SERVER DEPLOYMENT AUTOMATION

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Executive Summary

With the proliferation of new technologies, the cost of deploying and managing servers can be time consuming, decrease productivity, and increase operating expenses. To combat these challenges, TSS, in collaboration with Dell Technologies and customers like Qualcomm, has introduced a new methodology called Factory Express Automation.

Factory Express Automation is a scalable and adaptable reference architecture that can be used in multi-vendor enterprise server environments. This architecture, combined with Dell best practices and customer collaboration, provides rapid configuration, deployment and commissioning of enterprise server hardware.

The results achieved by this automation methodology are immense. Deployment and commissioning processes are simplified, and within days, not weeks, the hardware is available for production in a data center. Other advantages: Fewer resources are needed and they can be repurposed for other data center activities. Verification that the hardware is operational and correctly deployed can be accomplished remotely, saving more time.

Introduction

Qualcomm uses Dell EMC PowerEdge platforms for many high-end workloads including grid computing, Release Management Lifecycle (production, staging, beta-testing, integration, and development) in both US and abroad. Of the compute mix, 75% of the servers are used for a high-performance compute (HPC) grid to design and simulate semiconductors. Qualcomm manages petabytes of storage and creates terabytes every day driven off of compute workloads.

In this fiercely competitive market, systems administrators must perform flawlessly to stand up environments faster and help engineering teams design, develop and get products to market quickly.

Some of the challenges faced by any customer like Qualcomm are:

- Pre-deployment planning time
- Configuration accuracy
- Consistency
- Speed of deployment vs schedule
- Resource allocation
- Logistics – multiple datacenters & multiple touch points
- Site readiness

Factory Express Automation helps to deploy servers efficiently, consistently and accurately at the Qualcomm data center.

For rack unit efficiency, most servers are in blade chassis and share power supplies, fans and systems management.

Solution Overview

Factory Express Automation involves

Pre-work - Customers (like Qualcomm) provide, to the data center, profiles of the servers and the chassis in a spreadsheet. Qualcomm pre-defines datacenter profiles of every new Dell blade and chassis in a primary spreadsheet for each applicable datacenter. The information includes the following:

- Customer Intent Document (CID)
- Datacenter code(s)
- Chassis keys #s – (which is a unique name for each server and has a corresponding XML)
- User P.O
- IP addresses for all the included components
- Naming conventions for all included components

Process - The RACADM script on the Dell EMC Chassis Management Controller (CMC) of the Dell EMC PowerEdge FX2 server chassis parses out all the settings in the spreadsheet and applies them to the server at the Dell staging facility. This step obviates the need for manual input of settings, prevents human error, and saves time by catching all DOA's prior to their arrival at Qualcomm. The CMC has access to each server. This eliminates the need to program servers individually. After programming the servers, the CMC notes the MAC address, service tag # and other attributes and appends this data back to the spreadsheet. Next, the spreadsheet is uploaded to the SharePoint.

Delivery - After the servers have been programmed, packed, and labeled with the identifying key and PO#, they are loaded in sequential order to accelerate racking, stacking and cabling upon arrival at the Qualcomm datacenter. Once the server is installed at the Qualcomm datacenter, Qualcomm can create kick-start files for each server from the spreadsheet. Once powered on, the servers' health is checked by Dell EMC OpenManage Enterprise and OpenManage Power Center before they are connected to the Qualcomm server grid. If a server is deemed healthy, a *change password script* is run, and the server is added the Qualcomm HPC grid.

Pre Work Workflow Steps *(moving counter clockwise)*

1. Qualcomm creates a Spreadsheet which contains the server/chassis profile (Picture 2).

2. Qualcomm creates a Chassis Key which is a unique identifier correlating to the CMC and Dell EMC iDRAC XML profile for each server. The CMC

and iDRAC XML profiles are organized in a directory tree system based on location (Picture 3).

3. The Python scripts pull the CMC and iDRAC XML profiles from the SharePoint Site. The Python scripts also parse the settings from the spreadsheet (Picture 2) and program these settings to the server/ chassis. *(Utilize the python code (or other) to generate unique CMC and iDRAC XML profiles to corresponding unique chassis keys (folders)).*

4. The SharePoint Site is a secure co-accessible (TSS, Dell and customer can access) repository which contains:
    a. A spreadsheet containing all targeted deployments for a given data center. (picture 2)
    b. CMC and iDRAC XML files which are saved in a directory tree system based off of data center and chassis key (Picture 3).

5. RACADM scripts are used to apply the appropriate configuration.

6. Back to step 1. The cycle completes with the MAC address and service tag numbers appended to the spreadsheet for automated self-documentation. The SP is finalized with the MAC address

7. The CMC GUI is used to determine if the settings track with the spreadsheet. If so the CMCs are added to the network and a new password is set for the CMC and iDRAC.

8. The boxes are loaded into the truck, based on installation order in the customer site (last in first out) delivery order to minimize “ship to rack” time. The servers and chassis are boxed with labels identifying the PO#, location, and chassis key.

9. The servers and chassis are delivered, unboxed, racked, stacked and powered on by chassis key.

10. OME which has been pre-configured to discover all the IPs provided as part of CMC and IDRAC XML profiles upon rack, stack cabling once the IP addresses become accessible without admin interaction

11. Dell EMC OpenManage Power Center can be used to monitor the power of the chassis/ server and throttle the server if the power cap is exceeded.

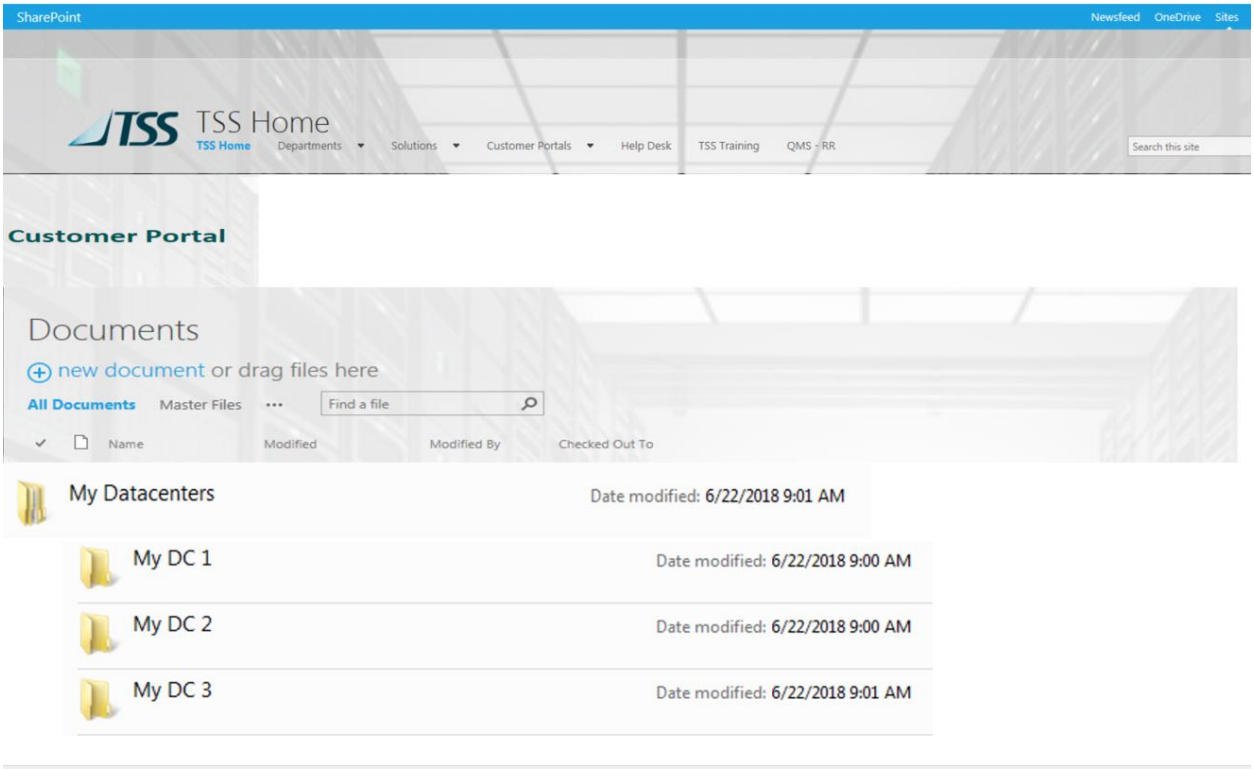
Picture 1

Picture 2

Chassis Key	Row	Rack_ Name	Chassis #	Data Center Zone	Chassis_Name	Server_Names	Slot_Names	iDrac_Names	CMC_Name	CMC_IP
DataCenterName-1	A	A12	1	1	FX2DC1-A12-1	DC1-A12-1-01 - 04	DC1-A12-1-01 - 04	idrac-dc1-a12-1-01 - 04	CMC-FX2DC1-A12-1	1.1.1.1
DataCenterName-2	A	A12	2	1	FX2DC1-A12-2	DC1-A12-2-01 - 04	DC1-A12-2-01 - 04	idrac-dc1-a12-2-01 - 04	CMC-FX2DC1-A12-2	1.1.1.2
DataCenterName-3	A	A12	3	1	FX2DC1-A12-3	DC1-A12-3-01 - 04	DC1-A12-3-01 - 04	idrac-dc1-a12-3-01 - 04	CMC-FX2DC1-A12-3	1.1.1.3
DataCenterName-4	A	A12	4	1	FX2DC1-A12-4	DC1-A12-4-01 - 04	DC1-A12-4-01 - 04	idrac-dc1-a12-4-01 - 04	CMC-FX2DC1-A12-4	1.1.1.4
DataCenterName-5	A	A12	5	1	FX2DC1-A12-5	DC1-A12-5-01 - 04	DC1-A12-5-01 - 04	idrac-dc1-a12-5-01 - 04	CMC-FX2DC1-A12-5	1.1.1.5
DataCenterName-6	C	C3	1	3	FX2DC2-C3-1	DC2-C3-1-01 - 04	DC2-C3-1-01 - 04	idrac-dc2-c3-1-01 - 04	CMC-FX2DC2-C3-1	1.1.2.1
DataCenterName-7	C	C3	2	3	FX2DC2-C3-2	DC2-C3-2-01 - 04	DC2-C3-2-01 - 04	idrac-dc2-c3-2-01 - 04	CMC-FX2DC2-C3-2	1.1.2.2
DataCenterName-8	C	C3	3	3	FX2DC2-C3-3	DC2-C3-3-01 - 04	DC2-C3-3-01 - 04	idrac-dc2-c3-3-01 - 04	CMC-FX2DC2-C3-3	1.1.2.3
DataCenterName-9	C	C3	4	3	FX2DC2-C3-4	DC2-C3-4-01 - 04	DC2-C3-4-01 - 04	idrac-dc2-c3-4-01 - 04	CMC-FX2DC2-C3-4	1.1.2.4
DataCenterName-10	C	C3	5	3	FX2DC2-C3-5	DC2-C3-5-01 - 04	DC2-C3-5-01 - 04	idrac-dc2-c3-5-01 - 04	CMC-FX2DC2-C3-5	1.1.2.5
DataCenterName-11	E	E11	1	5	FX2DC3-E11-1	DC3-E11-1-01 - 04	DC3-E11-1-01 - 04	idrac-dc3-e11-1-01 - 04	CMC-FX2DC3-E11-1	1.1.3.1
DataCenterName-12	E	E11	2	5	FX2DC3-E11-2	DC3-E11-2-01 - 04	DC3-E11-2-01 - 04	idrac-dc3-e11-2-01 - 04	CMC-FX2DC3-E11-2	1.1.3.2
DataCenterName-13	E	E11	3	5	FX2DC3-E11-3	DC3-E11-3-01 - 04	DC3-E11-3-01 - 04	idrac-dc3-e11-3-01 - 04	CMC-FX2DC3-E11-3	1.1.3.3
DataCenterName-14	E	E11	4	5	FX2DC3-E11-4	DC3-E11-4-01 - 04	DC3-E11-4-01 - 04	idrac-dc3-e11-4-01 - 04	CMC-FX2DC3-E11-4	1.1.3.4
DataCenterName-15	E	E11	5	5	FX2DC3-E11-5	DC3-E11-5-01 - 04	DC3-E11-5-01 - 04	idrac-dc3-e11-5-01 - 04	CMC-FX2DC3-E11-5	1.1.3.5
DataCenterName-16	B	B5	1	2	FX2DC4-B5-1	DC4-B5-1-01 - 04	DC4-B5-1-01 - 04	idrac-dc4-b5-1-01 - 04	CMC-FX2DC4-B5-1	1.1.4.1
DataCenterName-17	B	B5	2	2	FX2DC4-B5-2	DC4-B5-2-01 - 04	DC4-B5-2-01 - 04	idrac-dc4-b5-2-01 - 04	CMC-FX2DC4-B5-2	1.1.4.2
DataCenterName-18	B	B5	3	2	FX2DC4-B5-3	DC4-B5-3-01 - 04	DC4-B5-3-01 - 04	idrac-dc4-b5-3-01 - 04	CMC-FX2DC4-B5-3	1.1.4.3
DataCenterName-19	B	B5	4	2	FX2DC4-B5-4	DC4-B5-4-01 - 04	DC4-B5-4-01 - 04	idrac-dc4-b5-4-01 - 04	CMC-FX2DC4-B5-4	1.1.4.4
DataCenterName-20	B	B5	5	2	FX2DC4-B5-5	DC4-B5-5-01 - 04	DC4-B5-5-01 - 04	idrac-dc4-b5-5-01 - 04	CMC-FX2DC4-B5-5	1.1.4.5

This spreadsheet is uploaded to a SharePoint site. As changes are made, Qualcomm and Dell have a repository documenting the deployment.
Once Dell receives the purchase order from Qualcomm, the Dell deployment team accesses the spreadsheet on the SharePoint site like shown below:

Picture 3



The content is structured by Qualcomm datacenter with each directory containing a primary spreadsheet and a scripts directory per blade chassis.
Qualcomm provides the scripts to be applied to all the components and associated configurable settings for each blade/chassis

Automation process/paradigm

The OpenManage Systems Management Ecosystem has a combination of hardware and software for adapting Qualcomm's workflow and handling the life cycle of its servers with CMC being a core component.

Factory Express Automation was achieved by leveraging a combination of industry standard software solutions and TSS proprietary shop floor control systems. The core components of the solution and the functionality provided is as follows:

- CMC Interface – Is a graphical management interface that provides at-a-glance status and alerting on all hardware components, including servers, storage, switches, fans and PSUs.
  Advantages of CMC are:
    - Efficient IT operations: Automates modular systems management requests such as discovery, inventory, configuration and update. This automated server setup saves time and improves accuracy. The quick deploy profile is applied when a server is inserted and this reduces the sys admin time to configure hardware in a single click. Also enables group server BIOS/FW update thereby saving time on initial deployment and later updates. In the end, customers can save up to 92% less time deploying new servers when they use CMC (http://www.principledtechnologies.com/Dell/CMC_4_45_1013.pdf).
    - Enhances productivity: 1-many automation with profile based configuration and multi-server update.
    - Proactive management: centralized monitoring of all chassis components, power and cooling
- MS SharePoint – Serves as the front-end Customer Interface and primary data repository. Also provides the ability to write/append the original customer configuration file located in the various directories. The original customer file is appended with site specific configuration information i.e. MAC address, Node Name, iDRAC information, etc. This also serves to provide the absolute confirmation ALL servers & nodes are configured per the customer's specifications prior to any hardware shipping to the sites.
- MS Excel – Provides standardized formatting for configuration data and customer asset & configuration reporting
- Custom Scripting & Programs – TSS developed automation code that retrieves customer configuration data from SharePoint repository, parses the data for use by application Server specific system configuration utility. Feeds of information from and to TSS's production tools allow for scheduling, processing, and configuration automation.
- Navio – TSS's shop floor control system that is utilized to setup, schedule production, BOM information, Job routing data, and customer specific asset capture.
- MSSQL DB – Collection database used to Store, normalize, and associate data from SharePoint, TSS production systems, and configuration log files. A custom table was developed to store data and the output is written directly back to original customer file on the SharePoint site.
- Custom Product Routing – Post configuration, the all servers and associated hardware are uniquely labeled using the unique site/server key and the customer PO information. The equipment is then loaded according to the planned delivery & routing information to reduce onsite delivery times and eliminate unnecessary handling. Server rails are removed and shipped as over pack to enable the onsite technicians to install the hardware more efficiently and commission racks within 24hrs.

- Onsite Installation Services – Level 2 technicians are onsite when the equipment arrives to rack and stack all the hardware on behalf of the customers

Delivery

Once the order is received by Qualcomm, they input the MAC address of the blades to the appropriate OS image provisioning systems. These OS images are automatically deployed in parallel to all the blades (kick-start files)

The operation efficiencies achieved by automating the entire process

- Less time/effort in creating and deploying Blade Chassis scripts manually for both Dell and Qualcomm
- Time-to-use efficiency increased from ~87% to ~96%
- System configuration derived from deployment and planning documentation ahead of installation
- “Reactive” to “Proactive” – For example, prebuild PXE prior to system delivery with time for verification
- ITOS proactive asset management -- Avoids manual, iterative bar-code entry; Labels *pre-created*
- Document once, deploy many times
- Repeatable process across projects/datacenters
- Minimizes human error in operationalizing new Dell Blade Chassis acquisitions

Conclusion

This automated flow has yielded a 75% improvement in efficiency and a 96% decrease in the deployment time.

Automation decreases the mistakes in programming things such as default gateway or subnet mask have slowed down the process of getting servers into production. This automated golden template ensures consistency. Staging servers prior to arrival at Qualcomm catches the DOAs and insures there are no interoperability issues with Dell EMC PowerEdge servers.

Sharing information between Dell and Qualcomm refines the flow and enhances the Dell EMC OpenManage Systems Management Ecosystem for customers.

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Steve has been with Qualcomm Inc since 1997. His focus is delivering global compute and deployment standards across the enterprise with an emphasis on large scale deployments with increased operational efficiencies. He partners with product teams across multiple OEM's to provide guidance in relation to current and future hardware platforms as well as working to mature related Firmware and Software updates for increased functionality and manageability. His combined focus has resulted in nearly zero touch deployments/onboarding of compute within Qualcomm Datacenters.

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Vandana has extensive experience as a product manager and a product developer. Prior to joining Dell Technologies in 2015 as a Product Manager in the Systems Management group, she worked as a product manager in Halliburton. She was responsible for the launch of the next generation virtualization platform aimed to provide improved connectivity and seamless integration of data from disparate data sources. She has also worked in IBM as a kernel developer on their AIX operating system.

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Hany has been with TSS since 2012 and is a solutions-driven professional with over 25 years of experience in sales and project management as well as the design and delivery of technical solutions for Fortune 1000's spanning multiple industries including in engineering, technology services, retail, banking and entertainment industries.

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Sam has been with Dell EMC as a Systems Consultant since 2006. His focus is on working with cloud customers and high performance compute clusters to increase efficiency and lower TCO. Prior to his time at Dell, Sam was as an Engineer with Synopsys-Avanti in electronic design automation where he focused on hardware emulation. He also worked at Boeing-Douglas as a System Administrator and as a Flight Simulation Engineer.