamic aggregation of class values. You can override these methods and attributes to extend and change the functionality of the data provider.

In addition to the data provider class, the actual data access components are individual classes with a clearly defined interface. The MDP component of SAS/MDDB Server software provides data access components for SAS multidimensional databases (MDDBs), SAS data sets, SAS views and star schemas. You can extend the set of data access components by subclassing the abstract class SASHELP.MDDB.DSOURCE.CLASS and implementing the
The HOLAP data provider or MDP can also be integrated into your own SAS/AF software applications. The MDP is used for data retrieval. You can request to return the query results as a data set, an MDDB, or as an in-memory SLIST. You must provide a model to track dimensional and navigational information.

**HOLAP METADATA**

The glue that holds together all the disparate data sources of a HOLAP data group is a set of metadata. You can edit the HOLAP metadata via the MDMDDB command or from the SAS/EIS Metabase Window by selecting Edit > Distributed Multidimensional Metadata. Definitions of logical cubes are stored in the metadata as data groups. A data group is made up of one or more data sources. You use the Define Data Group window to add or change the data sources in a data group (Figure 2).

After you specify general information about your data source, select the Subtables tab to specify or to verify the aggregation levels that your data source contains. A subtable (or aggregation level) is defined by the combination of class variables it represents. If a subtable exists in more than one data source, the subtables will be merged at query time. This enables you to store parts of individual aggregations in different data sources ("racking").

Metadata about a specific data source contains the location of the data source, the analysis columns/statistics and the subtables or aggregations (Figure 3). If the data source is password-protected, you can specify the password in this window to avoid prompting the user when the data is accessed at application runtime. If it is a non-local data source, select Server to open a window in which you specify an MDP server. For existing data sources, the information about aggregation levels and analysis columns/statistics is automatically filled in for you.

In addition to the HOLAP Data Groups themselves, you can also define servers within the metadata (Figure 5). Server definitions enable you to not only specify the location of the data servers, but also add post-logon and pre-logoff code and options for controlling remote processing load. You can also choose to let the HOLAP data provider control the signing on/off to the servers at query time.

Once you define the metadata for a HOLAP Data Group, you can use it within your own SAS/AF software applications or you can export it to the SAS/EIS software metabase for use in SAS/EIS software applications (Figure 6). When exporting, a proxy or skeleton MDDB is created and assigned the HOLAP attribute. Additional attributes, such as colors and ranges, and computed columns can then be added to the proxy registration. (NOTE: This is a different procedure than what was required to use the 6.12 HOLAP Extensions. In 6.12, you added an attribute to an existing SAS/EIS software registration. In Version 8, you define the HOLAP metadata and then export it.)

With Version 8, there is an experimental batch interface for reading and writing MDP Metadata from and to a flat file, as a means to programmatically update the metadata as data sources are added, updated, or removed. Instructions on how to use the interface can be downloaded from the SAS Institute Technical Support web page (see References).
INTEGRATION WITH SAS SOLUTIONS

In SAS/EIS Software
With Version 8, the multidimensional data model of SAS/EIS software fully supports the HOLAP Data Provider. No additional setup is required other than creating the HOLAP metadata and exporting the metadata to the SAS/EIS software metabase. Once you have created the SAS/EIS software registration, you can build any of the following SAS/EIS software multidimensional reports using the registration:

- 3D Business Graph
- Bubble Chart
- Map
- Multidimensional Business Trends
- Multidimensional Chart
- Multidimensional Pie Chart
- Multidimensional Report
- Organizational Chart
- Graphical Variance Report
- Critical Success Factors (CSF) and Dimension Navigators of the Application Screen Builder

Additionally, the Setup window in SAS/EIS software provides an interface for customizing the multidimensional environment (Figure 7). Through the Setup interface, you can specify which HOLAP Data Provider class you want to use, either the one shipped from SAS or a subclass that you have created. You can also provide custom classes for the Distributed Multidimensional Metadata user interface.

Figure 7 SAS/EIS Multidimensional Environment window

The SAS/EIS software metabase also provides a new table attribute, COMPSRV. This attribute enables you to take advantage of the remote computing capabilities of the MDP without having to define a HOLAP Data Group. The attribute is only available for MDDBs that reside on a remote server.

Finally, by using the Access Control feature of SAS/EIS software with a HOLAP or MDP Data Group, you can control access to the cubes and columns, as well as setting subsets and navigation states.

In MDDB Report Viewer
The MDDB Report Viewer enables users who do not have access to SAS software (or who do not want to invoke SAS software) to view the data in an MDDB. This capability eliminates the need to have SAS software running on all users’ machines and provides access to the MDDB reports and graphs in a Web environment. The MDDB Report Viewer provides full support for HOLAP data groups by using the same multidimensional model that ships with SAS/EIS software.

In AppDev Studio™
AppDev Studio is a complete suite of application development tools for building thin-client SAS applications. Two of its core components, webAF™ and webEIS™ provide support for the MDP component of SAS/MDDB Server software.

In Open OLAP Server
The Open OLAP Server grants OLE DB for OLAP consumers access to multi-dimensional data stored in SAS. Consumers can access either SAS/MDDB Server MDDBs or HOLAP data groups.

SAS/Warehouse Administrator® software now directly integrates more complete support for HOLAP through its new OLAP Groups, OLAP Tables, and OLAP MDDBs. These new OLAP metadata objects provide better and more flexible support for OLAP-specific attributes, such as crossings (aggregations), dimensions, and hierarchies. Export of metadata for all of these new OLAP objects into the SAS/MDDB Server software MDP or HOLAP metadata is supported. You'll find more information on this in the paper, New Features in SAS/Warehouse Administrator® (see References).

WHAT’S NEW SINCE THE VERSION 6.12 HOLAP EXTENSIONS
In addition to the coveted remote computing capabilities and the splitting out of individual aggregations (“stacking”), already available with the Version 6.12 HOLAP Extensions, the Version 8 MDP component provides you with the ability to split data sources by class value (“racking” – the combination of stacking and racking is called “stracking”). Version 8 MDP also supports multiple statistics per analysis variable. The MDP component also has the capability of processing derived analysis values (“computed columns”), thus passing local processing of these on to the server.

More generally, the HOLAP component has moved from being an extended attribute of SAS/EIS software metabase registrations to a stand-alone part of the SAS/MDDB Server software and is now supported by many different clients. You can also use the HOLAP data provider or MDP as part of your SAS/AF software applications.

MIGRATION FROM VERSION 6.12
Version 6.12 SAS/EIS software applications using the HOLAP extensions can be moved to Version 8 with little effort. Both the metabase registrations and the applications need to be updated for Version 8.

METABASE REGISTRATIONS
As you convert your Version 6 Metabase into a Version 8 Repository (as described in the Version 8 installation instructions), any registrations with the _ASSDATA attribute will be converted as follows:

- A new MDP Data Group will be created in the same repository.
- From this new MDP Data Group, the metadata registration will be updated and a new table attribute, HOLAP, will be added, pointing back to the MDP Data Group.
- You access and modify the information previously stored in the _ASSDATA attribute through the Distributed Multidimensional Metadata interface previously.

You may also need to add server definitions for any remotely accessed data sources.

APPLICATIONS
Applications that used the Version 6.12 HOLAP extensions needed to use an alternative model and, for application screen builders, an alternative resource and viewers. You can use the utility, sashelp.eistools.happlconvert.scl, to programmatically convert the attributes of these applications. The syntax for this utility is included in the source code header (see References).

SYSTEM REQUIREMENTS
- SAS/MDDB Server software on each platform that has data accessed by the MDP.
- SAS/MDDB Server software on the client platform (which
might be the application server platform)
- SAS/EIS software, if used through an EIS application
- SAS/IntrNet™ software, if using the MDDB Report Viewer
- AppDev Studio, if using webEIS

CONCLUSION
The HOLAP component of the Version 8 SAS/MDDB Server software provides flexibility in designing, accessing, and maintaining HOLAP data groups. HOLAP enables the integration of both multidimensional and relational data stores that can be used in concert to address issues with scalability and performance. It is clearly the most flexible and powerful OLAP solution out there.

REFERENCES

Marge Scerbo, The ABC of MDDBs, Paper 121, Proceedings of the 24th SAS Users Group International Conference


General information on OLAP and OLAP in SAS:
http://www.sas.com/software/olap/

Instructions on using the batch interface for reading/writing MDP metadata from/to flat files can be found at:

Information on how to migrate Version 6.12 SAS/EIS software applications to Version 8 can be found by selecting the file, eis_v8_migration.zip, found at:


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