Tier B (Database Server)

There is one database server in this TPC-E configuration. It is created by connecting two x3850 X5 chassis (nodes) using scalability cables. The resulting server will have eight processor sockets, fourteen PCI-e slots, four onboard Ethernet ports, and room for 128 memory DIMMs. This document describes how it should be setup and configured.

Hardware

- Install the hardware components so you have:
  - Processors- 4 x 2.40GHz in each node
  - Memory- 64 x 16GB in each node
  - Storage- 2 x 250GB SATA in drive bays 0 and 7, node 0 only
  - Storage adapter- M5015 adapter in internal PCI-E slot, node 0 only
  - Network - dual-port Ethernet adapter in PCI-e slot 6, node 0 only
  - Do not install any other hardware into the system yet
- System Settings:
  - Boot each node and press F1 when prompted to drop into UEFI setup. Once there:
    - Load default settings
    - Set the correct date and time
    - Set a static IP address & mask for the Integrated Management Module (IMM), so it is on your lab network
    - Under System Settings -> Operating Modes -> Choose Operating Mode, select "Performance Mode"
    - Save settings and then turn the nodes off
- Management network:
  - Connect each node's System Management Ethernet port to the lab network
  - Another system, such as the driver, on the lab network can now manage the nodes via a web browser pointed at the static IMM address entered above
- Update both nodes to the same code levels, one at a time:

- Download the latest system code levels for this server from IBM.COM:
    - FPGA
    - IMM
    - UEFI
    - Diags
- Connect to the node's IMM via a web browser. After logging in, click on "Firmware Update" on the left side. Browse to and select the newly downloaded IMM update file (update the IMM first, with the system's power off). Click [Open], then click [Update], and follow the onscreen directions. The IMM will then be updated.
- When the IMM update is done, restart the IMM and wait until you can log back into it.
- With the node still off, follow the same process, using the IMM interface, to update the FPGA code. When that update is complete, pull the A/C power from the node, wait a minute, then plug the node back in.
- Log back into the node's IMM web interface when it is available.
- Power the node on and, after POST, use the IMM interface to update the node's UEFI and diagnostics code.

- When done, power both nodes off.

OS

Creating the Internal OS Array:

- This will be done using node 0 by itself.
- The M5015 adapter should be connected to the two internal drive bay backplanes
- Two drives for the OS should be in internal drive bay slots 0 and 7
- Boot the system. During POST press F12 when prompted, and select to boot "Legacy Only".
- Enter onboard SAS configuration utility via CTRL-H during POST
    - Set Adapter Properties:
        - Load adapter factory defaults, then set:
            - Rebuild Rate = 100
            - Patrol Read Rate = 0
            - BGI Rate = 100
            - CC Rate = 0
            - Reconstruction Rate = 100
            - S.M.A.R.T. Polling = 65535 seconds
            - Disable Alarm
            - Disable scheduled consistency check
    - Configuration Wizard:
        - New Configuration; OK to clear current config
        - Manual Configuration [Next]
        - Select the two drives in slots 0 and 7 [Add to Array]
        - [Accept DG] [Next]
        - [Add to Span] [Next]
        - Virtual Drive Definition. Use the default settings, except set the write policy to WriteThrough
        - [Accept]
        - [Yes] to verify WriteThrough mode
        - [Next]
        - [Accept]
        - [Yes] to save the configuration
        - [Yes] to initialize. Wait for initialization to complete.
    - Exit WebBIOS and reboot the system

Installing the OS:

- Again, do this using node 0 only.
- Be sure the system date and time are correct in F1 setup

- Due to a bug in Windows 2008 R2 (preSP1), it will not install or boot on a UEFI system with 1TB or more of memory in the system. So, until the patch fixing this problem is installed, simply remove one of the eight memory cards from the node. Or install using a Windows image that contains SP1.
- Windows installation may also hang if there are more than 64 logical processors, as we have in this case. This applies to both RTM and SP1 installation media. In this case, you can disable Hyper-Threading until the OS is installed and KB2529956 is installed.

- Insert the Windows Server 2008 R2 installation DVD into the node and boot from it
- Install Windows
    - Language to install = English
    - Time and currency format = English (United States)
    - Keyboard or input method = US [Next]
- Select "Install Now"
- Choose "Windows Server 2008 R2 Enterprise (Full Installation)" [Next]
- Check "I accept the license terms" [Next]
- Select "Custom (advanced)" installation type
- Highlight "Disk 0 Unallocated Space" [Next]
- Windows will now install. This will take several minutes, and the system will reboot more than once. No user interaction is needed.
- After a few minutes, a screen will appear saying "The user's password must be changed before logging on the first time" [OK]
- Enter a new secure password for the Administrator twice [→]
- "Your password has been changed." [OK]
- You are now brought to the Windows desktop. Windows is installed. You can remove the installation DVD now.

<u>Configuring the OS:</u>
- Continuing from above, the "Initial Configuration Tasks" window is displayed.
    - Select "Set Time Zone"
        - Set time zone to "(UTC-05:00) Eastern Time (US & Canada)"
        - Uncheck "Notify me when the clock changes"
        - On the "Internet Time" tab, "Change Settings…", and uncheck "Synchronize with an Internet time server" [OK]
        - [OK]
    - Select "Provide computer name and domain"
        - [Change…]
        - Set computer name to "IBMSERV"
        - Set workgroup to "TPCC" [OK]
        - "Welcome to the TPCC workgroup" [OK]
        - "You must restart your computer to apply these changes" [OK]
        - Go to the "Remote" tab
            - Select "Allow connections from computers running any version of Remote Desktop"
            - [OK] to acknowledge firewall change
        - Go to the "Advanced" tab
            - Performance [Settings…]
                - Select "Adjust for best performance" [OK]
            - Startup and Recovery [Settings…]
                - Uncheck "Automatically restart"
                - "(none)" debugging information [OK]
            - [Close]
        - [Restart Later]
    - Select "Enable automatic updating and feedback"
        - "Manually configure settings"
        - Windows automatic updating [Change Setting…]

            - “Never check for updates” [OK]
        - Windows Error Reporting [Change Setting…]
            - “I don’t want to participate, and don’t ask me again” [OK]
        - Customer Experience Improvement Program [Change Setting…]
            - “No, I don’t want to participate” [OK]
        - [Close]
    - Select “Configure Windows Firewall”
        - Select “Turn Windows Firewall on or off”
        - Select “Turn off Windows Firewall” for both public and private network location settings [OK]
        - Close the “Windows Firewall” window
    - Select “Do not show this window at logon”
    - [Close]
- The “Server Manager” window comes up
    - Select “Do not show me this console at logon”
    - Close the window
- You are now at the desktop.
- Right click on an empty part of the desktop; View; Small Icons
- Right click on Start Menu; Properties; [Customize…], uncheck “Use Large Icons” [OK]
- Select the Taskbar tab, and check “Use Small Icons” [OK]
- Open Control Panel
    - View by: “Small Icons”
    - User Accounts; “Change User Account Control settings”; Set slider to “Never Notify” [OK]
    - Power Options; “High Performance”
    - Internet Options; Use blank home page [OK]
    - Folder Options, “View Tab”
        - Select “Always show menus”
        - Select “Show hidden files, folders, and drives”
        - Uncheck “Hide empty drives in the Computer folder”
        - Uncheck “Hide extensions for known files types”
        - Uncheck “Hide protected operating system files” [YES]
        - [OK]
    - Display; Adjust resolution; Select 1024x768 [Keep Changes]
    - Autoplay; uncheck “Use Autoplay for all media and devices” [SAVE]
    - Administrative Tools
        - Services; Set the following services to a manual start:
            - DHCP Client
            - Diagnostic Policy Service
            - DNS client
            - IP Helper
            - Print Spooler
            - Windows Remote Management
            - Windows Update
        - Local Security Policy
            - Account Policies; Password Policy
                - Set “Maximum password age” to zero
                - Set “password must meet complexity requirements” to disabled
            - Local Policies; User Rights Assignment; Lock Pages in Memory
                - Add the group “Administrators”
            - Press CTRL-ALT-DEL and change password to a simpler one
        - Event Viewer
            - Right click on each “Windows Logs” type; Properties; set “maximum log size” to 256,000 [OK]
- Run gpedit.msc

    - Computer Configuration; Administrative Templates; System; Display Shutdown Event Tracker (in the right pane near the bottom); Select “disabled” [OK]
- Run “control userpasswords2”
    - Uncheck “Users must enter a user name and password to use this computer” [OK]
    - Enter your account password twice [OK]
- Reboot the computer to apply all those settings

Windows Updates:
- If Windows SP1 is not yet installed, install it now. Download it from Micosoft.com, run it, and follow the on-screen prompts. The server will reboot itself as needed during the installation.
- Download and install the following patches from Microsoft.com: KB2510206, KB2529956.
- Reboot after all have been installed.
- Allow the system to boot back to the Windows desktop. On the way, you will see messages relating to the patches being installed.
- Once the system reaches the desktop, the patches have been installed.
- If you removed a memory card and/or disabled Hyper-Threading as workarounds to getting the OS installed, you can reinstall and/or re-enable those features now.

Remaining Hardware:
- Remove AC power from both nodes.
- Install one ServeRAID M5000 Series Performance Accelerator Key onto each ServeRAID M5025 adapter.
- Install ServeRAID M5025 adapters into node 0 slots 1-5 and node 1 slots 1-6.
- Cable the nodes together, to form a 2-node server:
    - Remove both QPI wrap cards from each node
    - Carefully connect the two nodes together using the four QPI scalability cables:
        - The “J1” side of each cable must be inserted into node 0, to make it the base node
        - Connect the leftmost ports of each node to each other
        - Connect the rightmost ports of each node to each other
        - Connect the remaining ports in an ‘X’- inner left ports connect to inner right ports of the other node
- Apply AC power and boot the merged system. You should see 8 processors and 2TB of memory.
- There should be no errors in either node’s IMM event log.
- Windows will take some time to reconfigure itself and find device drivers.

Device Drivers:
There are Windows-compatible versions for most of these code updates. Download these versions from IBM.COM, copy them over to the server, run the EXE there, and choose to do the update immediately, rather than extracting the files for later.
- Networking:
    - Download the latest networking drivers and firmware for this system
    - Install the Ethernet device drivers
    - Install the Ethernet firmware update
- Onboard SAS (to update the default Microsoft drivers)
    - Download the latest onboard SAS drivers and firmware for this system
    - Install the drivers
    - Install the firmware update
- Reboot

IP Addresses & Network Connections
- One of node 0’s onboard Ethernet ports will be used for the lab network. Connect port 1 to a Gb Ethernet switch that will create the lab network, linking the database server, clients, driver, and any other needed systems. This network is used to copy files between the systems, synchronize system times, manage the systems, etc.. Its only use during a benchmark run is for the clients to report their status and results to the driver.

- Also on node 0, Ethernet port 2, plus one of the dual-port Ethernet adapter ports (port 3), will both be used for connecting client10 directly to the database server. These connections are made with Ethernet crossover cables. These network connections are used during the benchmark run.
- Node 0 IP addresses:
  - Port 1: Set IP as needed for your lab network
  - Port 2: Set static IP 10.10.1.1 / 255.255.255.0
  - Port 3: Set static IP 10.10.2.1 / 255.255.255.0
- On node 1, both onboard Ethernet ports will be used to connect directly to client20 using crossover cables. These network connections are also used during the benchmark run.
- Node 1 IP addresses:
  - Port 1: Set static IP 10.20.1.1 / 255.255.255.0
  - Port 2: Set static IP 10.20.2.1 / 255.255.255.0
- After connecting the four Ethernet crossover cables between the server and clients, test each connection using ping.

Miscellaneous OS Setup:
- Copy TPC-E kit files to the server. See the kit documentation for details.
- Update the hosts file in c:\windows\system32\drivers\etc so it has entries for the server, clients, and driver systems
- Place a BAT file, synctime.bat, into the startup folder to synchronize the time with another server every time the system is rebooted. The driver, server, and clients will have this same BAT file in their startup folders, and they all sync their times off of the same system. The systems are rebooted before a run of TPC-E and this insures that all of the system clocks will be synchronized. Test the BAT file to be sure it works.

SQL Server

Installation:
- First, the .NET Framework Feature must be installed:
  - Open Server Manager and under Features, select “Add Features”.
  - Place a check next to “.NET Framework 3.5.1” (under “.NET Framework 3.5.1 Features”)
  - Press [Install] to install the feature.
- We will install SQL Server 2008 R2 Enterprise x64 Edition. You will need this media.
- Run setup.exe
- On the SQL Server Installation Center window, click “Installation”, on the left side.
- Click “New installation or add features to an existing installation”
- All setup support rules pass [OK]
- Specify free edition “Enterprise Evaluation” [Next>]
- Accept the license terms [Next>]
- Setup Support Files [Install]
- Setup Support Rules – none failed [Next>]
- Setup Role- Select “SQL Server Feature Installation” [Next>]
- Feature Selection- Select the following features for installation:
  - Instance Features
    - Database Engine Services
  - Shared Features
    - Client Tools Connectivity
    - Management Tools – Complete

  [Next>]
- Installation Rules – none failed [Next>]
- Instance Configuration [Next>]
- Disk Space Requirements [Next >]
- Server Configuration
  - Service Accounts tab
    - Change “SQL Server Database Engine” from automatic to manual

            - [Use the same account for all SQL Server services]
                - Enter “Administrator” user ID and its password [OK]
        - Collation tab
            - Database Engine [Customize…]
                - Select “Windows collation designator and sort order”
                - Select “Collation Designator” = “Latin1_General”
                - Select “Binary” sort order [OK]
        - [Next>]
- Database Engine Configuration
    - Account Provisioning tab
        - Select Mixed Mode
        - Enter the same password as for the Administrator account
        - [Add Current User]
            - (Adds “Administrator” as a SQL Server administrator)
    - [Next>]
- Error Reporting – Insure option unchecked [Next>]
- Installation Configuration Rules – none failed [Next>]
- Ready to Install [Install]
- Complete [Close]
- Close the SQL Server Installation Center

<u>Configuration:</u>

- To configure the softNUMA nodes, merge the included file SoftNuma_8PWEX.reg into the registry.

- To bind networking ports to softNUMA nodes, start the SQL Server Configuration Manager
    - On the left, expand “SQL Server Network Configuration”
        - Highlight “Protocols for MSSQLSERVER”
            - On the right, double click on “TCP/IP”
                - Protocol tab
                - Set “Enabled” to “Yes”
                - Set “Listen All” to “No”
                - IP Addresses tab
                - Find and enable each of these IP addresses, and set “TCP Port” to the string shown:

IP Address	TCP Port String
10.10.1.1	1400, 1430[0x3], 1431[0xC], 1432[0x30], 1433[0xC0], 1434[0x300]
10.10.2.1	1440[0xC00], 1441[0x3000], 1442[0xC000], 1443[0x30000], 1444[0xC0000]
10.20.1.1	1450[0x300000], 1451[0xC00000], 1452[0x3000000], 1453[0xC000000], 1454[0x30000000]
10.20.2.1	1460[0xC0000000], 1461[0x300000000], 1462[0xC00000000], 1463[0x3000000000], 1464[0xC000000000]

[OK] [OK]
    - Close SQL Server Configuration Manager

- To turn on large pages for text, start regedit and drive to (see included file LargePagesForText.reg): HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Image File Execution Options
    - Create a new key there called “sqlservr.exe”
        - Under that key, create a DWORD value
            - Set the name to “UseLargePages”
            - Set the value to 0x1

- Configure SQL Server options:
    - Open SQL Server Management Studio. Load and execute the included file SQLconfig.sql. It will configure SQL Server for this workload on this system.

    - When done, close the SQL Server Management Studio and restart SQL Server

- Configure SQL Server startup flags (see included file StartSQL.bat):
    - Use the following flags to start SQL Server from now on
        - -c start SQL independent of the service control manager
        - -x disable performance statistics
        - -T3502 display checkpoint messages in the SQL errorlog
        - -T834 use large page allocations for the buffer pool
        - -T661 disable the ghost record removal process
        - -T8744 disallow prefetch for ranges
        - -T652 disable page prefetch scans

Storage

Hardware Connections:

- Turn off the server
- Mount the drive enclosures into the racks.
- Install the drives into the enclosures:
    - Put 13 SAS SSD drives into each of eleven external enclosures (database data)
    - Put 24 SAS HDD drives into the other five external enclosures (backup & temp space)
    - Put ten SAS HDD drives into one of the external enclosures with 13 SSDs. (60-Day space)
    - Insert six 2.5" database log disks into internal server drive bays 1,2,3,4,5,6. (Log space)
- Connect one port of each ServeRAID M5025 adapter to one of the two input ports on each enclosure containing SSD drives.
- There are five more enclosures, each containing 24 HDDs for backup and temp space. Connect each one of those to one of the eleven SSD enclosures. So there will be five pairs of enclosures connected to five ServeRAID M5025 adapters and six SSD enclosures connected, one each, to the other six ServeRAID M5025s.
- Power on the enclosures, then the server and boot the OS.
- Update the M5025 adapters:
    - Download the latest ServeRAID M5025 adapter driver and firmware from IBM.COM
    - Update the device driver
    - Update the firmware
    - Reboot the system when done
- Update the drives:
    - Download the latest SAS/SATA hard drive update program from IBM.COM.
    - Run the program and update the firmware on any downlevel drives.
    - Reboot the system when done.
- Install Storage Manager
    - Download the latest version of MegaRAID Storage Manager from IBM.COM
    - Install it

Controller Settings:

- Enter the SAS adapter configuration utility via CTRL-H during legacy-mode POST. For each of the SAS adapters, do the following:
    - Set Controller Properties:
        - Load adapter factory defaults, then set:
            - Rebuild Rate = 100
            - Patrol Read Rate = 0
            - BGI Rate = 100
            - CC Rate = 0
            - Reconstruction Rate = 100
            - S.M.A.R.T. Polling = 65535 seconds
            - Disable Alarm
            - Disable scheduled consistency check

- Exit WebBIOS and reboot the system

<u>Creating Arrays:</u>

- Boot the OS and run MegaRAID Storage Manager. After logging in, wait for the adapter scan to complete.

- To create the log array, follow this manual method:
  - In the Physical view, right click on the M5015 adapter. Select "Create Virtual Drive"
  - Choose "Advanced" [Next]
  - Drive Group Settings
    - Choose RAID 1
    - Highlight the 6 unconfigured drives and press [Add >]
    - [Create Drive Group]
    - [Next]
  - Virtual Drive Settings. Set to the following:
    - Virtual Drive Name = "Log"
    - Leave the default capacity
    - Initialization State = "Full Initialization"
    - Stripe size = 64k
    - Read Policy = "Adaptive Read Ahead"
    - Write Policy = "Write Through"
    - IO Policy = "Direct IO"
    - Access Policy = "Read Write"
    - Disk Cache Policy = "Disabled"
    - [Create Virtual Drive]
    - [Yes] to verify write through mode
    - [Next]
  - Summary [Finish]
  - [OK] to acknowledge drive was created
- The array for the database log is now created.

- Now create all the external arrays. This can be done by either importing an LSI_Adapter_Configuration_X.cfg file on each M5025 RAID adapter, or by using the following manual procedure until all of the external arrays have been created.
  - Data Arrays: In the Physical view, right click on a M5025 RAID adapter. Select "Create Virtual Drive"
    - Choose "Advanced" [Next]
    - Drive Group Settings
      - Choose RAID 5
      - Highlight the 13 SSDs from one enclosure and press [Add >]
      - [Create Drive Group]
      - [Next]
    - Virtual Drive Settings.
      - Choose the following settings:
        - Virtual Drive Name = "data X", where X is an incrementing number , 1-11
        - Leave the default capacity
        - Initialization State = "Full Initialization"
        - Stripe size = 64k
        - Read Policy = "No Read Ahead"
        - Write Policy = "Write Through"
        - IO Policy = "Direct IO"
        - Access Policy = "Read Write"
        - Disk Cache Policy = "Disabled"
      - [Create Virtual Drive]

            - [Yes] to verify write through mode
            - [Next]
        - Summary [Finish]
        - [OK] to acknowledge drive was created

    - Backup Arrays: Follow the same procedure as for the data arrays, but use 24 drives per array, make these arrays RAID-10, and name them "backup X" instead of "data X".

    - 60-Day Space Array: After all the SSDs have been assigned to arrays, there will be some unconfigured SAS HDDs in one enclosure. Create a RAID-5 array using these HDDs, using the above settings. This array will be used to augment the server's storage space, to meet the 60-Day space requirements.

- Now add the arrays into Windows. On the desktop, right click on the "My Computer" icon and select "Manage".
    - Select Storage->Disk Management on the left side.
    - You will be asked to initialize the disks.
        - Be sure all the new arrays are selected
        - Choose GPT as the style
        - [OK]
    - You should now see the new data, backup, and log arrays on the display. Now we will create the partitions.
        - Find the array created for the database log.
            - Create one partition on it, 1,500,000MB in size, and make it drive E:. Don't format it.
            - Using the rest of the free space, create another partition and make it drive F:. Quick-format it NTFS.
        - Find the array created for the 60-Day space
            - Using all of the free space, create a partition and make it drive S:. Quick-format it NTFS.
        - The rest of the new arrays will be for database data and database backup space
            - Create mount points in the folder c:\mp to access these new partitions. See the included files rc11.bat and rc.bat. These files will create three mount point folders for each data array: fx***Z***, gw***Z***, and bk***Z***, where ***Z*** is an integer denoting the drive number, 1-11 (data) and 1-5 (backup).
                - Fx mount points are for fixed data
                - Gw mount points are for growing data
                - Bk mount points are for backup, flat files, and tempdb space
            - Create the partitions on each data and backup drive and assign them to the mount points. See the included file Diskpart_WEX8P_Create.txt for details.
            - Quick-format and label all of the backup partitions. See the included file formt.bat.
    - The arrays should now look like the included screenshot files WindowsDiskLayout_x.JPG.

- The log and data arrays have now been created. The next step is to load the TPC-E database. Follow the directions in the TPC-E kit.