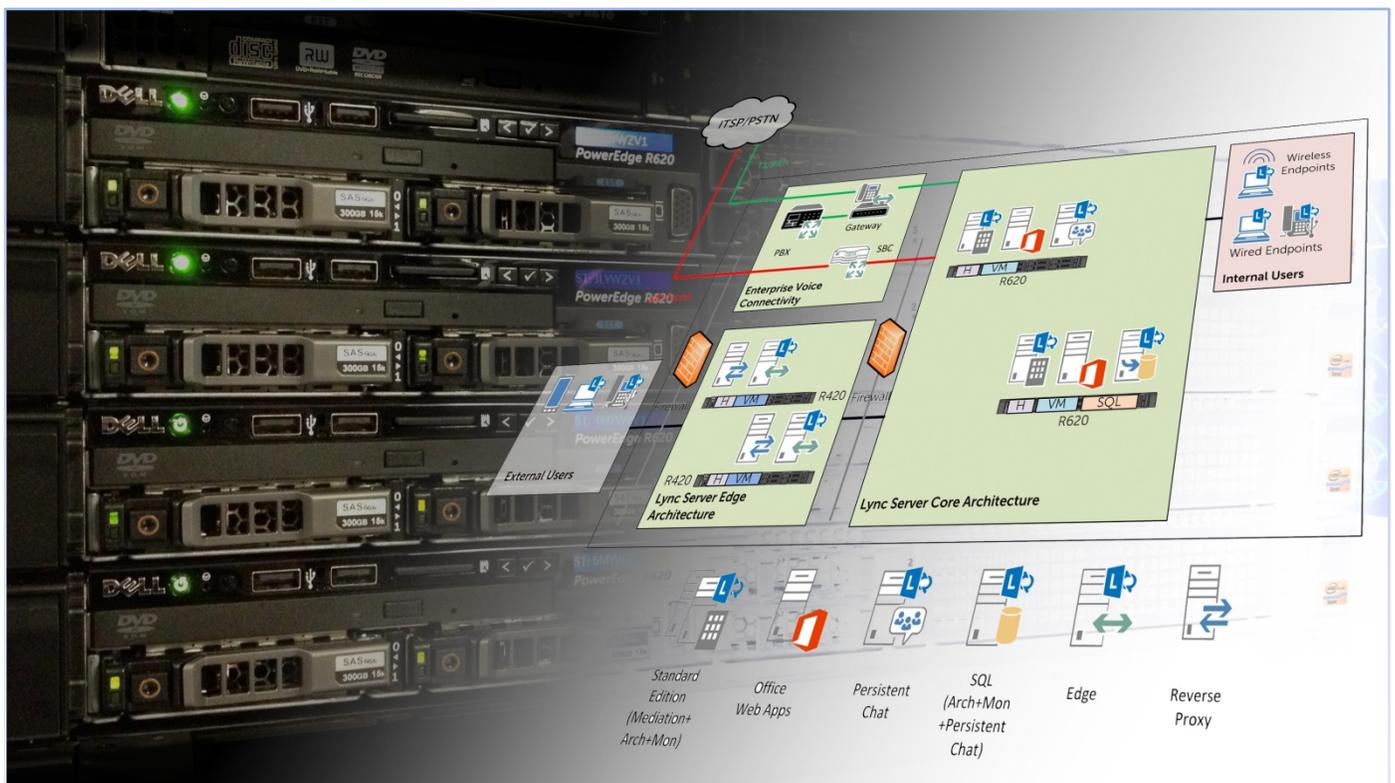




# Dell Unified Communication Solution with Microsoft Lync Server 2013 for Single Site Implementation

A Dell Reference Architecture for Lync Server 2013 Solution for a single site with up to 1,000 users



Dell Global Solutions Engineering  
October 2013



## Revisions

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# 1 Introduction

Unified Communication is becoming increasingly critical for organizations to have an efficient, flexible and effective work experience. It not only enables and provides the benefits of having real-time communication between peers, whether local, remote or geographically disbursed, but also enables instant communication with partners, suppliers and directly with customers. Further, all of these capabilities are provided while reducing the telephony, travel and IT cost.

This Dell™ Unified Communications Solution provides a complete solution not only with essential instant messaging, presence and audio-video conferencing but also with web conferencing and telephony integration (Enterprise Voice). The fully featured solution integrates Dell products, and Microsoft® Lync® Server 2013 software with Dell Services available for assistance if requested. The products consists of Dell™ PowerEdge™ servers, Dell™ Networking switches and wireless, third-party voice gateways, client devices such as Dell™ Latitude™ laptops and Dell™ XPS™ tablets and Ultrabooks™. The solution is designed to leverage server virtualization offered by Microsoft® Windows Server® 2012 with Microsoft® Hyper-V® to allow better consolidation and utilization of resources. Further, the architecture is designed for availability and functions upon the failure of a server<sup>1</sup>, network or voice gateway. Such a design enables IT administrators to perform maintenance tasks without incurring any Lync application downtime.

Microsoft Lync Server 2013 enables instant messaging, presence, audio-video conferencing, web conferencing and telephony solutions that support enterprise-level collaboration requirements. It can also integrate with existing PBX systems or replace aging PBX systems to offer a complete unified-communications experience, including telephony integration through the use of Lync clients.

Designing a complete Unified Communication Solution can be complex. To help with the process, the following reference architecture details the design and implementation for a 1,000-user Microsoft Lync Server 2013 implementation on a single site. The architecture provides resilient voice and conference services for the users that enable Lync features, including Enterprise Voice. Sizing of the architecture followed the Microsoft Best Practices and used the [Microsoft Lync Stress and Performance Tool](#) to generate real-time workloads on Lync servers. The voice gateways were also validated through a thorough lab study.

This reference architecture is structured in multiple sections. Section 2 goes over a quick introduction of the Lync Server 2013 and its key features and roles. It also briefly touches upon some of the major changes in the Lync Server architecture. Section 3 details the end-to-end design and implementation of the Dell Unified Communication Solution. It discusses the design principles that dictated the architecture. For simplicity, it breaks down the solution into five portions and goes in depth into each of them. Following this, Section 4 provides the technical specification, including detailing all the virtual and physical components that make up the complete solution. Toward the end of this guide, Section 5 provides an overview of the verification that was performed to ensure that the solution met the design principles.

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<sup>1</sup> Failure of the Front End Server requires the IT administrator to bring up another backup Front End registrar manually.



## 1.1 Audience

This reference architecture is intended for IT professionals and administrators interested in designing and deploying an end-to-end, real-time collaboration solution using Microsoft Lync Server 2013 on Dell servers and networking, third-party gateways/session border controllers, and associated client devices. While the reference architecture provides an overview of the important solution components, the reader is expected to have an understanding of Lync Server 2013 and voice gateways. Familiarity with Windows Server 2012 and Hyper-V virtualization will also aid the reader's comprehension of the content in this document.



## 2 Microsoft Lync Server 2013

Microsoft Lync Server 2013 enables instant messaging and presence, audio and video conferencing, web conferencing, and voice-interoperability. Its functionality can be extended by the use of Session Initiation Protocol (SIP) trunks or PBXs/voice gateways to communicate with users on the telephony network (PSTN). There are a number of different modalities that Lync Server provides to users, including:

- **IM and Presence:** The ability to view the status of other Lync users and update current status (Available, Busy, Away, etc.). Conferencing with multiple users via IM is also supported.
- **Audio Conferencing:** Communicate with other Lync users using SIP and Real-time Transport Protocol (RTP). Audio conferencing using Lync is especially cost-effective for enterprises with employees spread across geographical locations because users can communicate using the enterprise data network instead of expensive long-distance telephony.
- **Video and Web Conferencing:** Video and Web Conferencing allow users to run meetings using 1:1 and group video conferences, including optional recording, combined with desktop and application sharing. These workloads are available with Lync Server and can be leveraged for day-to-day tasks in the enterprise.
- **Voice Interop with PSTN:** Lync Server's Mediation Server role, which can be collocated on Front End or Standard Edition servers, works with a SIP trunk or telephony device (IP-PBX/gateway) to communicate with telephone users within and outside the enterprise. In order to have Lync and phone systems integrated, the Mediation Server role must be installed and configured.

Listed below are the new and existing server roles of Lync Server 2013:

- **Front End Server**—The Front End Server role handles Lync client authentication, instant messaging, web conferencing, audio-video conferencing and user presence updates. It is the central component of a Lync Server topology. The Front End Server has a local database that stores user data and topology information. This role can be deployed in an Enterprise Edition pool. In Lync Server 2013, the Archiving and Monitoring role is combined with the Front End role. The Archiving and Monitoring component of the Front End role can be used to monitor user statistics and quality of experience (QoE) within the Lync environment, for archiving conference content and instant messages for future audits. This component also allows IT administrators to access call detail records and quality of experience (QoE) statistics for Lync communication. Organizations can also deploy separate Archiving and Monitoring roles, or use the new unified archiving features in Exchange Server 2013, as per their requirements.
- **Back End Server**— Microsoft® SQL Server® serves as the backend for Enterprise Edition servers, and is also responsible for Archiving and Monitoring roles and Persistent Chat roles. SQL Server maintains a copy of the topology information, user contact lists, archiving/monitoring databases and logs, and other data. Lync Server 2013 supports SQL mirroring with primary and secondary copies. High availability for SQL databases can be provided via two SQL Servers servicing SQL mirrors.
- **Mediation Server**—This Lync role provides Enterprise Voice capabilities and handles the communication between Lync front ends and media gateways or session border controllers (SBCs). This role can be collocated with the front end. The Mediation Server facilitates traffic



encryption/decryption and transcoding. Traffic encryption and decryption is made possible by the use of TLS (Transport Layer Security) instead of traditional TCP. This is more secure than transmitting clear traffic over the wire. Transcoding refers to the process of converting media streams between different audio codecs. Transcoding becomes necessary if the telephony codec used is not G.711, i.e. the codec used by Lync.

- **Director Server**—This is an optional role in Lync Server 2013. The Director role provides resiliency and redirection to user requests to their home pool, which can be either a Standard Edition server or an Enterprise Edition Front End pool. A Director protects Front End servers from denial-of-service attacks and cannot be collocated with any other server role.
- **Persistent Chat Server**— This is a new and separate role in Lync Server 2013 that provides features similar to group chat in earlier versions of Lync. Persistent chat allows users to participate in multiparty and topic-based chat. Chats can be categorized by topic in a chat room and are not transient like un-archived instant message conversations or audio/video/web conferences.
- **Edge Server**—This role in Lync 2013 is responsible for handling all communications that are made available to external and federated users except anything related to HTTP/HTTPS. All other traffic, such as SIP or RTP, is routed to the external users using the Edge Server.
- **Standard Edition Server**—The Standard Edition server delivers the features of Lync Server 2013 using integrated databases on a single server. This configuration enables an organization to have Lync Server 2013 infrastructure at a low cost and in a form that can be deployed with a backup registrar<sup>2</sup> to provide limited high availability features. This handles all Lync workloads, including client authentication, instant messaging, user presence updates, web conferencing, audio/video conferencing and Enterprise Voice, all running on one server.

This reference architecture represents a single site Lync Server 2013 deployment with up to 1,000 users. Microsoft Lync Server 2013 Standard Edition is suited for small implementations that reduce customer total cost of ownership (TCO) and increase return on investment (ROI).

Listed below are the other roles that can be a part of a Lync Server 2013 deployment:

- **Office Web Apps Server**—Lync Server 2013 uses Office Web Apps Server to provide enhanced web conferencing with PowerPoint® presentations. This role enables the use of presentations with custom fonts, animated slides and higher-resolution content sharing.
- **Reverse Proxy Servers**—This role is an external component that complements the Edge Server role by handling web services traffic. With the Reverse Proxy, external users can access web services available

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<sup>2</sup> <http://blogs.technet.com/b/nexttop/archive/2013/09/04/understanding-hadr-in-lync-server-2013.aspx>



through simple URLs. Some of these features include meeting content downloads, address book downloads, location information and Lync Web App. HTTP and HTTPS traffic is routed to the Reverse Proxy, which then forwards the requests to the Front End Server.

## 2.1 Lync 2013 Standard Edition with Backup Registrar Pool

Microsoft Lync Server 2013 provides the option of using paired Standard Edition pools, one as the primary registrar and the second as the backup registrar. In cases with relatively small user counts, a Standard Edition server with backup registrar provides sufficient availability at lower cost. In the event of a primary registrar failure, ongoing calls still continue, but Lync clients display a "limited functionality" message.

In Lync Server 2013, when a Standard Edition Server is specified as a backup registrar in a paired Standard Edition pool, a new service called the Lync Server Backup Service is installed. This service provides real-time data replication to keep the pool synchronized. Replicated data includes user information, contacts, conferencing data and other information stored within the SQL Express database. When the Front End service is non-functional on the primary server, users fail over to the backup registrar with limited features. The most notable feature limitation is the lack of presence status (Available, Busy, In a meeting, etc.) on the Lync clients. When the IT administrator becomes aware of the Front End failure, he/she can fail over the pool to the backup pool by issuing commands in the management shell.

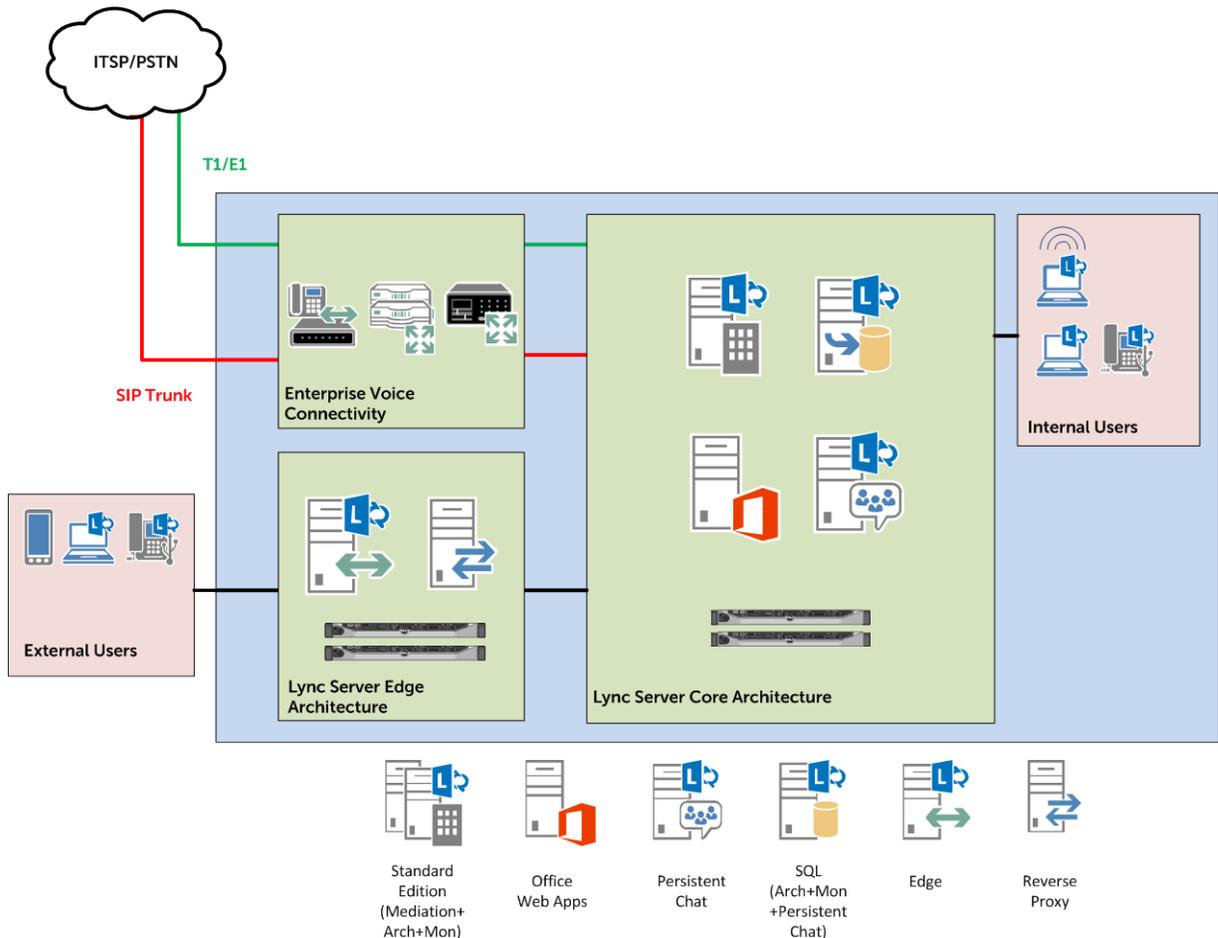
Even though administrator intervention is needed, the disruption that users experience can be mitigated, which enables reasonable service continuity for users.



### 3 Dell Unified Communication Solution Reference Architecture

A high-level diagram of the reference architecture is depicted in Figure 1. It shows a customer scenario that consists of a single site only. For voice connectivity, the site may have either ISDN (T1/E1) or SIP trunk connections provided by Internet Telephony Service Provide/Public Switched Telephone Network ITSP/PSTN providers. Although the customer may not have both ISDN (T1/E1) and SIP trunk, the design takes into consideration the different possibilities of voice connectivity.

Figure 1 Dell Unified Communication Solution Logical Architecture



There are four major portions of the reference architecture:

- Lync Server 2013 Core Architecture:** This area hosts the server roles that provide the main features of Microsoft Lync Server 2013, which include IM, presence, conferencing (web conferencing, audio-video conferencing, dial-in conferencing and IM conferencing) and others.



As expected, to support these crucial Lync Server components, sufficient computing and storage resource should be allocated to fulfill the demand from the targeted number of users. The design should incorporate high availability to ensure minimal service downtime. Therefore, multiple instances of those important server roles are utilized to avoid a single point of failure.

- **Lync Server Edge Architecture:** Edge Servers and the Reverse Proxy Servers are located at the perimeter network. They support the communications across the organization's firewall between internal users and various types of external users, such as customers, partners and offsite employees. For example, internal users can use IM and presence to communicate with external users, and they can participate in audio-video and web conferencing with remote employees.
- **Enterprise Voice Connectivity:** Besides the Voice over IP (VoIP) components at the Standard Edition servers and signaling and media translation by the Mediation Servers, there are other PSTN connectivity components required to implement the Enterprise Voice features. This portion covers those components, such as PSTN gateways, PBX and SBC, and how they connect to the Lync Server core architecture.
- **End User Connectivity:** End users connect with Lync services via different types of end-point devices. This reference architecture describes their connectivity options and highlights how Dell™ Networking W-series switches enhances the user experience of wireless-connected Lync clients.

The physical configuration and design criteria of each major portion will be addressed in the subsequent sections of this reference architecture guide. The guide will first discuss the design considerations of the overall reference architecture in Section 3.1 .

Note that Active Directory architecture, firewall and security configuration and data center networking are outside the scope of this reference architecture. Dell Services can help design a solution for each individual customer-specific environment.

## 3.1 Design Considerations

The key design considerations that guided the reference architecture presented in the preceding sections include:

- High availability
- Application performance
- Resource consolidation

### 3.1.1 High Availability

The first design consideration is high availability (HA). High availability is a feature that must be considered at every layer to ensure minimal application downtime. Lync is a critical communication workload at any enterprise and should it be the only communication end-point for end users, high availability should be treated as being mandatory. There are two layers of high availability that were considered in the reference architecture:



- **Application-level high availability** entails utilizing multiple instances of server roles to provide services in the event of a failure. By ensuring that there is no single point of failure at the application level, service downtime to the end user is minimized.
- **Infrastructure high availability** is provided when a hardware resource fails; there is another preconfigured resource that takes over.

It should also be noted that during scheduled downtime, infrastructure availability ensures that there are additional hardware resource, and the application-level availability will keep the application services up for the end users. This is particularly important to IT administrators who wish to apply patches or upgrades to their data center equipment.

### 3.1.2 Application Performance

While maintaining high availability is critical, applications must still perform well to ensure a reliable end-user experience. The Dell Global Solutions Engineering group performed detailed verification to ensure that the reference architecture presented is appropriately sized to meet the needs of a 1,000-user Lync deployment. Some of the workloads sized in this reference architecture included audio conferencing, video conferencing using multi-view, application sharing, distribution list expansion, address book downloads and instant messaging. In order to size these workloads, the [Microsoft Lync 2013 Stress and Performance Tool](#) was used.

It should also be noted that following application best practices help prevent performance bottlenecks. These best practices are detailed in the next sections. Some of the major ones include:

- Static memory allocation, instead of dynamic memory allocation for virtual machines (VM)
- Virtual CPU to physical core ratio maintained at 1:1
- No co-existence of like roles on the same host
- Dedicated hard drive spindles for hypervisor, virtual machine (VM) and SQL data stores

### 3.1.3 Resource Consolidation

The final design consideration, in addition to availability and application performance, is resource consolidation. In such a solution that touches Lync, voice gateways/session border controllers, and PSTN or PBX systems, it is important to consolidate multiple components to the best extent possible and reduce data center footprint and cost.

In the context of this reference architecture, server virtualization is primarily used to consolidate the different Lync Server roles and not leveraged to provide application high availability. High availability is provided natively by Lync as opposed to using virtualization clustering and HA.

Another important consideration is the overall network architecture. While this reference architecture provides guidance on networking and details on the host server networking configuration, the detailed sizing and configuration of the end to end networking components are outside the scope of this reference architecture.



## 3.2 Lync Server 2013 Core Architecture

When deploying a Lync solution, the first step is to articulate a design that will address the communication requirements across the enterprise. The following section provides the design framework adequate for 1,000 Lync users with instant messaging, audio/video, web conferencing and Enterprise Voice communication modalities.

The primary component of this architecture is a paired Lync Server 2013 Standard Edition server pool that serves these different modalities. The Standard Edition pool consists of two Standard Edition servers that are identical and provide communication services for a group of users. This pool of identically configured servers provides scalability as well as availability in the event of a server failure. The Standard Edition server is also the primary store for the user and conference data, where each user's data is replicated to another Standard Edition server. The Lync Standard Edition server that acts as the primary registrar hosts an SQL Express instance to store the databases, and these databases are synchronized with the databases on another Standard Edition server for Lync, which acts as the backup registrar. The databases are important to show the presence information and to continue other user activities.

In addition, an SQL Server virtual machine is deployed to host the Archiving+Monitoring and Persistent Chat server databases.

Figure 2 provides a high-level schematic of a Lync Server 2013 core architecture that has been sized for 1,000 users. The architecture has been built on the design principles discussed in Section 3.1.

### High Availability

- **Application-level high availability.** The Microsoft Lync Server 2013 core architecture uses paired Standard Edition servers and two Office Web Apps servers (OWS). By ensuring that there are two instances of the server roles, there is no single point of failure at the application level and thus service downtime to the end user is minimized.
- **Infrastructure high availability.** This is provided by having the VMs hosted on multiple physical Hyper-V hosts and by having the hosts connected to redundant network switches. Further, the placement of these VMs is arranged to ensure that no VMs with identical server roles are on the same physical Hyper-V host. Note that the Hyper-V hosts are not part of a virtualized cluster and the VMs do not fail over or live migrate across Hyper-V hosts. Lync service availability is provided by having paired the pool of Lync applications, which is a native high availability feature.

### Resource Consolidation

- **Leveraging virtualization.** By virtualizing the Lync Server roles on top of Windows Server® 2012 Hyper-V hosts, dedicated hardware for each role is no longer necessary. For example, in the reference architecture, one of the Dell™ PowerEdge™ R620 hosts consolidates Lync Standard Edition, Office Web Apps (OWS) and a Lync Persistent Chat role on a single server.
- **Service consolidation.** By deploying the Mediation Server, Archiving and Monitoring roles collocated with the Standard Edition server, management complexities are reduced without any

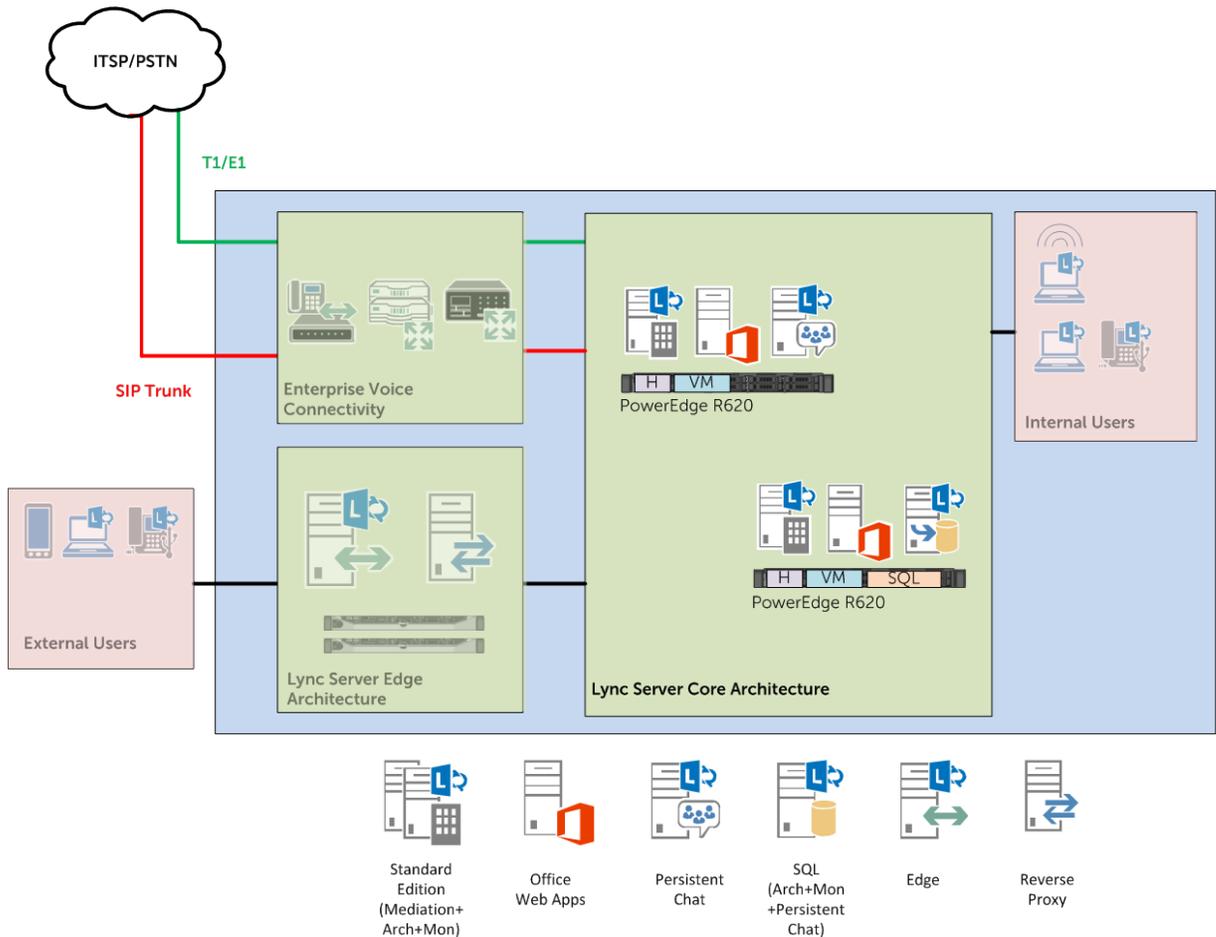


performance compromise. In addition, consolidating these roles saves administration costs and eases management.

- **Using internal server storage.** With a different RAID set within the server chassis for the guest VM, host OS and SQL database, costs are reduced while application best practices and performance requirements are met. The use of internal storage instead of external direct-attached arrays or SANs is more cost effective and simplifies deployment.

As shown by the highlighted block in Figure 2, the overall design for the Lync Server 2013 core architecture consists of two Dell PowerEdge R620 1U servers. Each of these servers is running Windows Server 2012 with Hyper-V. The detailed hardware specification for these servers is provided in Section 4.

Figure 2 Lync Server 2013 Core Architecture



For providing high availability at the application level, two Lync Standard Edition VMs each collocated with Mediation and Archiving+Monitoring roles are configured in a paired Standard Edition pool. These VMs are placed on separate physical Hyper-V hosts to ensure that a single physical server failure does not impact more than one Lync Standard Edition VM. Lync 2013 requires Office Web Apps Servers (OWS) to provide an



enhanced web conferencing experience. In this reference architecture, two OWS servers are deployed to enable high availability. Table 1 presents a VM resource summary for the Lync Server core architecture.

Table 1 Core Architecture VM Resource Summary

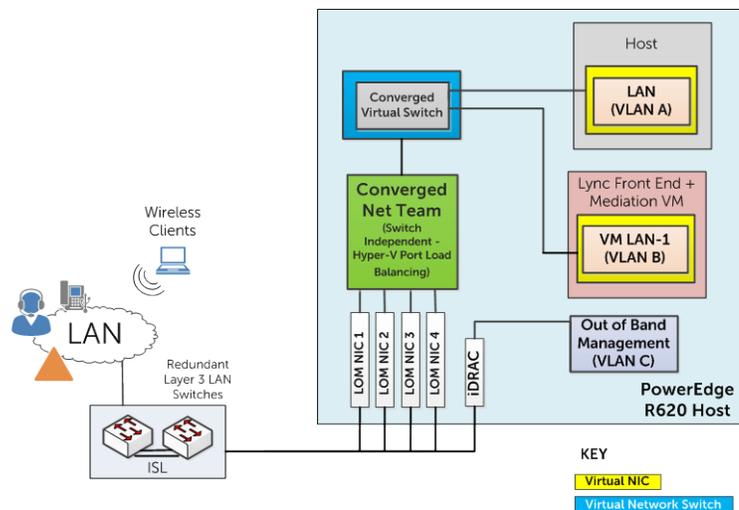
Purpose	VMs	Total Virtual CPU (vCPUs)	Total Memory (GB)
Lync Server 2013 Standard Edition (with Mediation and Archiving + Monitoring roles)	2	12 (6 per VM)	64 (32 GB per VM)
Lync Server 2013 Back End for Archiving + Monitoring and Persistent Chat (SQL Server 2012 Standard Edition)	1	4 (4 per VM)	16 (16 GB per VM)
Lync Server 2013 Persistent Chat Server	1	4 (4 per VM)	8 (8 GB per VM)
Office Web Apps Server (OWS)	2	8 (4 per VM)	16 (8 GB per VM)

### 3.2.1 Network Architecture

A summary of the networking configuration required on the Standard Edition hosts is provided in Figure 3. Each PowerEdge R620 server provides four 1GbE network connections that are used for redundancy and to avail the collective bandwidth the host can provide. On the Microsoft Hyper-V host, a converged network design using Microsoft NIC teaming is used to provide networking connectivity to the virtual machines. This reference architecture describes only host networking and not the configuration of individual networking elements used in the reference architecture.

Figure 3 shows, the connectivity of the Lync Front End VMs to the Converged Virtual switch, which connects to the Converged Network team. The teamed NICs from the hosts connect over 1GbE to the Dell Networking switches, which are in turn fed into a pair of redundant layer 3 switches for Lync clients and the media gateways/SBCs for VOIP connectivity.

Figure 3 Network Architecture of Lync Core Server Hosts



## 3.2.2 Storage for Lync, SQL, and Hypervisor

All physical servers hosting the entire Lync core infrastructure leverage internal server storage. Using local storage instead of iSCSI or Fibre Channel SANs or direct-attached external arrays is a cost-effective solution for this small Lync deployment. The internal server storage in this design has been logically partitioned into three separate storage blocks with multiple RAID sets, which comprise separate disks. One storage block each is allocated to the host operating system, VM storage and Lync SQL database storage. Use of different storage blocks with isolated disks guarantees that there is no contention for disk access among the three different stores.

## 3.2.3 Storage for Hyper-V Hosts

The functional separation of disk drives allows for simplified storage management. This storage design for the physical hosts abides by the Hyper-V best practice that recommends against the placing of system files, application data and logs on shared physical storage drives. Table 2 details the storage design for the physical hosts.

Table 2 Lync Core Architecture Storage Requirements

Storage Building Blocks	Disks Allocated	RAID Configuration
Hyper-V® Server hypervisor	2 x 900-GB 10K RPM SAS	RAID 1
Virtual machines	2 x 900-GB 10K RPM SAS	RAID 1
SQL databases <sup>3</sup>	6 x 900-GB 10K RPM SAS	RAID 10

As shown in Table 2, 10,000 RPM SAS drives were leveraged for their throughput rather than higher capacity NL-SAS or SATA drives. By using standardized 900-GB drives, sufficient capacity is provided for the VM store and for the SQL databases. Note that these volumes are mirrored and therefore the effective capacity is only half the total. For the VM store, a single VHDX volume was created for all VMs. The Lync Standard Edition VMs need to be allocated some extra local hard disk space to account for the Lync database.

Since Microsoft recommends VHDX format from Hyper-V 2012 onward, this solution leverages VHDX volumes to ensure performance from all virtual machines. VHDX format has multiple benefits, including several-fold improved performance over VHD format and its capability to store custom metadata about operating system version, patches applied and more. Only fixed VHDX volumes are used for this solution.

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<sup>3</sup> Not required for PowerEdge R420 hosts running Edge and Reverse Proxy services. Only required for PowerEdge R620 hosts running SQL server database.



Dynamic and differencing disks are not recommended since guaranteeing optimum performance and consistent user experience even under peak load is the primary design objective.

## 3.2.4 Best Practices

In addition to design considerations, certain best practices must also be considered while deploying Lync Server 2013 on Hyper-V. These best practices are detailed below.

### 3.2.4.1 Infrastructure Best Practices

In order to have a successful Lync 2013 implementation on Hyper-V, certain recommendations are provided for the infrastructure, which includes server, CPU, networking, disks and operating system. These recommendations include:

- Use 64-bit Intel® Xeon® processors for the hosts, with a minimum of two sockets per server. Using multiple populated sockets allows more cores per server, increasing density and allowing virtualization to be leveraged.
- Use at least a dual-port network adapter with teaming on 1Gbps. In this deployment, the PowerEdge R620 hosts for the Lync Standard Edition were deployed with four teamed 1GbE network adapters. Further details are available in Figure 3.
- Use separate disks for the hypervisor, guest virtual machines and SQL databases. Doing so ensures that there is no contention for disk access among the three different stores. In addition, it is a Hyper-V best practice to not store system files on other storage drives.<sup>4</sup> If there is a period of high I/O activity in SQL store, the hypervisor and VM stores will not experience any bottlenecks that will cause sluggishness in the entire topology, should this best practice be followed. This separation of disks by different LUNs also allows for easier management.
- Use Windows Server 2012 Datacenter or Standard edition. Although Windows Server 2008 R2 is supported, the recommendation is to consider Windows Server 2012 in order to take advantage of the latest features from the operating system and hypervisor.
- Use SQL Server 2012 or SQL Server 2008 R2 for the databases. SQL 2012 was used for lab validation.
- Provision physical hosts with identical hardware configuration in a virtualized environment. In this reference implementation, PowerEdge R620 hosts with identical hardware and configuration are used to avoid any degradation in user experience due to performance variations among the VMs on different hosts. This recommendation is more critical in environments that use Hyper-V failover clustering, but should be considered in deployments such as the one presented.

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<sup>4</sup> For details, see the article "[6 Best Practices for Physical Servers Hosting Hyper-V Roles](http://technet.microsoft.com/en-us/magazine/dd744830.aspx)" in *TechNet* magazine: <http://technet.microsoft.com/en-us/magazine/dd744830.aspx>



### 3.2.4.2 Lync-Specific Best Practices

Shown below are some of the best practices specific to Lync:

- Use two Lync Standard Edition Server in a paired pool or three Lync Front Ends in an Enterprise pool. Doing so abides by the [Microsoft Best Practice](#). This ensures best use of the “brick architecture”<sup>5</sup> in Lync Server 2013 Enterprise Edition and that there is a copy of user data on each of the three Front Ends.
- Place similar VMs on separate hosts. There are a few different Lync Server 2013 roles in the deployment. By placing like roles on different hosts, IT administrators can ensure there is no loss of availability if one host fails.
- Use a minimum of six disks for the SQL data store. The official Microsoft recommendation is to also use six disks<sup>6</sup> for SQL Server databases. This recommendation ensures that there is sufficient disk performance during periods of high I/O, such as durations with high user login rates. There are a number of different DB-Log pairs within the SQL architecture for Lync:
  - Xds—for information about the topology used by the Central Management Store
  - RtcDyn— for transient user data, such as presence
  - Rtc— for persistent data, such as contact lists and contacts
  - Lcslog, LcsCdr and QoEMetrics—for archiving and monitoring database and log requirements
  - Rtcab—to store Lync address books
  - Rgsdyn, Rgsconfig—to store database and log information for response groups
  - And many others<sup>7</sup>
- For SQL Server, it is preferable to place the tempdb within the SQL store and not in the default system volume location. The tempdb database is the working “scratch pad” that SQL uses to perform operational tasks. Placing it on the system volume can cause unwanted disk contention.
- There should be adequate network provisioning to accommodate audio and video traffic that Lync enables. Allocate 65Kbps per audio stream and 500Kbps per video stream.<sup>8</sup>
- Sufficient memory must be allocated for each of the Lync Server roles.
- Use statically assigned memory instead of dynamic memory. The use of fixed amounts of memory for each VM provides resources that may be required at all times instead of allocation on demand by the hypervisor to each VM. Considering that Lync 2013 is a real-time workload, using dynamic memory may cause unwanted latencies in delay-sensitive audio/video traffic. For example, during peak hours

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<sup>5</sup> For details, see “Lync Server 2013: Keep in touch” in TechNet magazine: <http://technet.microsoft.com/en-us/magazine/jj839700.aspx>

<sup>6</sup> For details, see “Server Hardware Platforms” on TechNet: [http://technet.microsoft.com/en-us/library/gg398835\(OCS.15\).aspx](http://technet.microsoft.com/en-us/library/gg398835(OCS.15).aspx)

<sup>7</sup> For more examples, see “SQL Server Data and Log File Placement” on TechNet: <http://technet.microsoft.com/en-us/library/gg398479.aspx>

<sup>8</sup> <http://technet.microsoft.com/en-us/library/gg425841.aspx>



for conferencing, the Front End VM may need to periodically request increased memory from the hypervisor instead of being guaranteed resources.

- Use fixed disks instead of dynamic disks. The use of fixed disks (or pass-through disks) guarantees best performance and is recommended for production environments.
- Microsoft recommends that physical CPUs not be oversubscribed by the VMs residing on the host. For example, if the number of cores available is 16 and the number of vCPUs allocated is 24, this indicates over-subscription since the Virtual CPUs (vCPU) : Processor Cores ratio is more than 1:1. Over-subscribing the CPUs will cause contention for resources. Since Lync works with delay-sensitive voice and video traffic, there could be adverse effects due to over-subscription, and it is not recommended at this time.
- The use of "Synthetic network adapter" is preferred over "legacy network adapter" in Hyper-V and offers better performance.

### 3.3 Lync Server 2013 Edge Architecture

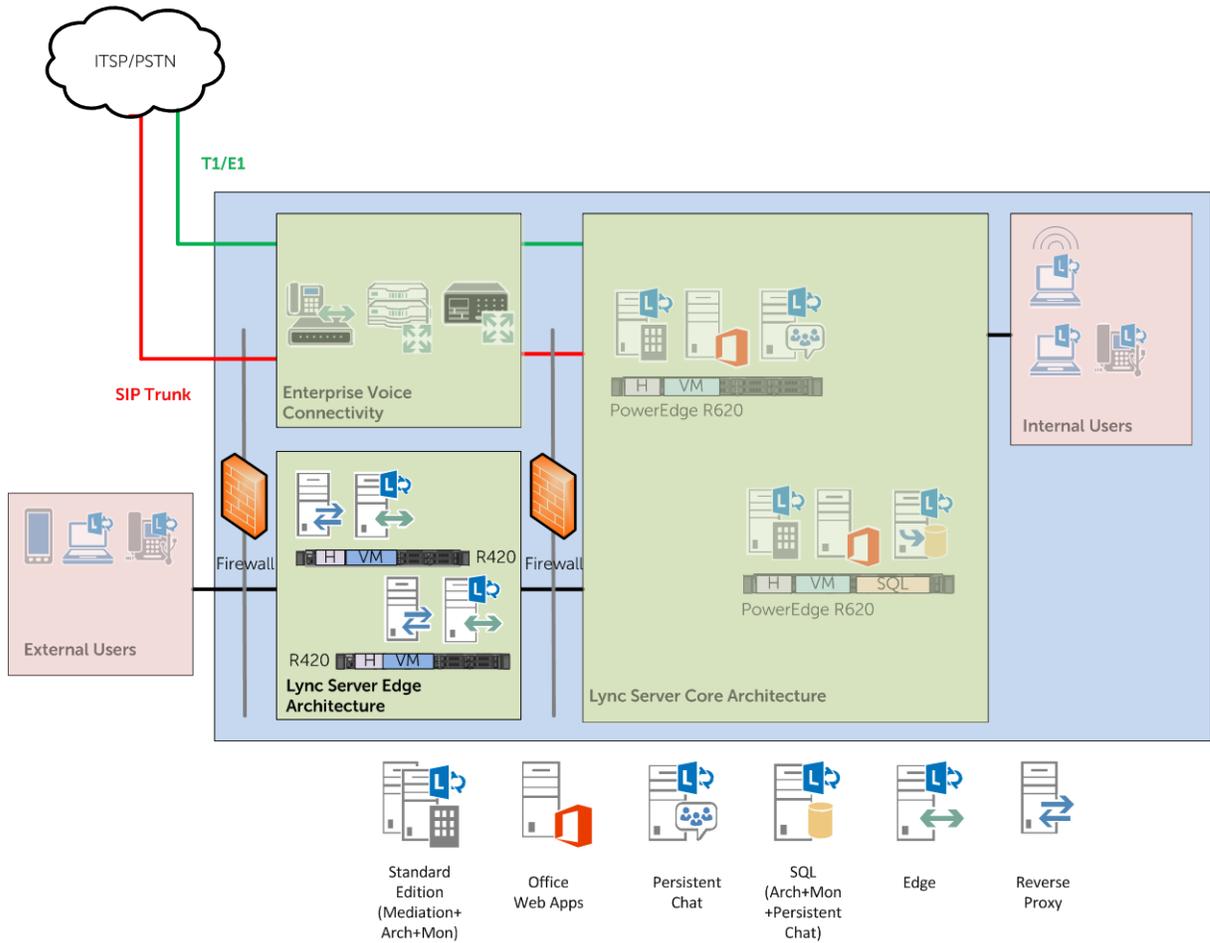
The highlighted section of Figure 4 shows the Lync components that need to reside in the perimeter network with internal and external firewalls. This reference architecture assumes that an existing perimeter network already exists and does not explicitly provide details for firewalls. [Dell SonicWall](#) has a wide range of products to fulfill any needs for security or firewall devices.

In order to follow the high availability design principle, the proposed Edge architecture consists of an Edge pool with two Edge Server VMs and uses DNS load balancing on both the internal and external Edge interfaces. An HTTPS Reverse Proxy can also be configured and is required to support the sharing of web content and web services to federated and external users and for enabling certain features as detailed on the [Microsoft Setting Up Reverse Proxy Servers](#) site. Since Reverse Proxy cannot be collocated with the Edge Server, two additional VMs would be needed if a Reverse Proxy Server is required. To see a list of Reverse Proxies qualified with Microsoft Lync Server 2013, visit the [Infrastructure qualified for Microsoft Lync site](#).

Both the Edge and Reverse Proxy Servers are consolidated as VMs on two Dell™ PowerEdge™ R420 1U servers, each with dual-socket Intel® Xeon® E5-2400 series processors, 32 GB of DDR3 RAM and support for up to 8 x 2.5-inch internal HDDs. Each of these servers is running Windows Server 2012 with Hyper-V. The detailed hardware specifications for these servers are provided in Section 4.



Figure 4 Lync Server Edge Architecture



The recommended configuration details of the VMs are provided in Table 3.

Table 3 Lync Edge Architecture VM Resources

Purpose	VMs	Total Virtual CPU (vCPUs)	Total Memory (GB)
Lync Server 2013 Edge Pool	2	4	16
Reverse Proxy	2	4	8

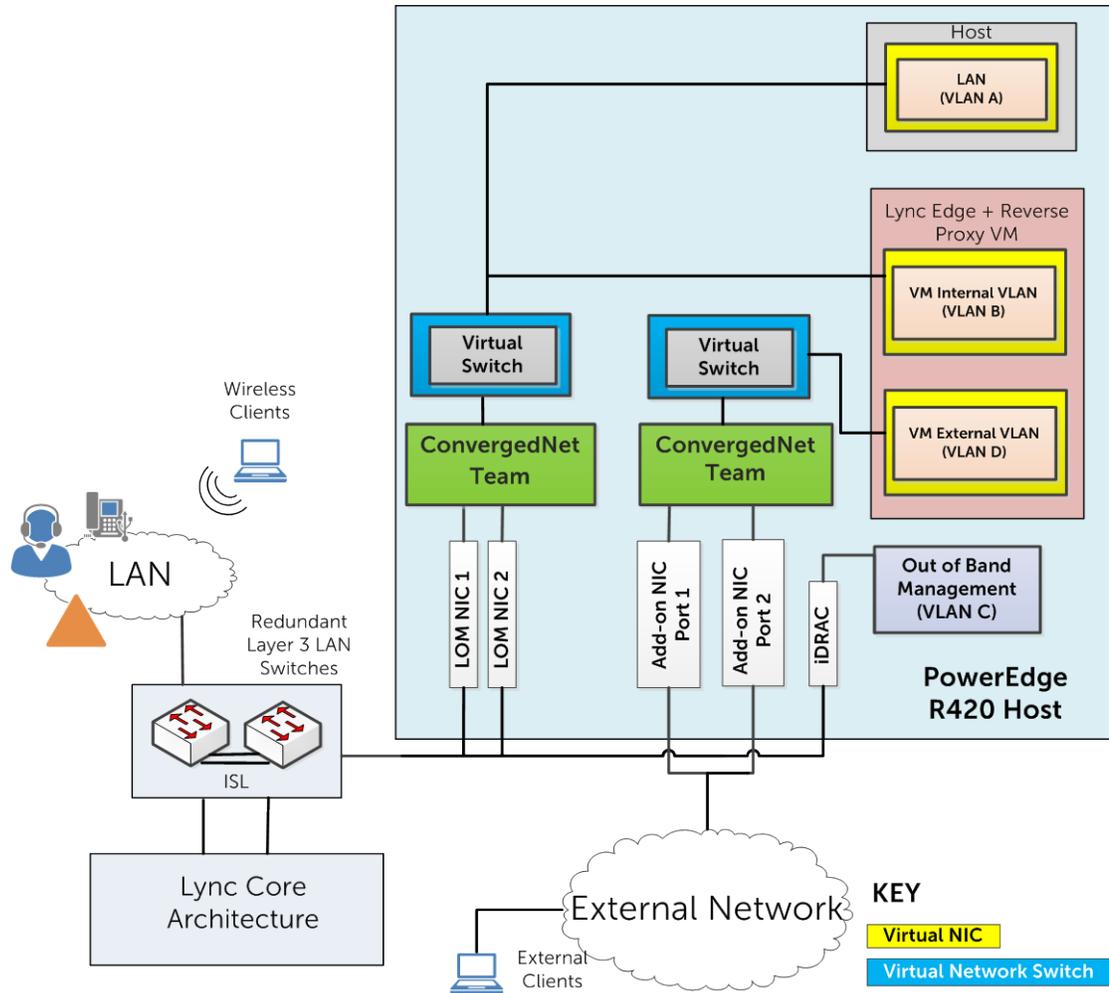
### 3.3.1 Edge Network Architecture

Figure 5 details the network connectivity for each of the PowerEdge R420 servers hosting the Edge and Reverse Proxy server VMs. The PowerEdge R420 server uses the Broadcom® 5720 dual-port 1Gb LAN on Motherboard (LOM) and has an optional Broadcom 5719 quad port 1Gb add-on Network Interface Card (NIC) configured. Two of the ports from the LOM are teamed together and provide the connectivity to the internal networking and two of the ports from the add-on NIC are teamed to provide external network



connectivity. Separate virtual switches are created on each of the teams and each of the VMs has a separate virtual NIC connecting to the internal and external networks, as depicted in Figure 5.

Figure 5 Network Architecture for Edge/Reverse Proxy Hosts



The internal network connects to the Lync core architecture and Lync clients on the LAN. The external network allows access for authenticated Lync clients from the Internet.

### 3.3.2 Reverse Proxy

The Reverse Proxy Server is an external component that is not part of the Lync topology. Even though external users can still log in and use critical Lync features, such as calls, desktop sharing and federated communications, without the deployment of this role. With a Reverse Proxy, external users are able to take advantage of functionalities that are available through web services, including:

- Downloading meeting content for meetings
- Expanding distribution groups



- Downloading files from the address book service
- Accessing the Lync Web App client
- Enabling the Lync 2013 client, Lync Windows Store app and Lync 2013 mobile client to locate the Lync Discover (autodiscover) URLs and use Unified Communications Web API (UCWA), etc.

Per Microsoft recommendation, these web services are made available to external users by publishing them through external simple URLs. HTTP and HTTPS requests from external users are handled by the Reverse Proxy Server, which forwards them internally to the Lync Front End pool. If Reverse Proxy is not present, these external users will not have access to the functionalities. Furthermore, the Lync mobile client for phones and tablets will not be functional for external users as they are web-based and require the Reverse Proxy to communicate with the Lync Front End pool's IIS mobility website.

### 3.3.3 Best Practices for Edge and Reverse Proxy Host

In order to deploy the Edge and Reverse Proxy Servers, the following best practices should be considered:

- Two separate network interfaces should be used for internal and external networks at minimum. These should use separate subnets that are not routable across each other. Only the external interface should include the default gateway and not the internal interface.
- Static routes must be defined on the Edge Server for connectivity to internal subnets.
- A standard SSL certificate, with common name field set to the Edge Server's FQDN, should be used for the internal Edge certificate; this certificate cannot contain a subject alternative name (SAN) field.
- Whenever possible, internally facing certificates should be obtained from an internal Windows® Enterprise CA.
- The external edge certificate should be a UCC or SAN certificate issued by public trusted certificate authority. It should include a common name field set to the access edge FQDN and subject alternative name field that contains both the access edge FQDN and the web conferencing FQDN.
- Additionally, externally facing certificates not include any of the internal hostnames. Broadcasting the internal namespace on an external certificate is considered a poor practice.
- Although it is not recommended to use the same external certificate for both the external Edge Server interface and the Reverse Proxy Server interface, should this be done for cost-saving purposes, the access edge FQDN must be specified in the common name field and the Reverse Proxy FQDN in the SAN (subject alternative name) field.

## 3.4 Enterprise Voice Connectivity

In Lync Server 2013, the functionality of the Mediation Server can be part of the Front End Server by default and thus a separate Mediation Server is no longer required. This means that the Front End pool can now directly connect to a PSTN gateway, an IP-PBX or to a SIP trunk via a session border controller (SBC).

This reference architecture assumes connectivity to an ITSP via an intermediary on-premise SBC or to a PSTN via a media gateway, as shown in Figure 6.

While the reference architecture collocates the mediation server with the frontend server, it is recommended that you contact Dell services to scope out the optimal solution to fit your needs.

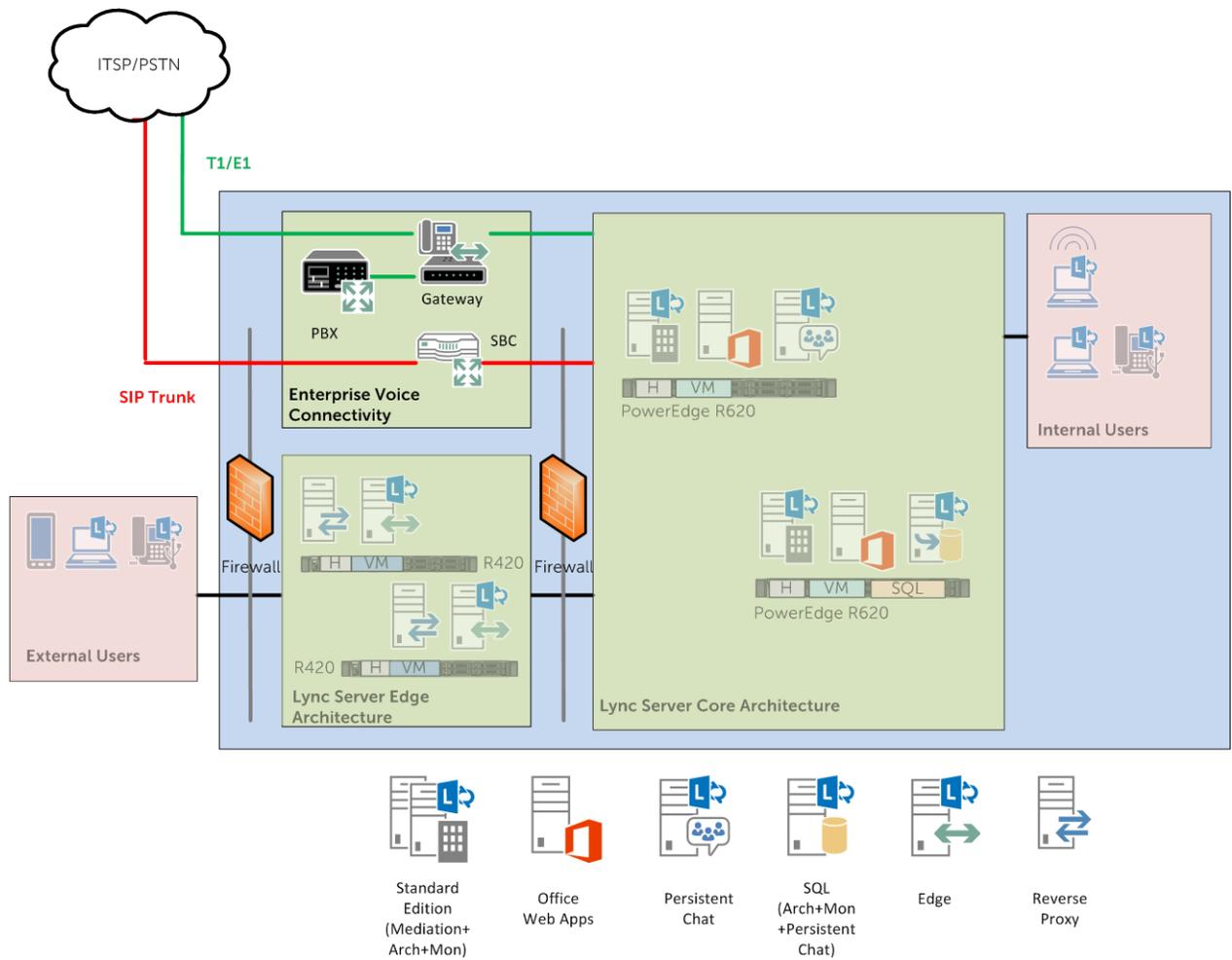


The enterprise connectivity options, as shown in Figure 6, are:

- T1/E1 connectivity from PSTN to a media gateway, which in turn connects to the Lync infrastructure via SIP
- SIP trunk from an ITSP to an SBC, which then connects to Lync infrastructure via SIP
- PBX connecting to a media gateway via a T1/E1, which in turn connects to the Lync infrastructure via SIP

If connecting to a SIP trunk via an on-premise SBC, consider placing the SBC in the perimeter network to provide the appropriate level of security. If connecting directly to a SIP trunk provider without an intermediary SBC, a separate Mediation Server may be required. The preferred third-party gateway, as validated in this reference architecture, is the Sonus SBC 1000 or SBC 2000.

Figure 6 Enterprise Voice Connectivity



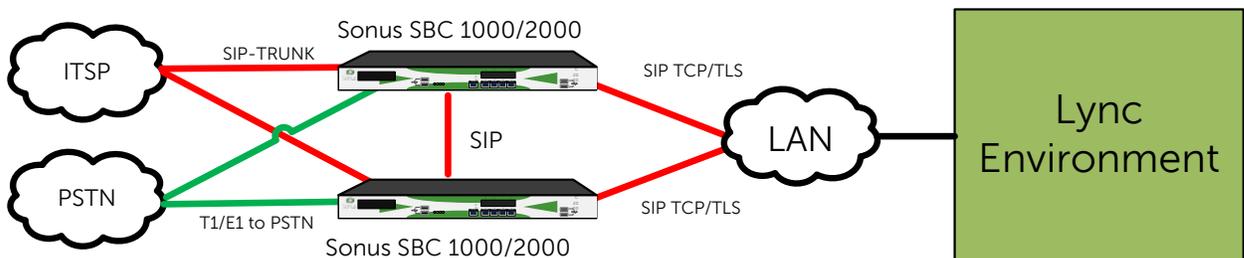
### 3.4.1 Sonus SBC 1000/2000

The Sonus SBC 1000/2000 is a Microsoft-qualified enhanced media gateway that has a session border controller (SBC) for SIP trunking and gateway operation for T1/E1 telecom connectivity.

The SBC 1000 offers two 1GbE ports for SIP trunking and two T1/E1 interfaces while SBC 2000 offers four 1GbE ports for SIP trunking and sixteen T1/E1 interfaces. When used as a gateway, the SBC 1000/2000 can function between the legacy PBX infrastructure within the data center and the Lync Mediation Server. In this particular case, the Mediation Servers are collocated on the Front End and hence the Front End pool is the next hop for the SBC 1000/2000 gateway. If used as an SBC, this device needs to be equipped with SIP trunks from an Internet telecom service provider (ITSP) and connects through the provider's switching network into the PSTN. Both cases enable calls to external phone users.

Figure 7 shows the connectivity options for SBC 1000/2000, whereby the device can act as both an enhanced media gateway connecting to a PSTN via T1/E1 interfaces or as an SBC connecting to an ITSP via a SIP trunk. The Lync environment is in turn connected via SIP TCP or TLS. This provides an option to fallback to a PSTN in the event the connectivity to the ITSP goes down. Further, the SBC 1000/2000 can be configured in a highly available active-active mode, which provides resiliency and scalability by load balancing the traffic.

Figure 7 Sonus SBC connectivity options



The SBC 2000 is similar to the SBC 1000 with more expandability options and the ability to scale to a higher number of simultaneous sessions. Thus, depending on an organization's voice needs, the appropriate voice gateway should be considered. This reference architecture leverages Sonus SBC 1000.

The Sonus SBC series also supports the Lync Survivable Branch Appliance (SBA). Using the SBA, the branch office communications are always available, even when the WAN link to the central site is down.

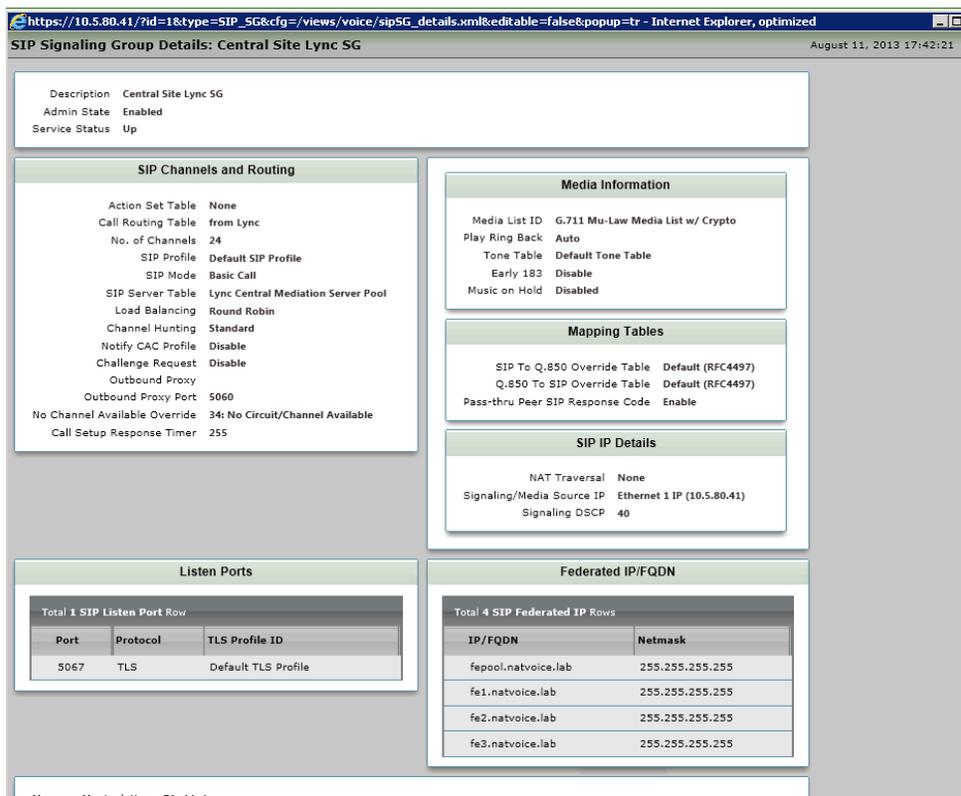
### 3.4.2 SBC 1000 Gateway Configuration

In order to configure the SBC 1000 as a gateway or SBC, the following configurations must be made:

- **Signaling Groups:** A signaling group defines a virtual trunk that receives inbound calls and sends outbound calls. For example, a signaling group can comprise a trunk to Lync endpoints. This signaling group would be set to point to the Mediation Server as its next hop. The Figure 8 screenshot shows an example of such a signaling group.



Figure 8 Signaling Group Example



As shown in the Figure 8 screenshot, the signaling group is set as a trunk to calls being sent outbound on the “from Lync” routing table. Inbound calls will be directed to the SIP server table specified as the “Lync Central Mediation Server Pool.”

- Call Routing Tables:** These rules define how a call should be routed. For example, a routing table associated with the Lync signaling group will most likely be set to forward calls to specific outbound interfaces. In this example, if operating as an SBC, the routing tables for calls from Lync will specify Ethernet interfaces connected to the ITSP in the tables. On the other hand, if operating as a gateway, the routing tables for the Lync signaling group will specify the T1/E1 interfaces as the outbound route. Figure 9 shows the default route from the previous example of a Lync signaling group.



Figure 9 Call Routing Tables Example

The screenshot shows a web browser window with the URL <https://10.5.80.41/?id=4:1&type=RoutingTableEntry&cfg=/views/voice/callRouteEntry.xml&editable=>. The page title is "Call Routing Entry: To Dell PBX and PSTN".

**Route Details**

Description	To Dell PBX and PSTN
Admin State	Enabled
Route Priority	1
Call Priority	Normal
Number/Name Transformation Table	E164 to Dell PBX and PSTN

**Destination Information**

Destination Type	Normal
Message Translation Table	None
Cause Code Reroutes	None
Cancel Others upon Forwarding	Disabled
Fork Call	Yes
Destination Signaling Groups	(ISDN) ITSP/PSTN Dev2k ISDN SG (SIP) ITSP/PSTN Dev2k SG *

**Media**

Media Transcoding	Enabled
Media List	None

**Quality of Service**

Quality Metrics Number of Calls	10
Quality Metrics Time Before Retry	10
Min. ASR Threshold	0
Min. MOS Score	0.0
Enable Max. R/T Delay	Enabled
Max. R/T Delay	9999
Enable Max. Jitter	Enabled
Max. Jitter	3000

As shown in Figure 9, the default route for the Lync signaling group specifies two entries. The first entry is a T1/E1 interface and the second entry is a SIP trunk. In this particular example, the SBC is being used as both a gateway and a session border controller.

- **Phone Number Transformations:** In order to route calls between virtual trunks/signaling groups, number transformations may become necessary. Internal extensions may take only seven digits but external calls may require a prefix, such as an area code. Such transformations are handled in these tables using regular expressions. These transformations are applied prior to a call being sent to the outbound route.

In order to successfully implement the SBC 1000 within the SMB, these are the some signaling groups that may be required:

- **Signaling group for Lync:** routed outbound to the SIP trunk and the T1/E1, depending on whether the SIP trunk or T1/E1 functionality is being leveraged
- **Signaling group for SIP trunk:** routed outbound to the Lync signaling group AND/OR
- **Signaling group for T1/E1:** routed outbound to the Lync signaling group



For detailed information on Sonus SBC 1000 configuration, please refer to the [Sonus Online Support Portal](#).

## 3.5 End-User Client Connectivity

End-user client connectivity is achieved via the Lync 2013 desktop or mobile clients, Lync Web App, Lync Windows Store App, Lync Phone Edition or through specialized Lync devices. The Lync 2013 desktop clients can be installed on Windows-based desktops, laptops or hybrids, such as the Dell™ XPS 12 Ultrabook™. The Lync 2013 mobile clients are available for Windows Phone devices, Apple iOS devices (including the iPhone and iPad) and many popular devices running Google Android. Specialized Lync devices, such as the PolyComm CX series, are designed to integrate with Microsoft Lync, and some of these devices run the Lync Phone Edition natively on them. These devices can be connected through a wired connection or wirelessly.

### 3.5.1 Wired Connectivity with Dell Networking Switches

The Dell™ Networking 7000 series switches are managed layer 3 GbE switches that provide wire-speed throughput. Select Dell Networking 7000 series models offer 24 or 48 ports of Power over Ethernet (PoE) support to connect to devices with power requirements of up to 30 watts without the need for a separate power cable. This enables powering Dell Dell W-Series Access Points as well as specialized Lync 2013 VoIP clients, such as the PolyComm CX600, to be powered on by directly connecting to the Dell Networking 7000 switches.

### 3.5.2 Wireless Networking with Dell Networking W-Series

The Dell™ Networking W-Series provides full-featured mobility controllers and access points that are secure, reliable and flexible. The Dell™ W-Series W-3200 controller and W-AP135 access point provide a mobility solution for Lync 2013 over wireless. Both controller and access point should be connected to a Dell PoE (Power-over-Ethernet) switch. This switch can also be connected to other internal Lync client devices or be connected to a separate set of client access switches. Internal clients are those devices that are logged into the corporate domain and external clients are those that belong to visitors and are placed on a “guest” wireless network.

Configuration of the controller and access point can be done through a browser-based interface once the management interface of the controller is configured on the network via a serial connection and the controller’s CLI. The management interface allows IT administrators to perform a number of different tasks, including viewing and editing controllers and access points used in the topology.

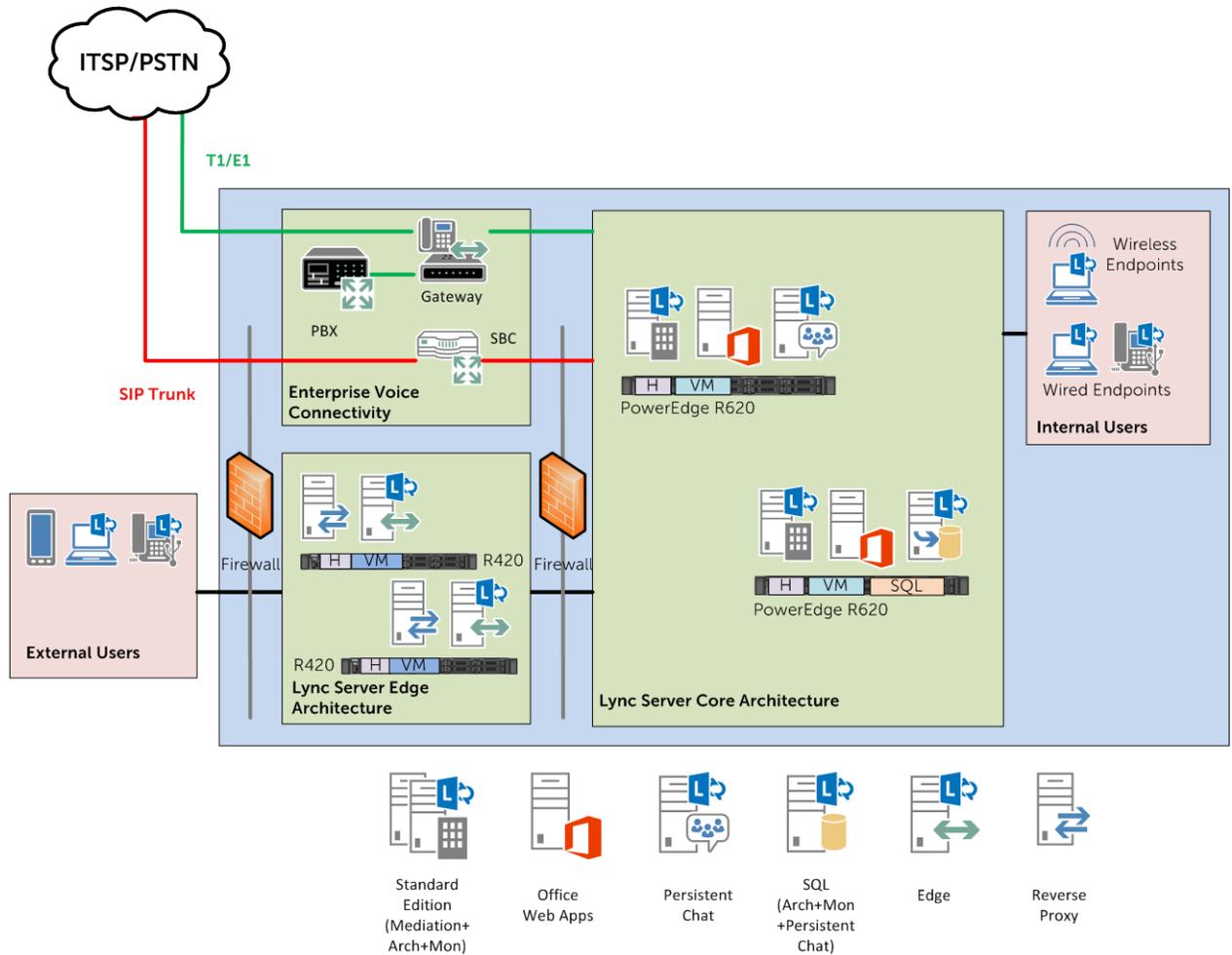
To enable Lync wireless clients to authenticate, it is recommended to set up a RADIUS server through the Microsoft Windows Network Policy Server role and to configure the controller as a RADIUS client. Additionally, in order to ensure quality of service (QoS) for Lync, specific system configurations are required. These settings are described in the [Dell Networking W-Series Wireless LAN Mobility Controller Optimizations for Microsoft Lync](#) white paper.



## 4 Technical Specifications

This section details the technical specifications for all of the physical and virtual components that make up this reference architecture for the Dell Unified Communication Solution. Figure 10 shows the complete logical view of the Dell Unified Communication Solution for a 1,000-user single-site deployment.

Figure 10 Dell Unified Communication Solution



### 4.1 Virtual Machine Specifications

Many Lync® Server 2013 server roles are deployed in separate virtual machines, as detailed in Section 3. Each virtual machine has specific resource requirements in terms of compute and memory. This allocation of vCPU, memory and networking seems sufficient based on validation using the [Microsoft Lync Stress and Performance Tool](#) and per Microsoft best practices.



Table 4 Virtual Machine Configuration Details

<b>2 x Lync Front End VMs (includes Archiving-Monitoring and Audio-Video Conferencing Roles)</b>	
Operating System	Windows Server 2012
Virtual Machine Configuration	6 x vCPU
	32 GB RAM
Networks	1 x Virtual Network Adapter
Software	Lync Server 2013 Standard Edition
<b>1 x SQL Server VM (for Archiving+Monitoring and Persistent Chat)</b>	
Operating System	Windows Server® 2012
Virtual Machine Configuration	4 x vCPU
	16 GB RAM
Networks	1 x Virtual Network Adapter
Software	SQL Server 2012 Standard Edition
<b>2 x Office Web Apps Server (OWS) VMs</b>	
Operating System	Windows Server 2012
Virtual Machine Configuration	4 x vCPU
	8 GB RAM
Networks	1 x Virtual Network Adapter
Software	Lync Server 2013 Standard Edition
<b>1 x Persistent Chat Server VM</b>	
Operating System	Windows Server 2012
Virtual Machine Configuration	4 x vCPU
	8 GB RAM
Networks	1 x Virtual Network Adapter
Software	Lync Server 2013 Standard Edition
<b>2 x Edge Server VMs</b>	
Operating System	Windows Server 2012
Virtual Machine Configuration	4 x vCPU
	16 GB RAM
Networks	2 x Virtual Network Adapter (1 internal, 1 external)
Software	Lync Server 2013 Standard Edition
<b>2 x Reverse Proxy VMs</b>	
Operating System	Windows Server 2012
Virtual Machine Configuration	4 x vCPU
	8 GB RAM
Networks	2 x Virtual Network Adapter (1 internal, 1 external)
Software	IIS ARR 2012 or MS Forefront® TMG 2010 <sup>9</sup>

<sup>9</sup> Internet Information Services Application Request Routing and Microsoft® Forefront Threat Management Gateway



Table 4 has the details about the recommended configuration for the virtual machines that make up this solution. Based on the role performed by each virtual machine, optimum amounts of compute, memory, network and storage resources have been allocated. CPU resources are allocated to ensure that the core:vCPU ratio is not oversubscribed for delay-sensitive real-time traffic. Memory is allocated statically to each VM, ensuring that resources are guaranteed during peak usage hours.

For service availability in the event of failure at the application level, more than one virtual machine has been provisioned for all critical Lync server roles. Since persistent chat is not critical for the continued availability of this solution, only one virtual machine has been incorporated in this solution. The same logic holds true for the back-end SQL Server for the Archiving+Monitoring and Persistent Chat databases.

Since the Lync Server external website listens on port 4443, instead of on the standard port 443, a Reverse Proxy is necessary for port translation between the two. The Reverse Proxy can use Microsoft IIS Application Request Routing (ARR) 2012 to provide access to non-HTTP/HTTPS content for the Lync user requests originating from outside of the "external firewall." The IIS ARR component enables IIS to handle Reverse Proxy requests, URL rewrites and load balancing. It also enables increased web application scalability and reliability through rule-based routing, client and host name affinity, load balancing of HTTP server requests, distributed disk caching and optimized resource utilization for application/web servers, among other benefits.

In addition, the Microsoft Forefront Threat Management Gateway (TMG) 2010 or Unified Access Gateway (UAG) 2010, another solution from Microsoft, can perform the role of Reverse Proxy Server as well. These are comprehensive secure web gateway solutions that help to protect Lync users from web-based threats. Forefront TMG/UAG also delivers simple, unified perimeter security, with integrated firewall, VPN, intrusion prevention, malware inspection and URL filtering. Even though TMG is discontinued, Microsoft continues to support it, and enterprises that are already using ForeFront TMG can still leverage it.

## 4.2 Hardware Specifications

The physical hardware components of the reference architecture are detailed in the following tables.

Table 5 Server Host Configuration Details

<b>Host1 for Lync Core Server</b>	
Hardware	Dell PowerEdge R620 rack server with 2.5-inch drive chassis
CPU	2 x Intel® Xeon® processor E5-2660 CPUs with 8 cores per CPU
RAM	64 GB
Networks	Quad-port Broadcom® network adapter (within a network team)
Storage	PERC H710P
	4 x 900 GB 10K RPM SAS
Host Operating System	Windows Server 2012 Datacenter or Standard Edition with stacked licenses (Hyper-V role enabled)



Virtual Machines	1 x Lync Standard Edition Virtual Machine Primary Lync Front End Standard Edition VM
	1 x Office Web Apps Server Virtual Machine
	1 x Persistent Chat Server Virtual Machine
<b>Host2 for Lync Core Server</b>	
Hardware	Dell PowerEdge R620 rack server with up to 10 x 2.5-inch drive chassis
CPU	2 x Intel Xeon processor E5-2660 CPUs with 8 cores per CPU
RAM	64 GB
Networks	Quad-port Broadcom® network adapter (within a network team)
Storage	PERC H710P
	10 x 900 GB 10K RPM SAS
Operating System	Windows Server 2012 Datacenter or Standard Edition with stacked licenses (Hyper-V role enabled)
Virtual Machines	1 x Lync Standard Edition Virtual Machine Backup Registrar Lync Front End VM
	1 x Office Web Apps Server Virtual Machine
	1 x Back End SQL Server® Virtual Machine
<b>Host3 and Host4 for Lync Edge Server</b>	
Hardware	Dell PowerEdge R420 rack server with 2.5-inch drive Chassis
CPU per Host	2 x Intel Xeon processor E5-2420 CPUs with 6 cores per CPU
RAM per Host	32 GB
Network per Host	Quad-port Broadcom network adapter (within 2 network teams)
Storage	PERC H710P
	4 x 900 GB 10K RPM SAS
Operating System	Windows Server 2012 Standard Edition (Hyper-V role enabled)
Virtual Machines per Host	1 x Edge Server Virtual Machine
	1 x Reverse Proxy Virtual Machine

As shown above, PowerEdge R620s are used for the Lync core architecture, and two of these servers are required, as detailed in section 3.2. For the Edge and Reverse Proxy, two PowerEdge R420 servers are required.

Please note that the server hosts can use either Windows Server 2012 Datacenter edition or optionally Windows Server 2012 Standard edition with stacked licenses as detailed below.



- On the hosts deployed for virtualizing the Lync Server roles, two Windows® Server 2012 Standard edition licenses<sup>10</sup> are stacked. This allows up to four virtual machines on the same physical server running Windows Server 2012 Standard edition. For the Edge Server role, one Windows Server 2012 Standard license is required.

Table 6 Enterprise Voice Components

Voice Components	
Voice Gateways	2 x Sonus SBC 1000 or SBC 2000

Table 7 Additional Recommended Components

Additional Recommended Components	
Networking (Core Architecture)	2 x Dell Networking S55
Networking (Client Connectivity) – Wired and Wireless	Dell Networking 7048P (PoE capable)
	Dell Networking W 3200 Controller and Dell Networking W-AP135 Access Point
Remote Management	1 x iDRAC 7 with vFlash 8GB SD Card per host server
Peripherals—Tablets and Notebooks	Dell Venue Pro Tablet
	Dell Latitude Tablet
	Dell XPS Ultrabook
Peripherals—Personal Phones	Polycom CX 300, 500, 600
Peripherals—Conferencing	Polycom Roundtable CX5000, CX7000 Plantronics 620
Peripherals—Personal Headsets	Plantronics Voyager Pro UC B230-M Jabra GN 2000 Duo Jabra Pro 350-MS

## 4.2.1 Dell PowerEdge Servers

For the Front End hosts, the architecture uses Dell PowerEdge R620 rack servers with two Intel Xeon processor E5-2660 CPUs with eight cores per CPU. These servers enable remarkably fast processing for compute-intensive tasks. This server supports up to 768 GB of memory, which is more than sufficient for the Front End hosts. Sufficient internal storage is critical to this design. The PowerEdge R620 server

<sup>10</sup> [Windows Server 2012 Licensing Data Sheet](#)  
[Windows Server 2012 Licensing & Pricing FAQ](#)



provides up to 10 terabyte of internal storage. The preferred chassis is the option that accommodates 10 2.5-inch drives.

For the perimeter network hosts, the platform chosen is the Dell PowerEdge R420 server equipped with two Intel Xeon processor E5-2420 CPUs with six cores per CPU. Memory support for the PowerEdge R420 server is up to 384 GB. The preferred chassis is the eight-drive option. Further details on Dell PowerEdge servers are available on the [Dell PowerEdge Portfolio site](#).



Figure 11 Dell PowerEdge R620 Server



Figure 12 Dell PowerEdge R420 Server

## 4.2.2 Dell Networking

The Dell networking portfolio includes top-of-rack, aggregation, core and distributed core switches. This implementation can use Dell™ Networking S55 or Dell™ Networking 7048 switches within the data center. The Dell Networking S55 provides 44 10/100/1000Base-T ports and four ports that can be configured as copper or fiber (SFP). It is a 1 rack unit top-of-rack, low-latency switch. The Dell Networking 7048 provides 48 10/100/1000Base-T ports. Both switches can also accommodate two 10GbE modules, each with dual 10Gbps ports.





Figure 13 Dell Networking S55 Layer 3 Top of Rack Switch



Figure 14 Dell Networking 7048 Layer 3 Top of Rack Switch

For client devices (access switches), Dell™ Networking 7048P Power over Ethernet can be used. These switches provide 30.8 watts per port for Lync clients, including the Polycom CX600 IP phones, and eliminate the need for an external power source.

### 4.2.3 Wireless Networking

For Lync 2013 real-time workloads, Dell recommends the Dell Networking W-Series wireless controllers and access points (PowerConnect W). The W-Series 3200 controller can support up to 2,048 users and can manage 32 LAN access points and 128 remote access points (APs). The access point chosen for this configuration is W-AP135, which can deliver wireline-like data rates of up to 450 Mbps. This translates to a capability to handle numerous audio-video sessions simultaneously, assuming each audio stream is 65 Kbps and each video stream is 500 Kbps. It should be noted though that the performance and quality of experience of Lync Server must be monitored, and these throughput values should not be used as the only metric to assess quality of experience.





Figure 15 Dell Networking W-3200 Controller and Dell Networking W-AP135 Access Point

#### 4.2.4 Sonus SBC 1000/2000 Gateway

The SBC 1000/2000 are advanced session border controllers (SBC) built for smaller enterprise networks. It delivers robust security, high availability and proven interoperability with Lync Server 2013. The SBC 1000 is a versatile device that can work as a traditional gateway with T1/E1 trunks or as a session border controller with newer SIP trunks. The SBC 1000 is a Lync 2013 qualified gateway as well as Lync 2013 qualified session border controller. The SBC 1000 provides up to two x T1/E1 interfaces, while the SBC 2000 can support up to 16 x T1/E1 interfaces. For complete details on the Lync 2013 qualification matrix, check the Microsoft [Infrastructure qualified for Microsoft Lync page](#).



Figure 16 Sonus SBC 1000

#### 4.2.5 Client Devices

This enterprise VoIP implementation has an end-to-end UC solution that includes client hardware components in addition to data center hardware. Dell has a rich product portfolio of client devices that can be used to run the Lync end-user client. The Dell Latitude, XPS, Inspiron, Precision and Venue Pro product lines offer a complete range of productivity devices that are ideally suited to run the Lync 2013 client software/app. Visit the [Dell Laptops, Tablets and Workstations site](#) to browse client products suited for the workplace.





Figure 17 Dell Venue 8 Pro Tablet (left) and Dell XPS12 Convertible Ultrabook (right)

The Polycom CX300, CX500 and CX600 are third-party desk phones that can be used as Lync endpoints. For a complete list of client devices available for Lync, please contact Dell Services.



## 5 Verification

Verification of the topology involved a number of different scenarios in the lab. These included performance validation of Lync Server, quality of experience (QoE) results from monitoring server reports, validation of the Sonus SBC 1000 gateway and SBC configuration and performance, failover validation of the Lync Front End, and verification with Lync and Polycom clients.

The performance verification involved measurements from performance monitor after the [Lync Stress and Performance Tool](#) was run. There were a number of different counters that were looked at, including CPU, memory, disk I/O, conferencing statistics and connected users. In line with Microsoft recommendations, CPU performance was taken from the hosts, since these counters are a more reliable indicator than CPU performance counters taken directly from the VM. QoE, which is particularly important for real-time traffic, such as audio and video in Lync, was also measured using the Lync Monitoring Server. These results indicate that the suggested reference architecture is adequate for 1,000 Lync users.

Figure 18 Lync Server 2013 Load Configuration Tool

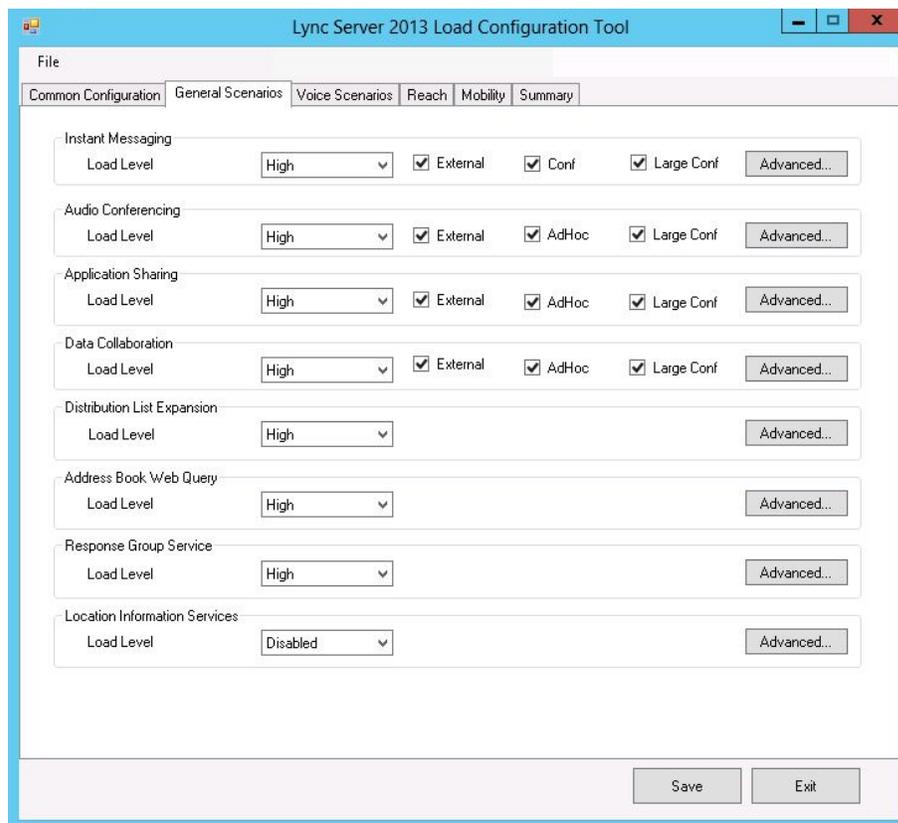


Figure 18 shows the general scenario load settings of the Lync Server 2013 Load Configuration, which is part of the Lync Stress and Performance Tool. This utility is used to set the Lync feature scenario and the load parameters to be stressed against the Lync infrastructure. As seen from the screen shot, the load level across the different feature scenarios was set to high. The multi-view video conference was also set to



true by changing the settings under Audio Conferencing to ensure that video conferencing load was simulated by the tool.

In addition to performance analysis, Dell conducted a thorough investigation of other components in the architecture, including the Sonus SBC 1000 SBC/gateway. The SBC 1000 was validated for SIP trunking and T1/E1 connectivity, i.e. both as an SBC and as a gateway. In addition, the failover capability of the device in an active-active pair was also verified. In an active-active pair, the SBC 1000 provides the needed availability in case one unit was to fail.

Next, failover functionality of the Front End to the backup registrar pool was also verified. Failover to the backup registrar is relatively simple and can be accomplished by running the following commands:

```
Invoke-CsManagementServerFailover -BackupSqlServerFqdn <backupregistrarfqdn>  
BackupSqlInstanceName RTC - Force
```

```
Invoke-CsPoolFailOver - PoolFqdn <poolfqdn> - Disastermode - Verbose
```

It should be noted that the user contact lists and presence are not available until the IT administrator takes these manual steps in the event that failover is needed. However, ongoing instant messages and audio/video/web conferences continue even upon failure of the primary Front End.

Lastly, client devices were validated for both internal and external connectivity. Devices used included Dell Latitude 10 tablets and Polycom CX600 phones. The Latitude 10 tablets provide audio/video/web conferencing using the Lync app available from the Microsoft store.



## 6 Conclusion

The Dell Unified Communication Solution as presented in this reference architecture provides an end-to-end Unified Communication solution for organizations with up to 1,000 users. This integrated solution uses Microsoft Lync Server 2013 as the Unified Communication software and is built on the wide ranging Dell product portfolio, including Dell servers, wired/wireless networking and client devices.

This reference architecture focuses on deployment of Lync Server 2013 with different communication modalities using Lync 2013 Standard Edition. Deploying Lync Server 2013 as detailed in this document results in a solution that is cost-effective and simple to manage and administer. Certain best practices were adhered to while implementing this solution. In addition to these tenets, three design principles—availability, application performance and resource consolidation—determined the overall architecture for 1,000 users.

To verify the implementation, the Lync Stress and Performance Tool was run with instant messaging, audio conferencing, video conferencing using multi-view, application sharing, and other workloads. The performance of the Lync Front End was verified as being within recommended thresholds.

Leveraging this configuration to run Microsoft Lync provides benefits that include consolidation and availability. Lync Server roles are deployed in virtual machines, reducing physical server count and making the above configuration a well-suited design for organizations looking to save on hardware and maintenance costs. Further, the solution caters to more than just instant messaging and conferencing needs within the organization. Enterprise Voice recommendations to reach external telephone users are provided, as well as Edge Server and Reverse Proxy guidance for Lync clients connecting remotely.



## A Additional Resources

Dell is focused on meeting your needs with proven services and support: <http://www.dell.com/learn/us/en/555/by-service-type-it-consulting> or <http://www.dell.com/learn/us/en/555/services/unified-communications-consulting>

[DellTechCenter.com](http://DellTechCenter.com) is an IT community where you can connect with Dell customers and Dell employees for the purpose of sharing knowledge, best practices and information about Dell products and installations.

Other references:

- Dell PowerEdge Rack Servers:  
<http://www.dell.com/us/business/p/poweredge-rack-servers>
- Dell Networking Switches:  
<http://www.dell.com/networking>
- Dell Networking Wireless:  
<http://www.dell.com/wireless>
- Dell Networking Lync Certification  
<http://technet.microsoft.com/en-us/lync/gg131938>
- Lync Stress and Performance Tool:  
<http://www.microsoft.com/en-us/download/details.aspx?id=36819>
- Lync Sizing Guidance for Physical Environments:  
<http://www.microsoft.com/en-us/download/details.aspx?id=36828>
- Lync Planning Tool:  
<http://www.microsoft.com/en-us/download/details.aspx?id=36823>
- Lync Requirements, Planning and Deployment:  
<http://technet.microsoft.com/en-us/library/gg398616.aspx>

