White Paper

EMC FEDERATED TIERED STORAGE (FTS)
Allows Seamless Integration Between EMC Symmetrix VMAX Series and Third-Party Storage Arrays

Abstract

This white paper describes the external provisioning of HP XP24000 (equivalent to HDS USP-V) in order to provide storage devices to be used by Oracle 11g. The capacity provided by HP XP24000 is provided as additional capacity beyond the capacity provided by VMAX disks connected through the VMAX DA directors.

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Table of contents

Introduction

With the substantial increases in the amount of data stored, businesses continue to strive for ways to leverage and extend the value of existing resources, reduce cost of management, and drive the best performance achievable in the environment. Adding to the challenge is the desire to ensure that data is kept on an appropriate storage tier so that it is available when needed but stored in as cost-effective and environmentally responsible a manner as possible.

EMC® Symmetrix® Federated Tiered Storage (FTS) addresses many of these concerns by allowing existing qualified storage platforms to be used as physical disk space for a Symmetrix VMAX™ array. This allows IT organizations to manage diverse storage platforms using proven and robust Symmetrix software and microcode features such as EMC SRDF®, TimeFinder®, and Virtual Provisioning™.

Federated Tiered Storage (FTS) is a new feature of Enginuity 5876 that allows supported, SAN-attached disk arrays to provide physical disk space for Symmetrix VMAX. This permits the user to manage, monitor, migrate, and replicate data residing on both Symmetrix and non-Symmetrix arrays using familiar EMC software and Enginuity™ features. This applies equally to data that already exists on external arrays as well as to new storage that is being allocated.

FTS is designed to allow for seamless integration between various third- party storage arrays and the VMAX family of arrays by consolidating array views and reducing the number of physical connections from host to storage.

This white paper describes the external provisioning of HP XP24000 (equivalent to HDS USP-V) in order to provide storage devices to be used by Oracle 11g. The capacity provided by HP XP24000 was provided as additional capacity beyond the capacity provided by VMAX disks connected through the VMAX DA directors.

Purpose   The purpose of this document is to provide an overview of some of the features of FTS and present a use case.

Scope   This document focuses on the encapsulation feature of FTS, specifically dealing with HP-UX running Oracle on HP XP storage arrays and presented through an EMC VMAX.

Audience   This document is intended for anyone seeking an overview of EMC FTS and looking for an example of a potential use case.

Technology overview

FTS   Federated Tiered Storage (FTS) allows LUNs that exist on external arrays to be used to provide physical storage for Symmetrix VMAX. The external LUNs can be used as raw storage space for the creation of Symmetrix devices in the same way internal Symmetrix physical drives are used. These devices are referred to as eDisks. Data on the external LUNs can also be preserved and accessed through Symmetrix devices. This allows the use of Symmetrix Enginuity functionality such as local replication, remote replication, storage tiering, data management, and data migration with data that resides on external arrays.

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FTS is implemented entirely in Enginuity and does not require any additional Symmetrix hardware. Connectivity with an external array will be established through the same fiber optic SLICs currently used for configuring FAs and RFs. Instead of running FA or RF emulation, however, the processors will run a new type of emulation.

DX directors

A new emulation, referred to as DX, (for DA eXternal) has been developed that adapts the traditional DA emulation model to act on external logical units as though they were physical drives. The fact that a DX is using external LUNs instead of a DA using internal LUNs is transparent to other director emulations and to the Enginuity infrastructure in general. With respect to most non-drive-specific Enginuity functions, a DX behaves the same as a DA.

eDisk

An eDisk is a logical representation of an external LUN when it is added into the VMAX configuration. The terms *eDisk* and *external spindle* both refer to this external LUN once it has been placed in an external disk group and a virtual RAID group.

Virtual RAID group

An unprotected, virtual RAID group gets created for each eDisk that gets added to the system. The RAID group is virtual because eDisks are not protected locally by the VMAX; they rely on the protection provided by the external array.

Modes of Operation

FTS has two modes of operation depending on whether the external LUN will be used as raw storage space or has data that must be preserved and accessed through a VMAX volume.

External Provisioning — Allows the user to access LUNs existing on external storage as raw capacity for new Symmetrix devices. These devices are called *externally provisioned devices* and are used in the same way that an internal Symmetrix physical drive is used. New Symmetrix volumes are created from external storage using disk groups containing external LUNs that, when configured for FTS, are called *eDisks*.

Encapsulation — Allows the user to preserve existing data on external LUNs and access it through Symmetrix volumes. These devices are called *encapsulated devices*. The encapsulation process configures external LUNs as eDisks but preserves any data that exists on them. It also creates associated Symmetrix volumes through which to access the data on the eDisk. There are two different options with encapsulation, each briefly discussed next.

Standard encapsulation
The external spindle is created and added to the specified external disk group and unprotected RAID group. Symmetrix devices are also created at the same time, allowing access to the data that has been preserved on the external LUN.

Virtual Provisioning encapsulation
Just as with Standard encapsulation, the external spindle is created and added to the specified external disk group and to an unprotected RAID group. Data devices (TDATs) are then created and added to a specified thin pool. Fully, non-persistently allocated thin devices (TDEVs) are also created and bound to the pool. Extents are allocated to the external LUN through the TDAT.

Implementation

Prior to encapsulating third-party array volumes through the VMAX, the external array must be physically connected to the VMAX. This is accomplished by connecting VMAX DX ports to the external array front end Fibre Channel (FC) ports through the SAN. DX, (DA eXternal), is a new emulation that allows Fibre Channel directors to function like DAs. DX directors use the same Fibre Channel boards that run FA or RF emulation.

Once the DX directors have been configured and are properly zoned to the external array storage ports, devices presented on those external ports are available to be added as eDisks for external provisioning or for encapsulation. In this paper, the devices contain an Oracle database that needs to be preserved, so the external LUNs will be encapsulated as eDisks.

Once this is done, the Symmetrix volumes created as part of the encapsulation process can be presented to a host through the VMAX and will contain the exact same data that existed on the LUN before encapsulation. Encapsulation allows the user to easily integrate a third-party array and data into a VMAX environment and perform simple VLUN migrations from encapsulated third-party volumes to native VMAX volumes.

Configuring FTS

Hosts that were accessing an Oracle database on HDS storage volumes were moved to the VMAX and the HDS volumes were presented to the DX ports and encapsulated using FTS. The HDS data was then available to the hosts through the VMAX volumes and eDisks that were created during the encapsulation operation. The VMAX volumes were then mapped and masked to the hosts via standard VMAX masking and mapping procedures, giving the hosts access to the original data, even though they are connected only to the VMAX.

For an in-depth description of FTS, along with implementation details and examples of FTS operations, refer to *Design and Implementation Best Practices for EMC Symmetrix Federated Tiered Storage (FTS) Technical Notes*, available at http://powerlink.emc.com.

Tested configuration

EMC E-Lab™ tested the following configuration.

Arrays
- EMC VMAX 40K array running EMC Enginuity 5876 code
- HDS-UPS array

Primary host
- HPUX 11iV3 with EMC PowerPath®, MPIO, and DMP

Secondary hosts
- Windows 2K3 with PP 5.5
- Windows 2K8 with DMP
- ESXi 5.0 with PP/VE 5.7
- ESX 4.1 with native MP
- Solaris 10 with PP
- Solaris 11 with MPxIO
- AIX 6.1 with MPIO and PowerPath

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- RHEL 6.2 with PP
- SLES 11 SP2 with native MP
- HPUX 11iv2 with PP, DMP, and pvLinks

Usage case   HPUX XP24K as externally provisioned devices for Oracle Enterprise Manager 11G.

Host and storage configuration   First the hosts were zoned with the HDS storage array and volumes were assigned to each host WWN. Once the hosts had volumes assigned and could access them, the hosts were moved to the VMAX 40K and the volumes were assigned to FTS, as shown in Figure 1.
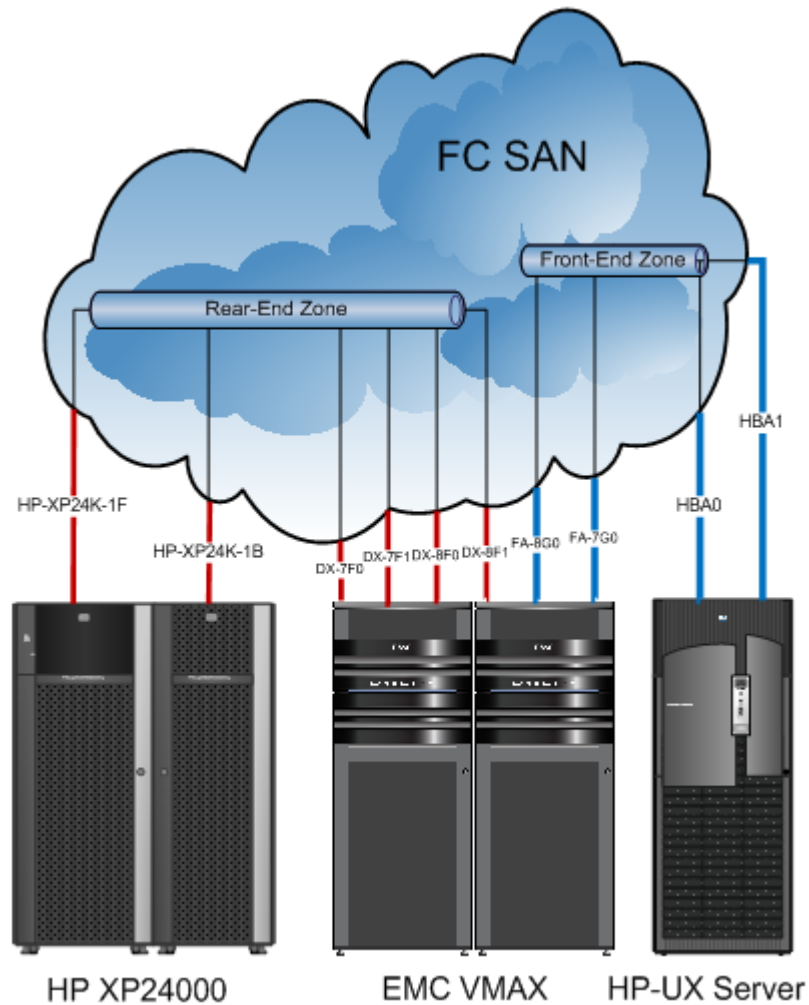
Figure 1.   Host and storage configuration

The **symsan** command provides the list of the HP XP24K Port WWN that is externally encapsulated through DX dir 7F and port 0, as shown in Figure 2.

```
C:\>symsan -sid 453 list -sanports -DX 7F -port 0
Symmetrix ID: 000195700453


       Flags                                     Num
DIR:P   I   Vendor          Array                LUNs Remote Port WWN
-----  ----- ------------- ---------------- ---- --------------------
07F:0   .   HP              0000000000000000  12 50060E8005426D05
07F:0   .   HP              0000000000000000  12 50060E8005426D01


Legend:
  Flags: (I)ncomplete : X = record is incomplete, . = record is
                                                    complete.
```

Figure 2.   symsan command

The **symsan** command   displays the list of the LUNs that are provisioned as tiered LUN to VMAX 40K HK000195700453. Each HP XP 24K LUN is displayed with its corresponding WWUID, as shown in Figure 3.

```
C:\>symsan list -sanluns -sid 453 -DX 7F -port 0 -wwn 50060E8005426D05

Symmetrix ID:      000195700453
Remote Port WWN:   50060E8005426D05


       ST
        A
        T  Flags  Block   Capacity   LUN   Dev   LUN
DIR:P   E  ICRTHS Size      (MB)     Num   Num   WWN
-----  --  ------- ----- ----------- ----- ----- --------------------------------
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233303420*
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233303520*
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233303620*
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233303720*
07F:0  --  X..F..   512      100000    0   N/A 5235303020303030313730303530303233303820*
07F:0  --  X..F..   512      100000    0   N/A 5235303020303030313730303530303233303920*
07F:0  --  X..F..   512      100000    0   N/A 5235303020303030313730303530303233313020*
07F:0  --  X..F..   512      102000    0   N/A 5235303020303030313730303530303233313120*
07F:0  --  X..F..   512      102000    0   N/A 5235303020303030313730303530303233313220*
07F:0  --  X..F..   512      102000    0   N/A 5235303020303030313730303530303233313320*
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233313420*
07F:0  --  X..F..   512      102400    0   N/A 5235303020303030313730303530303233313520*


Legend:
 Flags: (I)ncomplete : X = record is incomplete, . = record is complete.
        (C)ontroller : X = record is controller, . = record is not controller.
        (R)eserved   : X = record is reserved, . = record is not reserved.
        (T)ype       : A = AS400, F = FBA, C = CKD, . = Unknown
        t(H)in       : X = record is a thin dev, . = record is not a thin dev.
        (S)ymmetrix  : X = Symmetrix device, . = not Symmetrix device.
```

Figure 3.   List of LUNs

The **symdisk** command provides the corresponding VMAX 40K devices that are related to the external HP LUN. Note that these VMAX 40K devices are externally provisioned and available as extra capacity as long as they were mapped to HP hosts, as shown in Figure 4.

```
C:\>symdisk -sid 453 show -wwn 52353030203030303031373030303530303233303420

Symmetrix ID                    : 000195700453
  Director                      : DX-8F
  Interface                     : N/A
  Target ID                     : N/A
  Spindle ID                    : 1E00
  External WWN                  : 52353030203030303031373030303530303233303420
  Disk Group Number             : 512
  Disk Group Name               : DISK_GROUP_512
  Disk Location                 : External
  Technology                    : N/A
  Speed (RPM)                   : N/A
  Form Factor                   : N/A

  Vendor ID                     : EMC Corp
  Product ID                    : N/A
  Product Revision              : N/A
  Serial ID                     : N/A

  Disk Blocks                   : 209715839
  Block Size                    : 512
  Actual Disk Blocks            : 209715839
  Total Disk Capacity (MB)      : 102400
  Free Disk Capacity (MB)       : 16073
  Actual Disk Capacity (MB)     : 102400
  Rated Disk Capacity (GB)      : N/A

  Spare Disk                    : False
  Spare Coverage                : N/A
  Encapsulated                  : False
  Disk Service State            : Normal


  Hypers (3):
  {
  #   Vol   Emulation           Dev  Type          Mir Mbr Status          Cap(MB)
  --- ----- ------------------- ---- ------------- --- --- --------------- --------
    1 N/A   FBA                 03A5 Ext-Data       1   1  Ready             28776
    2 N/A   FBA                 03B1 Ext-Data       1   1  Ready             28776
    3 N/A   FBA                 03BD Ext-Data       1   1  Ready             28776
  }
```

Figure 4.   symdisk command

The **symdisk** command displays the assignment of the new disk group ID 512 to the externally provisioned VMAX 40K devices, as shown in Figure 5.

```
C:\>symdisk list -dskgrp_summary -external -sid 453

Symmetrix ID: 000195700453

     Disk Group                    Disk                        Capacity
--------------------- ---------------------- ------------------------------
                         Flgs Speed  Size      Total      Free      Actual
Num Name              Cnt LT  (RPM)  (MB)      (MB)       (MB)       (MB)
--------------------- ---------------------- ------------------------------

512 DISK_GROUP_512     12  X-    N/A    N/A    1220403    184480    1220403
                                                ---------- ---------- ----------
Total                                          1220403    184480    1220403

Legend:
  Disk (L)ocation:
    I = Internal, X = External
  (T)echnology:
    S = SATA, F = Fibre Channel, E = Enterprise Flash Drive, - = N/A
```

Figure 5. Assignment of new disk group ID

Oracle

Oracle Enterprise Manager 11G was then configured on the encapsulated volumes, as shown in Figure 6, Figure 7, and Figure 8.
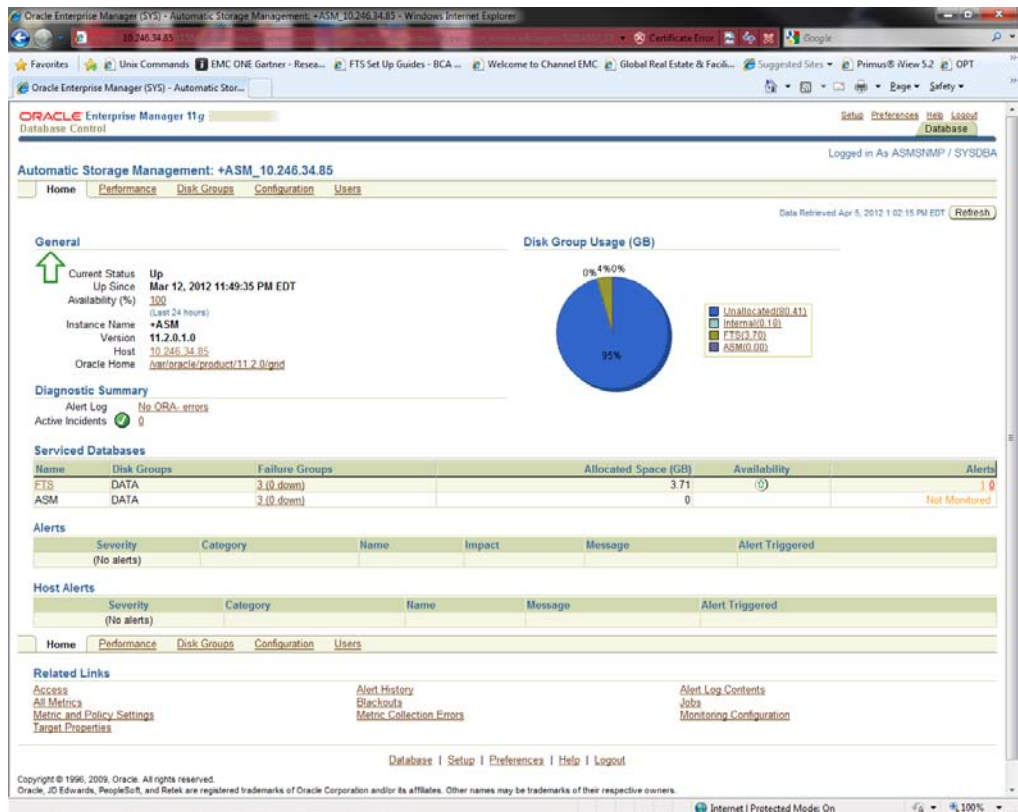

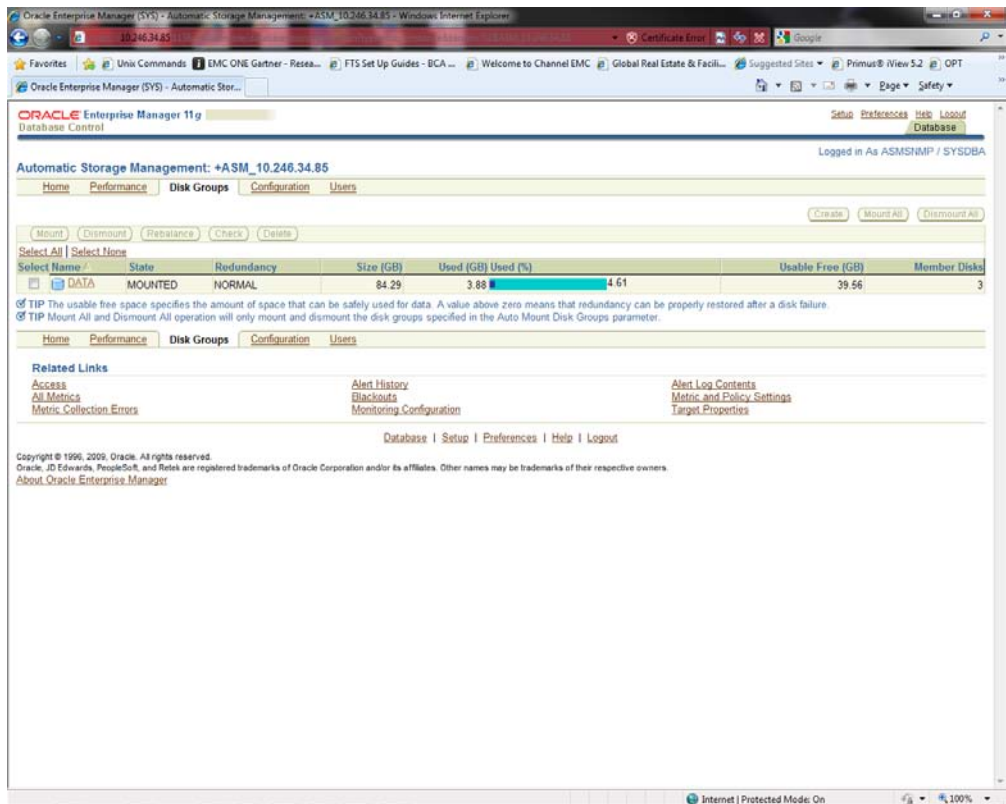**Figure 6.** Oracle Database configuration

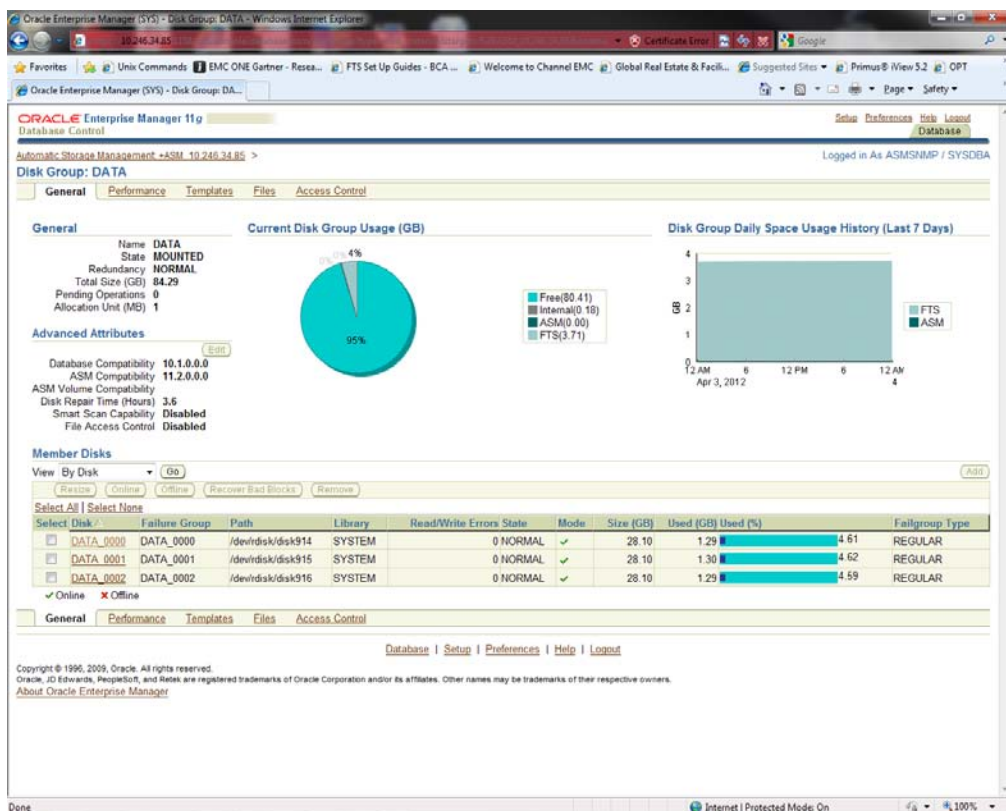Figure 7.   Oracle Database properties

Figure 8.   Oracle Database volumes

The host was then able to access the database transparently with no side effects from the encapsulation, as shown in Figure 9.
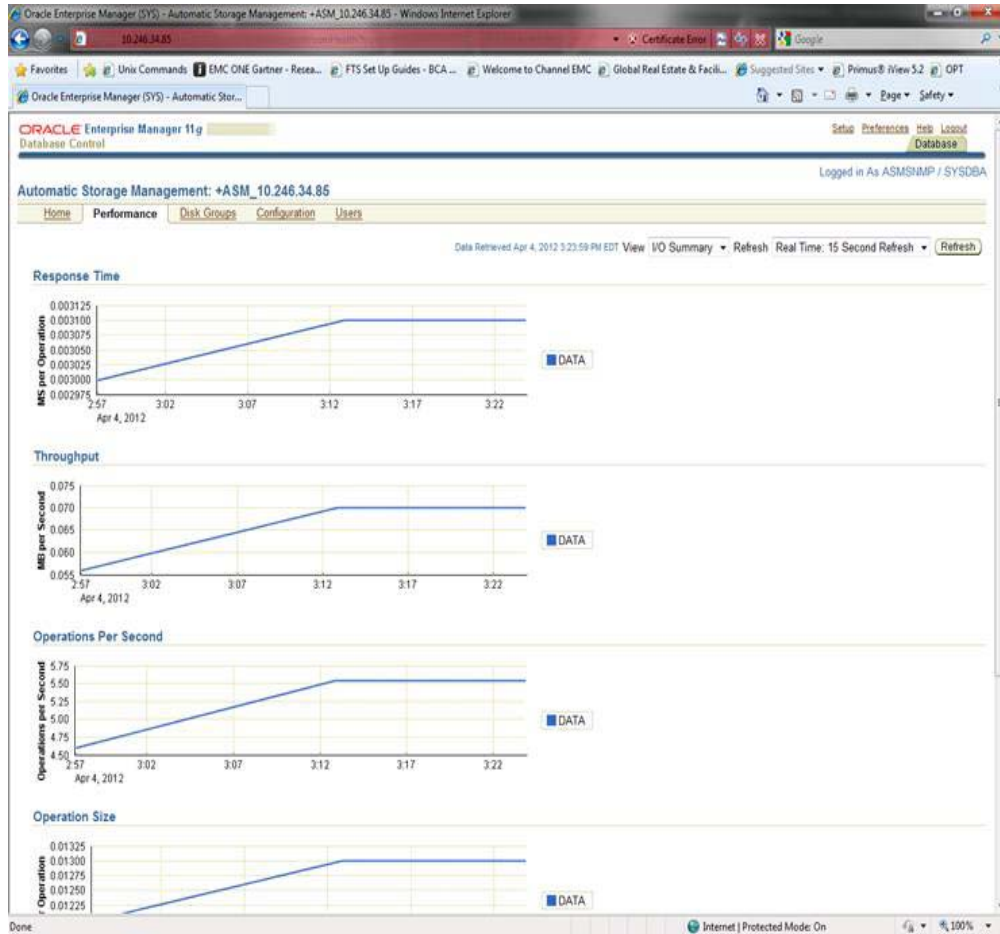

Figure 9.   Host has transparent access to database

Conclusion

In conclusion, EMC E-Lab testing confirmed that an Oracle database can run on an HP XPS array and present those volumes, via encapsulation, to a host through an EMC Symmetrix VMAX array. The host is able to have transparent access to the original XPS storage volumes that have a physical connection to the XPS storage array. This reduced the number of physical connections from host to storage.

References

FTS documentation can be found on http://powelink,emc.com, including:

- *Design and Implementation Best Practices for EMC Symmetrix Federated Tiered Storage (FTS) Technical Notes*