# Getting Started with SAP Sybase IQ Column Store Analytics Server

Lesson 6: Scaling Out with Multiplex and Distributed Query Processing



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## 1. Introduction

If your analytics workload becomes too large for a single machine, SAP Sybase IQ can be configured in a clustered configuration called a "Multiplex" that scales to accommodate more users and more complex queries.



Need to scale!

Unlike shared-nothing MPP (massively parallel processing) architectures utilized by many vendors, SAP Sybase IQ uses a shared-everything approach. With shared-nothing architectures, data is physically partitioned, and each partition is assigned to a separate machine with its own memory and storage systems. Queries are then distributed, and the various machines independently process the portion of the data allocated to them. A master node collects the intermediate results from each participating machine and aggregates them to deliver the final result. This strategy eliminates contention between the machines, because there are no shared resources, and therefore delivers good performance. However, over time as data distributions begin to skew, keeping data balanced across nodes requires extensive monitoring and data movement. Also, as more users come online, bottlenecks through a single master node can occur. For these reasons, SAP Sybase IQ opted for a shared everything architecture that it has branded the PlexQ<sup>TM</sup> Distributed Query Platform. With this architecture, all data occupies a central, shared store that all nodes can access. No data partitioning and redistribution is required. Also, PlexQ's automatic workload re-balancer aggressively works to avoid contention among users for CPU resources. There is no single "master node", and any node in the cluster can operate as either a master or a worker. And a PlexQ feature called *logical servers* allows you to dynamically provision computing resources for particular workloads. Check out this white paper for more information about PlexQ:

 $\underline{http://www54.sap.com/bin/sapcom/downloadasset.scaling-out-query-performance-with-sap-sybase-iq-pdf.edx}$ 

In this lesson, you will create a SAP Sybase IQ Multiplex composed of two SAP Sybase IQ servers connected to the same database. Once you create the Multiplex, and add a DBFile to the IQ\_SHARED\_TEMP DBSpace (used for transmission of intermediate query results), distributed query execution is enabled by default. You can run a query, and see whether the query optimizer decided that it would improve performance to distribute it.

# 2. Creating a SAP Sybase IQ Multiplex

Sybase Control Center (SCC) is not only a monitoring facility, but can also be used to administer SAP Sybase IQ servers. Take a look at Lesson 2, Product Installation and Database Creation, to learn how to install, start and connect to SCC. Register your SAP Sybase IQ TPCH database as a resource in SCC as shown in that lesson, and then continue with this lesson as follows.

Note: This lesson will be most beneficial after the first three lessons of this quick start course have been completed.

## 2.1 Start SAP Sybase IQ

During the first 3 lessons of this quick start course, you created a database with a TPCH schema, and loaded data into it. When a database is accessed by a single SAP Sybase IQ server, it is called a simplex. In this lesson, you are going to add a second SAP Sybase IQ server to your current TPCH server that will interact with the same TPCH database. When you do this, you are converting your simplex database configuration to a *multiplex*.

To start this process, if SAP Sybase IQ is not already running, go to the directory where your TPCH database resides, and enter the following command:

```
start iq @tpch.cfg tpch.db
```

You are now going to use SCC to create a SAP Sybase IQ Multiplex.

## 2.2 Register the Agent for Administration

If you have not already done so, open up a browser to connect to SCC. Enter the following URL:

```
https://<scc server hostname>:8283/scc
```

Ignore the security warning, and login to SCC with user "sccadmin" and no password.

In the Perspective Resources view in SCC, highlight the "tpch" resource, click on the triangle to the right, and choose "Administration Console".

We will register and authenticate the agent as done in Lesson 2. Monitoring a SAP Sybase IQ server does not require an agent, but administration of the server does. The agent is installed during the SAP Sybase IQ installation and interacts with SCC to perform administration tasks on the SAP Sybase IQ database.

Highlight "IQ Servers" in the left pane of the console, and then move your mouse over the "tpch" IQ server name in the right pane. Click on the drop-down, and choose "Register Agent":

Specify the host of the machine where SAP Sybase IQ is installed, and the default port of 9999.

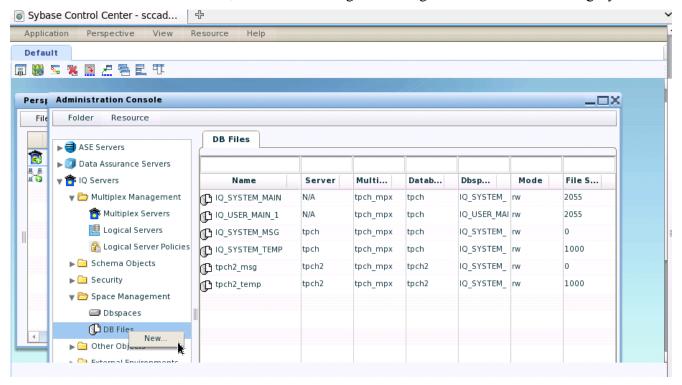
Click "OK". The next step is to authenticate to the agent. Click on the triangle to the right of the "tpch" IQ server as you did in the previous step, but this time choose "Authenticate Agent". In the pop-up leave the default user, uafadmin, with the password specified in the installation.

# 2.3 Add a DBFile to the IQ\_SHARED\_TEMP DBSpace

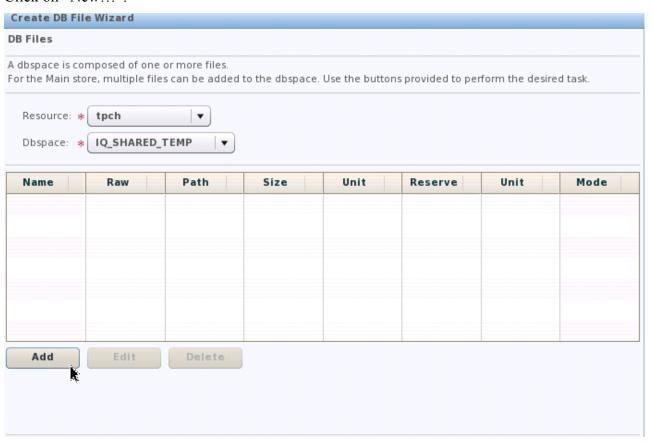
Distributed query processing requires a DBSpace called IQ\_SHARED\_TEMP that all nodes in the Multiplex can read from and write to. The purpose of IQ\_SHARED\_TEMP is to allow transmission of intermediate data for servers involved in a distributed query. Initially, when you create a database,

IQ\_SHARED\_TEMP is created, but there are no DBFiles in it. Therefore, IQ\_SHARED\_TEMP has no space allocated to it. You need to add a DBFile to it in order for distributed query processing to occur.

In the SCC administration console, click on the triangle to the right of the "DB Files" category:



#### Click on "New...":

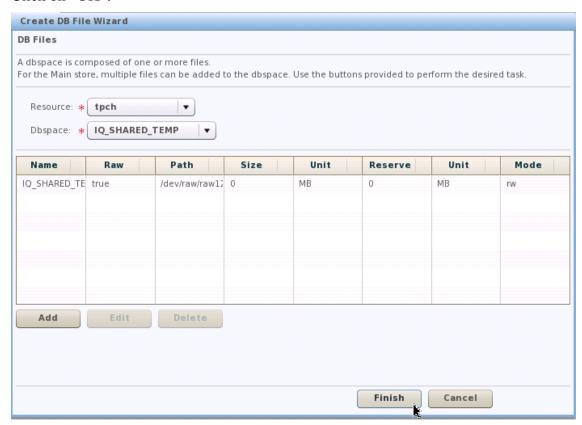


Choose the "tpch" resource, and the "IQ SHARED TEMP" DBSpace. Click on "Add":



Give the DBFile a logical name of your choice, and assign a raw device to it. 1GB is a reasonable device size for the database you have already created. Note that raw is required for Multiplex shared storage on a Linux machine.

#### Click on "OK":

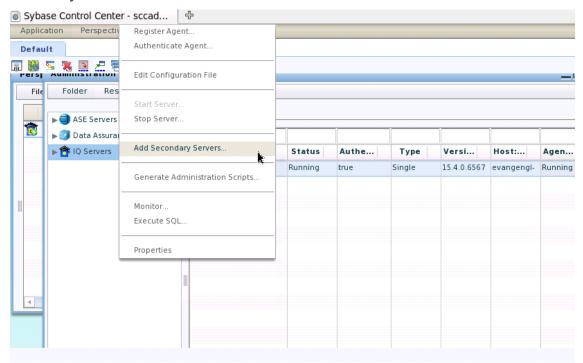


Click on "Finish" to add the DBFile.

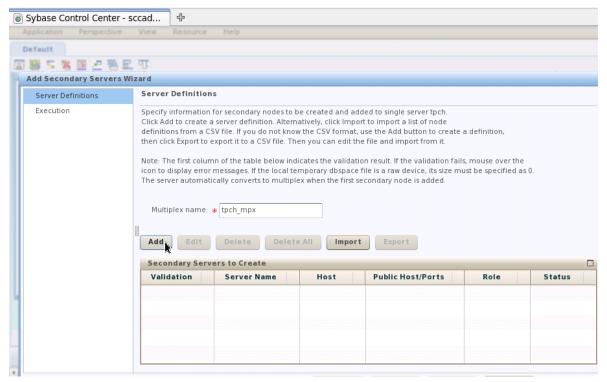
## 2.4 Convert SAP Sybase IQ Simplex to a Multiplex

A SAP Sybase IQ simplex is immediately converted to a Multiplex when you add a secondary server to it.

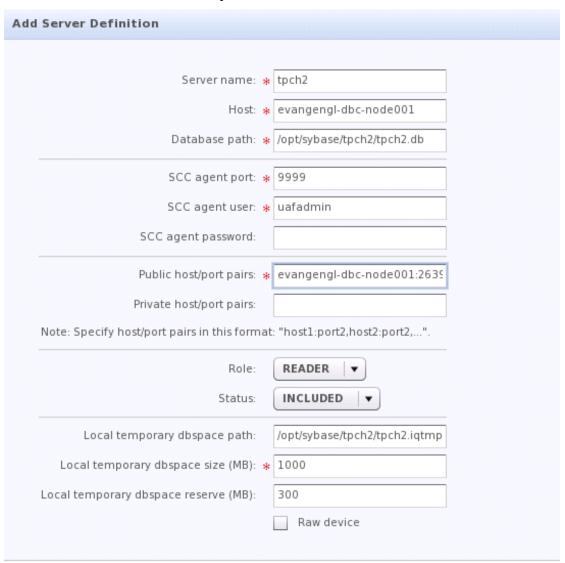
In SCC, click "IQ Servers". Then, click on the triangle next to the "tpch" IQ server, and choose "Add Secondary Servers":



You will see the following display. Enter a name for the Multiplex:



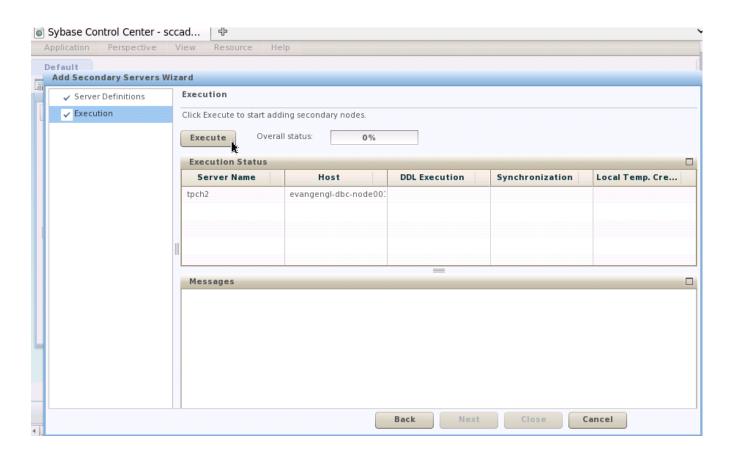
### Click on "Add" to add a secondary server.



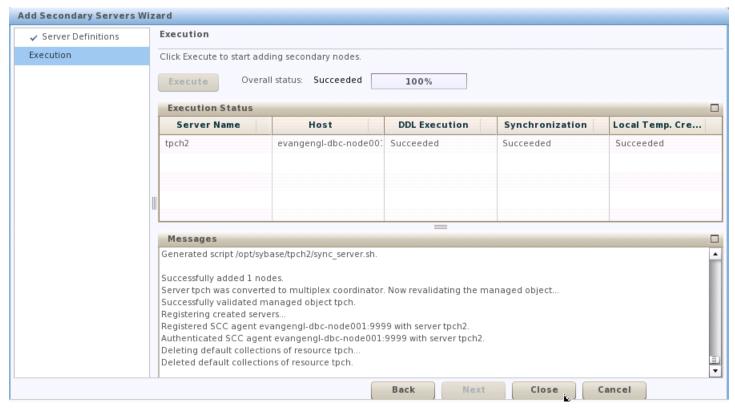
This example creates another server on the same machine as your original server. (If you have the resources, you can create the secondary server on a different machine. Then you will be able to see true query distribution across machines.) The catalog file for the new server will be in a different directory: /opt/sybase/tpch2. In the public host/pair ports, you are choosing a new port number – 2639 – different from the port number (2638) of the original server. (Private host/port pairs are optional.) Fill in other fields similar to those shown above. Click on OK. A summary screen will display:



#### Click on "Next":



No servers are created until you choose to execute the task. Click "Execute". When the secondary server is successfully created (there will be lots of messages as servers are started and re-started), you will see the following:



Click "Close"

## 3. Query Distribution

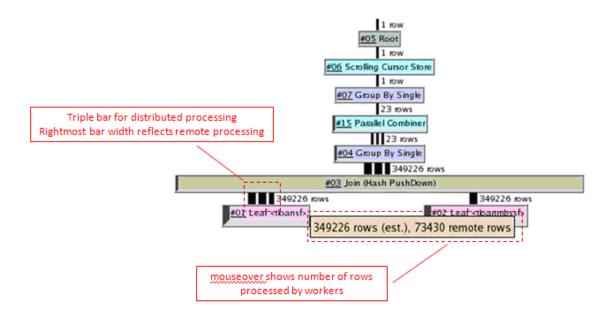
By default, query distribution across a Multiplex is enabled, as long as you have added a DBFile to your IQ\_SHARED\_TEMP DBSpace.

When the SAP Sybase IQ query optimizer determines that a query might require more CPU resources than are available on a single node, it will attempt to break the query into parallel "fragments" that can be executed concurrently on other servers in the Multiplex. DQP is the process of dividing the query into multiple, independent pieces of work, distributing that work to other nodes in the multiplex, and collecting and organizing the intermediate results to generate the final result set for the query.

It is important to emphasize that if a query does not fully utilize the CPU resources on a single machine, then it will usually not be advantageous to distribute it. For example, if the optimizer is going to parallelize a query 7 ways (keep 7 threads at a time busy) on an 8 core box, it will probably not distribute it. Distribution requires network and storage overhead to assign work, and store and transmit intermediate results. The objective in a DBMS is to execute queries as quickly as possible. A simple query will run fastest on a single machine. However, large and complex queries that can exceed the CPU capacity on a machine may be better served by incurring the overhead of distribution. If performance is improved, then distribution is a win.

The SAP Sybase IQ query plan gives you visibility into whether or not a query was distributed. The query plan provides detailed information that indicates which servers participated in the query processing, measures how the work was distributed, and displays timing information.

If a part of a query is distributed, you will see a triple black line between nodes that were distributed. When you hover your mouse cursor over the row count next to the parallel lines in the display, it will show the number of remote rows (how many were distributed). The width of the rightmost bar is sized depending on the number of remote rows. Here is an example:



Of the queries included as part of this quick start course, "\$TPCHROOT/TPCH/Queries/query1.sql", tends to distribute and scale the best, due to certain characteristics of the query. Queries that are likely to distribute well have the following attributes:

- Compute-intensive column scans, such as LIKE conditions.
- Complex queries involving aggregation, expensive expressions, and numeric data types.
- Queries comprised of query fragments that reduce the size of intermediate or final results.
- Low cardinality data often uses hash-based processing, which is more likely to scale. This
  occurs with star schemas, which are characterized by a large fact table with low-cardinality
  dimension tables.

If a query was not distributed, you can see the reason in the query plan. Look for the string "DQP Ineligible Reason". Here is an example:

Output 1 FPVALUE(FPORDINAL(TPCD.SUPPLIER.s\_suppkey, 2))

#11 Join (Hash)			
Parent Node	<u>#13</u>		
Left Child Node	<u>#09</u>		
Right Child Node	<u>#10</u>		
Generated Result Rows	393		
Estimated Result Rows	400		
Valid Join Algorithms	NLJ, NLPDJ, SMJ, SMPDJ, HJ, HPDJ		
Optimization Note	Replaced equated TPCD.SUPPLIER.s_nationkey with TPCD.NATION.n_nationkey		
DQP Ineligible Reason	fragment hash join DQP cost too large		
SMP ineligible reaso	Too few estimated rows		
Optimizer est. max hash rows for these keys 2500000			

# 4. Summary

During this lesson, you have been introduced to SAP Sybase IQ's shared everything PlexQ architecture, converted a SAP Sybase IQ Simplex to a Multiplex using Sybase Control Center, learned about distributed query processing in SAP Sybase IQ, and learned how to determine whether a query should be distributed or not to improve its performance.

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