

# Designing a Microsoft Office Communications Server 2007 architecture with HP BladeSystem



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## Executive summary

Through the years, the process of business communication has changed. From the handing out of written memos, to the telephone, and finally to email, each change in the communications medium has brought an exponential shift in the speed with which employees can communicate. Now a new model is beginning to emerge, unified communications.

Microsoft®'s unified communications strategy is to bridge the gap between the messaging and telephony world. With Exchange Server 2007 and Office Communications Server 2007, Microsoft can streamline business communications to deliver voice, messaging, and video data as an integrated component of the applications that workers use to get their jobs done. While working on a document in Microsoft Office SharePoint Server, a worker can view the presence information of the author and start a voice conversation to get more information, without ever picking up a phone. While away from the office, employee's can access their mailbox through a phone; and voice mail messages are delivered to their mailbox and accessible through their Microsoft Office Outlook client. While collaborating over instant messaging (IM), workers can decide to launch an ad-hoc web conference to share an Office PowerPoint presentation and discuss an upcoming meeting.

With Microsoft Office Communications Server 2007 and the Office Communicator 2007 client, companies can realize these levels of interaction and provide faster forms of communication. Microsoft Office Communications Server (OCS) 2007 delivers instant messaging, presence, web conferencing, and Enterprise Voice, a voice over IP (VoIP) telephony solution. This white paper is focused on the design and architecture of an OCS 2007 environment in an HP BladeSystem infrastructure. The document outlines a building block approach to deploying OCS on the HP BladeSystem and focuses on how the design decisions around levels of availability, scalability, and the OCS 2007 feature set impact the hardware that is deployed and the version of OCS that is used. The white paper also covers a brief overview of the Microsoft Unified Communications framework including Microsoft Exchange Server 2007 and Office Communications Server 2007 and an overview of the HP BladeSystem architecture and how the HP BladeSystem can help lower the total cost of ownership (TCO).

**Target audience:** This white paper is intended for audiences responsible for designing and planning the architecture for Microsoft Office Communications Server 2007. Previous knowledge of Microsoft Office Communications Server 2007 and the HP BladeSystem architecture are beneficial. Additional background information is available at [www.hp.com/solutions/microsoft/uc](http://www.hp.com/solutions/microsoft/uc), [www.hp.com/go/ bladesolutions/exchange](http://www.hp.com/go/ bladesolutions/exchange), and [www.hp.com/go/ bladesystem](http://www.hp.com/go/ bladesystem).

There are a number of white papers available from Microsoft discussing all aspects of Microsoft Office Communications Server 2007 in great detail. These can be downloaded from <http://technet.microsoft.com/en-us/library/bb676082.aspx>.

# Microsoft Unified Communications

Microsoft has long held a leadership position in the messaging space. From the original release of Exchange 4.0 to the latest release of Exchange Server 2007, Microsoft has continued to improve the software to enable more efficient, secure, productive, and cost-effective messaging solutions. With the release of Exchange 2000, Microsoft included chat and conferencing as part of Exchange 2000 in an attempt to tightly integrate presence, collaboration, and messaging in one product. When Exchange 2003 was launched, Microsoft had removed the chat and conferencing functionality from Exchange and released Microsoft Live Communications Server 2005 and Microsoft Office Live Meeting. Live Communications Server 2005 delivered a scalable instant messaging and presence solution that tightly integrated with Exchange 2003. The presence information from Live Communications Server 2005 is also published through Microsoft SharePoint Server 2003, Microsoft's document and collaboration software. This gave workers the ability to instantly determine the status of a co-worker and collaborate via IM or email. Live Meeting added further functionality, providing customers with a solution to enable real-time remote collaboration solutions.

However, while employees now had the ability to instantly communicate via IM, email, or a real-time web conference, telephone communication was still separate. Third party products could be used to integrate telephony and messaging. But until now, this was outside the scope of the suite of Microsoft collaboration software. With the release of Microsoft Exchange Server 2007 and Microsoft Office Communications Server 2007, Microsoft has delivered on the vision of unified communications.

Consider the following scenario. An employee in the United States is reading a draft of a document written by an employee in Australia. Seeing that the coworker in Australia is online, the U.S. worker starts up an instant messaging chat session to talk about changes that need to be made to the Microsoft Office Word document. However, a third worker in China and a fourth worker in Germany have also worked on the document. Seeing that the worker in China is online, an ad-hoc web conference with audio and video support is initiated between the three employees where the document can be shared and edited together. However, the worker in Germany has to sign off on any final changes. The U.S. employee initiates a call to the German worker by clicking on the Call option from the Office Communicator 2007 client. This call traverses over the network and is instantaneously routed to the employee's desk phone. The German worker has also setup automatic call forwarding to their cell phone. The German worker answers the cell phone and is able to join the ad-hoc meeting to help finalize the document.

This is just one example of the power of unified communications. Unified communications can transform the way employees work, providing a more efficient way to work and collaborate, in real-time, with anyone, anywhere.

## Microsoft Exchange Server 2007

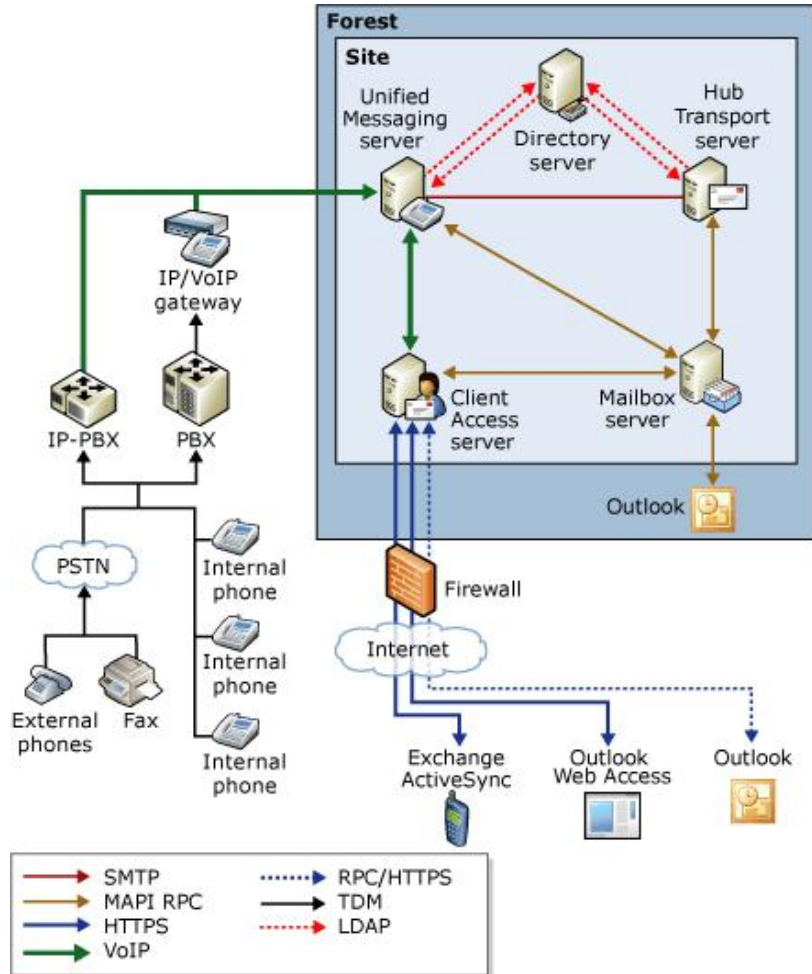
Microsoft Exchange Server 2007 provides the core infrastructure to support an organization's messaging requirements. With Exchange Server 2007, Microsoft formalized the notion of Exchange server roles, breaking the product up into five distinct server roles: Mailbox Server, Client Access Server (CAS), Hub Transport (HT) Server, Edge Server, and Unified Messaging (UM) Server. The Mailbox, CAS, and HT server roles are required server roles for Exchange Server 2007 deployments. The Edge server role is a new role that sits in the perimeter network and is the first point of contact for email between the internal corporate intranet and external Internet. This role is responsible for message hygiene through anti-virus and anti-spam email scanning. The fifth role, the Exchange UM server role, is also a new role introduced with Exchange Server 2007. The UM server role is a key component in Microsoft's unified communications architecture. Exchange Unified Messaging performs several key functions including the following:

- Call answering – The ability for Exchange to act as the voicemail system and deliver the voicemail message to a user's inbox in the same manner that email is delivered today.
- Inbound fax – The ability for Exchange to receive and route incoming fax calls to a user's inbox.

- Outlook Voice Access (OVA) – The ability for a user to access their mailbox, calendar, contact, and global address list (GAL) information from a telephone interface.
- Auto Attendant – The ability for companies to provide a menu based call routing and transfer system for the telephone system.

The Exchange UM role provides the integration point between the Exchange messaging environment and the existing telephony system. Figure 1 below shows an example Exchange Server 2007 configuration with the Exchange UM role deployed.

**Figure 1.** Exchange Server 2007 Unified Messaging architecture



The Exchange UM server role connects to an existing traditional PBX through a gateway device or an IP-PBX phone system directly to provide the communication path between calls originating from the PBX environment and voicemail messages routing to the Exchange Mailbox server. With Exchange UM deployed, users have a single point of access, their inbox, for voicemail, email, and faxes. The OVA feature provides the ability to access an inbox using a traditional phone. For example, a user running late to a meeting can dial into their mailbox and change the start time of the meeting. The new meeting time would then be emailed out to the rest of the attendees indicating the new start time.

While it is important to understand the role Exchange plays in the unified communications strategy, further discussion of Microsoft Exchange Server 2007 and the UM server role is outside the context of

<sup>1</sup> This diagram is from the Microsoft Exchange Server 2007 product help file documentation

this white paper. For more information on Exchange Server 2007 and UM, please visit [www.microsoft.com/exchange/default.mspx](http://www.microsoft.com/exchange/default.mspx) and read the Exchange Server 2007 product help file. For more information on deploying Exchange on the HP BladeSystem, the "Best practices for HP BladeSystem and Microsoft Exchange Server 2007<sup>2</sup>" white paper is available to download at [www.hp.com/solutions/activeanswers/](http://www.hp.com/solutions/activeanswers/) – Solutions – Microsoft Exchange Server.

## Microsoft Office Communications Server 2007

While Microsoft Exchange Server 2007 is an important component of Microsoft's Unified Communications framework, Microsoft Office Communications Server 2007 is the critical piece. OCS 2007 provides the framework for enterprise instant messaging and presence, web conferencing, and Enterprise Voice. And coupled with the functionality provided by Exchange Unified Messaging, the two applications provide a compelling unified communications experience.

This section provides a backdrop for the remainder of the white paper that will go into detail on some of the design criteria and methodology behind planning an OCS 2007 implementation on the HP BladeSystem. For more in-depth background, deployment, and installation information covering OCS 2007, there are a number of white papers available from Microsoft. These can be downloaded from <http://technet.microsoft.com/en-us/library/bb676082.aspx>.

Office Communications Server 2007 is made up of a number of different server roles that provide different functionality. For some deployments, these server roles will coexist on the same physical server and for other implementations, the roles will be installed on separate servers.

The following is a list of the major server roles that can be deployed with OCS 2007.

OCS 2007 server roles:

- IM Conferencing Server – Provides server-managed group IM.
- Web Conferencing Server – Enables multiparty data collaboration.
- A/V Conferencing Server – Enables audio and video conferencing.
- Telephony Conferencing Server – Enables audio conference integration with ACPs (audio conferencing providers)
- Access Edge Server – Validates and forwards session initiation protocol (SIP) signaling traffic between internal and external users.
- Web Conferencing Edge Server – Enables data collaboration with external users.
- A/V Edge Server – Enables audio and video conferencing and A/V peer-to-peer communications with external users who are equipped with the Office Communicator 2007 client. Peer-to-peer communications traverse between the clients and do not go through the A/V Conferencing Server
- Communicator Web Access Server – Provides IM and presence through a web-based client
- Archiving/CDR Server – Enables archiving and collection of CDRs (call detail records) to track IM, VoIP, and meeting usage
- Director – Authenticates remote users and routes traffic to the appropriate server or Enterprise pool. Directors are recommended when you support external user access, but they are not required.
- Mediation Server – Performs signaling and media translation between the VoIP infrastructure and a basic media gateway
- Media Gateway – 3<sup>rd</sup> party devices that translates signaling and media between the public switch telephone network (PSTN) and the Enterprise Voice infrastructure
  - Basic media gateway – A hardware device that works in conjunction with the mediation server for medial and signal translation
  - Advanced media gateway – A single hardware device that combines the functionality of a basic media gateway and the mediation server

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<sup>2</sup> The direct URL to access the white paper is

<http://h71028.www7.hp.com/erc/library/GetPage.aspx?pageid=504609&audienceid=0&statusid=0&ccid=225&langid=121&ERL=true>

- Hybrid media gateway – A single Microsoft Windows® Server 2003 server that collocates a basic media gateway with a mediation server

There are also a number of infrastructure roles that may be required. These are listed below.

Infrastructure server roles:

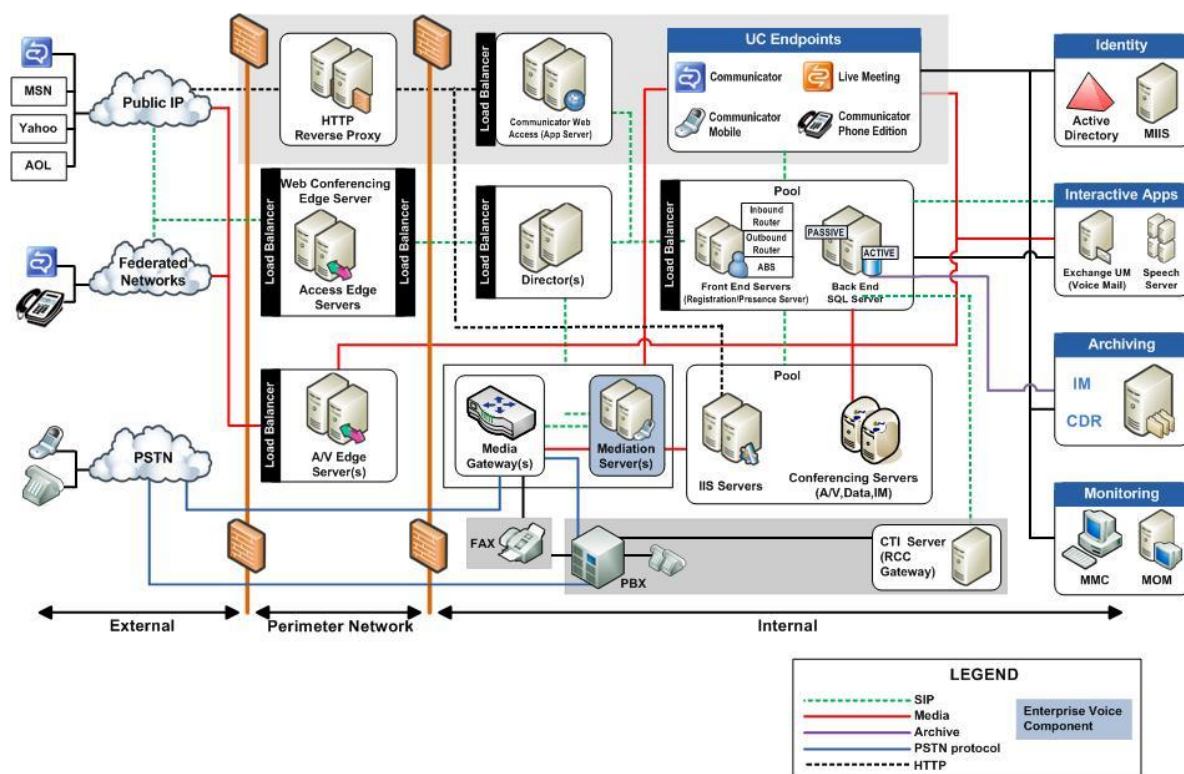
- Internet Information Services (IIS)
- Active Directory (AD)
- HTTP reverse proxy (when external access is enabled)
- SQL server
- PKI (public key infrastructure) infrastructure

How the server roles are deployed will depend on the type of base OCS configuration that is utilized. There are three installation options for OCS 2007. These include OCS Standard Edition (SE), OCS Enterprise Edition (EE) consolidated configuration, and OCS Enterprise Edition expanded configuration. All three will be discussed in greater detail in the [Designing a Microsoft Office Communications Server 2007 deployment with the HP BladeSystem](#) section below.

The base installation of OCS in any of the three configurations provides IM, presence, and web conferencing. VoIP would also be functional between users in the same OCS environment, meaning users can only talk to other users in the same OCS configuration. Additional features such as external access or web access to conferencing and IM, Enterprise Voice integrated with an existing telephony system, or archiving can be added incrementally to the base configurations.

There are numerous ways that OCS 2007 can be deployed depending on the size of the company and the desired feature set. This can range from a single OCS 2007 SE server, up to tens and possibly hundreds of OCS servers for a large global implementation with multiple remote branch sites. Figure 2 below depicts a logical architecture diagram showing the different server roles deployed in a fully scaled-out, highly available OCS 2007 Enterprise Edition deployment with connectivity to existing telephony systems.

**Figure 2.** Architecture diagram of Office Communications Server 2007 Enterprise Edition deployment



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From this diagram one can get a sense of the scope and complexity that comes with designing and deploying OCS 2007 for a large enterprise. However, you'll see in the [Designing a Microsoft Office Communications Server 2007 deployment with the HP BladeSystem](#) section below, that by taking a building block approach with the HP BladeSystem and working from the base SE configuration up to the EE expanded configuration, the complexity of designing the server hardware architecture for an OCS environment can be simplified.

## Why HP BladeSystem for Microsoft Office Communications Server 2007

As organizations begin to embrace instant messaging and web conferencing as core services integral in running the business, a greater importance is placed on IT to ensure that these services are secure and always available to employees. Workers will demand that a VoIP implementation has the same level of service as existing, traditional PBX implementations. Thus, it is critical for customers to deploy Microsoft Office Communications Server 2007 on a highly available, high performing and secure infrastructure that can reduce the likelihood of downtime.

Deploying an OCS 2007 Standard Edition configuration is a single server solution supporting up to 5,000 users (more detail on the different OCS 2007 configurations is covered in the [Designing a Microsoft Office Communications Server 2007 deployment with the HP BladeSystem](#) section below). In order to achieve application redundancy, an OCS Enterprise Edition (EE) consolidated or expanded configuration must be implemented. However, these configurations are designed to scale to

<sup>3</sup> This diagram is from the "Microsoft Office Communications Server 2007 Technical Overview" white paper available at <http://www.microsoft.com/downloads/details.aspx?familyid=09b218ea-6ff6-4679-a117-9767ab98990a&displaylang=en>



much larger user configurations (30,000 – 125,000 users). Thus, for smaller deployments, it is imperative that the OCS 2007 SE configuration is deployed on an infrastructure platform with the highest levels of availability and redundancy. And for larger OCS 2007 EE deployments, availability is achieved through a scale-out model, with additional servers being added to achieve redundancy for the various OCS server roles. This can add significant hardware and operational costs that must be accounted for as companies design their OCS 2007 infrastructures. The HP BladeSystem, as a key enabler of the Adaptive Infrastructure, can help customers build a lights-out, 24x7 Office Communications Server 2007 deployment that reduces their IT expenses, both in terms of initial acquisition and ongoing operational costs.

## Reducing the total cost of ownership with HP BladeSystem

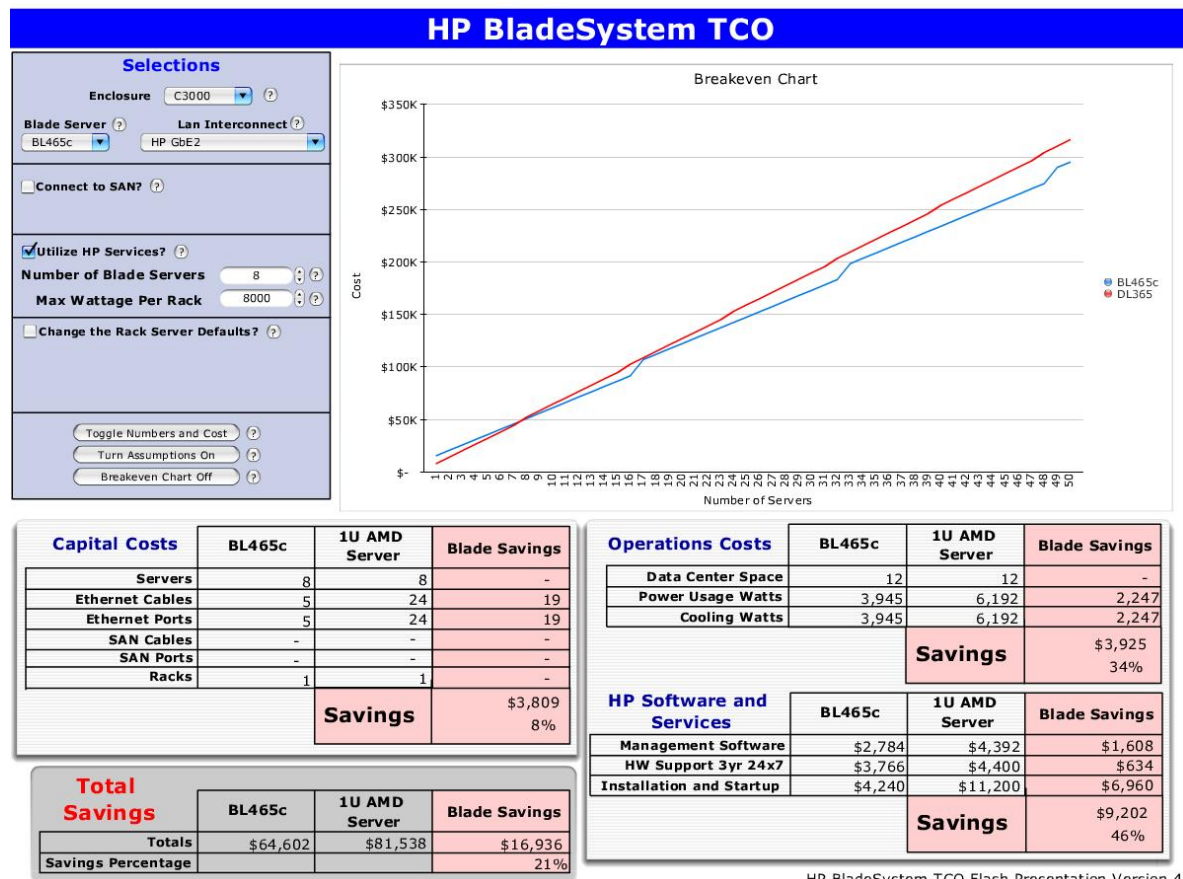
There are two major factors that drive the cost of ownership for an OCS 2007 deployment. These are the initial acquisition costs of the hardware and software to deploy OCS 2007 and the on-going operation expenses to manage and run the environment. The HP BladeSystem can help reduce both acquisition and operational costs versus comparable rack and tower infrastructure deployments.

While the initial hardware acquisition costs are typically a small percentage of the overall costs associated with the lifetime of a server, these costs can still be significant. The modular, shared architecture design of the HP BladeSystem helps businesses realize an incremental cost benefit as the number of server blades increases. A common misconception around HP blades is that because of the shared infrastructure components, server blades will be more expensive than comparable rack or tower mount servers. This may be the case in the smallest business scenarios where the customer is only looking to deploy a maximum of 1 or 2 servers for the entire organization. However, when moving beyond a couple of servers, HP server blades quickly become compelling from a pure cost standpoint. The specific number of servers needed to transition from rack mount to server blades will vary depending upon the specific customer configuration; whether the HP BladeSystem is connected to a SAN, the type of network interconnects, etc.

For example, with as few as eight server blades with network connectivity, the HP BladeSystem is approximately 8 percent less expensive than comparable rack-mounted infrastructures. Figure 3 below shows the output from the HP BladeSystem TCO tool for an eight server configuration in a fully populated HP BladeSystem c3000 enclosure, comparing the HP ProLiant BL465c server blades against an HP ProLiant DL365 server.



Figure 3. BL465c versus DL365 TCO comparison



When checking the option to “Connect to SAN” in the TCO example above (not shown), the capital costs savings jumps to 21%. These costs benefits can significantly add up when looking at deploying tens to hundreds of server blades.

While the acquisition costs of the hardware may not be insignificant, the operational expenses make up the greatest percentage of the total cost of ownership for an OCS 2007 deployment. The major operational costs for OCS are much the same as they would be for any application deployment and include the following expenses:

- Real estate
- Power and cooling
- Management

For organizations looking to improve the density of their OCS IT environment, the HP BladeSystem provides the architecture to considerably reduce a data center’s infrastructure footprint. By consolidating to the HP BladeSystem, companies can realize a significant reduction in the real estate footprint. Organizations can deploy up to 64 server blades in a single 42U rack. This compares to a total of only 42, 1U rack mount, or 21, 2U rack-mount servers in the same space. And this can be accomplished without having to sacrifice server features and performance for density. The BladeSystem environment also allows customers to integrate the necessary network and storage area network switches or HP Virtual Connect modules within the enclosure. In a traditional non-blade environment, these components would consume valuable rack space in the data center and generate a significant cable management problem in dense server environments. With the HP BladeSystem

environment, cable and port reduction can save money and help reduce unplanned downtime attributed to human error.

Another common misconception is that a server blade consumes more power and/or requires more cooling than comparable rack mount models. This is also not true. In fact, in a study directly comparing rack mount and server blades, the rack mount servers actually consumed more power<sup>4</sup>. However, because of the density of a server blade environment, data center layouts need to be designed and validated to meet the power and cooling requirements of increasingly dense server environments. Technologies such as the HP Modular Cooling System<sup>5</sup> and HP Dynamic Smart Cooling<sup>6</sup> can help customers increase cooling resources in dense server environments. However, one of the major focuses during the design phase of the HP BladeSystem was around improving the intelligence and efficiency of the infrastructure. The HP BladeSystem will treat power and cooling requirements as a resource; dynamically adjusting the power supply utilizations and fan speeds to provide a more efficient utilization of thermal resources than rack or tower mount servers. The operational costs shown above in Figure 3 report a 34% savings in terms of power and cooling resources compared to the 1U rack mount server.

The cost benefits of the HP BladeSystem in terms of hardware, real estate, power and cooling are tangible benefits that provide real dollar returns for a company's OCS 2007 deployment. Beyond these costs, server management makes up the other major chunk of operational costs that is incurred. To maximize the benefits of the integrated HP BladeSystem environment and reduce operation costs, HP provides a centralized management and deployment environment with HP Insight Control. With HP Insight Control, management of server, storage and network resources is controlled from a single console interface. The HP BladeSystem also provides location awareness and system intelligence integrated into the management environment. Combining this awareness and intelligence, with the flexibility of the HP BladeSystem architecture also allows customers to react more dynamically to shifting business requirements.

## HP BladeSystem c-Class architecture overview

The HP BladeSystem c-Class portfolio consists of a number of different components designed to meet the demands of a wide range of customer architectures. Customers can choose between two enclosure models, the c7000 and c3000, various types of blade devices including server, storage, and expansion devices, numerous I/O connectivity modules, and several types of power options. This flexibility enables customers to design and architect a solution that meets their needs, from the smallest, remote office deployments to large-scale enterprise data center implementations.

One of the driving factors behind the HP BladeSystem is the concept of a "blade everything" model. This means not only designing server blades, but also looking at redesigning other aspects of the data center into a blade form factor. This includes blades for local direct-attached and shared storage, tape blades for local tape backup, and workstation blades for workstation computing.

As of September 2007, the following server blades are available:

- ProLiant BL460c server blade
- ProLiant BL465c server blade
- ProLiant BL480c server blade
- ProLiant BL680c server blade
- ProLiant BL685c server blade
- Integrity BL860c server blade

The naming convention is such that models ending in a zero are based on Intel® Xeon® or Itanium® CPUs, while model numbers ending in 5 are based on AMD Opteron™ CPUs.

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<sup>4</sup> Please read the report published at [www.hp.com/go/blade/powerreport](http://www.hp.com/go/blade/powerreport) for more information on the study.

<sup>5</sup> <http://h18004.www1.hp.com/products/servers/proliantstorage/racks/mcs/index.html>

<sup>6</sup> <http://h71028.www7.hp.com/enterprise/cache/434556-0-0-000-121.html>

Other available blade devices are<sup>7</sup>:

- StorageWorks Ultrium 448c tape blade
- StorageWorks All-in-One (AiO) SB600c shared storage blade
- StorageWorks SB40c storage blade
- HP PCI expansion blade
- ProLiant xw460c blade workstation

All of the blade devices are interchangeable between the c3000 and c7000 enclosures (described in more detail in the [HP BladeSystem c7000 enclosure](#) and [HP BladeSystem c3000 enclosure](#) sections below). The BL460c and BL465c are half-height server blades and up to 16 can be installed in a single c7000 enclosure, or 8 in a c3000 enclosure. The BL480c, BL680c, BL685c and BL860c are full-height server blades and up to 8 can be installed in a c7000, and 4 in a c3000 enclosure.

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**Note:**

The HP BL860c<sup>8</sup> server is based on the Intel Itanium processor family and is not supported with Microsoft Office Communications Server 2007 or Microsoft Exchange Server 2007.

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On the Intel side, the BL460c and BL480c are two processor servers with support for either dual-core or quad-core processors. This provides scalability of up to 8 processor cores for these blades. The BL680c is a four processor, quad-core server blade with the ability to scale out to 16 processor cores. For the AMD server blades, the BL465c is a two processor server with dual-core processor support. The BL685c is a four processor server with dual-core processor support.

Moving beyond the server blades, there are several storage blade options that can be utilized for Microsoft Office Communications Server 2007 deployments. These include the SB40c, SB600c storage blades, and the 448c tape blade. The SB40c is a half-height blade that supports up to six small form factor (SFF), serial attached SCSI (SAS) or serial ATA (SATA), drives. This provides up to 876 GB of direct attached storage (DAS) to an adjacent server blade. The SB600c consists of two half-height blades and provides iSCSI or NAS connectivity to shared storage consisting of up to eight SFF SAS drives. The SB600c also includes the AiO Storage Manager (ASM) for simplified setup and administration of storage for applications like Exchange and SQL Server. The Ultrium 448c tape blade is a half-height blade that provides direct attached and network based data backup within the enclosure.

### **HP BladeSystem c7000 enclosure**

The c7000 enclosure is a 10U chassis designed to provide the power, cooling, and I/O requirements necessary to support business and mission-critical applications in the data center. The c7000 can support a combination of up to 8 full-height or 16 half-height blades. See the picture below (Figure 4) for an example of a fully populated c7000 enclosure with 16 BL460c servers.

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<sup>7</sup> Please visit [www.hp.com/go/bladeSystem](http://www.hp.com/go/bladeSystem) for the latest HP BladeSystem portfolio information

<sup>8</sup> For more information of the HP BL860c please visit <http://h18004.www1.hp.com/products/servers/integrity-bl/c-class/860c/index.html>

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**Figure 4.** Fully populated c7000 enclosure with 16 HP BL460c server blades



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There are two additional features on the c-Class enclosure worth noting from Figure 2 above. First, up to six power modules can be installed in the enclosure. This provides either single or three phase N+N or N+1 redundant power, self-contained within the enclosure. The second thing to observe is the integrated HP Insight Display panel. The HP Insight Display provides administrators an easy way to perform initial enclosure setup and a diagnostic display of the status of the HP BladeSystem environment.

Figure 5 below shows an example of a fully populated c7000 enclosure from the rear view.

**Figure 5.** Rear view of c7000 enclosure



The c7000 enclosure supports up to four, fully redundant, or eight non-redundant, I/O modules supporting Fibre Channel (FC), Ethernet, and InfiniBand (IB) protocols. Customers have the choice between several different I/O interconnect types including pass-thru, integrated switches, and HP Virtual Connect<sup>9</sup> modules. In total, the HP BladeSystem c-Class provides up to 5 Tb of available bandwidth to the 16 server blades in the chassis. The bottom slot in the enclosure (directly above the bottom set of fans) is where the HP Onboard Administrator (OA) management modules are installed<sup>10</sup>. The Onboard Administrator serves as the brains of the enclosure, reporting on system health, power usage and cooling status.

The c7000 enclosure also utilizes a new fan architecture design. The HP Active Cool fans are an integral part of the c7000, providing a unique mix of optimized cooling, acoustics, airflow and performance to make thermal regulation more efficient than ever. The HP BladeSystem c-Class supports up to ten fans for complete redundancy across the enclosure<sup>11</sup>.

### **HP BladeSystem c3000 enclosure**

The c3000 enclosure is a 6U chassis designed to meet the demands typically associated with mid-market and remote office deployments, or data centers with special power requirements. The c3000 can support up to 8 half-height or 4 full-height blades, and supports the same blades as the c7000 enclosure. Figure 6 below shows a picture of the front of a c3000 enclosure with 8, half-height server blades.

<sup>9</sup> For more information on the HP Virtual Connect technology please visit, [www.hp.com/go/bladeSystem/virtualconnect](http://www.hp.com/go/bladeSystem/virtualconnect)

<sup>10</sup> Only one module is required, with the second module available for redundancy.

<sup>11</sup> For more information on the HP Thermal Logic technology with the HP BladeSystem please visit, [www.hp.com/go/bladeSystem/thermallogic](http://www.hp.com/go/bladeSystem/thermallogic)



**Figure 6.** Fully populated c3000 enclosure with 8 HP BL460c server blades



Like the c7000 enclosure, on the front of the c3000 enclosure is the Insight Display LCD for troubleshooting and configuring the enclosure directly from the unit. However, there are some additional changes that make the c3000 more suitable for smaller mid-market customers. On the front of the enclosure is an integrated DVD ROM drive that can be shared out to any of the server blades in the enclosure. This provides local media access and simplifies server setup and configuration from local media. The power supply modules have also been moved to the rear of enclosure. Figure 7 below shows a picture of the rear of the enclosure.

**Figure 7.** Rear view of c3000 enclosure



The power modules have been redesigned to run on either single phase power (C13/C14 power cord connection to an in-rack PDU) or standard 110 VAC low-line power from a wall outlet. This is designed to facilitate the deployment on blades for smaller environments where large scale data center power options may not be available.

The Onboard Administrator, cooling, I/O interconnect architecture remains unchanged from the c7000 with interchangeable OA modules, fans, I/O devices. The difference between the two units is that the c3000 only requires 6 fans for redundant cooling, where the c7000 utilizes 10. The c3000 also has fewer I/O bays, 4 as compared to the 8 bays in the c7000.

For a thorough look at the HP BladeSystem architecture, please visit [www.hp.com/go/bladeSystem](http://www.hp.com/go/bladeSystem).

## Designing a Microsoft Office Communications Server 2007 deployment with the HP BladeSystem

Microsoft Office Communications Server 2007 is a complex application. Depending on the customer profile and the desired functionality, there are numerous server roles that might be required. How many users will be supported? Will the deployment support only internal IM and web conferencing? Will external users be supported? Will Enterprise Voice be deployed? Is archiving for compliance a requirement? All of these questions will help shape what the design of an OCS 2007 environment will look like. Fortunately, Microsoft has taken an approach that helps to simplify the design of an OCS 2007 environment.

Microsoft has standardized on three base level installations for OCS 2007. The three configurations are OCS 2007 Standard Edition (SE), OCS 2007 Enterprise Edition (EE) consolidated, and OCS 2007 Enterprise Edition expanded configuration. Any deployment of OCS 2007 will be based on one of these deployment models. For small to medium configurations the OCS 2007 SE configuration can be used. This configuration is designed to support less than 5,000 users and doesn't address high availability or scalability. To add support for more than 5,000 users and/or high availability, the OCS 2007 EE consolidation configuration should be deployed. The consolidated configuration is designed to support up to 30,000 users. For larger, global deployments beyond 30,000 users and looking to implement high availability along with increased scalability, the OCS 2007 EE expanded configuration should be the design choice.

Each of these configurations provides the same base feature set including internal IM, presence information, and web conferencing. However, there is additional functionality that OCS 2007 supports. This includes IM and conferencing support for external users, federated access for users from other companies, web access to IM/presence information, archiving and call detail record (CDR) functionality, and Enterprise Voice (VoIP solution) integration with existing telephony environments. These features can be added incrementally to any of the standard configurations. This allows companies to take a building block approach to the design and deployment of OCS. One of the fundamental design goals for the HP BladeSystem infrastructure was to provide customers a modular architecture that can help customers realize significant cost-savings through a building block approach to application deployment. This design complements Microsoft's vision for deploying OCS 2007.

This section of the white paper centers on the three OCS 2007 base configurations. The focus of the discussion is around the high-level design decisions and how those will impact the OCS 2007 architecture. The goal is to provide customers with an idea of how an OCS 2007 deployment will map into an HP BladeSystem infrastructure and to give customers an idea around the hardware requirements necessary to support an OCS 2007 deployment.

The configurations are based on the information provided in the "Microsoft® Office Communications Server 2007 Planning Guide<sup>12</sup>". Microsoft provides general guidelines around the number and type

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<sup>12</sup> This document can be downloaded from <http://www.microsoft.com/downloads/details.aspx?familyid=723347C6-FA1F-44D8-A7FA-8974C3B596F4&displaylang=en>



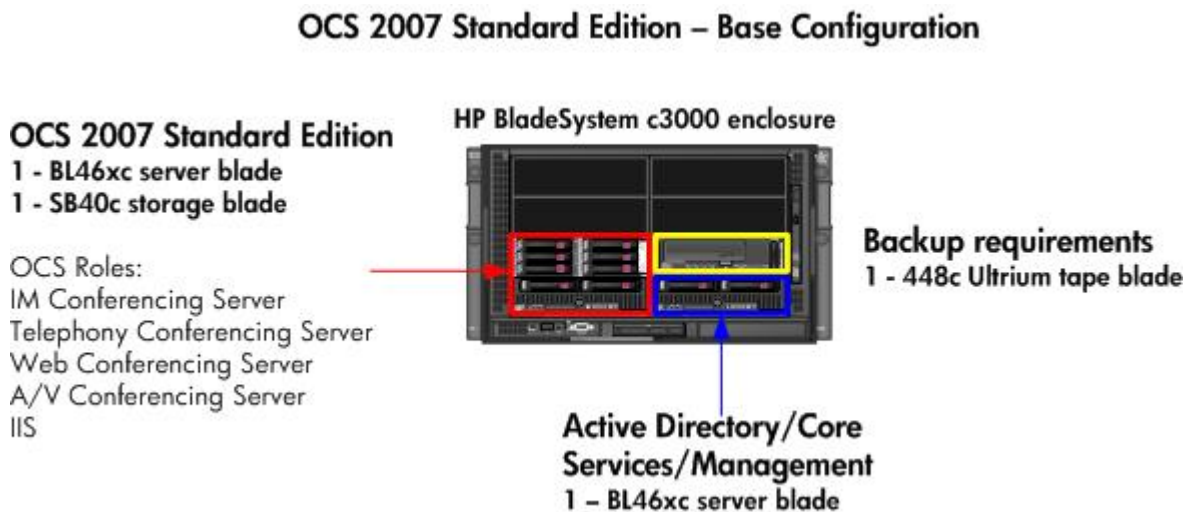
of users supported for each configuration. Those guidelines will be the basis of the OCS 2007 architectures discussed below. There is extensive detail provided around the user modeling and it is highly recommended that you become familiar with this information. This information can be found in “Step 5 Review System and Network Requirements” of the Microsoft planning guide.

As is the case with any application deployment, the user profile will have a significant impact on the infrastructure design. These configurations should only be used as base example configurations that can be modified and extended as the user profiles and functionality changes. HP Solution Alliances Engineering (SAE) is currently working on performance modeling of OCS 2007 in an effort to determine the specific performance requirements for different OCS functionality and user profiles. We plan to make this information available for download from the HP ActiveAnswers website, [www.hp.com/solutions/activeanswers](http://www.hp.com/solutions/activeanswers) or directly from the Unified Communications solutions web page, [www.hp.com/solutions/microsoft/uc](http://www.hp.com/solutions/microsoft/uc). The first document in this series is planned to be the “Performance report for Microsoft Office Communications Server 2007 Consolidated Server Architecture on HP BladeSystem”.

## OCS 2007 Standard Edition

The base SE configuration is a single server solution supporting IM, presence, web conferencing, and VoIP (without integration to existing telephony systems). The SE configuration is designed to provide a simple, cost-effective deployment option for a small number of users at a single location. This configuration would be targeted towards smaller companies, new installations (greenfield) or remote office deployments. Since the solution is based on a single OCS server, there is no application level redundancy and high availability. This deployment should only be considered when IM and conferencing are not considered a mission-critical application for the customer. Figure 8 below shows an example design of a base SE configuration using an HP BladeSystem c3000 enclosure. This solution is designed to support up to 5,000 users<sup>13</sup>.

**Figure 8.** OCS 2007 SE base configuration example configuration



There are three components to this solution. A single Active Directory (AD) server running on a BL46xc server blade provides the necessary directory information. Like many Microsoft applications, OCS 2007 leverages AD for user and application configuration information, and an existing AD forest is a requirement. OCS doesn't overly stress AD, so a single AD server is sufficient from a performance standpoint for this configuration. However, this is a single point of failure and additional AD servers

<sup>13</sup> All user profile information is based on information from the “Microsoft® Office Communications Server 2007 Planning Guide”

are required to provide high availability. This approach is taken in the OCS 2007 configurations discussed below.

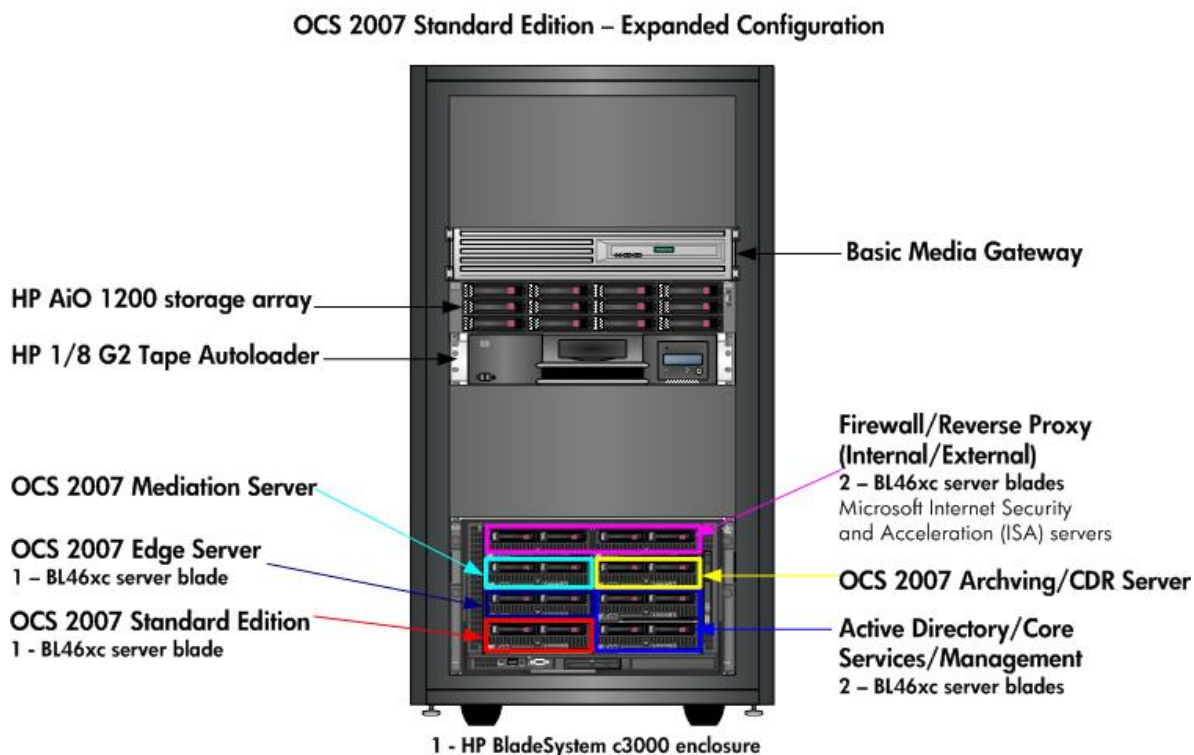
The second server in the c3000 enclosure is the OCS 2007 SE server. This server supports all the base OCS server roles on a single BL46xc server blade. This includes the IM, telephony, web, and A/V conferencing server roles along with IIS. The BL46xc is a two-socket server blade, supporting either a dual- or quad-core processor per socket depending on the specific model chosen. And the BL46xc can support up to 32 GB of memory. Microsoft recommends a dual-processor, dual-core server model with 4 GB of memory for this server role. The BL46xc provides more than the necessary CPU and memory requirements.

Also located on the OCS server in the SE configuration is the SQL Server instance, Microsoft SQL Server 2005 Express Edition. The SQL database stores user information and conference state information. To support the storage requirements of the backend SQL Server database, an HP StorageWorks SB40c storage blade was configured. The SB40c provides up to an additional six small form factor (SFF) 2.5" spindles directly attached to the adjacent server blade. The number of drives required will depend upon the usage profile but the SB40c gives you the flexibility to add the additional drives, and separate the SQL logs and database LUNs on separate physical disks to improve availability, without requiring external storage. The base recommendation for a 5,000 user SE configuration are two isolated two disk mirror sets, one for the SQL database and one for the SQL transaction logs.

The third component in this base configuration is the HP StorageWorks Ultrium 448c tape blade. This provides local network-based backup for the AD and OCS SE servers. This functionality can be provided by an external tape or backup target. However, for small deployments, providing a complete solution within the c3000 enclosure makes the deployment simpler and easier to manage.

From this base building block, additional server roles can easily be added to the OCS 2007 deployment to support additional features and functionality. The following example configuration, Figure 9, builds upon the base SE configuration from Figure 8 above and adds support for external access to IM and presence, archiving and CDR support, and Enterprise Voice.

**Figure 9.** Example configuration with a full OCS SE feature set



From the first base SE configuration above, the SB40c storage blade and 448c tape blade are removed and the c3000 enclosure is fully populated with 8 BL46xc server blades to support the increased feature set for the deployment. A second BL46xc server blade is configured as an AD server to provide additional availability for the directory service. One of the BL46xc server blades is used to support the OCS 2007 Edge server role. This consolidated Edge server includes the access edge, web conferencing edge, and A/V edge server roles on a single machine. This role allows external users to participate in IM sessions and A/V web conferences while outside the internal network. To do this securely, two security servers have also been added to this configuration. Two BL46xc server blades with Microsoft Internet Security and Acceleration (ISA) Server installed function as the firewalls and HTTP reverse proxy server to support secure access to the OCS 2007 Edge server from the external network. For compliance purposes, an OCS 2007 Archiving and CDR server role is configured on an additional BL46xc. Finally, the last BL46xc server in the enclosure is configured as an OCS 2007 mediation server to support Enterprise Voice integration.

To support the OCS 2007 SE SQL database storage requirements, an external HP StorageWorks 1200 All-in-One (AiO) storage array was utilized<sup>14</sup>. This provides iSCSI connectivity for 12 large form factor (LFF) 3.5" SAS drives. The AiO1200 will also support the SQL database instance for the archiving and CDR server. The archiving service utilizes a SQL database to maintain a record of IM conversations while the CDR service uses the SQL database to store detailed call record information. Instead of the internal Ultrium 448c tape blade, an external tape autoloader was configured in the rack to support network-based backup and restore requirements for AD and the OCS server roles.

The final component in the rack is the media gateway device. There are three mechanisms to provide VoIP integration with existing telephony systems as outlined in the [Microsoft Office Communications Server 2007](#) section above. For this example configuration, a single basic media gateway and mediation server are configured to provide this integration.

<sup>14</sup> For more information on the AiO 1200 array please visit <http://h18004.www1.hp.com/products/storageworks/aio1200/index.html>

From a networking standpoint, both the base configuration and expanded base configuration examples have the same options available. This includes pass-thru, integrated switch, or HP Virtual Connect Ethernet modules. The choice will depend on the specific customer's network requirements and current network infrastructure. For the expanded configuration, additional consideration must be taken due to the placement of internally and externally facing servers in the same enclosure. There are several options that are available to maintain security in this configuration. Pass-thru modules can be used to maintain physical isolation of every network cable. While this provides a distinct physical security boundary, this reduces the benefit of cable consolidation associated with an HP BladeSystem deployment and most likely requires additional network components outside the enclosure. A second option is to use integrated switches or Virtual Connect modules and utilize Virtual LANs (VLANs) as a logical security boundary on the switch. Individual ports can then be configured in specific internal or external VLANs to maintain isolation. A third option is to utilize an additional Ethernet mezzanine card and interconnect module to provide physical isolation between network cards. Then, only the externally facing servers would be configured with an additional Ethernet mezzanine card and that network would be used to route to the public network through a different switch or Virtual Connect module than the internal traffic. Each of these options has pros and cons and must be evaluated on a case by case basis to determine what the best approach for a specific customer deployment is.

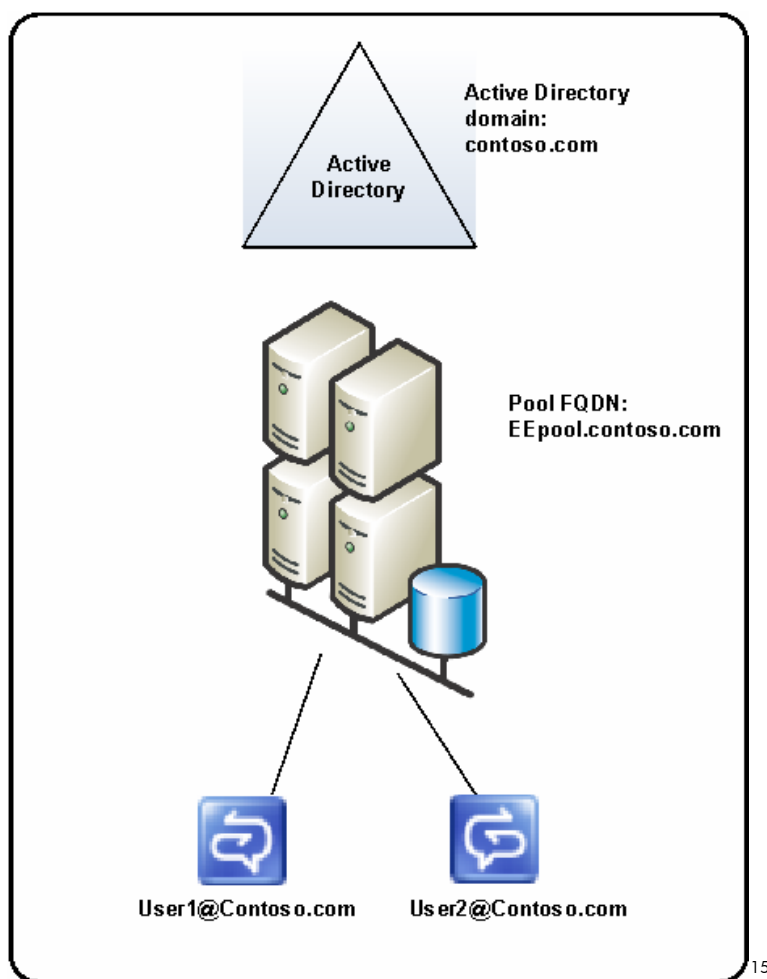
The limitation of any OCS 2007 SE configuration is the lack of high availability, fault tolerance, and scalability for the solution. While multiple AD, firewall, Edge, Mediation server/Gateway pairs, and Archiving/CDR servers can be deployed to provide high availability for those server roles, the base OCS SE server with a local SQL database instance will still be a single point of failure for the entire deployment. Thus, an OCS 2007 SE configuration should only be explored when OCS will not be considered business or mission-critical. For small to medium sized companies evaluating OCS 2007, departmental deployments, or remote branch offices, the OCS 2007 SE configurations may prove to be a compelling deployment model for implementing a cost-effective unified communications solution. And the HP BladeSystem c3000, focused on addressing remote office and midmarket customer needs, is the target infrastructure platform to deploy the solution on. Organizations requiring additional scalability and fault tolerance for their OCS deployment should look towards OCS 2007 EE and the HP BladeSystem c7000 enclosure for their mission or business-critical deployments as discussed in the example configurations below.

## OCS 2007 Enterprise Edition

Maintaining the building block approach, the features supported by the base OCS 2007 Enterprise Edition configurations are the same as the OCS 2007 SE configurations. And like the OCS SE installation, to add functionality, additional server roles can be added incrementally. However, the fundamental shift is around the design of the core OCS server role infrastructure. While the OCS 2007 SE configuration only allowed a single server with a local SQL database instance, the OCS 2007 EE configurations allow the use of multiple OCS EE servers and a dedicated SQL database server (or cluster) to provide increased availability and scalability.

There are two base OCS 2007 EE architectures. These are the EE consolidated and EE expanded configurations. The consolidated configuration is designed to support up to 30,000 users and utilizes a pool of servers to support the OCS front-end, A/V conferencing, and web conferencing server roles. Figure 10 below depicts a basic logical representation of the server pool architecture for the EE consolidated configuration.

**Figure 10.** Logical diagram of an OCS 2007 EE pool consolidated configuration



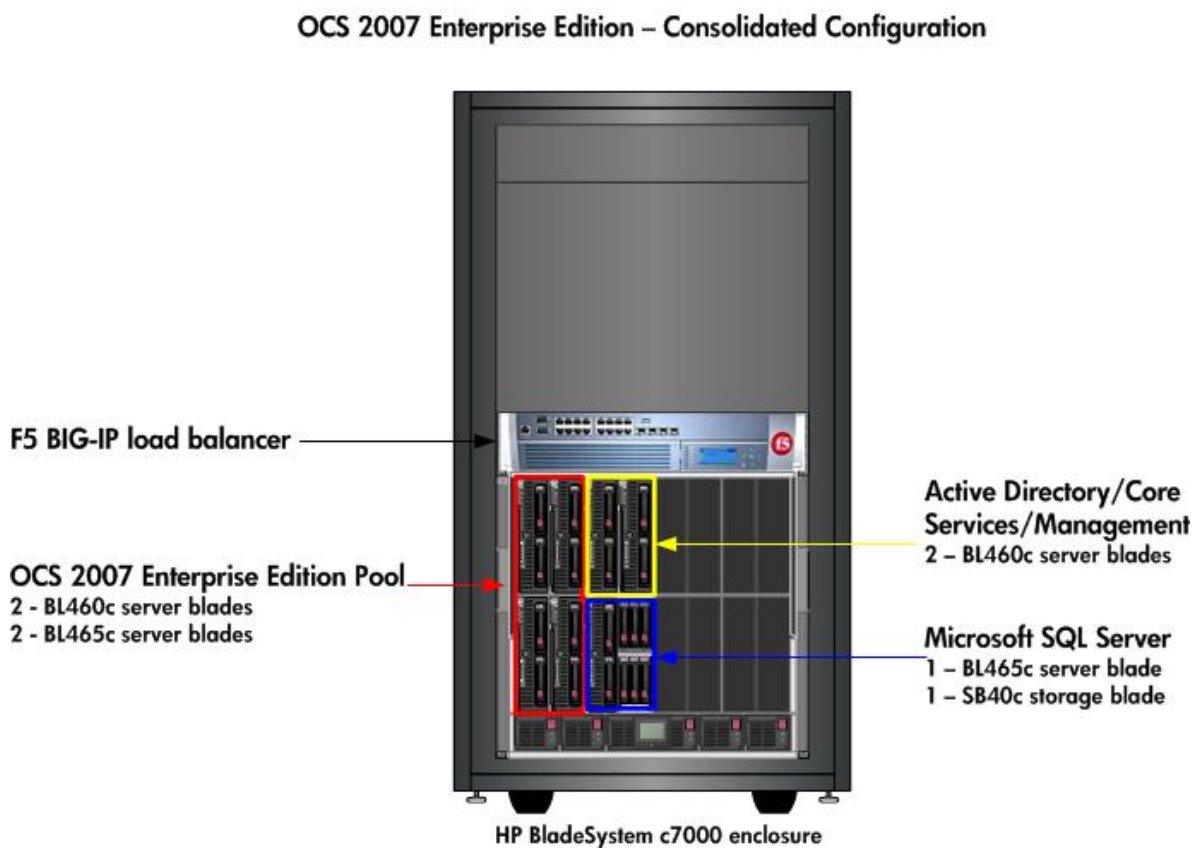
The multiple front end servers in the EE consolidated server pool provide a high availability solution for OCS. In the event of an individual server failure, the clients will automatically reconnect using one of the other available servers in the pool. This architecture also provides opportunities to patch or update servers since a single server can be taken offline without taking the entire service offline. If a server does go offline, the clients will experience a brief interruption of the service (IM, presence, or conferencing) and then quickly reconnect to resume the service through another front end server in the pool.

A hardware load balancer is used to evenly distribute the service requests to the servers in the pool. The SQL database is configured on a dedicated server, or for even higher levels of availability, an Active/Passive SQL server cluster. This provides high availability for the SQL database and improves performance of the front end server no longer tasked with running SQL Server.

Figure 11 below provides an example configuration based on the basic OCS 2007 EE consolidated configuration. This configuration is designed to support up to 30,000 users and utilizes four servers in the EE pool.

<sup>15</sup> This diagram is from the "Microsoft Office Communications Server 2007 Planning Guide" that can be downloaded from <http://www.microsoft.com/downloads/details.aspx?familyid=723347C6-FA1F-44D8-A7FA-8974C3B596F4&displaylang=en>

**Figure 11.** Example configuration for an OCS 2007 EE consolidated configuration



For this configuration, an HP BladeSystem c7000 enclosure is utilized. This provides support for up to 16 half-height blades or 8 full-height blades and enables greater scalability in a single enclosure than the c3000. In this example configuration, the c7000 enclosure houses seven server blades and one storage blade. Four server blades (2 BL460c and 2 BL465c blades) make up the EE pool configuration. In order to balance load between the EE pool servers, a hardware load balancer is used. In this case, an F5 Networks BIG-IP load balancer was configured to enable client redirection to the EE pool servers. Any other comparable load balancing product could also be utilized to provide the load balancing functionality between the EE pool servers. For the configurations in this white paper, the F5 BIG-IP load balancer is used as the example device.

Two BL460c server blades are configured as AD servers, providing directory service redundancy. The final server blade is the dedicated SQL server running on a BL465c blade. This blade is directly attached to the SB40c storage blade to support the storage requirements of the SQL database. For this configuration, the SQL server is not deployed in a cluster, so a loss of the SQL server would bring the OCS infrastructure offline until the SQL server was restored.

**Note:**

Microsoft OCS 2007 is a 32-bit application and will only utilize up to 4 GB of memory per server on a 32-bit Windows server. However, if SQL Server is deployed on a stand-alone server (OCS 2007 EE configurations only) then the Microsoft Windows Server 2003 x64 OS can be utilized to install the 64-bit version of SQL Server. Using a 64-bit version of SQL Server can improve database performance and scalability.

Noticeably missing from this example configuration is any backup/restore solution. Given that this is an enterprise deployment configuration, an existing tape or disk-to-disk backup infrastructure may already be in place. Otherwise, there are a number of options that can be implemented to provide backup and restore functionality for this environment. For more information on HP tape storage and the HP Virtual Library Systems please visit

<http://h18000.www1.hp.com/storage/tapestorage/index.html>.

From a networking standpoint, the options are the same as outlined above in the OCS 2007 SE configurations. These include the pass-thru, integrated switch, and HP Virtual Connect modules. Since there are no externally facing servers in the enclosure, isolating multiple internal and external networks is not a consideration.

This specific configuration is the first focal point of testing being conducted by HP's Microsoft Solution Alliances Engineering team. Testing and analysis is currently underway to determine the specific performance thresholds and user loads that this configuration can support. We plan to make the results of this testing available in a "Performance report for Microsoft Office Communications Server 2007 Consolidated Server Architecture on HP BladeSystem" white paper available on the HP ActiveAnswers website, [www.hp.com/solutions/activeanswers](http://www.hp.com/solutions/activeanswers) or directly from the Unified Communications solutions page, [www.hp.com/solutions/microsoft/uc](http://www.hp.com/solutions/microsoft/uc).

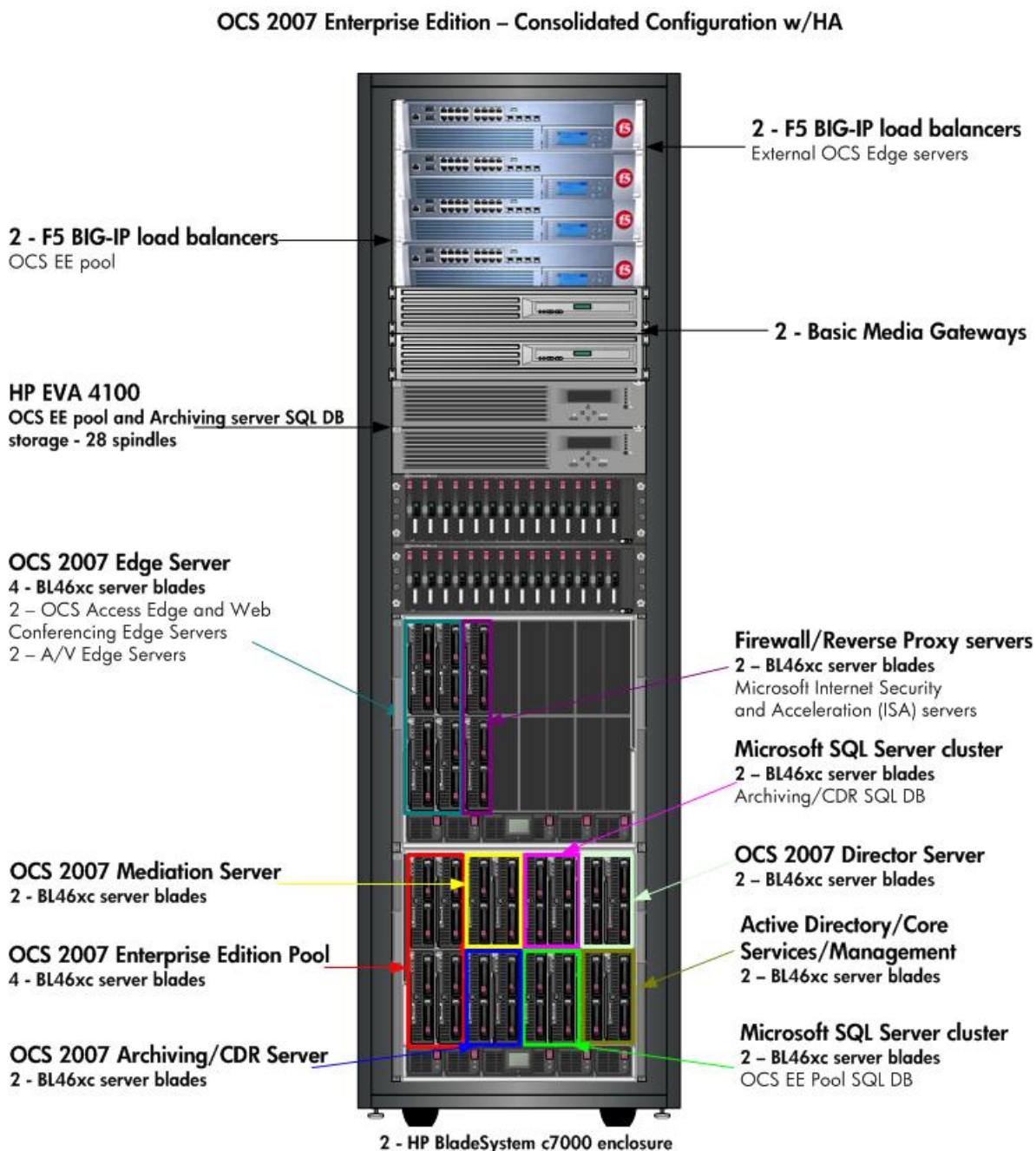
Looking at this configuration, an HP c3000 enclosure could have been used to house the server and storage blades. However, there are gaps in availability and functionality in the base OCS 2007 EE consolidated configuration. To provide a fully fault tolerant solution without a single point of failure, and a full OCS 2007 feature set, requires additional server blades. By deploying the c7000 enclosure, additional servers can be easily added to the enclosure without having to rack and wire equipment in a live data center. This provides a very scalable solution that can easily be grown as additional redundancy is required or features are demanded. This also provides an infrastructure in which other applications could be consolidated into, providing a single enclosure to deploy and manage in a small, consolidated footprint.

The next example configuration (Figure 12) takes this scale out approach, depicting a full featured, highly available OCS 2007 EE consolidated configuration using two HP c7000 enclosures.

From the base EE consolidated configuration, support for OCS 2007 Archiving/CDR, Enterprise Voice, and external access to IM, presence, and web conferencing has been added.



**Figure 12.** Example configuration for an HA OCS 2007 EE deployment



Within the bottom c7000 enclosure are 16 BL46xc server blades. The same 4 server blades are configured for the OCS EE pool as was in the previous example. For this configuration, two F5 BIG-IP devices are installed in the rack to provide load balancing between the four EE pool servers. Two BL46xc server blades are also configured as AD servers. Unlike the previous example in which the single SQL Server instance was a single point of failure, for this configuration, two BL46xc server blades are configured as an Active/Passive SQL cluster. This provides a highly available SQL deployment in the event of a server failure.

To support the storage requirements for the SQL databases and a shared cluster quorum disk, an external HP StorageWorks 4100 Enterprise Virtual Array (EVA) configured with 28, 300GB, 10K RPM Fibre Channel (FC) drives is utilized. This will also provide the external storage requirements for

the two BL46xc server blades servicing the OCS Archiving/CDR role. The archiving servers utilize a separate Active/Passive SQL cluster deployed on an additional two BL46xc server blades. Microsoft's installation documentation indicates that sharing the two SQL databases on the same SQL server is not recommended. The 28 spindles provide sufficient storage capacity on the EVA4100 for both the archiving and OCS EE pool requirements based on the usage profile outline by Microsoft. But, the storage requirements will be entirely dependent upon the workload and usage of OCS in the specific environment. Depending on the amount of IM traffic that needs to be archived, the call volume and number of CDRs that are generated, how many web conferences are recorded, etc., the storage requirements may vary from the base recommendations from Microsoft. With the HP EVA4100, an additional 28 drives can be added to expand the array up to a total of 56 FC spindles. To grow past 56 drives, the EVA4100 can be upgraded to either an EVA6100 or EVA8100 to scale up to a maximum of 240 drives in the array. For more information on the HP StorageWorks EVA family of arrays, please visit [www.hp.com/go/EVA](http://www.hp.com/go/EVA).

To provide support for Enterprise Voice and integration with existing IP or PBX based telephony systems, two mediation servers running on BL46xc server blades and two basic media gateway devices are configured. The final two BL46xc servers are configured as OCS 2007 Director servers. The director server role is used to authenticate remote users and route traffic to the appropriate server or Enterprise pool. This server role is recommended for large deployments configured to support external access.

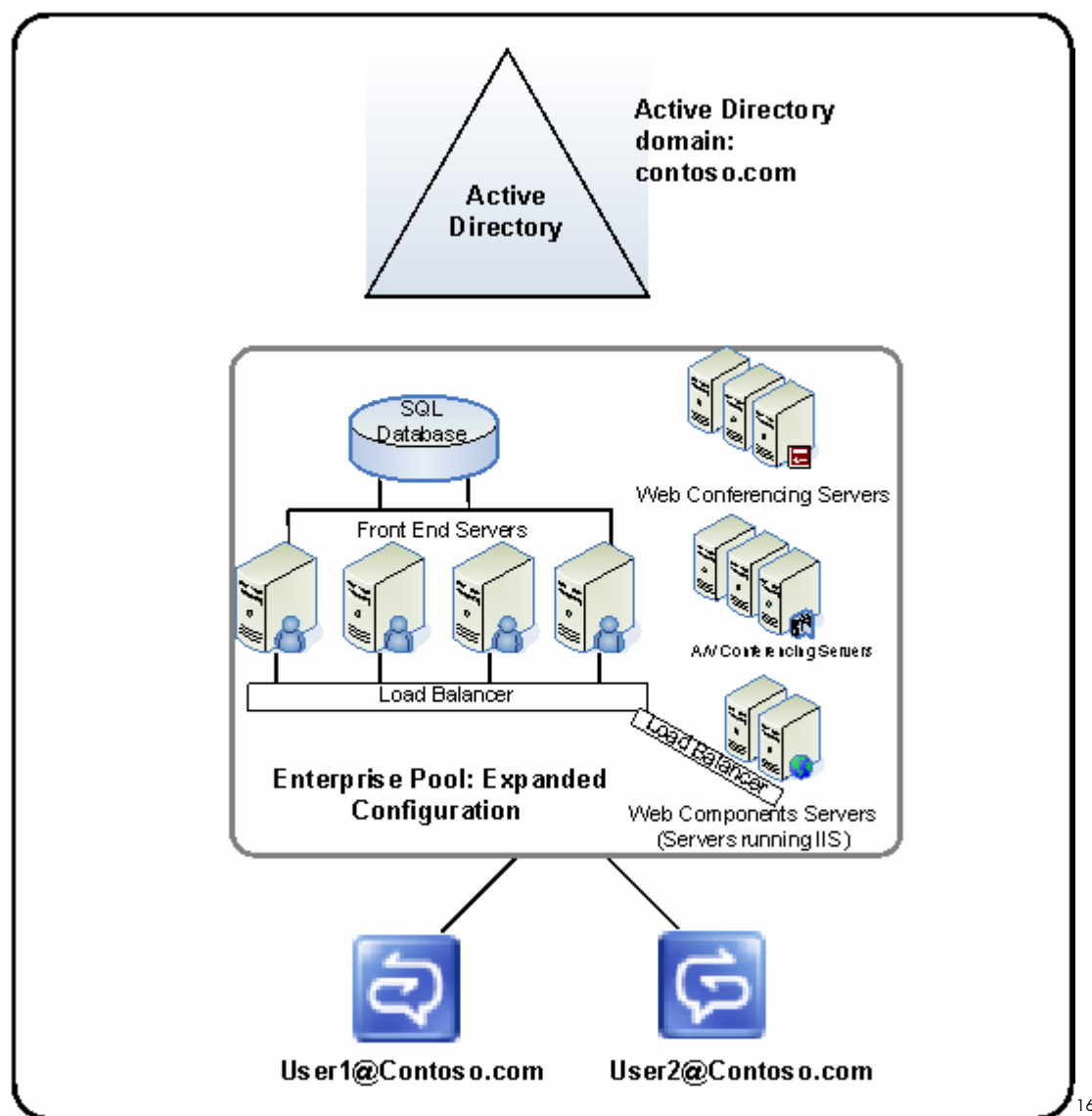
In the top c7000 enclosure, six BL46xc server blades have been configured. Four of the servers are configured as OCS 2007 Edge server roles. In order to provide high availability for the edge server roles, the three edge services (access, A/V, and web conferencing) must be broken out and can't be collocated on the same server blade. For this configuration, two of the servers are configured to run the A/V Edge role and the other two servers run the access and web conferencing services. This configuration could be scaled out even further by dedicating additional servers to the specific edge server roles. All four of these servers leverage the second pair of F5 BIG-IP load balancers to distribute incoming traffic. Finally, the other two servers are configured as firewall servers with Microsoft ISA Server to provide secure access to the BIG-IP load balancers and OCS Edge servers.

For network connectivity, the same options are available as for the previous configuration. In this configuration externally and internally facing servers are isolated in separated c7000 enclosures. The one change in I/O connectivity for this example configuration is the necessity for a FC connection to the EVA4100. To provide this connectivity from a server blade, the customer has the same three options as with Ethernet connectivity, pass-thru, integrated switch, and HP Virtual Connect Fibre Channel modules. For the SQL server blades, FC mezzanine cards would be added to provide the connectivity through one of three FC interconnect modules.

The EE consolidated configuration provides the level of high availability often required for business or mission critical applications that isn't attainable with OCS 2007 SE. However, because of the pool architecture and the sharing of multiple server roles on a single server, the EE consolidated configuration is not designed to scale beyond the 30,000 user level. The next evolution in the design of the OCS environment is moving beyond 30,000 users and providing support for large enterprise, global deployments scaling upwards of 125,000 users. To provide this level of scalability, the OCS 2007 EE expanded configuration should be the basis for the design. With the EE expanded configuration, all of the OCS server roles can be broken out to dedicated servers. This includes the web conferencing, A/V conferencing, and web components (IIS) which resided on the shared servers in the pool along with the IM and telephony services.

Figure 13 below depicts a basic logical representation of an EE expanded configuration for OCS 2007.

**Figure 13.** Logical architecture diagram of an OCS 2007 EE expanded configuration



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As the diagram depicts, in the EE expanded configuration topology, individual OCS server roles can be broken out onto separate physical servers. This provides the ability to add additional servers for specific OCS functionality under heavy utilization. For example, if the customer is a heavy user of Audio/Video web conferencing, additional dedicated A/V conferencing servers can be added as necessary to support the resource requirement. These dedicated role servers are configured as a load balanced cluster and provide the scalability and availability necessary for a large, enterprise business or mission-critical deployment.

Like the EE consolidated configuration, additional functionality can then be added incrementally to the solution to provide external access, archiving, and VoIP support. Given the large scale and complexity of the EE expanded configuration where specific customer requirements and number of users will dictate the number and type of server roles deployed, a separate example configuration on the HP BladeSystem is not discussed as part of this document. However, the same building block

<sup>16</sup> This diagram is from the "Microsoft Office Communications Server 2007 Planning Guide" that can be downloaded from <http://www.microsoft.com/downloads/details.aspx?familyid=723347C6-FA1F-44D8-A7FA-8974C3B596F4&displaylang=en>

approach to designing an OCS 2007 SE and EE consolidated configuration on the HP BladeSystem can be taken with the OCS 2007 EE expanded configuration design. The first step is to design the basic EE expanded configuration. Then build off of that initial design by adding functionality and availability incrementally until the desired featured set, performance, and redundancy levels have been reached to satisfy the service level agreements dictated for the OCS services. This will be especially important in large enterprises that rely on OCS 2007 as the primary telephony solution for the company. Like existing PBX based solutions, employees rely on the phone to be always on, with negligible downtime. This will need to be the same approach to designing an enterprise OCS solution that supports Enterprise Voice.

For large, global deployments with geographically dispersed infrastructures a mixture of OCS configurations may be utilized. For the primary data centers, OCS 2007 EE expanded configuration could be deployed; while in the remote offices, OCS SE or OCS EE consolidation configuration, could be utilized in order to provide adequate performance to local users. This will provide customers the opportunity to standardize on an HP BladeSystem infrastructure, while still deploying the right solution for the right environment. In the data center, the HP BladeSystem c7000 enclosure can provide benefits around power, cooling, and management to help reduce the costs of the OCS deployment. For the remote offices, the flexibility of the c3000 enclosure can be leveraged to provide an HP BladeSystem infrastructure that is optimized for remote office deployments where power and cooling limitations and limited IT staff abound.

## Conclusion

Microsoft Office Communications Server 2007 is one of the critical components of Microsoft's Unified Communications strategy. With OCS 2007, companies can deploy an enterprise class IM, presence, web conferencing, and VoIP solution to support the organizations communications requirements. Given the complexity of OCS 2007, customers should carefully evaluate and design an architecture that will not only provide the desired feature set, but also provide the required levels of scalability and high availability.

The goal of this white paper is to help customers begin to formulate an idea of the hardware design for their OCS 2007 deployments on the HP BladeSystem. Building from the base OCS 2007 Standard Edition up to the OCS 2007 Enterprise Edition installation, the HP BladeSystem provides a modular platform to help reduce the costs associated with deploying OCS versus traditional rack or tower architectures. Whether a remote office or a large data center, the HP BladeSystem can provide an infrastructure that meets the needs of the customer.

## For more information

For more information on the HP BladeSystem c-Class, please visit  
[www.hp.com/go/bladesystem](http://www.hp.com/go/bladesystem)

For additional information on Microsoft Office Communications Server 2007, please visit  
[www.hp.com/solutions/microsoft/uc](http://www.hp.com/solutions/microsoft/uc)

For additional information on Microsoft Unified Communications, please visit  
[www.hp.com/services/sprb/uc](http://www.hp.com/services/sprb/uc)

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