# Reference Architecture - Microsoft Lync Server 2013 on Dell PowerEdge FX

A Dell reference architecture for Lync Server 2013 with PowerEdge FX infrastructure and Dell Unified Communications Command Suite

Dell Global Solutions Engineering
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A Dell Reference Architecture

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# Acknowledgements

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# Executive summary

Unified communications (UC) provides an efficient, flexible and effective working experience while helping organizations reduce operations and capital costs. UC delivers real-time communication between peers —local, remote, or geographically dispersed—and enables instant and direct communication with partners, suppliers, and customers. Furthermore, all of these capabilities are provided while reducing administrative, telephony, travel, and IT costs compared to traditional communications solutions. The real challenge is the quality of end-user experience for real-time communications. To address this challenge while simplifying the design, deployment and management of Lync Server 2013, the Dell Global Solution Engineering group has created a scalable UC solution based on the 2U rack PowerEdge FX2s physical infrastructure. This solution deploys Lync Server core roles on physical servers and other supported roles on virtual machines. The physical deployment of certain roles enables the application to access the compute resources directly for better performance, while the virtual deployment of other roles reduces the physical server count. The resulting configuration is designed to deliver optimum end-user quality of experience balanced with IT efficiency, making it a well-suited, scalable and cost-effective design for enterprises.

The Dell UC solution provides instant messaging, presence, audio/video conferencing, web conferencing, telephony integration (enterprise voice), analytics and diagnostics. The fully featured solution integrates Dell products with Microsoft Lync Server 2013 software. The products consist of Dell PowerEdge servers, Dell Storage, Dell Networking switches and wireless, Dell Software, third-party voice gateways, client devices such as Dell Latitude laptops, Dell Venue Pro tablets, and Dell XPS tablets and Ultrabooks. Furthermore, the architecture is designed for high availability (HA) and functions even on the failure of a server or entire FX2s chassis, network or voice gateway. This design enables IT administrators to perform maintenance tasks without incurring Lync application downtime.

Lync Server can integrate with existing PBX systems or replace aging PBX systems to offer a complete UC experience, including telephony integration through the Lync clients. Lync also complies with legal requirements of specific countries by enabling Location-Based Routing.

To assist with design and implementation of a complete UC solution, the following reference architecture describes the resilient Lync Server infrastructure topology with all available communication modalities. The architecture is sized according to Microsoft's best practices. To validate the design, the Microsoft Lync Stress and Performance tool is used to generate real-time workloads on Lync servers.

This reference architecture is divided into multiple sections:

- Section 2 provides a quick introduction to the solution components that include Lync Server 2013, PowerEdge servers, Dell Storage, Dell Networking, Dell Software and client devices.
- Section 3 details the end-to-end design and implementation of the UC solution. For simplicity, this section divides the solution into two major portions and describes each of them.
- Section 4 provides the technical specifications, including all the physical and virtual components that make up the complete solution.
- Section 5 provides an overview of the verification process that was performed to ensure that the solution met the design principles.

# 1 Scope

This reference architecture describes the implementation of Lync Server 2013 on PowerEdge FC630 servers. The design is based on infrastructure design principles, which include HA, application best practices, hardware abstraction and resource consolidation. A sample implementation for 10,000 users, scalable to 60,000 users is given for reference.

## 1.1 Audience

This reference architecture is intended for IT professionals and administrators interested in designing and deploying end-to-end, real-time collaboration solutions using Lync Server 2013 on Dell server, storage and networking, third-party gateways/Session Border Controllers (SBCs), and associated client devices. This reference architecture provides an overview of the important solution components. However, the reader is expected to have an understanding of Lync Server 2013 and voice gateways. Familiarity with Windows Server 2012 R2 and SQL Server will also aid the reader's comprehension of the content in this document.

# 2 Introduction

Dell provides a validated end-to-end UC solution consisting of a Lync Server, PowerEdge servers, Dell storage, networking client devices, and monitoring/reporting tools. Also used are partner devices such as Public Switched Telephone Network (PSTN) gateway, SBC, load balancer, and Lync phones.

PowerEdge FC630 servers housed within 2U FX2s chassis minimize the overall hardware cost and datacenter footprint by enabling more instances of FC630 servers to meet application requirements. Unified communications and collaboration IT consulting services are available from Dell and Dell channel partners to customize the UC solution for each customer as per their business and technical requirements. Dell end-user devices optimized for Lync, as well as end-point and mobility management tools, enable secure, instant communication across devices.

## 2.1 Solution components

This reference architecture is built on the PowerEdge FX2s infrastructure using PowerEdge FC630 servers and incorporates Windows Server 2012 R2 and Lync Server 2013.

### 2.1.1 Overview of Dell PowerEdge FX2s Architecture

The PowerEdge FX2s architecture is a rack-based hybrid computing architecture. With a wide array of customer-inspired features and capabilities, the PowerEdge FX2s architecture offers optimized dimensions, security, acoustics and power options.

The PowerEdge FX2s enclosure is based on a 2U rack mount chassis and accommodates the PowerEdge FC830, PowerEdge FC630, PowerEdge FC430 and PowerEdge FM120x4 server sleds. A sled is a pluggable component in a modular architecture similar to that of the PowerEdge FX2s enclosure. The PowerEdge FX2s architecture offers flexibility in terms of infrastructure compute, storage and networking. The initial release of PowerEdge FX architecture supports four server sleds, the PowerEdge FX2s chassis and networking I/O modules as detailed in Table 1.

Table 1 Dell PowerEdge FX2s Component Overview

| Feature | Description |
|---|---|
| Server Compatibility | Dell™ PowerEdge™ FC830/FC630/FC430/FM120x4 servers |
| Form Factor | 2U rack enclosure |
| Number of Server Sleds | Up to two PowerEdge FC830 servers<br>Up to four PowerEdge FC630 servers<br>Up to eight PowerEdge FC430 servers<br>Up to four PowerEdge FM120x4 servers |
| I/O | 8 PCIe slots (supporting Ethernet and FC) |
| Power Supplies | Up to 2 x 1600w PSU (FC830, FC630 and FC430)<br>Up to 2x 1100w PSU (FM120x4) |

| | |
|---|---|
| Management | 1 Chassis Management Controller |
| Network | 2 x pass-through I/O Modules (IOM; 1 GbE or 10 GbE) |

The server connectivity in a PowerEdge FX2s architecture can be extended by adding supported PCIe peripheral cards. There are eight PCIe slots available for this purpose and they are internally mapped to servers. Table 2 shows the internal mapping of the server sleds to PCIe slots in a PowerEdge FX2s architecture.

Table 2 Server Sleds to PCIe Slot Mapping in a PowerEdge FX2 architecture

| Server Sled Number | PCIe Slot Number |
|---|---|
| Sled 1 | 8 |
| | 7 |
| Sled 3 | 6 |
| | 5 |
| Sled 2 | 4 |
| | 3 |
| Sled 4 | 2 |
| | 1 |

In this reference architecture, QLogic 2500 Series 8 Gbps FC Host Bus Adapters (HBAs) are used for providing Fibre Channel (FC) connectivity to the Storage Area Network (SAN) fabric. The PowerEdge FX2s architecture is managed through the Chassis Management Controller (CMC).

#### 2.1.1.1 Chassis Management Controller

The Dell Chassis Management Controller allows administrators to manage the entire chassis infrastructure from a single web console. It provides features to manage servers and IOMs and monitor PCIe slots in a PowerEdge FX2s chassis. Because CMC interacts with the server's integrated Dell Remote Access Controller (iDRAC), administrators can perform server-specific iDRAC functions such as managing the updates, changing the settings, or opening a remote console session from the CMC interface. CMC also helps administrators to monitor the system health from a single web console.

### 2.1.2 Overview of Dell PowerEdge FC630 server

This reference architecture employs the PowerEdge FC630 servers as the compute infrastructure. The PowerEdge FC630 servers support the latest Intel Ivy Bridge processors with a total of 36 processing cores and up to 768 GB physical memory. This enables PowerEdge FC630 servers to deliver performance for compute-intensive tasks. A QLogic 57840S 10 GbE Network Daughter Card (NDC) provides the network

connectivity through the 10 GbE pass-through IOM in the PowerEdge FX2s architecture. In addition, the PowerEdge FC630 servers use blade mezzanine cards to connect to the PCIe add-on peripherals. This connectivity can be leveraged to build optional redundancy for the network connections. Table 3 describes the components supported in a PowerEdge FC630 server.

Table 3 Overview of PowerEdge FC630 server

| Components | Supported in PowerEdge FC630 server |
|---|---|
| CPU | Up to 2 Intel E5-2600v3 family processors |
| Memory | 24 DIMMs; up to 768 GB[1] |
| Networking | QLogic 57840S 10 GbE NDC |
| Fibre Channel Connectivity | QLogic QLE2562 FC HBAs |
| Form Factor | ½ width Sled |
| PCIe slots | Provided by the PowerEdge FX2s architecture |
| Storage | 2 x 2.5-inch SAS or SATA drives |
| Storage – RAID for OS drives | H330 and S130 on-board controller |
| Systems Management | iDRAC8 Express or iDRAC8 Enterprise |

### 2.1.3 Overview of Dell Storage SC4020

The Dell Storage SC4020 array belongs to the Storage Center (SC) 4000 series arrays, which is based on the SC8000 platform. These storage arrays offer multi-protocol support and virtualized multi-tier, multi-RAID-level storage policies. Each SC4020 array comes with dual redundant controllers, 24 internal drive slots, eight 8 Gb Fibre Channel (FC) ports or four 10 Gb iSCSI network ports and four additional 10 Gb ports for management and replication traffic. This reference implementation employs an SC4020 array only for SQL server's data storage.

[1] Some processor heat sink configurations may not support 768 GB. Refer to the product manual for more information.

### 2.1.4 Overview of Storage Architecture and Configuration

This reference architecture employs the Dell Storage SC4020 array. The SC4020 array includes 24 x 1.2 TB 10K SAS drives. The Brocade 300 switch connects to the storage array and SQL Back End Server through FC connections.

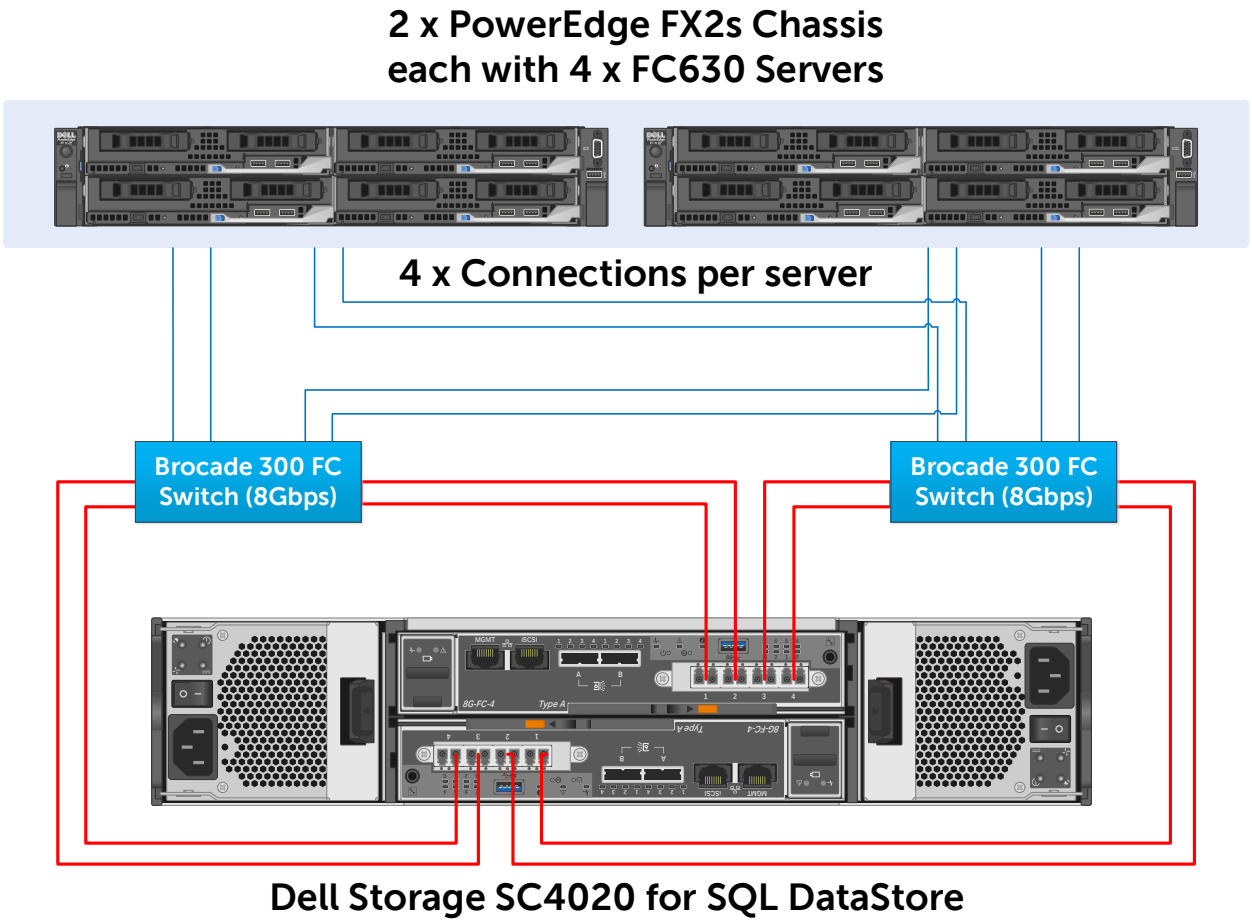


Figure 1 SAN Architecture

As shown in Figure 1, the SC4020 array is connected to both FX2s chassis where SQL server is deployed. The disk drives in the SC4020 array are configured as a single disk folder. Multiple LUNs have been created for the Lync Back End and Archiving and Monitoring databases.

### 2.1.5 Overview of Dell Networking

This reference architecture uses Dell Networking N4064F 10/40 GbE top-of-rack (ToR) switch purpose-built for applications in high-performance data center and computing environments. The N4000 series switches deliver line-rate L2 and L3 forwarding capacity with ultra-low latency to maximize network performance. The N4064F switch provides 48 dual-speed 10 GbE SFP+ ports as well as four 40 GbE

QSFP+ uplinks to conserve valuable rack space and simplify the migration to 40 Gbps in the data center core. In this solution architecture, two N4064F switches are deployed as LAN switches.

Figure 2 Dell Networking N4064F Layer 3 Top of Rack Switch

For client devices (access switches), the Dell Networking N3048P Power over Ethernet (PoE+) switches can be used. These switches provide 30.8 W per port for Lync clients, including the Polycom CX600 IP phones.

### 2.1.6 Overview of Network Architecture and Configuration

The PowerEdge FX2s enclosure offers 1 GbE and 10 GbE pass-through modules for network connectivity to the NDC network connections in the PowerEdge FC630 servers. The two N4064F switches are lagged together using 40 GbE links, which provide 80-Gb of bandwidth between the two switches.

This solution provides four 10 GbE uplinks from each switch to link into an existing core network infrastructure.

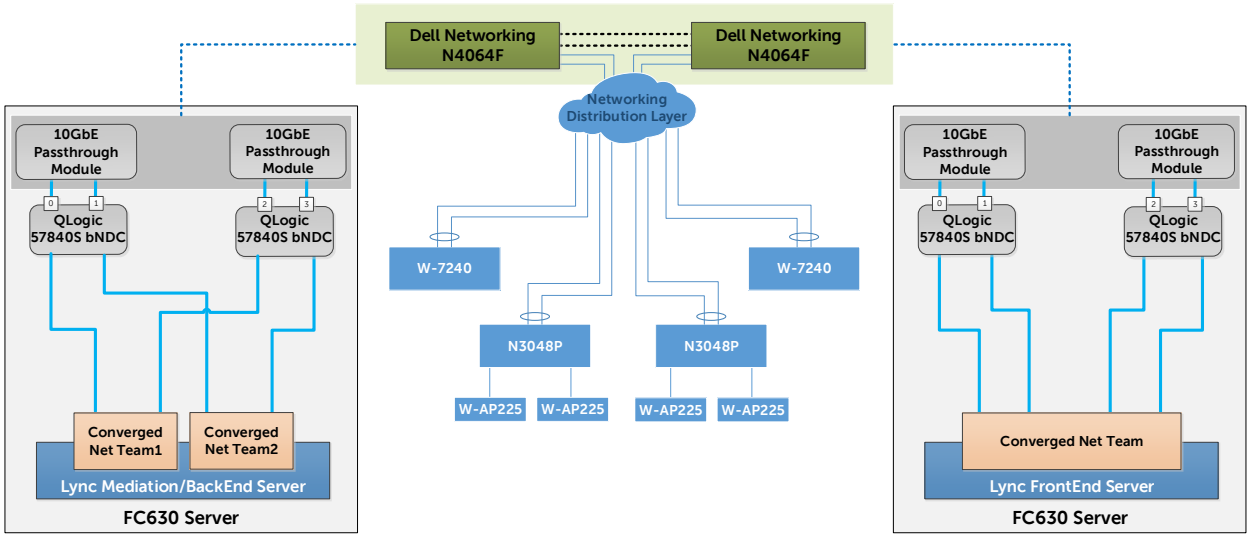


Figure 3 Network Architecture

As shown in Figure 3, a native Windows network team with four 10 GbE ports is created for all Lync Front End servers whereas two native Windows network teams are created for the Mediation and SQL servers.

SQL server connects one leg to the applications server network, while the other leg is connected to the Private network to provide heartbeat functionality in SQL cluster. One NIC team is used to connect Mediation server to the application server, while the other NIC team is used to connect Enterprise Voice setup.

### 2.1.7 Dell Networking wireless infrastructure devices

For Lync 2013 real-time workloads, Dell recommends Dell Networking W Series wireless controllers and access points. The W-Series W-7240 controller can support up to 32,768 users and can manage 2048 LAN access points (APs). The AP chosen for this configuration is W-AP225, which comes with dual-radio configurations and can deliver wireline-like data rates up to 600 Mbps at 2.4 GHz and 1.3 Gbps at 5 GHz. W-AP225 can handle numerous audio-video sessions simultaneously, assuming each audio stream is 65 Kbps and each video stream is 500 Kbps. However, the performance and Quality of Experience (QoE) of Lync Server must be monitored, and these throughput values should not be used as the only metric to determine quality.

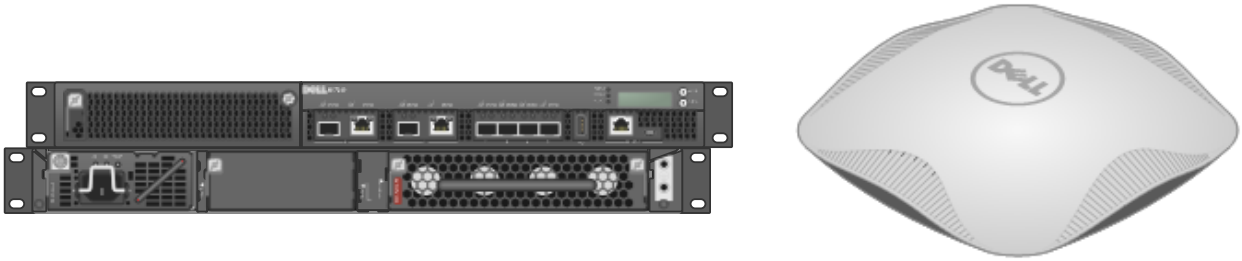

Figure 4 Dell Networking W-7240 Controller and Dell Networking W-AP225 Access Point

### 2.1.8 Client devices

The enterprise VoIP implementation is an end-to-end UC solution that includes client hardware components and data center hardware. Dell has a rich product portfolio of client devices that can be used to run the Lync end user client. The Latitude, XPS, Dell Inspiron™, Dell Precision™ and Venue Pro product lines are suited to run the Lync client software/app. Visit the Dell Laptops, Tablets and Workstations site to browse Dell client products suited for the workplace. The Polycom CX300, CX500 and CX600 phones are third-party clients that can be used as Lync end points. For a complete list of client devices available for Lync, contact your Dell sales representative.

### 2.1.9 Microsoft Lync Server 2013

Lync Server enables instant messaging, presence, audio/video conferencing, web conferencing and voice interoperability. Lync Server provides different modalities to users, including:

- **IM and Presence**: Enables users to view the status of other Lync users and update current status (Available, Busy, Away, etc.). Conferencing with multiple users is also supported.
- **Audio Conferencing**: Enables users to communicate with other Lync users using SIP and Real-time Transport Protocol (RTP). Audio conferencing using Lync is cost effective for enterprises with

employees spread across geographical locations as users can communicate using the enterprise data network instead of expensive long-distance telephony.

- **Video and Web Conferencing**: Enables users to run meetings using 1:1 and group video conferences, including optional recording and desktop and application sharing. These workloads are available with Lync Server and can be leveraged for day-to-day tasks in the enterprise.
- **Voice Interoperability with PSTN**: Enables users to communicate with telephone users within and outside the enterprise using Lync Mediation Server, which can be collocated on the Front End Server. Lync Mediation Server works with a SIP trunk or telephony device (IP-PBX/gateway).

The following are the Lync Server 2013 server roles:

- **Front End Server**: The Front End Server role manages Lync client authentication, instant messaging, web conferencing, audio/video conferencing and user presence updates. It is the central component of the 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 Server role. The Archiving and Monitoring role can be used to monitor user statistics and QoE within the Lync environment and archive conference content and instant messages for future audits. The Archiving and Monitoring role also allows IT administrators to access call detail records and QoE statistics for Lync communication.
- **Back End Server**: Microsoft SQL Server serves as the Back End for Enterprise Edition Front End Pools. SQL Server maintains a copy of the topology information, user contact lists, archiving and monitoring databases and logs, and other data. Lync Server supports SQL mirroring with primary and secondary copies. SQL mirroring or SQL clustering can be used to provide HA for the SQL databases. Archiving and Monitoring databases might be collocated with Lync Back End servers.
- **Mediation Server**: The Mediation Server role provides Enterprise Voice capabilities and manages the communication between the Front End Server roles and media gateways or SBCs. This role can be collocated with the Front End Server role. The Mediation Server role facilitates traffic encryption/decryption and transcoding by using Transport Layer Security (TLS) instead of traditional TCP. TLS is more secure than transmitting clear traffic over the wire. Transcoding refers to the process of converting media streams between different audio codecs. Transcoding is necessary if the telephony codec used is not G711, that is, the codec used by Lync.
- **Director Server**: This is an optional role in Lync Server 2013. The Director Server role redirects user requests to their home pool, which can be either a Standard Edition server or an Enterprise Edition Front End pool. The Director Server protects the Front End Server roles 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 such as unarchived instant message conversations or audio/video/web conferences. Persistent Chat Back End servers are required to store chat history data and information about categories and chat rooms. The optional Persistent Chat Compliance Back End server can be deployed to store the chat content and compliance events.

- **Edge Server**: This role in Lync Server manages all communications 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 by using the Edge Server.
- **Standard Edition Server**: The Standard Edition Server delivers the features of Lync Server 2013 by using integrated databases on a single server. This configuration enables an organization to have Lync Server 2013 infrastructure at a low cost that can be deployed with a backup registrar to provide limited HA features. This manages 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 uses the Lync Enterprise Edition Pool. Refer to the Dell Unified Communication Solution with Lync for Single Site Implementation for a reference architecture using the Lync Standard Edition Server.

The following are the other server applications that can be part of Lync Server 2013 deployment:

- **Office Web Apps Server**: This role provides enhanced web conferencing with PowerPoint presentations. Office Web Apps Server enables custom fonts, animated slides and higher-resolution content sharing in presentations.
- **Reverse Proxy Servers**: This role is an external component that complements the Edge Server role by handling web services traffic. With the Reverse Proxy Servers, external users can access web services available through simple URLs. Some of these features include meeting content downloads, address book downloads, location information, and Lync Web App. The HTTP and HTTPS traffic is routed to the Reverse Proxy Server which then forwards these requests to the Front End Server.

#### 2.1.9.1 Lync Server 2013 Enterprise Edition Pool

Lync Server 2013 Enterprise Edition follows Microsoft's "brick model" or "brick architecture." In this architecture, the SQL Back End Servers and the Lync Front End Servers are loosely coupled than in Lync Server 2010. Users are now distributed among up to three different user groups. Each user group is assigned to three Front End Servers within the Enterprise Edition pool—a primary, a secondary and a tertiary server. All user data is replicated across these three Front End Servers by using Windows Fabric, a management utility to handle replication. It is recommended to install a minimum of three Front End Servers when deploying an Enterprise Edition pool. Due to these changes in the Lync architecture, the Front End Servers are now primarily responsible for managing user state or presence. The presence information on the Front End Servers is synchronized and written back to the SQL database by using lazy writes.

### 2.1.10 Dell Unified Communications Command Suite

Dell Unified Communications Command Suite (UCCS) is a platform which offers diagnostics and analytics to manage messaging and real time communications infrastructure through a single console. UCCS - Diagnostics helps prevent environmental issues and identify root causes for

problems, while UCCS - Analytics provides dynamic analytics about your Exchange and Lync on-premises environments and Office 365 Exchange hybrid environments.

UCCS - Diagnostics provides:

- **Server health visualization** — View data flows through Microsoft Exchange and Lync servers. Bottlenecks are highlighted in yellow and red so you can drill down for accurate problem resolution.
- **Comprehensive at-a-glance views** —Get status updates on core operations, and monitor specific areas of concern after fixes are implemented to verify the effect of changes.
- **Streamlined deployment**— Increase the speed and ease of server deployment while cutting maintenance costs and reducing compatibility issues.
- **Improved system performance** — Maximize the availability and performance of both Lync and Exchange servers and dependent systems. Proactively receive messages when system health checks fail to allow issues to be avoided before they begin. System information across multiple platforms can be seen in real time within the diagnostic console.

UCCS – Diagnostics can be deployed on a single computer or distributed across two or more computers.

The components include:

- Database
- Diagnostic Service
- Web Reports
- Diagnostic Console
- Management Console

UCCS - Analytics delivers:

- **Aggregated analytics:** Analyzes usage and trends, increases user productivity and enforces communication policies using a single view into your on-premises (Exchange and Lync) or online hybrid (Office 365) communications solutions.
- **Customizable insights and dashboards:** Gives your business managers the ability to pull their own communication insights on workforce communications without extensive technical training.
- **Quality of experience analysis:** Provides quick answers about the quality of your Lync user experiences across offices, departments, geographical areas, devices, and network connectivity methods.
- **Secured communications:** Protects intellectual property, personally identifiable information, and other sensitive communications from leaving the company.
- **Better business decisions:** Transforms the data trapped in UC systems into actionable intelligence on workforce communications by allowing you to collect and analyze email communications.

UCCS – Analytics can be deployed on a single computer or distributed across two or more computers:

The components include:

- Website (Internet Information Services)
- Analytics Data Engine
- Analytics Query Engine service
- Analytics Storage Engine service

## 2.2 Design considerations

The key design considerations for this reference architecture include:

- High availability (HA)
- Application performance
- Resource consolidation

For the purposes of this reference architecture, the Quality of Service (QoS) implementation recommended by Microsoft is provided externally by the networking components.

### 2.2.1 High Availability

HA must be considered at every layer to ensure minimal application downtime. The following two layers of HA are considered in this reference architecture:

- **Application-level high availability** utilizes multiple instances of server roles to provide services in the event of a failure. This HA layer ensures that there is no single point of failure at the application level, thus minimizing service downtime to the end user.
- **Infrastructure high availability** is provided when a hardware resource fails; there is another preconfigured resource that takes over.

During scheduled downtime, infrastructure availability ensures that there is additional hardware resource, and the application-level availability keeps the application services running for the end users. This is important for IT administrators who want to apply patches or upgrades to their data center equipment.

### 2.2.2 Application performance

While maintaining HA is critical, applications must perform well to ensure a reliable end-user experience. The Dell Global Solutions Engineering group has used Lync 2013 Stress and Performance Tool to ensure that the reference architecture is appropriately sized to meet the needs of a 10,000-user Lync deployment. Some of the workloads sized in this reference architecture included instant messaging, audio conferencing, video conferencing using multi-view, application sharing, distribution list expansion, address book downloads and enterprise voice.

### 2.2.3 Resource consolidation

In a solution that uses Lync Server, voice gateways/session border controllers, and PSTN or PBX systems, it is important to consolidate multiple components to reduce data center footprint and cost.

This reference architecture uses 2U FX2s chassis to reduce the datacenter footprint. HA is provided natively by Lync or by using SQL mirroring/clustering. Only one SQL cluster has been deployed to cater to both backend database for Lync Back End and archiving and monitoring database for archiving and monitoring functionality.

# 3 Solution reference architecture

A high-level diagram of the reference architecture is illustrated in Figure 5. It shows a customer scenario that consists of one central site and one or more branch offices with WAN links between them. This design includes both voice connectivity methods—ISDN (T1/E1) and SIP trunk connections provided by Internet Telephony Service Provider (ITSP)/ PSTN providers. However, the customer may have either ISDN (T1/E1) or SIP trunk for the datacenter and branch offices.

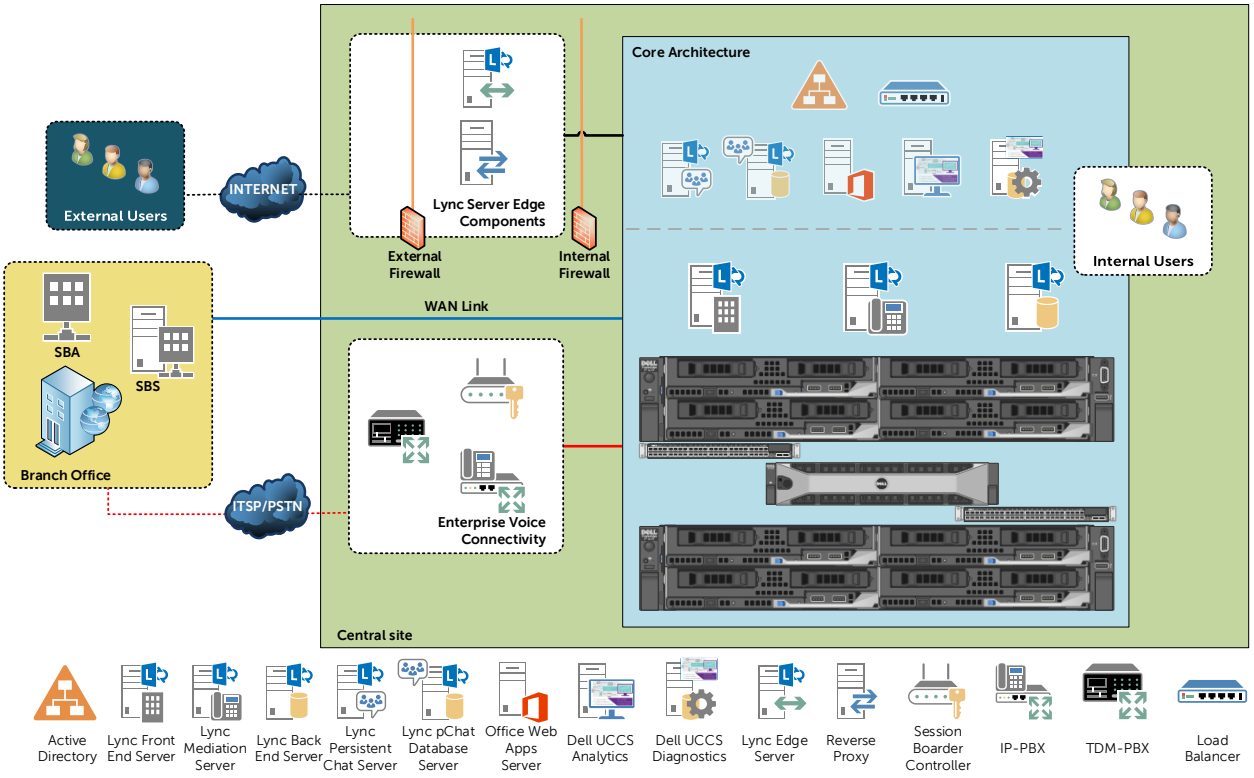


Figure 5 Dell UC Solution Logical Architecture

There are two major portions of this reference architecture:

- **Lync Server Core Architecture**: The core components area located at the central site hosts the server roles that provide the main features of Lync Server 2013. To support these crucial Lync Server components, sufficient computing and storage resources should be allocated to meet the requirements from the targeted number of users. The design should incorporate HA to ensure minimal service downtime. Therefore, multiple instances of server roles are utilized to avoid a single point of failure. The design also employs load balancers to distribute workload among these server roles. In this reference architecture, only Lync server core roles are sized and deployed on physical servers while rest of the dependencies such as Active Directory, Office Web Apps server and other monitoring tools are assumed to be a part of the current infrastructure or can be deployed as a VM. Persistent Chat pool is an optional Lync server role, which can be considered as part of the design based on business requirements.

- **Lync Server Auxiliary Architecture**: The following are the other components which are required as a dependency or to facilitate Lync services to the end user. Other components are described below:
  - **Lync Server Edge Components**: Edge Servers and the optional Reverse Proxy Servers are located in the perimeter network of the central site. They support communications across the organization's firewall between internal and external users.
  - **Enterprise Voice Connectivity**: This portion includes additional PSTN connectivity components required to implement the Enterprise Voice features, such as PSTN gateways, PBX and SBC, and shows how they connect to the Lync Server core architecture.
  - **Branch Office Connectivity**: The branch office supports a smaller number of users. The design has to ensure that branch office users can continue to make and receive calls through the local ISDN or SIP trunk in case of a WAN failure, which disrupts the connection between branch offices and the central site. The branch office can be equipped with a Survivable Branch Appliance (SBA) or Survivable Branch Server (SBS), which runs a Lync Server registrar and a Mediation Server component.
  - **End User Connectivity**: End users connect with Lync services through different types of end-point devices. This reference architecture describes their connectivity options and highlights how Dell Networking W-series wireless controllers and APs enhance the user experience of wireless-connected Lync clients.

**Note:** Step-by-step instructions for installing and configuring a complete Lync solution and any service applications used in this performance study are outside the scope of this paper. For more information, refer to the Additional Resources section of this paper.

## 3.1 Lync Server core architecture

When deploying a Lync solution, the first step is to develop a design that will address the communication requirements across the enterprise. Designing a simple solution for a small number of users can be easy whereas designing a large, scalable solution may be complex for system administrators or IT managers because it requires in-depth study and extensive expertise in that area. To resolve this issue, this reference architecture considers design principles for scalable Lync solution by just adding one Pod to another Pod.

This reference architecture uses the concept of Pod, which is a standardized configuration of the minimum server and storage resources sized to meet the solution requirements. The configuration within each Pod in a deployed solution must remain the same. To meet more number of user requirements, you need to increase the number of Pods. The following section provides the design framework adequate for 10,000 Lync users, which is easily scalable for 50,000-60,000 Lync users with instant messaging, audio/video, web conferencing and Enterprise Voice communication modalities.

Figure 6 provides a high-level diagram of Pods, which are designed for Lync Server 2013 core architecture. Each Pod has been sized for 10,000 users. Initially, the design uses two Pods and makes a complete building block for 10,000 Lync users considering application and hardware level HA. The solution can be scaled further by just adding one Pod for 10,000 users. Per Microsoft's recommendation, one Front End pool can have a maximum of 12 Front End servers. Therefore, this solution can be scaled up to six Pods that employ 12 Front End servers. However, more than one pool can be deployed to meet more number of user requirements or for any specific business requirements.

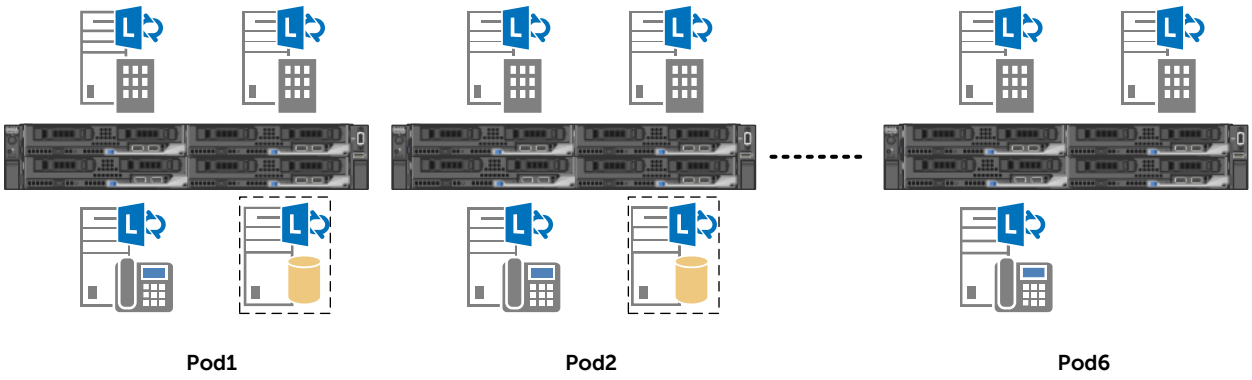


Figure 6 Pod Architecture

Pod 1 and Pod 2 use SQL Server, which is used for Lync Back End and Archiving and Monitoring databases. However, the rest of the Pods have only three servers in use, and the fourth server can be used for some other requirement, such as deploying persistent chat pool.

The primary component of this architecture is a Lync Server 2013 Enterprise Edition Front End pool. The Front End pool consists of four Front End servers that are identical and provide communication services for a group of users. This pool of identically configured servers provides scalability and availability in the event of server maintenance or failure. With Lync 2013, the Front End pool is also the primary store for user and conference data, where each user's data is replicated to up to three Front End Servers with an additional copy being backed up to the Back End Server. Each Lync Front End Server deploys a SQL Express instance to store the RTC Local and Lync Local database instances. RTC Local databases synchronize with the RTC databases on the SQL Back End Servers for Lync. The RTC local databases are required because they contain user presence information. The Lync Local database instance contains a database named lyss, which specifically works for a paired pool configuration.

For better Enterprise Voice calls, a dedicated Lync Mediation server pool is deployed. One leg of Lync Server Mediation pool connects to the Front End pool, while the other leg connects to the PBX/PSTN Gateway/SBC for enterprise voice connectivity.

The Back End Server hosts databases running SQL Server and does not run any Lync Server software. These databases serve as the backup store for user and conference data. The same SQL Back End Server can also be used as the primary store for other roles, such as Archiving and Monitoring. It is recommended that the Back End Server be mirrored or clustered for failover.

Figure 7 provides a high-level schematic of a Lync Server 2013 core architecture that has been sized for 10,000 users. The architecture has been built on the design principles discussed in Section 2.2.

The Lync Server 2013 core architecture consists of eight PowerEdge FC630 servers enclosed by two FX2s chassis. Each of these servers is running Windows Server 2012 R2. The detailed hardware specifications for these servers are provided in Section 4.

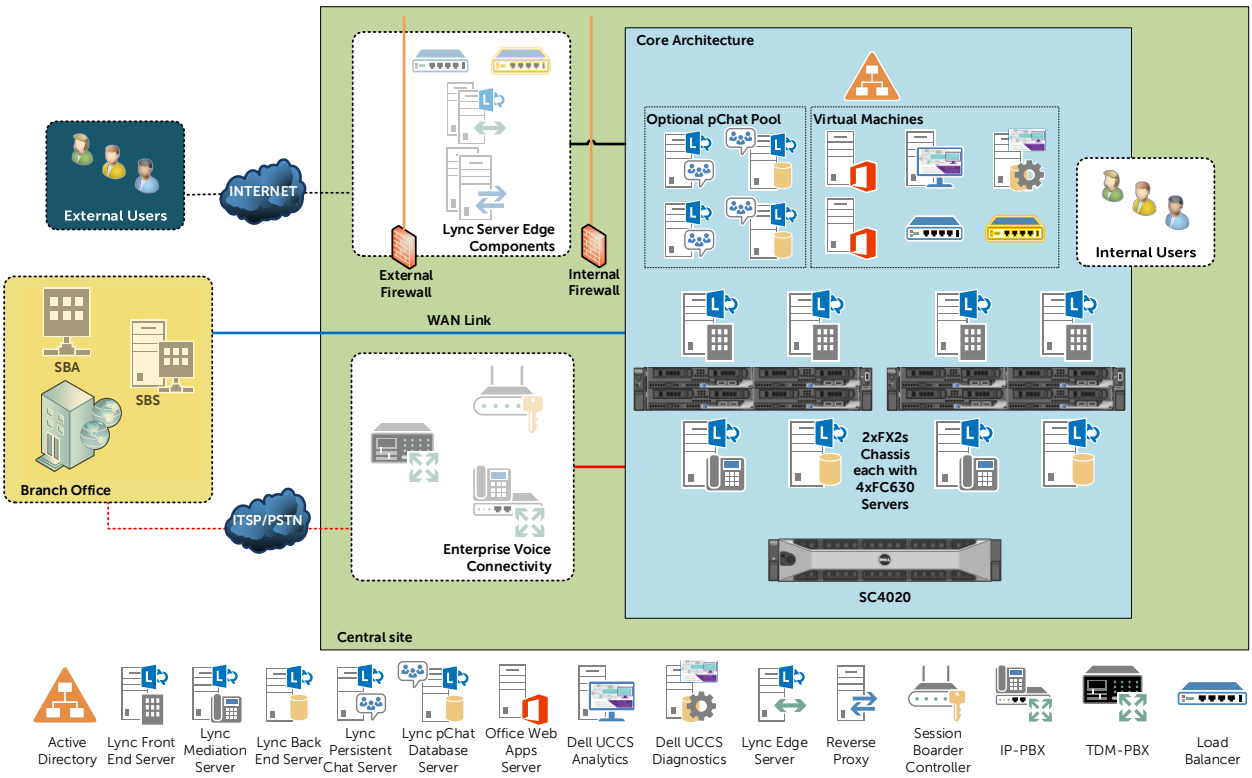


Figure 7 Lync Server 2013 Core Architecture

For providing HA at the application level, four Front End servers, each collocated with Archiving and Monitoring roles, are configured in a single Front End pool. Each FX2s chassis consists of a maximum of two Front End servers to provide chassis level HA. In addition, each FX2s chassis consists of Mediation pool with two Mediation servers to provide application, server and chassis level HA. For Lync Back End HA, a SQL cluster is used. Similar to the Front End and Mediation servers, SQL servers must be placed on a separate FX2s chassis. Because the design utilizes SQL cluster to provide HA, an external storage is required for databases. Lync 2013 requires Office Web Apps servers (OWS) to provide enhanced web conferencing experience. In this reference architecture, two OWS servers are deployed to enable HA of these services.

In addition to the above mentioned Lync-specific components, Dell UCCS for Lync and two virtual load balancer appliances in the active/standby mode are also optionally considered as a part of this design. UCCS provides comprehensive usage reporting and analysis. It allows organizations to monitor usage trends and adoption of Lync services. It can also be used as a billing and chargeback solution for Lync services. UCCS Diagnostics uses SQL server database. In this reference architecture, two UCCS VMs are deployed, one for analytics and another for diagnostics. SQL database is collocated on the same server where UCCS diagnostics is deployed.

### 3.1.1 Network architecture

The networking configuration required on the Front End servers is summarized in Figure 8. Each PowerEdge FC630 server provides four 10 GbE network connections by using pass-through I/O modules. On each Front End server, a converged network design using Microsoft NIC teaming is used to provide networking connectivity to the application. This section describes the host networking used in the reference architecture.

Figure 8 shows the connectivity of the Lync Front End server to the Converged Network team. The teamed NICs from the servers connect over 10 GbE 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.

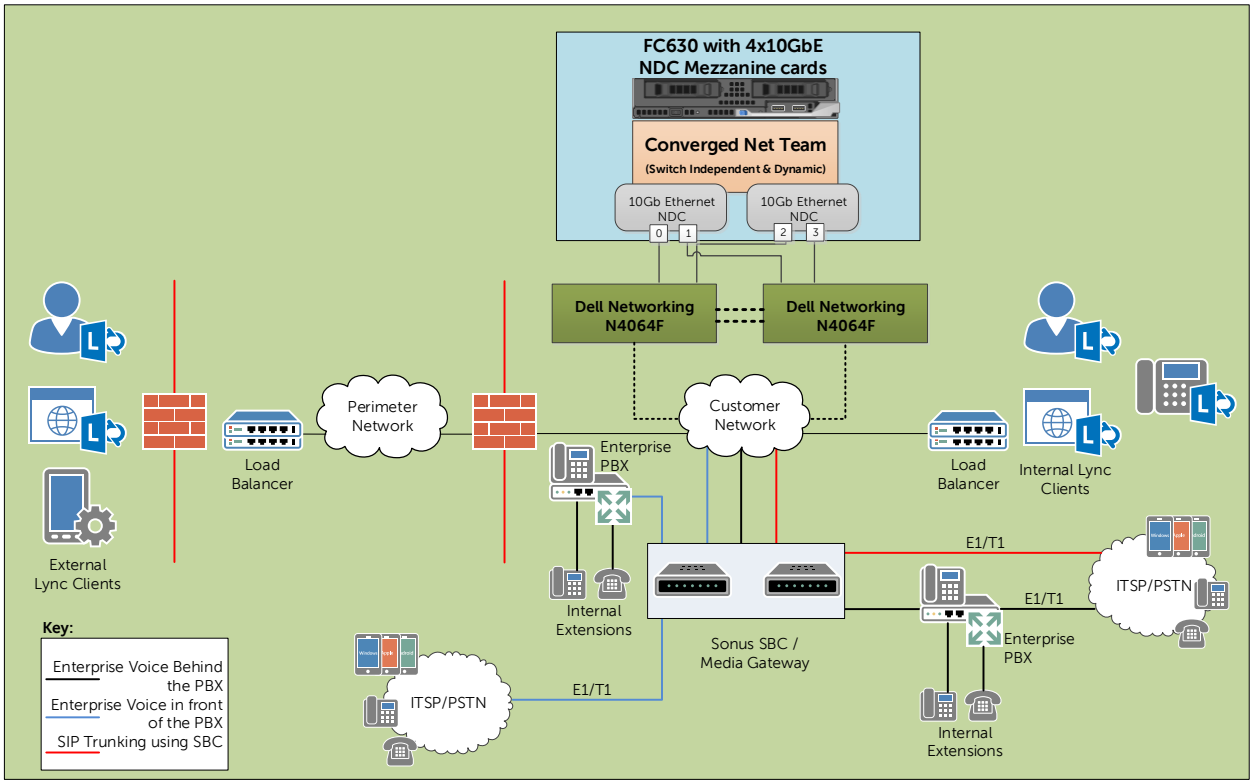


Figure 8 Network Architecture of Lync Core Server Hosts

Mediation and SQL servers have two NIC teams each with two adapters. However, one leg of the Mediation server connects to the Front End servers, while the other leg connects to the ITSP/PSTN network. In the same way, one leg of SQL server connects to the Lync infrastructure and the other leg is used for SQL cluster network.

### 3.1.2 Storage for Lync core infrastructure

All physical servers hosting the entire Lync core infrastructure use internal server storage, a cost-effective alternative to storage area networks or direct-attached storage for Lync deployment. The internal server

storage in this design has been configured with RAID 1 to store operating system and application data while for Lync Back End servers, the SC4020 array is configured to host the SQL databases.

## 3.2 Lync Server Auxiliary Architecture

A high-level illustration of Lync Server auxiliary architecture in Figure 9 describes the components that must be configured to facilitate Lync modalities.

This reference architecture assumes that connectivity to an existing perimeter network already exists and does not explicitly provide details for these components. Dell SonicWall has a wide range of products to meet any requirements for security or firewall devices.

Customers can deploy a Lync Edge server pool with two Edge servers in their existing perimeter network if load balancer and Reverse Proxy Servers already exist for other running applications.

Figure 9 shows many different options for voice connectivity using TDM-PBX/IP-PBX through Media gateway, SIP Trunk through SBC, Direct SIP etc. Customers can choose the best enterprise voice connectivity option that fits into their requirements.

The enterprise connectivity options are:

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

A wide range of Enterprise Voice components such as SBC or Media gateway can be leveraged through Dell business partners.

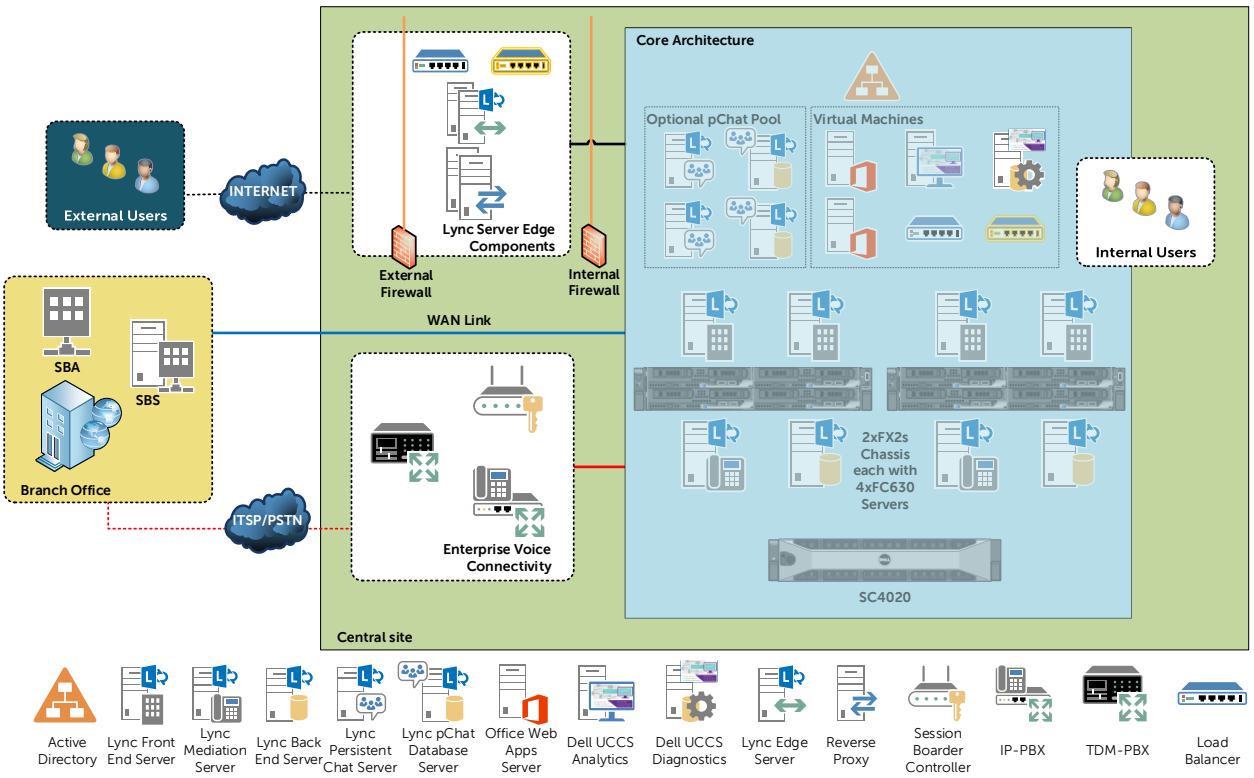


Figure 9 Lync Server Auxiliary Architecture

In addition to the above components, there is an option to connect one or more branch sites. The Lync core infrastructure resides at the central site. The branch sites are connected to the central site through a WAN, and they get most of their functionality from the Lync infrastructure pool at the central site. A SBA/SBS can be deployed at the branch site to provide voice resiliency at the branch site.

End-user connectivity is achieved through the Lync 2013 desktop or mobile clients, Lync Web App, Lync Windows Store App, and 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 Android devices. Specialized Lync devices, such as the Polycom CX series of phones, are designed to integrate with Lync, and some of these devices run the Lync Phone Edition natively on them. These clients can be connected through a wired connection or wirelessly.

**Note:** This reference architecture provides a high-level overview of auxiliary architecture. For more information about these architecture components, see the other Lync reference architectures at http://www.dell.com/ucc. It is recommended that you contact Dell Services or a Dell partner to scope out the optimal solution to fit your requirements.

# 4 Technical specifications

This section details the technical specifications for all of the physical and virtual components that make up this reference architecture and are part of the UC solution. Figure 10 shows the complete logical view of the UC solution for 10,000 users with central site and branch office connectivity.

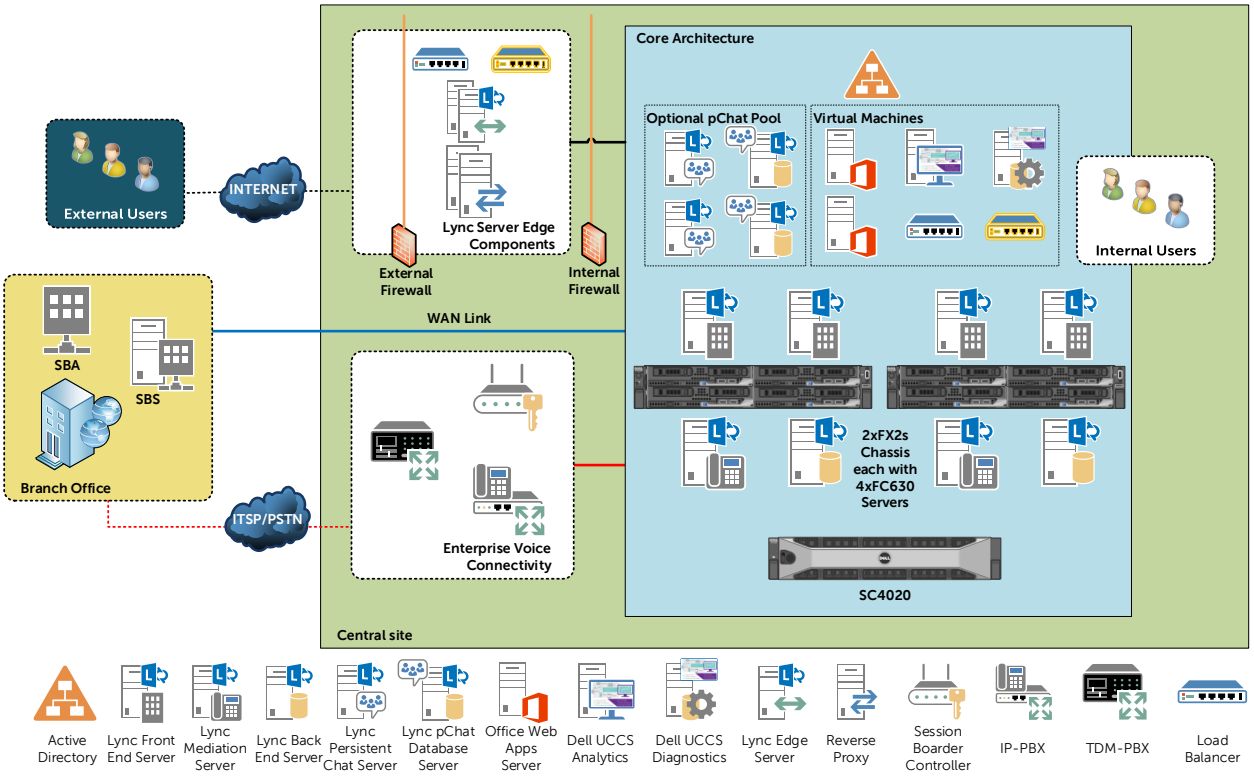


Figure 10 Dell UC Solution

## 4.1 Physical Server specifications

The core Lync Server roles have been deployed on physical servers. Lync Front End, Back End and Mediation servers are part of the PowerEdge FX2s chassis, while Lync Edge server is deployed on PowerEdge R430 Servers. Microsoft recommends using either physical or virtual servers for the entire Lync pool configuration and backup pool configuration in case of a DR scenario.

Table 4 Physical Server Configuration Details

| 4 x Lync Front End Server | |
|---|---|
| Hardware | Dell PowerEdge FC630 blade server with 2 x 2.5-inch drive chassis |
| CPU | 1 x Intel Xeon processor E5-2600v3 CPU with 12 cores |

| | |
|---|---|
| RAM | 32 GB |
| Network Adapter | QLogic 57840S 10 GbE NDC |
| RAID Controller | PERC H330 |
| Hard Drives | 2 x 600-GB 15k SAS 2.5” |
| Operating System | Windows Server 2012 R2 Standard Edition |
| Software | Microsoft Lync Server 2013 |
| **2 x Lync Mediation Server** | |
| Hardware | Dell PowerEdge FC630 blade server with 2 x 2.5-inch drive chassis |
| CPU | 1 x Intel Xeon processor E5-2600v3 CPU with 12 cores |
| RAM | 32 GB |
| Network Adapter | QLogic 57840S 10GbE NDC |
| RAID Controller | PERC H330 |
| Hard Drives | 2 x 600-GB 15k SAS 2.5” |
| Operating System | Windows Server 2012 R2 Standard Edition |
| Software | Microsoft Lync Server 2013 |
| **2 x SQL Back End Server** | |
| Hardware | Dell PowerEdge FC630 blade server with 2 x 2.5-inch drive chassis |
| CPU | 1 x Intel Xeon processor E5-2600v3 CPU with 12 cores |
| RAM | 32 GB |
| Network Adapter | QLogic 57840S 10GbE NDC |
| RAID Controller | PERC H330 |
| Hard Drives | 2 x 600-GB 15k SAS 2.5” |
| Fiber Channel Connectivity | 2 x QLogic QLE2562 FC HBAs |
| Operating System | Windows Server 2012 R2 Standard Edition |
| Software | Microsoft SQL Server 2012 Sp1 Enterprise Edition |
| **2 x Lync Edge Server** | |
| Hardware | Dell PowerEdge R430 rack server |
| CPU | 1 x Intel Xeon processor E5-2600v3 CPU with 8 cores |

| | |
|---|---|
| RAM | 32 GB |
| Network Adapter | 4 x 1GbE LOM |
| RAID Controller | PERC H330 |
| Hard Drive | 2 x 600-GB 10k SAS 2.5” |
| Operating System | Windows Server 2012 R2 Standard Edition |
| Software | Microsoft Lync Server 2013 |

## 4.2 Virtual Machine specifications

Many server applications that are associated with Lync 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. The allocation of virtual CPU, memory and networking has been validated by using the Microsoft Lync Stress and Performance Tool and per Microsoft best practices.

Table 5 Virtual Machine Configuration Details

| **2 x Office Web Apps Server (OWS) VMs** | |
|---|---|
| Operating System | Windows Server 2012 |
| Virtual Machine Configuration | 4 x vCPU |
| | 8 GB RAM |
| Networks | 1 x Synthetic Network Adapter per VMs |
| Software | Office Web Apps Server |
| **1 x UCCS Analytics VM** | |
| Operating System | Windows Server 2012 R2 |
| Virtual Machine Configuration | 4 x vCPU |
| | 16 GB RAM |
| Networks | 1 x Synthetic Network Adapter |
| Software | Dell Unified Communications Command Suite for Lync |
| **1 x UCCS Diagnostics VM** | |
| Operating System | Windows Server 2012 R2 |
| Virtual Machine Configuration | 2 x vCPU |
| | 8 GB RAM |
| Networks | 1 x Synthetic Network Adapter |
| Software | Dell Unified Communications Command Suite for Lync and SQL Server 2012 SP1 Standard Edition |
| **2 x Reverse Proxy VMs** | |
| Operating System | Windows Server 2012 R2 |
| Virtual Machine Configuration | 2 x vCPU |
| | 8 GB RAM |
| Networks | 2 x Synthetic Network Adapter (1 internal, 1 external) |
| Software | IIS ARR Win 2012 R2 |
| **4 x Virtual Load Balancer VMs** | |

| | |
|---|---|
| Operating System | Third-party provider defined |
| Virtual Machine Configuration | Third-party provider defined |
| Networks | 1 x Synthetic Network Adapter |
| Software | Third-party Virtual Load Balancer (Recommended: KEMP Virtual LoadMaster VLM) |

Table 5 provides the details of the recommended configuration for the VMs that make up this solution. Based on the role performed by each VM, 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 application level, more than one instance of virtual machine has been provisioned for all critical server roles.

**Note:** The server hosts can use either Windows Server 2012 R2 Datacenter edition or Windows Server 2012 R2 Standard edition with stacked licenses as detailed below.

On the hosts deployed for virtual servers, two/three Windows Server 2012 R2 Standard edition licenses[2] are stacked. This allows up to four/six VMs respectively on the same physical server running Windows Server 2012 R2 Standard edition.

Table 6 Enterprise Voice Components

| **Voice Components** | |
|---|---|
| Voice Gateways | 2 x AudioCodes Mediant SBC |
| SBA at Branch | 1 x Mediant 1000B SBA |

Table 7 Enterprise Voice Components

| **Additional Recommended Components** | |
|---|---|
| Networking (Core Architecture) | 2 x Dell Networking N4064F |
| Networking (Client Connectivity)–Wired and | Dell Networking N3048P (PoE+ capable) |
| Wireless | Dell Networking W-7240 Controller and Dell Networking W-AP225 Access Point |

[2] Windows Server 2012 R2 Licensing Data Sheet
Windows Server 2012 R2 Licensing FAQ

| | |
|---|---|
| Remote Management | 1 x iDRAC 8 with vFlash 8 GB SD Card per host server |
| Peripherals—Tablets and Notebooks | Dell Venue Pro Tablets<br>Dell Latitude Tablets |
| | Dell XPS 12 Convertible Ultrabook<br>Dell XPS 13<br>Dell XPS 14 Ultrabook |
| Peripherals—Personal Phones | Polycom CX 300, 500, 600 |
| Peripherals—Conferencing | Polycom Roundtable CX5000, CX7000<br>Plantronics 620 |
| Peripherals—Personal Headsets | Plantronics Voyager Pro UC B230-M<br>Jabra GN 2000 Duo<br>Jabra Pro 350-MS |

# 5 Verification

The verification process of the solution included performance validation of Lync Server, analysis of QoE results from monitoring server reports, failover validation of the Lync Front End Server, and verification with Lync and Polycom clients.

For stress analysis, system and application performance were measured using perfmon. The perfmon counters were set to analyze CPU, memory, disk I/O, conferencing statistics and connected users' data etc. In addition, QoE was measured by using the Lync Stress and Performance tool and monitored by the Dell UCCS and Lync Monitoring Server. The test results indicate that the suggested reference architecture will provide good performance for 10,000 Lync users.

Figure 11 shows the default load settings of the Lync Server 2013 Load Configuration, which is part of the Lync Stress and Performance Tool.

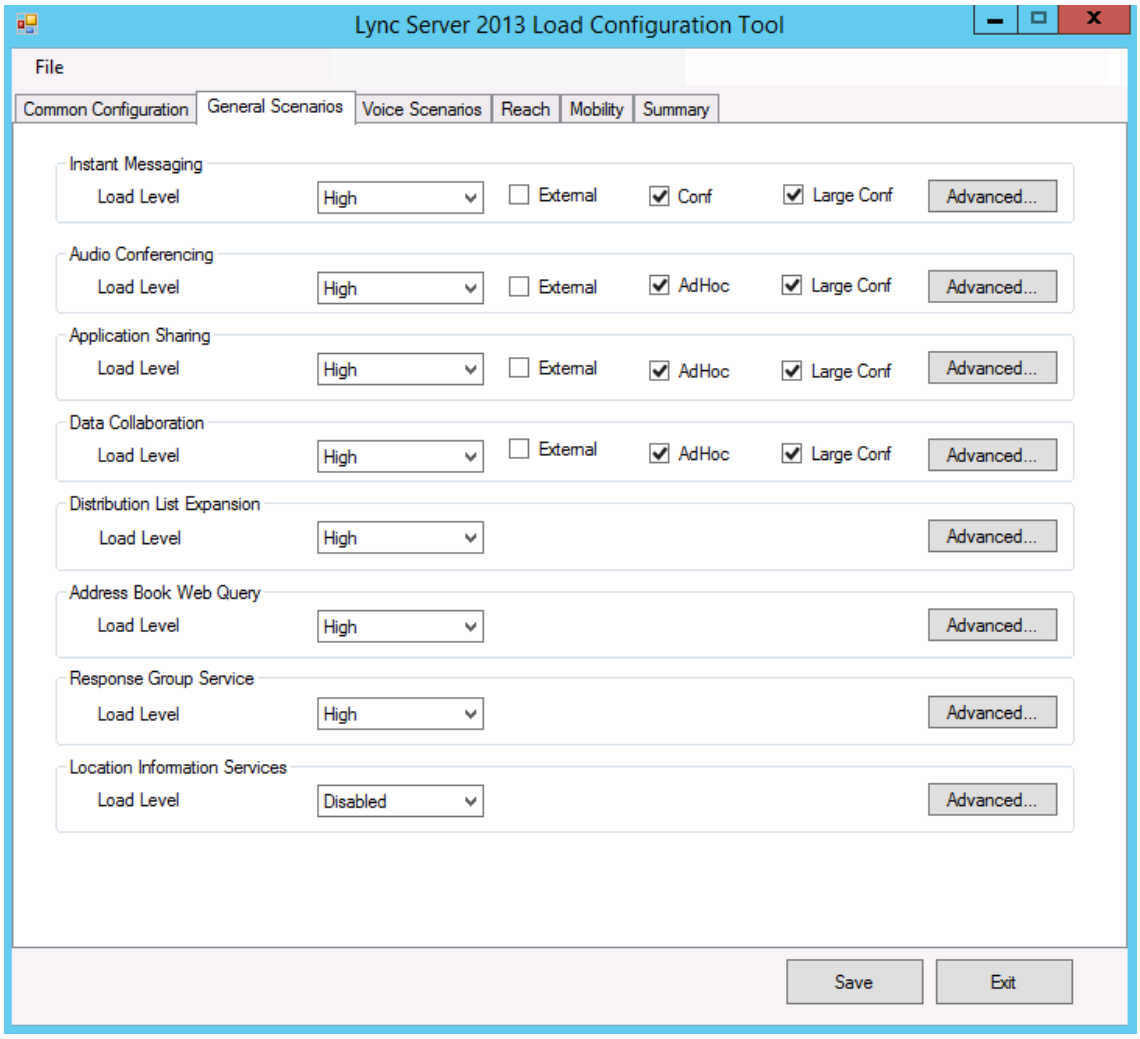


Figure 11 Lync Server 2013 Load Configuration Tool

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 screenshot, 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.

Next, the failover functionality of the Front End Server, Mediation Server and Back End Server was verified. The Lync Stress and Performance Tool was also run against the infrastructure in a degraded mode, where one of the entire FX2s chassis or half of the infrastructure was brought down and the load was measured across the other two Front End Servers and one Mediation Server to ensure that all the metrics were within the threshold.

Last, client devices were verified for both internal and external connectivity. Devices used included Dell laptops/tablets/ultrabooks and Polycom CX600 phones.

# 6 Conclusion

The UC solution presented in this reference architecture provides a Pod-based end-to-end solution for an enterprise with 10,000 or more users with one or more branch offices. The solution can be easily scaled to 60,000 users. This integrated solution uses Lync Server 2013 as the UC software and is built on the wide-ranging Dell product portfolio, including Dell's servers, storage, wired/wireless networking, software and client devices.

This reference architecture focuses on the deployment of Lync Server 2013 with all available communication modalities using Lync Server 2013 Enterprise Edition pool. Deploying Lync Server 2013 as detailed in this document results in a solution that is simple to scale, manage and administer. Specific best practices were adhered to while implementing this solution. In addition to these tenets, three design principles—high availability, application performance and resource consolidation—determined the overall architecture for 10,000 or more users. Lync Server core roles are deployed on physical servers, while the other supported roles are deployed on virtual machines, reducing physical server count and making this configuration a well-suited, scalable and cost-effective design for enterprises.

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 Lync Front End Server performed within the recommended thresholds.

# 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 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 PowerEdge FX converged infrastructure:
  http://www.dell.com/us/business/p/poweredge-fx/pd
- Dell Networking Solutions:
  http://www.dell.com/networking
- Dell Unified Communication Command Suite (UCCS):
  http://software.dell.com/products/unified-communications-command-suite
- Dell Networking Lync Certification
  http://technet.microsoft.com/en-us/office/dn788945
- Lync Stress and Performance Tool:
  http://www.microsoft.com/en-us/download/details.aspx?id=36819
- Lync Sizing Guidance for Virtual Environments:
  http://www.microsoft.com/en-in/download/details.aspx?id=41936
- 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
- AudioCodes Mediant SBC Virtual Edition:
  http://www.audiocodes.com/products/mediant-sw-sbc