CLABBY ANALYTICS

Research Report

Understanding the Differences between IBM's Flex System and Cisco's Unified Computing System

Executive Summary
In this *Research Report*, *Clabby Analytic*s examines how IBM Flex System converged infra-structure compares with Cisco's Unified Computing System (UCS), a blade architecture. By closely examining the technical specifications of each vendor, our research shows that Flex System architecture has strong design advantages – particularly related to performance and flexibility. These advantages position IBM Flex System more favorably than Cisco UCS for general purpose workloads; high performance workloads; large in-memory business analytics environments (such as SAP HANA); large cloud/virtual machine (VM) environments (with up to 80% more VMs than competitive servers); large populations of Enterprise Resource Planning (ERP) users who require strong performance and enterprise class reliability, availability and security; and large populations of Virtual Desktop Interface (VDI) users.

Three Major Differences
There are three major differences between a Cisco UCS blade environment and an IBM Flex System converged system environment. These differences can be found in:

1. ***Architecture*** – Cisco UCS is a traditional blade design that uses a centralized switching environment (Cisco FEX/NEXUS switches) to unite blade chassis with external storage and other input/output (I/O devices). IBM Flex System is a converged *system* that uses an advanced chassis design to allow all major systems components (compute/storage nodes and network switched) to share a common midplane.

> ***Flex System is architected as an integrated system rather than as a group of siloed system, storage and networking resources linked together through a large, centralized switch.***

2. ***Networking*** – There are major differences in the types of networks supported and network speeds. Flex System supports Ethernet (1 and 10 Gb), iSCSI as well as Fibre Channel over Ethernet [FCoE], and Infiniband) – whereas Cisco's UCS supports Ethernet, iSCSI and FCoE. Flex System also supports Fibre Channel connections at 8- and 16-Gb speeds – and offers native 40 Gb/s uplinks – Cisco's UCS does not).
3. ***Deployment/Management*** – Flex System offers deployment assistance using "patterns" (simplified deployment recommendations) – and Flex System offers more advanced manageability options (for instance, the use of predictive management facilities to help find problems before they cause an outage).

These Differences Manifest Themselves in Performance and in Configuration Flexibility
The way we see it, the architectural differences between Cisco's UCS and IBM's Flex System manifest themselves in two ways: 1) major differences in overall system performance; and, 2) in configuration flexibility. Flex System offers:

- Higher performance due to:
  - Faster networking [described above];
  - A faster backplane that can deliver 2.7X the theoretical maximum network (backplane) throughput of Cisco UCS (see this Tolley Group report for further details); and,
  - A much faster I/O subsystem.

- Greater configuration/deployment flexibility thanks to:
  - The ability to support up to 8 processor sockets with twice the number of cores in a single system (enabling buyers to build high-performance systems);
  - More networking choices (enabling buyers to connect to other devices [such as storage area networks – SANs] using different protocols);
  - Access to more internal storage (enabling data to be written and read more quickly – thus producing faster results.

Other Major Differences: Manageability and System Scalability
In addition to architectural differences, other important differences between Flex Systems and Cisco UCS environments can be found in manageability and in system scalability.

From a management perspective, both Flex System and Cisco UCS offer solid systems and network management tools and utilities. However, Flex System offers a more integrated approach to management with the Flex System Manager (FSM) that manages servers and networking, and *storage* in a holistic fashion – and because IBM now offers advanced predictive management facilities on Flex System (Cisco UCS does not have equivalent predictive failure tools).

From a scalability management perspective, the new Flex System X6 family is built on IBM Enterprise X architecture (EXA) which enables Flex System to start as a 2-socket server, and then be able to scale that to a 4 or 8-socket server. This is ideal for clients who require flexibility in their architecture (such as Managed Service Providers or MSPs) that can re-purpose systems depending on their current needs.

The Bottom Line
The bottom line when comparing IBM Flex System converged system environment with Cisco UCS blade environment is this:

> ***Major architectural differences in the I/O subsystem, in internal backplane throughput, in processor speed and scalability, in networking, in internal storage, and in management position IBM Flex System to better handle general purpose workloads, large virtual server environments (as found in many of today's cloud architectures), and mission-critical ERP workloads that require high service levels as compared with Cisco UCS architecture.***

Background
Clabby Analytics has long been a fan of blade architecture design. We like the overall simplicity of blade architectural design (single chassis with multiple blades that share power supplies, fans, network components, etc.). We like the blade upgrade path (it is easy to replace older blades with

newer, more powerful blades). And we like the price point (blade servers are usually less expensive than towered and/or rack systems as you scale-out).

Having voiced our admiration for blade architecture however, we note that blade servers also have several significant design constraints including:

1) higher network latency (when compared to some towered and converged system architectures);
2) chassis limitations (most of today's blade chassis rely on a hardwired mesh of copper connectors that make it difficult if not impossible to support speeds beyond 40 Gb without a chassis/midplane redesign); and,
3) limited memory.

These design limitations severely constrict blade server performance.

We also note that some traditional blade server environments are constrained by fewer networking options, by the inability to rapidly access large volumes of internal storage, and by siloed management (making it difficult to manage blade systems/storage and network elements in a holistic fashion as part of united, integrated server environment

To address blade architecture shortcomings, in 2012 IBM created a new "generation 2" blade solution known as IBM Flex System that helps overcome latency issues; that tackles siloed management; that helps overcome chassis backplane bottlenecks; that allows for access to much larger internal storage; and that allows access to large volumes of memory. IBM Flex System has proven to be a resilient, high performance, high utilization architecture that represents the second wave of blade architecture (Blade 2.0).

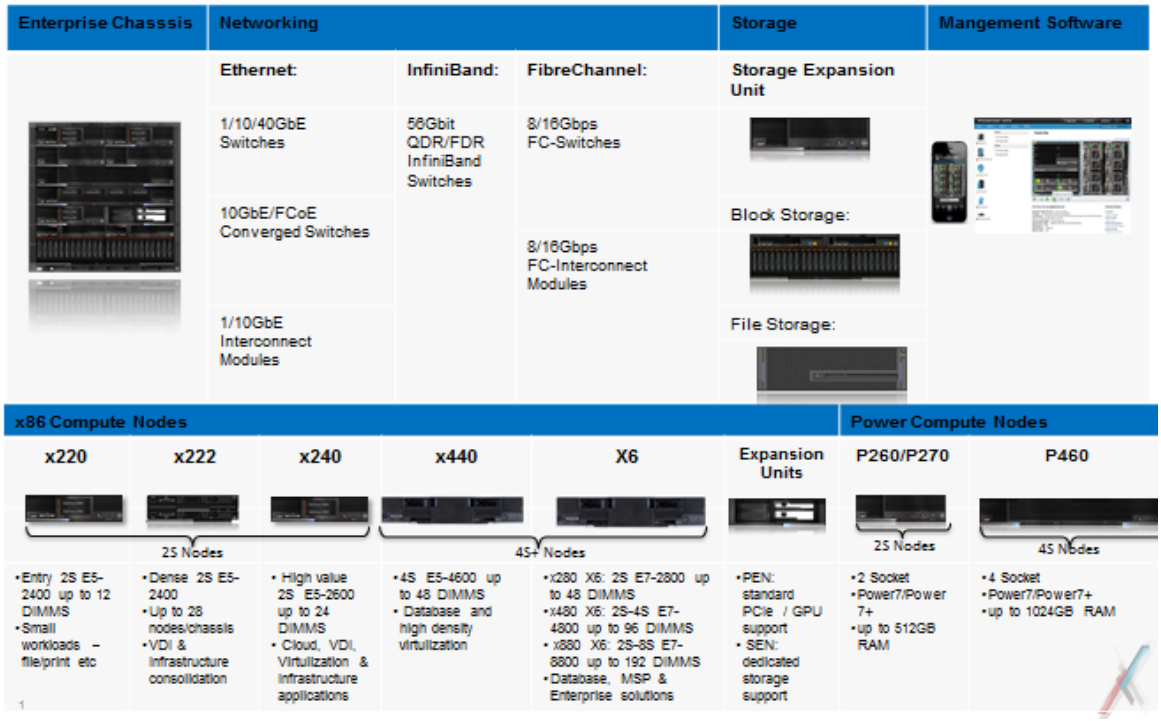
A Closer Look at Cisco UCS and Flex System Architectures

The Cisco UCS chassis contain blade servers and network adapters that connect blade servers to a large, external switch. This switch handles requests for services (such as program-to-program communications between discrete blades, data access to network attached storage or storage area networks, as well as access to the broader network).

In contrast, IBM's Flex System design can house compute nodes, storage expansion units, and a wide variety of network adapters – all within a common chassis (that has been designed to accommodate future advances in compute/storage and network hardware – see Figure 1). These devices connect to a common midplane (such that all devices can be managed in an integrated fashion) – and Flex System offers an optional management appliance is also available (known as the Flex System Manager) that provides access to advanced system/storage/management facilities.

Note that users can mix and match compute and storage nodes and network components in order to build system configurations that address differing workloads.

Figure 1: IBM Flex System Elements



Source: IBM Corporation — June, 2014

A Closer Look at Cisco UCS vs. IBM Flex System

A closer look at each architectural element in the Cisco UCS design as compared with the IBM Flex System design shows the following:

- ***Blade servers*** – IBM compute nodes support more computing cores with 2-, 4- and 8-way x86 configurations – UCS supports only 2- and 4-way blades.

  Note that IBM has made a statement of direction that its 8-way Flex System compute node (the x880 X6) will support up to 4 times as much memory/cache as Cisco's high-end UCS B460 M4 B series blade. This advantage better positions IBM's Flex System architecture to handle large, in-memory workloads as well as other data intensive applications as compared with Cisco's more limited-memory UCS blades.

- ***Networking*** – IBM's Flex System supports Ethernet, iSCSI, Infiniband and Fibre Channel over Ethernet (FCoE) connections. Cisco's UCS supports Ethernet, iSCSI and FCoE. Each vendor supports data transfer rates of 80 Gb using FCoE (although IBM states that its data transfer rate is 160 Gb capable).

  A closer look at each vendor's network offerings shows:

  - IBM network architecture enables information technology (IT) buyers to reduce complexity while maintaining efficiency and performance. The Flex System Interconnect Fabric simplifies Flex System POD deployments while offering simple connectivity to the data center core network. While UCS offers similar management architecture, it pushes switching to the Top Of Rack module creating a potential network bottleneck. Flex System Interconnect Fabric enables a flat network

architecture with single point of management but still maintains Layer 2 switching within the POD.

- *Fibre Channel support* – Flex System simultaneously supports four 10 Gb Ethernet and four Ethernet 8/16 Gb Fibre Channel interfaces per server. Cisco does not support native Fibre Channel or Infiniband (but supports FCoE).

> ***For performance reasons, we would rather see IT users have access to storage area networks using the native Flex System 8/16 Gb fibre channel connections as compared to the slower FCoE solutions that run in the 10 Gb per second range….***

- *40 Gb Ethernet support* – Flex system supports dual 40 Gb Ethernet links per node and a 720 Gb uplink speed. Cisco UCS can aggregate its eight 10Gb links to be dual 40Gb connections – but there is no native 40Gb uplink via switch in the UCS architecture.
- *Maximum uplinks bandwidth per chassis* – Flex System supports four 10Gb connections times twenty-two uplinks for a total of 880Gb uplink bandwidth per chassis. Cisco's UCS supports two times eight times 10Gb uplinks for a total of 160Gb per chassis.

- ***Backplane Speed*** – A backplane is the channel that connects blades/compute nodes to a switch. The faster the backplane speed, the more data can be sent/received through the switch. In a recent Tolley Group report, IBM's Flex System backplane speed can reach 438 Gb– while Cisco's UCS can deliver only 160 Gb. What this means is that IBM's maximum bandwidth throughput is almost three times faster than that of Cisco's UCS. With this type of speed advantage IBM's Flex System is less likely to experience backplane latency delays – a major advantage when it comes to sharing data within a given systems environment or through network adapters to distributed systems and storage.
  - A new Tolley Group report shows that IBM's Flex System networking implementation can deliver 2.7 times the theoretical maximum backplane throughput as compared to an equivalent UCS (IBM = 438 Gb, Cisco = 160 Gb).
  - Due to faster backplane throughput (about 4.8X more backplane throughput) Flex System moves virtual machines 2.5X faster than Cisco's UCS (moving virtual machines quickly is important to efficient systems operations – especially in large cloud environments).

- ***Directly Attached Storage*** –IBM Flex System can support up to 12 direct attach disks to their mainstream x240 servers for direct attach based workloads such as NAS implementations. Cisco does not have a direct attach node.

- ***Internal/External Storage Array*** – IBM's Flex System chassis can host IBM's Flex System V7000 Storage Node internally – placing up to 1.44 petabytes of storage in close proximity to processors (data can be accessed using FCoE or iSCSI connections). Note: the V7000 can also be deployed externally. *Cisco's UCS cannot host a similar storage array internally*.
  - Also worthy of note is that IBM's V7000 storage array offers advanced compression facilities (storing up to five times more active data in the same disk space using IBM's "Real-time Compression"); and this array also uses IBM's Easy Tier which can help buyers achieve three times better performance by introducing only 5% of Flash storage into an array. IBM's compression and Easy Tier represent high-end storage facilities that are packaged in a mid-tier storage array.

Further, the V7000 uses the storage virtualization capabilities of IBM's SAN Volume Controller (SVC) to increase storage utilization through virtualization.

Flexibility Advantages

There is a reason why IBM named its next generation blade environment "Flex System" architecture – this architecture is far more flexible than traditional blades. Examples of this flexibility include:

- ***Networking (Port Entitlements)*** – IBM's 10 Gb switch portfolio includes its CN4093 that comes with 24 "port entitlements" that allow Flex System buyers to structure their ports to flexibly address communication speed needs. For instance a customer may use 20 ports of 10 Gb Ethernet to connect various compute nodes – leaving 4 ports unassigned. These unassigned ports can be used to provide 4x10 Gb uplinks for connection to an upstream network.
- ***Networking (1 Gb Infrastructure)*** – For IT buyers who wish to connect to their 1 Gb Ethernet infrastructure, Flex System allows this connection directly from the chassis. Cisco requires upstream connectivity to the Fabric Interconnect before connecting to a 1Gb infrastructure.
- ***Compute Node Flexibility*** – From a scalability/growth perspective, IBM Flex System architecture can support 2-, 4- *and 8-way configurations*. (Cisco UCS supports only 2- and 4-way configurations). Flex System allows IT buyers to start low (with 2-way configurations) and expand up to 8-way environments by using specially-designed, pluggable IBM Flex System Scalability Connectors. Note: when starting with a 2-way configuration IT buyers need to purchase the appropriate Intel processors that allow for expansion to 4-way or 8-way configurations. Then, when it is time to upgrade, IT buyers make use of the scalability connectors to expand systems capacity.
- ***Setup/Configuration Flexibility*** – Another major difference when comparing Flex System to Cisco's UCS can be found in the setup/configuration process. IBM uses set-up "patterns" to enable IT managers and administrators to easily automate the provisioning process. These patterns are designed by systems experts and lead to greatly reduced set-up times, enabling users to deploy servers faster and reducing time-to-value. Cisco has also streamlined it set-up process – but not in the same way that IBM has. With Cisco, various components are easy to set up (blades, switches). With IBM Flex System entire, integrated systems can be set up.
- ***Virtual Fabric Enhancements*** –IBM Virtual Fabric environment is a software environment that makes it easier for IT managers and administrators to more easily configure and manage their network environments. Technically, it is a virtual network interface controller (vNIC) offering that carves-up network connections to allow applications to get access to 1GbE to 10 GbE communications links. Further, it simplifies the process of moving virtual machines; it helps maximize virtual machine I/O performance by optimizing bandwidth allocation; and it maximizes virtual machine density by offloading the CPU from having to perform communications processing for virtual machine workloads.

Features such as port entitlements help IT managers maximize switch usage; virtual fabric helps simplify virtual machine management while improving performance; compute node flexibility makes capacity upgrades easier. All in all, these IBM Flex System features give IT managers more choices in how to configure and optimize their systems environments than can be found in Cisco's UCS architecture.

Not to Be Overlooked: The Arrival of Self-Healing

IBM's most recent (May, 2014) Flex System announcements include several new IBM Flex System self-healing management functions that improve overall systems availability as well as increase system reliability – helping to make Flex System more suitable than UCS for running mission-critical ERP workloads. These new Flex System improvements include:

- *Page Retire* – The ability to proactively identify and quarantine memory page failures from affecting system or application availability;
- *Machine Check Architecture Core Recovery* – The ability for the OS to isolate MCA uncorrectable errors to a single VM or application rather than affecting the entire server;
- *Memory Page Sorting* – Real-time sorting of memory pages based on the level of integrity – keeping the most resilient memory pages available for applications; and
- *Fault Resilient Boot* – Allows the server to disable cores or processors and continue to boot if a failure is detected at startup, maintaining access to networking, storage, and system management.

IBM's self-healing systems features add greater resiliency to Flex System environments. We did not find functional equivalent self-healing functionality in Cisco's UCS portfolio.

Summary Observations

From a performance perspective, IBM Flex System environment offers fast processing; faster networking than Cisco's UCS; and Flex System has a faster input/output (I/O) subsystem. From a flexibility perspective, Flex System offers access to directly attached storage as well as access to a large, internal or external storage array; supports more flexible networking options than Cisco UCS (including the ability to combine and aggregate unused port capacity in order to create faster connections while offering greater investment protection [through better switch utilization], as well as the opportunity for cost reductions [by not requiring additional switches]). Furthermore, Flex System offers more advanced systems/storage/network management facilities (more specifically: advanced predictive management software).

All of these elements working together in a balanced fashion – resulting in better throughput on IBM's Flex System architecture as compared with Cisco's UCS blade environment.

The differences in each vendor's system design mean that some applications will run better and receive higher degrees of Quality-of-Service (such as reliability, availability and security) in one vendor's environment as compared with the other. Enterprises that need the ability to create large VMs or to run in-memory databases will benefit greatly from Flex System performance and headroom advantages. And enterprises that need to reduce operational costs (including security deployment and management costs) will benefit from Flex System management and integration. And finally, enterprises looking to reduce cost through better system utilization (which results in lower software and hardware costs), and through greater system density (fewer chassis are required, less data center real estate is used) will find Flex System to be the more cost effective architecture.

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