

Oracle Maximum Availability Architecture

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Oracle Exalytics Deployment for High Availability



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Introduction

Oracle Exalytics In-Memory Machine provides the fastest performance for business intelligence applications. These applications often provide critical information to business decision-makers and that requires the application to be available. To ensure the applications are available when they're needed, a high availability configuration is required to eliminate the single points of failure that can result in an application outage.

This white paper contains technical details about how to configure a two node cluster of Oracle Exalytics systems running Oracle Business Intelligence Enterprise Edition with Oracle Exadata to enable high availability. The Maximum Availability Architecture (MAA) configuration requires horizontal scale out to be configured for scalability and performance (load balancing).

Deploying Exalytics for High Availability

Oracle Exalytics runs the Oracle Business Intelligence (BI) Foundation along with Oracle TimesTen In-Memory Database. Oracle Exalytics supports both active-active and active-passive clustering to provide scalability and high availability. This MAA white paper will focus on the Oracle Exalytics active-active cluster configuration, where each Exalytics machine in the cluster runs its own Oracle BI Foundation and Oracle TimesTen database. Each BI Server has a separate Data Source Name (DSN) for communication with each TimesTen instance. Shared storage such as Oracle ZFS Appliance is configured for BI server repository, BI presentation catalog, and Global Cache.

Note: BI local cache resides on the local node on RAM disk.

Each Exalytics machine has InfiniBand connectivity to the Oracle Exadata Database Machine running the application database to take advantage of flash technology, cell offload processing, high availability, and other optimizations provided by Exadata.

Oracle HTTP servers must be installed on a separate pair of physical or virtual hosts between the load balancer and Exalytics machines.

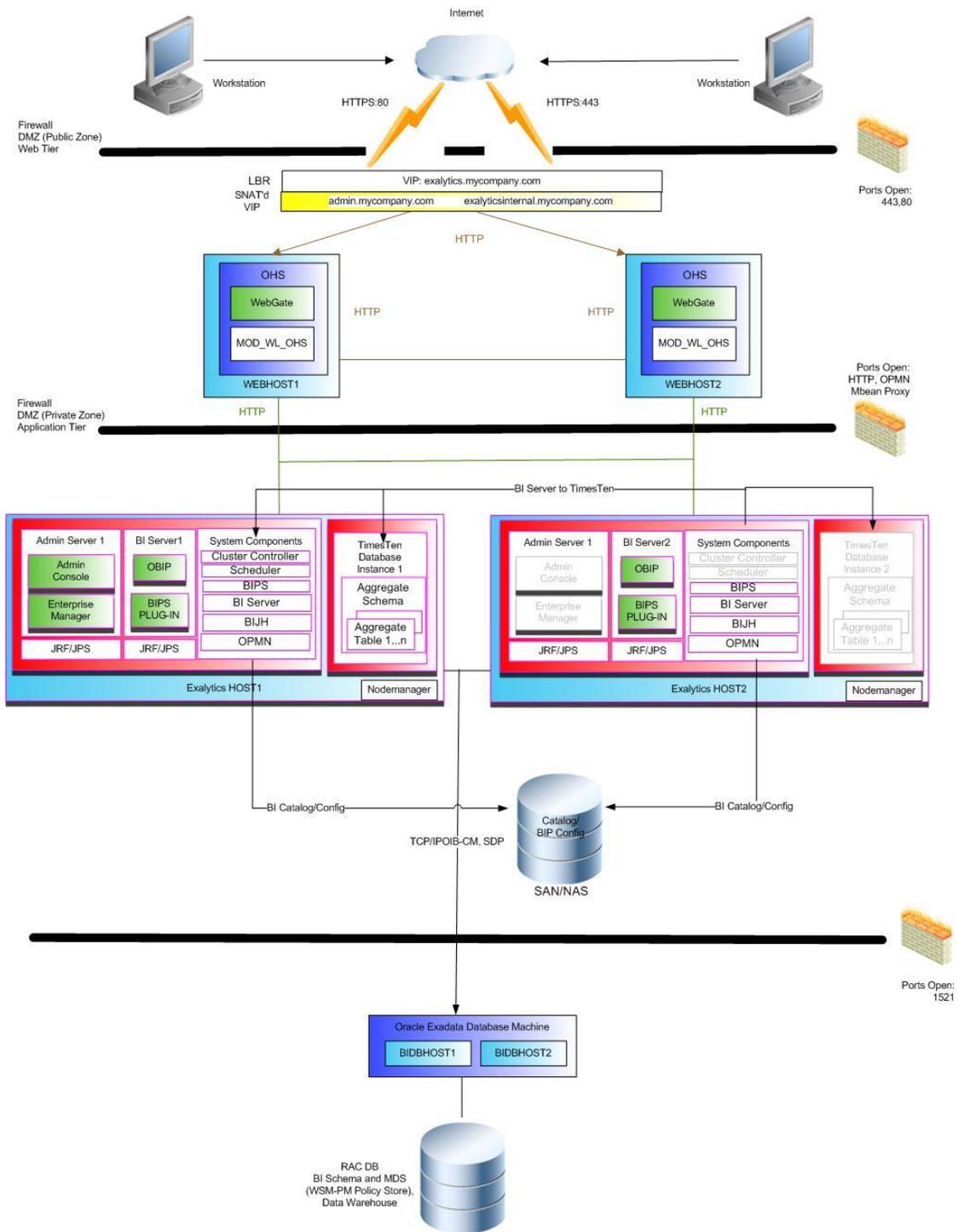


Figure 1: The full set of components in a High Availability cluster

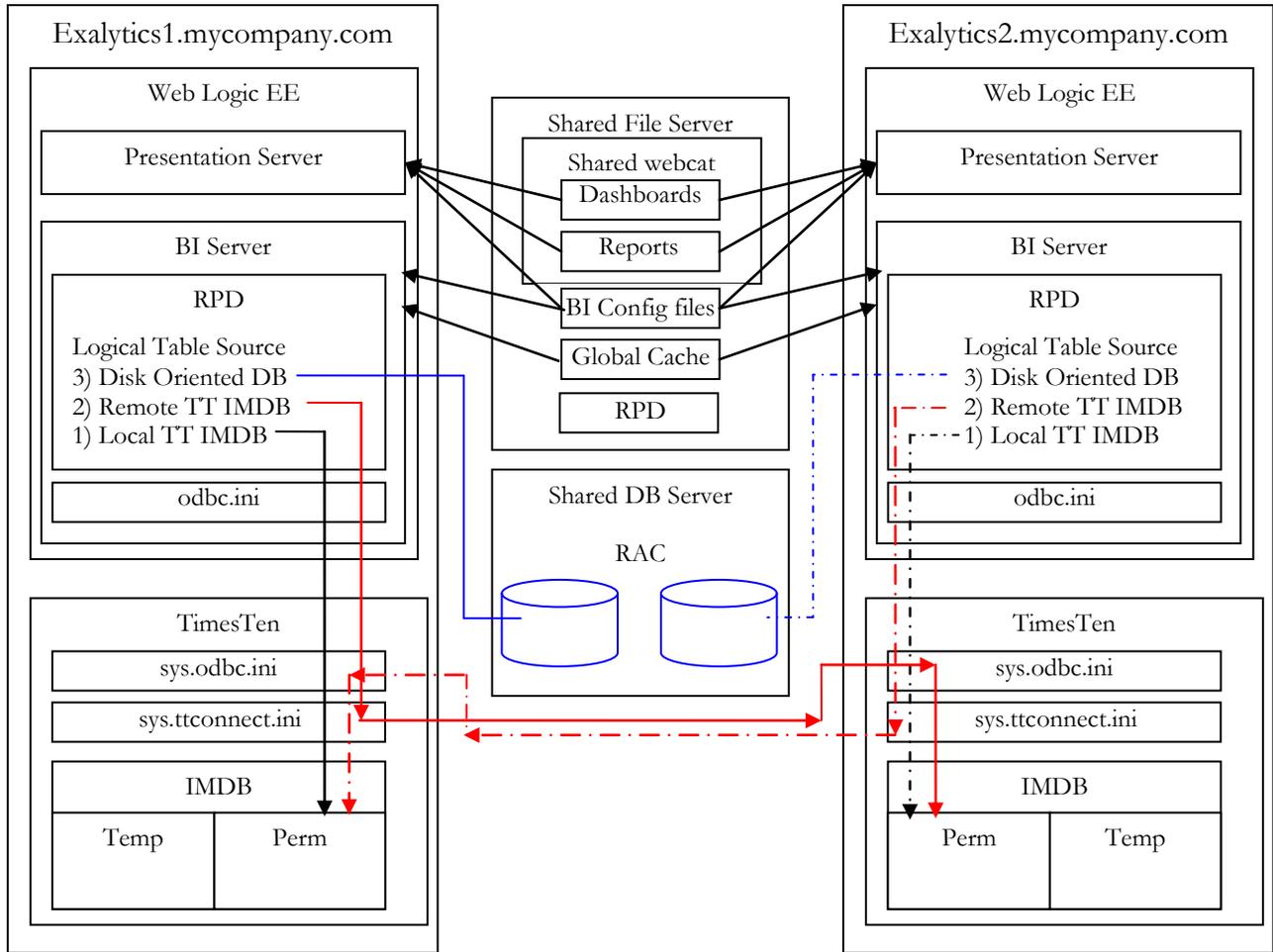


Figure 2: High Availability configuration elements for OBI EE and TimesTen

The two environments are effectively identical other than their host name, so the configuration of the `sys.odbc.ini` (TimesTen) and `odbc.ini` (OBI EE) files are identical. These both reference a TimesTen data store that is local to them and one that is remote to them. The difference is in the `sys.ttconnect.ini` file where the network addresses of the physical hosts are defined.

The BI Server will select the Logical Table Source (LTS) with the largest grain (the most aggregated values) that can satisfy any given query. This results in queries to the fact table with the smallest number of rows. If it finds two LTSes at the same grain, then it will prioritize the first one it finds in the list. Figure 2 uses numbers to show the relative order that the LTSes should appear in the RPD to reduce “line collisions”. In the RPD the aggregate LTSes would appear in the reverse order

Web Tier

In the web tier, two nodes, WEBHOST1 and WEBHOST2, run Oracle HTTP Server configured with mod_wl_ohs.

Through mod_wl_ohs, which allows requests to be proxied from Oracle HTTP Server to Oracle WebLogic Server, Oracle HTTP Server forwards requests to Oracle WebLogic Server running in the application tier.

The web tier should include an external load balancer to handle external requests. External requests are sent to the virtual host names configured on the load balancer. The load balancer then forwards the requests to the Oracle HTTP Server.

Application Tier

Nodes in the application tier are located in the DMZ secure zone.

In this tier, Oracle WebLogic Server is configured with Managed Servers for running Oracle BI Foundation and the Oracle TimesTen In-Memory Database. Multiple Exalytics servers are clustered together using InfiniBand for high availability. For more information, see *Oracle® Exalytics In-Memory Machine Owner's Guide*, Chapter 7 "[Connecting Oracle Exalytics In-Memory Machine to Oracle Exadata Database Machine](#)" and Chapter 7.2.3 "[Scenario 2: Clustered Exalytics In-Memory Machine with Oracle Exadata Database Machine](#)."

Note: Due to lack of InfiniBand support in the Firewalls today Exalytics placement in the Application Tier makes only sense if using Ethernet connectivity between Exalytics and Exadata. Until InfiniBand Support is available in Firewalls we recommend Exalytics to be located in the Data Tier.

Data Tier

Nodes in the data tier are located in the most secured network zone (the intranet).

In the data tier, the Oracle Exalytics machines are connected to Oracle Exadata Database Machine over InfiniBand.

Exalytics Prerequisites for Deployment

1. Ensure that the prerequisites in *Oracle® Fusion Middleware Installation and Administration Guide for Oracle Exalytics In-Memory Machine* for Installing Software on Exalytics are met.
2. Connect Exalytics HCA ports to each Exadata Database Machine InfiniBand leaf switch. One of ports 5B, 6A, 6B, 7A, 7B, or 12A on the leaf switches of the Exadata Database Machine should be used even if additional ports are open. On partial rack configurations, some ports are reserved for potential future expansion.

3. Configure DNS client settings on the Exalytics machine. It is best to use the same DNS servers as used by the Exadata Database Machine nodes if possible.
4. Enable NTP client settings on the Exalytics machine. It is best to use the same NTP servers as used by the Exadata Database Machine nodes if possible.
5. Configure HugePages if TimesTen requires more than 256 GB. Activate the number of HugePages in `/etc/sysctl.conf` file and by setting the parameter `vm.nr_hugepages = 410200`.
6. The largest recommended memory for TimesTen is a number that leaves enough memory for the other installed components and the Operating System to function adequately; the larger the number of concurrent users the higher this memory value needs to be. As a very rough guide no more than 80% - 85% of the memory should be devoted to active TimesTen databases. If you are running EPM on the same Exalytics machine then that number should be reduced to provide adequate memory resources to the EPM system.

Exalytics and Exadata InfiniBand Configuration

1. Enable automatic RDS kernel module loading on Exalytics.
This can be done in rolling fashion
 - a. Edit `/etc/infiniband/openib.conf` to set `RDS_LOAD=yes` and `SDP_LOAD=yes`.
 - b. Edit the `/etc/modprobe.conf` file and add this at the end as single line:
`options ib_sdp sdp_zcopy_thresh=0 rcv_poll=0 sdp_apm_enable=0`

Note:

In Exalytics physical environment, disable APM at Exalytics node level.

In Exalytics virtual environment, disable APM at guest VM (DomU) level.

The setting `sdp_apm_enable=0` is if Exadata Image is 11.2.3.3.x or 12.1.1.1.x and if this parameter is defined in the Linux kernel module `ib_sdp`

```
modinfo ib_sdp | grep sdp_apm_enable
```

- c. Reboot after change.
2. Create InfiniBand listener on each Exadata compute nodes.
This can be done in rolling fashion
 - a. Edit `/etc/infiniband/openib.conf` to set `RDS_LOAD=yes` and `SDP_LOAD=yes`.
 - b. Edit `/etc/ofed/libsdp.conf` and change both lines.
Change


```
use both server * :
use both client * :
```

to

```
use tcp server *:*
use tcp client *:*
```

“use tcp” means that TCP is the default protocol, SDP is available on demand.

- c. Edit the `/etc/modprobe.conf` file and add this at the end as a single line:

```
options ib_sdp sdp_zcopy_thresh=0 recv_poll=0 sdp_apm_enable=0
```

The setting `sdp_apm_enable=0` is if Exadata Image is 11.2.3.3.x or 12.1.1.1.x and if this parameter is defined in the Linux kernel module `ib_sdp`

```
modinfo ib_sdp | grep sdp_apm_enable
```

- d. Reboot the compute node.
- e. Edit `/etc/hosts` on each Exalytics machine and Exadata Database Machine compute node to add the virtual IP addresses for use on the InfiniBand network, for example, Exadata Database Machine quarter rack (2 compute nodes). Choose a valid IP address on the IB private network for each Exadata compute node and ensure those IPs are not in use currently.

```
192.168.10.21 dm01db01-ibvip.mycompany.com dm01db01-ibvip
192.168.10.22 dm01db02-ibvip.mycompany.com dm01db02-ibvip
```

- f. As `root` user on one of the Exadata Database Machine compute nodes, execute the following steps to create a network resource for the InfiniBand network, and add start virtual IP addresses for each compute node on it. Make appropriate substitutions for the network and subnet mask in use on your private network (it may not be `192.168.10.0/255.255.255.0`). Ask your administrator or use `ipcalc`, based on network mask to calculate the network.

```
srvctl add network -k 2 -S 192.168.10.0/255.255.255.0/bondib0
```

```
srvctl add vip -n dm01db01 -A dm01db01-ibvip/255.255.255.0/bondib0 -k 2
```

```
srvctl add vip -n dm01db02 -A dm01db02-ibvip/255.255.255.0/bondib0 -k 2
```

Starting with X4 hardware using Active/Active IB, use instead:

```
srvctl add network -k 2 -S 192.168.10.0/255.255.255.0/ib0\|ib1
```

```
srvctl add vip -n dm01db01 -A dm01db01-ibvip/255.255.255.0/ib0\|ib1 -k 2
```

```
srvctl add vip -n dm01db02 -A dm01db02-ibvip/255.255.255.0/ib0\|ib1 -k 2
```

Bug fix 17551223 in GI HOME is required to bring up new cluster ware resources. It is included in 11.2.0.3 BP21, 11.2.0.4, 12.1.0.1 and 12.1.0.2.

```
srvctl start vip -i dbm01db01-ibvip
```

```
srvctl start vip -i dbm01db02-ibvip
```

- g. On one of the Exadata Database Machine compute nodes, as `oracle` user (or owner of the Grid Infrastructure `ORACLE_HOME`), execute following command

```
srvctl add listener -l LISTENER_IB -k 2 -p TCP:1522/SDP:1522
```

- h. On each Exadata Database Machine compute node, as `oracle` user (or owner of the Grid Infrastructure `ORACLE_HOME`), create or append to `tnsnames.ora` in `GRID_HOME/network/admin` the following new entries

Note: *IBREMOTE and *IBLOCAL entries will be slightly different on each node to reference the proper remote and local VIP names-you cannot copy the entries from one node to another without some modifications:

```
DBM =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = dm01-
scan.mycompany.com)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = dbm)
    ))

DBM_IB =
  (DESCRIPTION =
    (LOAD_BALANCE=on)
    (ADDRESS = (PROTOCOL = TCP)(HOST = dm01db01-
ibvip.mycompany.com)(PORT = 1522))
    (ADDRESS = (PROTOCOL = TCP)(HOST = dm01db02-
ibvip.mycompany.com)(PORT = 1522))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = dbm)
    ))

LISTENER_IBREMOTE =
  (DESCRIPTION =
    (ADDRESS_LIST =
      (ADDRESS = (PROTOCOL = TCP)(HOST = dm01db02-
ibvip.mycompany.com)(PORT = 1522))
    ))

LISTENER_IBLOCAL =
```

```
(DESCRIPTION =
  (ADDRESS_LIST =
    (ADDRESS = (PROTOCOL = TCP)(HOST = dm01db01-
ibvip.mycompany.com)(PORT = 1522))
    (ADDRESS = (PROTOCOL = SDP)(HOST = dm01db01-
ibvip.mycompany.com)(PORT = 1522))
  ))
```

```
LISTENER_IPLOCAL =
  (DESCRIPTION =
    (ADDRESS_LIST =
      (ADDRESS = (PROTOCOL = TCP)(HOST = dm0101-
vip.mycompany.com)(PORT = 1521))
    ))
```

```
LISTENER_IPREMOTE =
  (DESCRIPTION =
    (ADDRESS_LIST =
      (ADDRESS = (PROTOCOL = TCP)(HOST = dm01-
scan.mycompany.com)(PORT = 1521))
    ))
```

- i. On one Exadata Database Machine compute node, connect to the database instance as sysdba.

```
SQL> alter system set listener_networks='((NAME=network2)
(LLOCAL_LISTENER=LISTENER_IBLOCAL)(REMOTE_LISTENER=LIST
ENER_IBREMOTE))',
'((NAME=network1)(LOCAL_LISTENER=LISTENER_IPLOCAL)(REMOTE
_LISTENER=LISTENER_IPREMOTE))' scope=both;
```

- j. On one Exadata Database Machine compute node, as oracle user (or owner of the Grid Infrastructure ORACLE_HOME) restart the listener named LISTENER_IB.

```
srvctl stop listener -l LISTENER_IB
```

```
srvctl start listener -l LISTENER_IB
```

Exalytics Deployment on the First Exalytics Node

Follow Section “Deploying Oracle Exalytics for High Availability” in *Oracle® Fusion Middleware Installation and Administration Guide for Oracle Exalytics In-Memory Machine*.

In the `input.properties` file specify the virtual IP addresses you used for the InfiniBand network.

For example:

DATABASE_CONNECTION_STRING= dbm01db01-ibvip.mycompany.com:1522:dbm1^dbm01db02-
ibvip.mycompany.com:1522:dbm2@dbm

Respectively in RCU

Connect String: dbm01db01-ibvip.mycompany.com:1522:dbm1^dbm01db02-
ibvip.mycompany.com:1522:dbm2@dbm

Post Installation Steps

Oracle TimesTen

1. Run the daemon configuration scripts as `root` to start TimesTen on boot.

```
/u01/app/oracle/product/TimesTen/tt1122/bin/setuproot -install
```

2. Configure large pages. You can configure large pages for the TimesTen database by editing the following file and adding the following lines to

```
/u01/app/oracle/product/TimesTen/tt1122/info/ttndaemon.options
```

```
-linuxLargePageAlignment 2
```

3. Define the logical Local and Remote server name for Oracle TimesTen in

```
/u01/app/oracle/product/TimesTen/tt1122/info/sys.ttconnect.ini
```

```
[tt_exalytics_local]
Description=TimesTen Server
Network_Address=exalytics1.mycompany.com
TCP_PORT=53397
```

```
[tt_exalytics_remote]
Description=TimesTen Server
Network_Address=exalytics2.mycompany.com
TCP_PORT=53397
```

4. Define the Local and Remote TimesTen In-Memory Database using a DSN that is contained in the `/u01/app/oracle/product/TimesTen/tt1122/info/sys.odbc.ini` file.

```
[ODBC Data Sources]
TT_AGGR_STORE_LOCAL=TimesTen 11.2.2 Driver
TT_AGGR_STORE_REMOTE=TimesTen 11.2.2 Client Driver
```

```
# The DSN below defines a TimesTen In-Memory Database with 40GB devoted to
# tables and indexes and 40GB for handling queries and their results,
```

the overall memory consumption will be approximately 81GB (PermSize + TempSize + LogBufMB + 64).

```
[TT_AGGR_STORE_LOCAL]
Driver=/u01/app/oracle/product/fmw/./TimesTen/tt1122/lib/libtten.so
DataStore=/u01/app/oracle/product/fmw/./aggregate_store/tt_aggr_store
LogDir=/u01/app/oracle/product/fmw/./aggregate_store/logs
DatabaseCharacterSet=AL32UTF8
ConnectionCharacterSet=AL32UTF8
LogFileSize=1024
LogBufMB=1024
LogBufParallelism=16
Preallocate=0
PermSize=40000
TempSize=40000
MemoryLock=4
CkptFrequency=30
CkptLogVolume=0
CkptRate=0
PrivateCommands=1
RecoveryThreads=40
```

The DSN below references it remote equivalent in case the local TimesTen instance # fails. This DSN will be used by the BI Server in cases where it detects that the # local TimesTen database is no longer available.

```
[TT_AGGR_STORE_REMOTE]
TTC_SERVER = tt_exalytics_remote
TTC_SERVER_DSN = TT_AGGR_STORE_LOCAL
```

5. Instantiate Oracle TimesTen Database. The TimesTen In-Memory Database is instantiated when the first connection is made to the database.

```
cd /u01/app/oracle/product/TimesTen/tt1122/bin
./ttisql
connect dsn=TT_AGGR_STORE_LOCAL;
create user exalytics identified by password;
grant create session to exalytics;
grant create table to exalytics;
grant select on SYS.OBJ$ to exalytics;
```

Use the following command to test the connection to the local TimesTen In-Memory Database. There are no tables yet configured to return.

```
CONNECT "DSN=TT_AGGR_STORE_LOCAL;uid=exalytics";
tables;
EXIT;
```

The Connectivity Test to the remote TimesTen In-Memory Database must be postponed until it has been installed and configured.

Oracle WebLogic Server

1. Create `boot.properties` for Admin Server to start without prompting you for the administrator username and password in

```
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/servers/AdminServer/security.
```

```
password=<WLS Admin User Password>
username=<WLS Admin User>
```

2. Enable SDP Support for JDBC.

- a. Ensure that you have specified the virtual IP addresses used for InfiniBand network during BI Domain creation. The console automatically generates the complete JDBC URL as shown in the following example:

For mds-owsm multi data source, we have 2 generic data sources:

- mds-owsm-rac0
URL:
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=TCP)(HOST= dm01db01-ibvip.mycompany.com)(PORT=1522)))(CONNECT_DATA=(SERVICE_NAME=dbm)(INSTANCE_NAME=dbm1)))
- mds-owsm-rac1
URL:
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=TCP)(HOST= dm01db02-ibvip.mycompany.com)(PORT=1522)))(CONNECT_DATA=(SERVICE_NAME=dbm)(INSTANCE_NAME=dbm2)))

- b. In the JDBC URL, replace TCP protocol with SDP protocol. For example:

- mds-owsm-rac0
URL:
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=SDP)(HOST= dm01db01-ibvip.mycompany.com)(PORT=1522)))(CONNECT_DATA=(SERVICE_NAME=dbm)(INSTANCE_NAME=dbm1)))
- mds-owsm-rac1
URL:
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=SDP)(HOST= dm01db02-ibvip.mycompany.com)(PORT=1522)))(CONNECT_DATA=(SERVICE_NAME=dbm)(INSTANCE_NAME=dbm2)))

```
dbm)(INSTANCE_NAME=dbm2)))
```

- c. Manually add the system property `-Djava.net.preferIPv4Stack=true` to the `startWebLogic.sh` script, which is located in the `bin` directory of `DOMAIN_HOME` as follows:
 - i. Locate the following line in the `startWebLogic.sh` script:


```
. ${DOMAIN_HOME}/bin/setDomainEnv.sh $*
```
 - ii. Add the following property immediately after the above entry:


```
JAVA_OPTIONS="`${JAVA_OPTIONS}` -Djava.net.preferIPv4Stack=true -Doracle.net.SDP=true"
```
 - iii. Save the file and close it.
 - iv. Restart the BI Domain.

Oracle Business Intelligence

Configure ODBC Connection from Oracle Business Intelligence to Oracle TimesTen in `/u01/app/oracle/product/fmw/instances/instance1/bifoundation/OracleBIApplication/coreapplication/setup/odbc.ini` to contain references to the TimesTen database.

```
[ODBC Data Sources]
AnalyticsWeb = Oracle BI Server
Cluster = Oracle BI Server
SSL_Sample = Oracle BI Server
TT_AGGR_STORE_LOCAL = TimesTen 11.2.2 Driver
TT_AGGR_STORE_REMOTE = TimesTen 11.2.2 Driver

[TT_AGGR_STORE_LOCAL]
Driver = /u01/app/oracle/product/fmw/./TimesTen/tt1122/lib/libttclient.so
TTC_SERVER_DSN = TT_AGGR_STORE_LOCAL
TTC_SERVER = tt_exalytics_local
TTC_TIMEOUT = 0

[TT_AGGR_STORE_REMOTE]
Driver = /u01/app/oracle/product/fmw/./TimesTen/tt1122/lib/libttclient.so
TTC_SERVER_DSN = TT_AGGR_STORE_REMOTE
TTC_SERVER = tt_exalytics_remote
TTC_TIMEOUT = 0
```

Basic Exalytics Start-Stop Scripts first Node

These scripts are only examples and can be enhanced for better security and prerequisite checking as required. The goal of these examples is to provide the necessary commands and ordering for starting and stopping the processes on the Exalytics system.

startExalytics.sh

```
nohup
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/startWebLogic.sh &

sleep 60

nohup /u01/app/oracle/product/fmw/wlserver_10.3/server/bin/startNodeManager.sh &

export ORACLE_INSTANCE=/u01/app/oracle/product/fmw/instances/instance1

/u01/app/oracle/product/fmw/instances/instance1/bin/opmnctl startall

/u01/app/oracle/product/fmw/instances/instance1/bin/opmnctl status

nohup
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/bin/startManagedWeb
Logic.sh bi_server1 t3://exalytics1:7001 &

/u01/app/oracle/product/TimesTen/tt1122/bin/ttDaemonAdmin -start
```

stopExalytics.sh

```
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/bin/stopManagedWeb
Logic.sh bi_server1 t3://exalytics1:7001 biadmin password

export ORACLE_INSTANCE=/u01/app/oracle/product/fmw/instances/instance1

/u01/app/oracle/product/fmw/instances/instance1/bin/opmnctl stopall

/u01/app/oracle/product/TimesTen/tt1122/bin/ttAdmin -ramUnload
TT_AGGR_STORE_LOCAL (See note below)

/u01/app/oracle/product/TimesTen/tt1122/bin/ttDaemonAdmin -stop

/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/bin/stopWebLogic.sh
biadmin password

ps -ef | grep NodeManager | grep -v grep | perl -lane 'print $F[1]' | xargs kill -9
```

Note: It is extremely important that any active TimesTen databases are properly and cleanly shut down before stopping the main daemon. Because the recommended setup on Exalytics is for all TimesTen databases to use ramPolicy manual, it is necessary to explicitly shut down the local database using `ttAdmin -ramUnload TT_AGGR_STORE_LOCAL`, and wait for it to complete prior to stopping the main daemon. If there are any application connections open against the database then ramUnload cannot complete.

Exalytics Deployment on the Second Exalytics Node

Follow Section “Configuring for High Availability” Step 2 “Preparing the Second Exalytics Machine” in *Oracle® Fusion Middleware Installation and Administration Guide for Oracle Exalytics In-Memory Machine* to deploy Exalytics.

Oracle TimesTen Installation

1. Install TimesTen using the Installer script
/home/oracle/EXALYTICS_INSTALLERS/tt/setup.sh.
2. Run the Post Installation Steps for TimesTen described for the first Exalytics Node.
The only difference will be

```
/u01/app/oracle/product/TimesTen/tt1122/info/sys.ttconnect.ini
```

```
[tt_exalytics_local]
Description=Local TimesTen Server
Network_Address=exalytics2.mycompany.com
TCP_PORT=53397
```

```
[tt_exalytics_remote]
Description=Remote TimesTen Server
Network_Address=exalytics1.mycompany.com
TCP_PORT=53397
```

Oracle WebLogic Server Installation

1. Use the WLS Installer script to install Oracle WebLogic Server and create the Middleware Home.

```
/home/oracle/EXALYTICS_INSTALLERS/wls/wls1036_linux64.bin
```

In the Choose Middleware Home Directory screen, for Middleware Home Directory, enter the same directory as the first Exalytics Machine. For example:

```
/u01/app/oracle/product/fmw
```

In the Choose Install Type screen, select **Custom** and deselect Coherence. Coherence does not need to be installed.

In the Installation Complete screen, clear the **Run Quickstart** option and click **Done**.

2. **Update** /u01/app/oracle/product/fmw/instances/instance2/config/OPMN/opmn/opmn.xml to point to the driver location for ODBC for Oracle TimesTen by editing the following "variable" elements. The edited text is shown in **bold**.

```
<variable id="LD_LIBRARY_PATH"
value="$ORACLE_HOME/common/ODBC/Merant/5.3/lib$;$ORACLE_HOME/bifoundation/server/bin$;$ORACLE_HOME/bifoundation/web/bin$;$ORACLE_HOME/clients/epm/Es
```

```
sbase/EssbaseRTC/bin$:$ORACLE_HOME/bifoundation/odbc/lib$:$ORACLE_INSTANCES$
:$ORACLE_HOME/lib:/u01/app/oracle/product/TimesTen/tt1122/lib"
append="true"/>
<variable id="TIMESTEN_DLL"
value="/u01/app/oracle/product/TimesTen/tt1122/lib/libttclient.so"/>
```

3. Restart OPMN.

Oracle Business Intelligence Installation

1. Use the BI runInstaller script to install the BI Software.
(/home/oracle/EXALYTICS_INSTALLERS/bi/bishiphome/Disk1/runInstaller).

In the Select Installation Type screen, select **Software Only** Install.

2. Set up Shared File Locations for Oracle BI.

As part of configuring Exalytics cluster, you must configure the following persistent stores to be placed on shared storage to ensure that they are available from both Exalytics machines.

- RPD Publishing Directory – Repository for Oracle BI Server. Specify a shared RPD publishing directory in Fusion Middleware Control to propagate online repository changes in a cluster.
 - Oracle BI Presentation Catalog – Each Oracle BI Presentation Services instance loads the catalog from the catalog location that is specified in Fusion Middleware Control. Copy any existing catalogs to the shared storage before updating the location of the Oracle BI Presentation Catalog.
 - Global Cache – The global cache resides on shared storage and stores purging events, seeding events, and results sets that are associated with seeding events.
 - BI Publisher Configuration Folder
 - BI Publisher Scheduler Temp Directory
3. Scale Out the Existing BI Domain using
/u01/app/oracle/product/fmw/Oracle_BI1/bin/config.sh.
 4. Scale Out System Components using Fusion Middleware Control as described in *Oracle Fusion Middleware System Administrator's Guide for Oracle Business Intelligence Enterprise Edition*:
 - The Oracle BI Server
 - Oracle BI Presentation Services
 - JavaHost
 5. Configure Secondary Instances of Singleton System Components using Fusion Middleware Control

- Oracle BI Cluster Controller
 - Oracle BI Scheduler
6. Configure ODBC connection from Oracle Business Intelligence to Oracle TimesTen in `/u01/app/oracle/product/fmw/instances/instance2/bifoundation/OracleBIApplication/coreapplication/setup/odbc.ini` as described for the first Exalytics Node

Basic Exalytics Start-Stop Scripts Second Node

These scripts are examples and can be enhanced for better security and prerequisite checking as required. The goal of these examples is to provide the necessary commands and ordering for starting and stopping the processes on the Exalytics system.

startExalytics.sh

```
nohup /u01/app/oracle/product/fmw/wlserver_10.3/server/bin/startNodeManager.sh &

export ORACLE_INSTANCE=/u01/app/oracle/product/fmw/instances/instance2

/u01/app/oracle/product/fmw/instances/instance2/bin/opmnctl startall

/u01/app/oracle/product/fmw/instances/instance2/bin/opmnctl status

nohup
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/bin/startManagedWeb
Logic.sh bi_server2 t3://exalytics1:7001 &

/u01/app/oracle/product/TimesTen/tt1122/bin/ttDaemonAdmin -start
```

stopExalytics.sh

```
/u01/app/oracle/product/fmw/user_projects/domains/bifoundation_domain/bin/stopManagedWeb
Logic.sh bi_server2 t3://exalytics1:7001 biadmin password

export ORACLE_INSTANCE=/u01/app/oracle/product/fmw/instances/instance2

/u01/app/oracle/product/fmw/instances/instance1/bin/opmnctl stopall

/u01/app/oracle/product/TimesTen/tt1122/bin/ttAdmin -ramUnload
TT_AGGR_STORE_LOCAL

/u01/app/oracle/product/TimesTen/tt1122/bin/ttDaemonAdmin -stop

ps -ef | grep NodeManager | grep -v grep | perl -lane 'print $F[1]' | xargs kill -9
```

Building Aggregates

Aggregates are built by running an Aggregate Persistence script, this creates the aggregate star, it populates it with data, and it updates the RPD with new LTS entries. It is a very convenient mechanism for creating new aggregates to accelerate query performance. In

In addition to manual execution of the Aggregate Persistence scripts, Exalytics offers the Summary Advisor, a feature that uses query logs to recommend what aggregates to create, and to then build the appropriate Aggregate Persistence scripts. These scripts then need to be executed.

This section looks at how to execute Aggregate Persistence scripts; it does not explain how to run Summary Advisor nor does it cover design consideration for building these scripts.

For more information look at Fusion Middleware Metadata Repository Builder's Guide for Oracle Business Intelligence Enterprise Edition, Chapter Creating and Persisting Aggregates for Oracle BI Server Queries

We will use an example to illustrate a recommended approach.

Let us assume that we have the following RPD configuration:

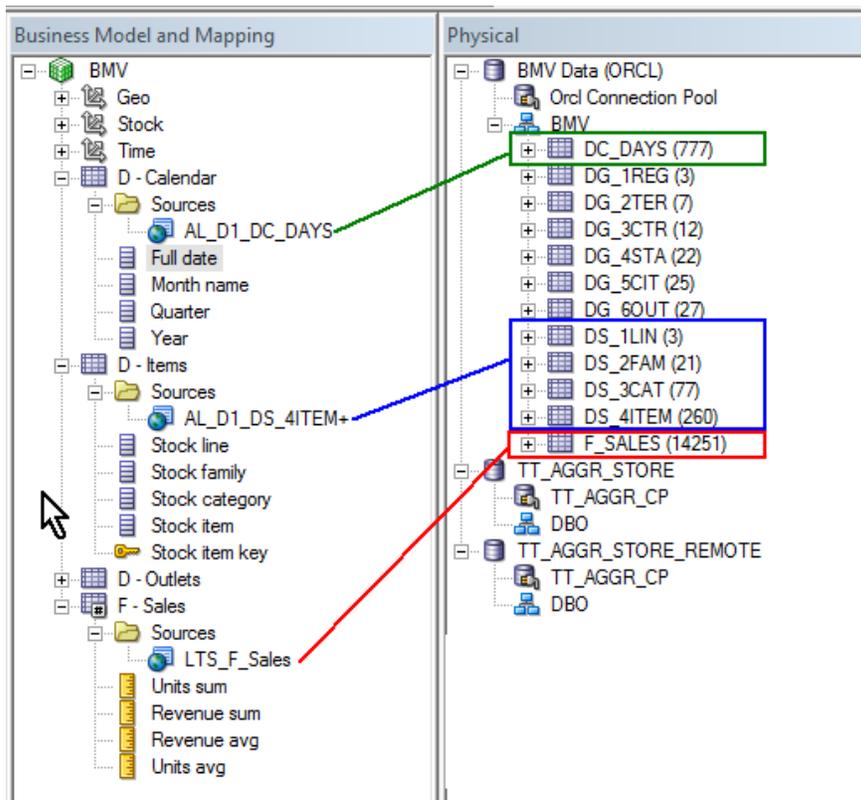


Figure 3: Logical and Physical elements of the RPD prior to running aggregate create script

Create Aggregates in the Local TimesTen Instance

Execute the following script.

```
set variable LOGLEVEL=7 :
create aggregates "ag_F_Sales_Yr_Ln"
for "BMV"."F - Sales" (
```

```

    "Units sum","Revenue sum",
    "Units avg","Revenue avg"
  )
  at levels(
    "BMV"."Time"."Year" using_surrogate_key,
    "BMV"."Stock"."Line" using_surrogate_key
  )
  using connection pool
    "TT_AGGR_STORE"."TT_AGGR_CP"
  in "TT_AGGR_STORE".. "DBO";

```

The BI server will read the “**F - Sales**” star from the most efficient source, in this case **BMV Data Base (ORCL)** and create aggregates at the level of **Year** and **Line**, deploying them under the DBO user in TimesTen as defined by the connection pool **TT_AGGR_STORE.TT_AGGR_CP**. For this step we will ensure that this points to our local TimesTen instance.

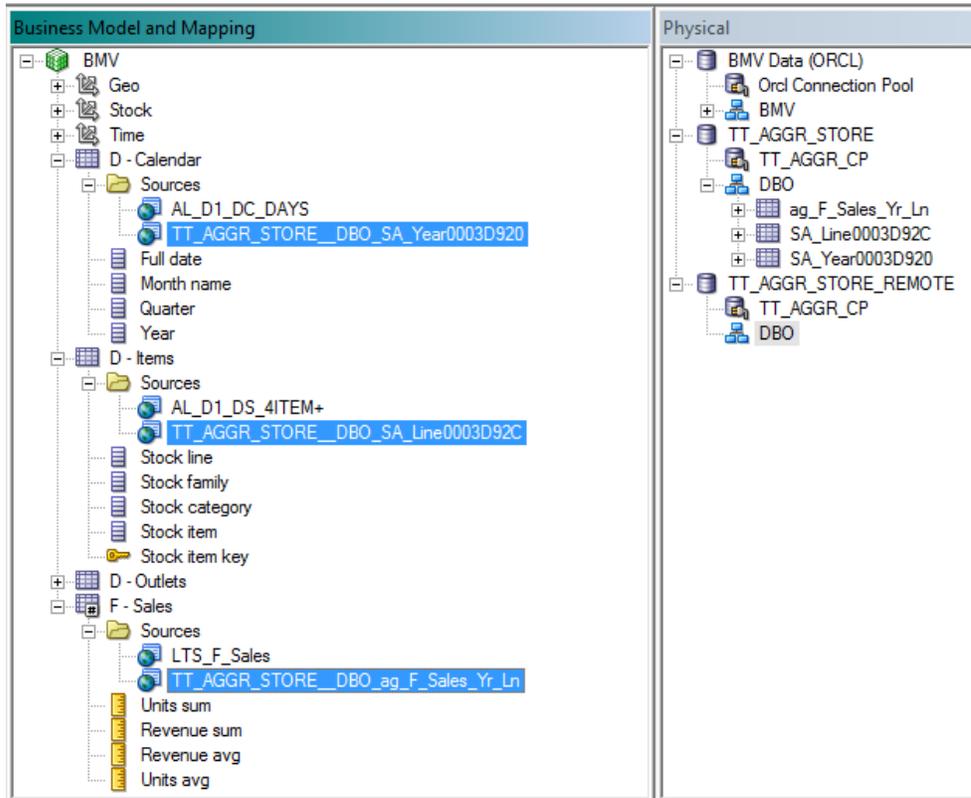


Figure 4: Logical and Physical elements of the RPD after aggregate create script

Create Aggregates in the Remote TimesTen Instance

Copy and modify the script in the previous section so that it can create aggregates in the remote TimesTen instance. The modifications are highlighted below.

```

set variable LOGLEVEL=7 :
create aggregates "ag_F_Sales_Yr_Ln"
  for "BMV"."F - Sales"(
    "Units sum","Revenue sum",
    "Units avg","Revenue avg"
  )
  at levels(
    "BMV"."Time"."Year" using_surrogate_key,
    "BMV"."Stock"."Line" using_surrogate_key
  )
  using connection pool
    "TT_AGGR_STORE_REMOTE"."TT_AGGR_CP"
  in "TT_AGGR_STORE_REMOTE"."DBO";

```

The BI server will read the “**F - Sales**” star from the most efficient source; here it will use the **TT_AGGR_STORE** database and create replicas of the aggregates at the level of **Year** and **Line**, deploying them under the **DBO** user in the remote TimesTen as defined by the connection pool **TT_AGGR_STORE_REMOTE.TT_AGGR_CP**.

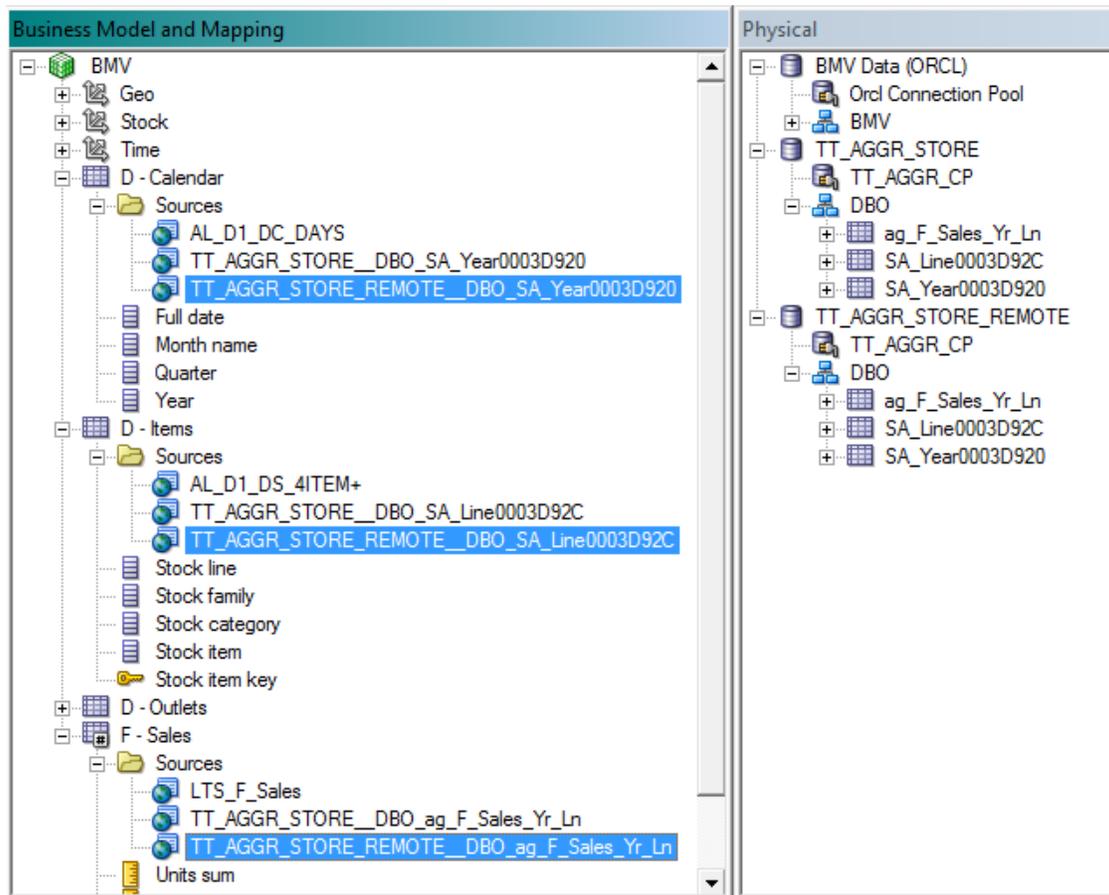


Figure 4: Logical and Physical elements of the RPD after running the 2nd aggregate create script

As both LTSes generated by the scripts are at the same level of aggregation, the BI Server will select the first one in the list, and so the local TimesTen instance will be prioritized. If the local TimesTen instance is not available, then the BI Server will go to the remote TimesTen instance.

The RPD is now ready and should be made available to both BI Servers via a rolling restart.

Refresh Aggregates in the Local TimesTen instance

Copy and modify the initial “local” script so that it can drop and recreate the aggregates from the disk-oriented data warehouse (a less efficient data source with fresh data) and not from the remote in-memory TimesTen instance (a more efficient data source with state data). The changes are highlighted in yellow.

```

set variable LOGLEVEL=7 :
delete aggregates "TT_AGGR_STORE".."DBO"."ag_F_Sales_Yr_Ln";

set variable LOGLEVEL=7,
set variable INACTIVE_SCHEMAS= "TT_AGGR_STORE_REMOTE".."DBO":
create aggregates "ag_F_Sales_Yr_Ln"
  for "BMV"."F - Sales"(
    "Units sum","Revenue sum",
    "Units avg","Revenue avg"
  )
  at levels(
    "BMV"."Time"."Year" using_surrogate_key,
    "BMV"."Stock"."Line" using_surrogate_key
  )
  using connection pool
    "TT_AGGR_STORE"."TT_AGGR_CP"
  in "TT_AGGR_STORE".."DBO";

```

The BI server will now ignore **TT_AGGR_STORE_REMOTE** and will issue the query to build aggregates using **BMV Data (ORCL)** the disk-oriented database schema with the latest data.

Refresh Aggregates in the Remote TimesTen instance

Copy and modify the initial “remote” script in order for it to drop and recreate the aggregates from the remote TimesTen instance. The changes are highlighted in yellow.

```

set variable LOGLEVEL=7 :
delete aggregates "TT_AGGR_STORE_REMOTE".."DBO"."ag_F_Sales_Yr_Ln";

set variable LOGLEVEL=7 :
create aggregates "ag_F_Sales_Yr_Ln"
  for "BMV"."F - Sales"(
    "Units sum","Revenue sum",
    "Units avg","Revenue avg"
  )
  at levels(
    "BMV"."Time"."Year" using_surrogate_key,
    "BMV"."Stock"."Line" using_surrogate_key
  )
  using connection pool
    "TT_AGGR_STORE_REMOTE"."TT_AGGR_CP"
  in "TT_AGGR_STORE_REMOTE".."DBO";

```

The BI server will read the “**F - Sales**” star from the most efficient source; here it will use the **TT_AGGR_STORE** database and create replicas of the aggregates at the level of **Year** and **Line**, deploying them under the **DBO** user in the remote TimesTen as defined by the connection pool **TT_AGGR_STORE_REMOTE.TT_AGGR_CP**.

Additional Considerations

- Tune the BI Server Cache on an Exalytics machine to reside on RAM disk so it can also benefit from in-memory capabilities. First create the actual RAM disk. Then mount the BI Server Cache directory to RAM disk so that it is running in memory. The tmpfs mount will give you the power of fast reading and writing of files, from and to, the primary memory.
- Configure Usage Tracking and Summary Advisor Settings.
Usage Tracking is required for Summary Advisor Statistics. For more details refer to "Managing Usage Tracking" in Oracle Fusion Middleware System Administrator's Guide for Oracle Business Intelligence Enterprise Edition
- Configure SDP-enabled JDBC Drivers for GridLink Data Sources for JDBC connectivity.
For more details refer to Fusion Middleware Configuring and Managing JDBC Data Sources for Oracle WebLogic Server and see Enable SDP Support for JDBC in this document
- Exalytics 10GbE Configuration

Currently InfiniBand on OVM on Exalytics is not supported. For details check When Will Oracle Exalytics Support InfiniBand with OVM (Doc ID 1918880.1)

For Best Practices using 10Gb Interfaces on Exalytics for Exadata connectivity consider Oracle VM 3: 10GbE Network Performance Tuning (Doc ID 1519875.1) resp.

Best Practices for Oracle Solaris Network Performance with Oracle VM Server for SPARC (Doc ID 1908136.1)

- Migration Steps from 10GbE to InfiniBand Configuration
 - Create IB Listener and add Database listener_networks Parameter (see Exalytics and Exadata InfiniBand Configuration)
 - Change WLS data sources to use SDP and InfiniBand IPs (see Enable SDP Support for JDBC above).

Note: Some of the DataSources still don't support SDP Protocol. Use TCP instead of SDP in such cases

- Exalytics and 12c IMDB
For supported local configurations and recommended 12c Database Parameters check Installing Oracle Database 12c In-Memory (IMDB) for Oracle Exalytics (Doc ID 1925793.1)
- Exalytics Certification Matrix

Exalytics Certification Matrix depends on Exalytics Patchset Version and can be found at <http://www.oracle.com/technetwork/middleware/bi/oracle-exalytics-ps4-2147225.xls>



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