Clearspan® Product Overview

Clearspan®

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REVISION HISTORY

The following represents the revision history of this publication.

REVISION NUMBER	DATE COMPLETED	POINT OF CONTACT	DESCRIPTION
009	02/03/2018	Clearspan Technical publications	Rebranded for Release 22.
008	08/31/2014		Final edits for Release 20.
007	6/6/2014		Updated Device Management information.
006	04/22/14	Gary Mading	Final edit for Release 19 and clients.
005	10/30/13	Gary Mading	Additions for Clearspan applications.
004	09/14/09	Bev Marsh	Update for Release 19.
003	09/14/09	Bev Marsh	Corrections to TOC, Index, and formatting.
002	07/25/08	D. Woelfle	
001	04/25/07	C.Ellis	Initial release of this publication.

INTRODUCTION

From its inception, Clearspan has focused on developing and delivering mission critical telephony and unified communications systems to large enterprises, network providers (hosted) and private, managed service providers. These networks need carrier-class systems to reach resiliency and scalability requirements, while keeping support and maintenance costs low. To deliver these values to next generation Voice over Internet Protocol (VoIP) customers Clearspan was introduced. Clearspan brings carrier-class solutions to fulfill the promise of Unified Communications.

Clearspan is an open, standards-based (SIP/RTP), highly resilient and easily managed VoIP platform, capable of elegantly scaling to millions of users. Deployed on industry standard servers, the solution delivers lower total cost of ownership (TCO) by lowing implementation, operating, support and maintenance costs. IT and Telecom managers will enjoy an easy-to-provision and easy-to-manage unified communications solution. Clearspan offers the following unified communications functionality:

- Full PBX features
- Integrated Call Center
- Fixed Mobile Convergence
- Unified Messaging
- Single Number Reach
- Audio & Video Conferencing
- Web Collaboration
- Desktop Sharing
- Paging
- Multi-vendor support of SIP phones
- Support for analog phones
- Soft Client support
- Remote and mobile workers

End user deployment and management are one of the most time consuming tasks for any IT or Telecom manager. Clearspan has developed the OpEasy suite of management and provisioning tools, also known as Operational Support Systems (OSS), to simplify the deployment and management of the user population. At a high level, OpEasy provides these features/benefits:

- Simplified Provisioning
- Bulk Provisioning
- Phone Auto Discovery
- Reporting
- System Performance Monitoring

CLEARSPAN ARCHITECTURE

Typically, Clearspan is centrally deployed and remotely managed. As such, the architecture is ideal for premises-based, private network and hosted data centers. The following figure shows a high-level architecture for Clearspan.
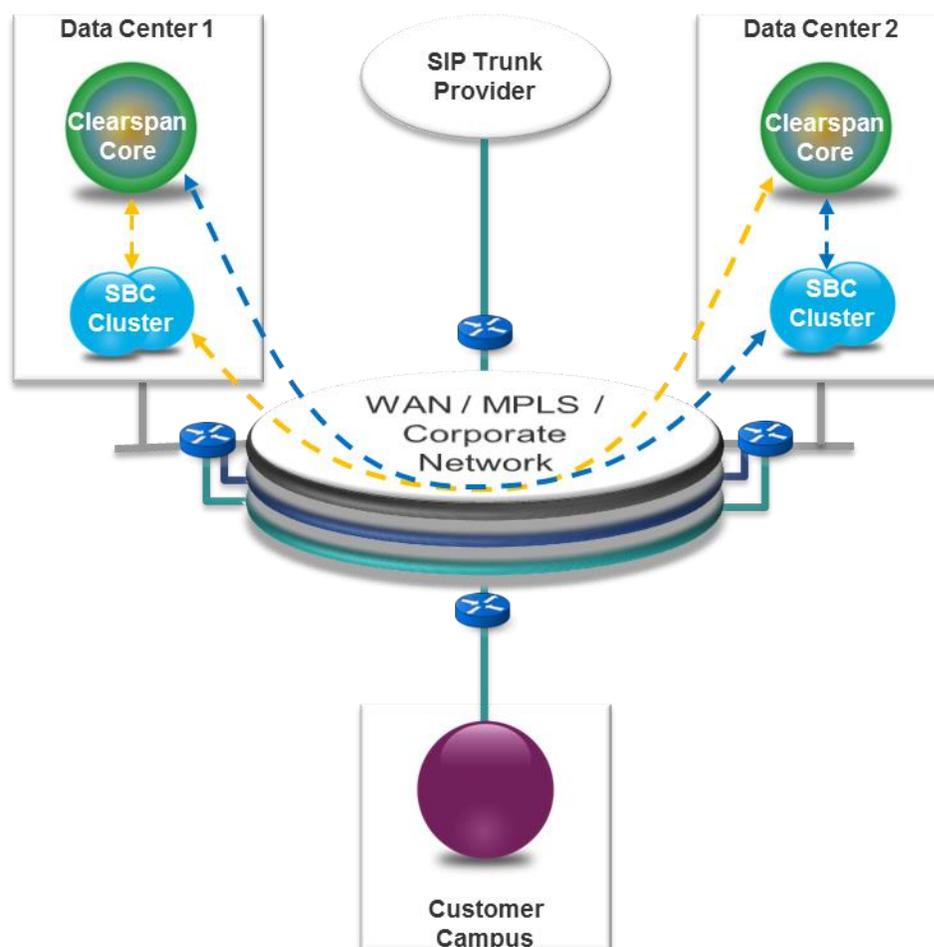
Figure 1. High-Level Clearspan Architecture.

A Clearspan 'Core' is an important term used to define a group of equipment and services that provide call control, security, media resources and web-based management functions. A basic deployment has two fully redundant cores that are typically deployed in geographically dispersed data centers. Then one or more networks are used to provide access to users.

A Clearspan 'Campus' is the other important term used. A Campus may be co-located with the cores (premises model) or remote (managed services or hosted model). Tremendous flexibility allows mixing

the models to match exact customer requirements. A Campus may be a large or small population of users.

Cores and Campuses will be described in further detail later in this document.

CORE ARCHITECTURE

The Clearspan Cores provide all of the Unified Communication (UC) features and functions. The following figure shows the conceptual view of the Clearspan Cores. At the center resides the BroadWorks server complex – a multi-tenant architecture deployed in the largest carriers in the world. Wrapped around the BroadWorks server complex is a layer of advanced security and interconnect. The outer layer adds all of the advanced UC applications.

Open standards – SIP-to-the-Core
Five 9's resiliency
Geographic redundancy
Multi-tenant
Scales to millions of users
IPV4/IPV6 support

Highly secure
OpEasy® provisioning & reporting
Multiple languages
Open APIs
Cloud interconnect and services

Fully integrated UC feature set:
 - Call Center
 - Fixed-mobile Convergence
 - Audio/Video/Web Conferencing
 - IVR
Integrated with desktop applications
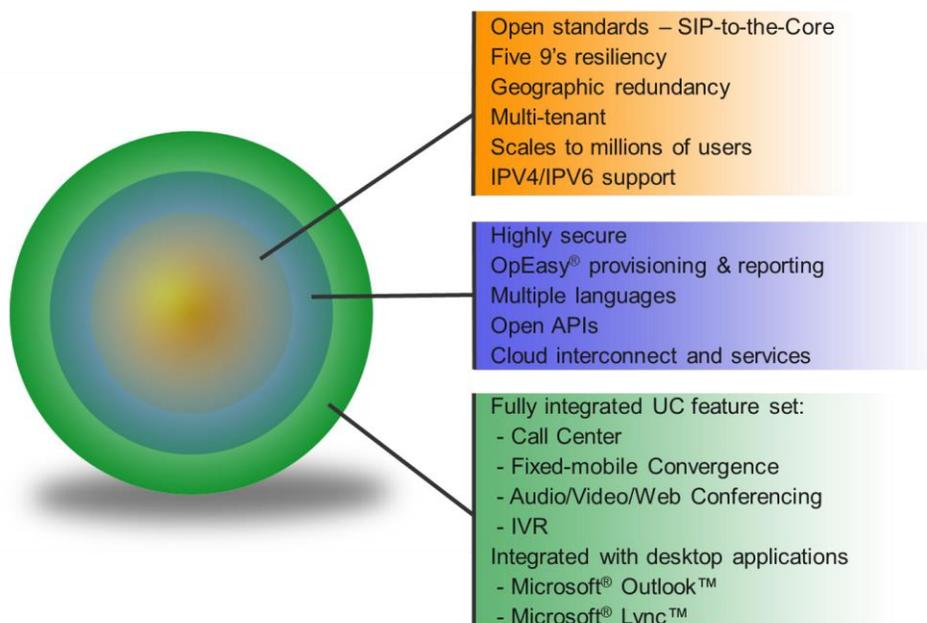 - Microsoft® Outlook™
 - Microsoft® Lync™

Figure 2. Conceptual View of Clearspan Cores.

The Core software is realized on off-the-shelf servers as shown in Figure 3. The software-only solution runs on a combination of IBM BladeCenter chassis and discreet servers, using either AC or DC power options.

Figure 3. Core Software on Off-the-Shelf Hardware.

CLEARSPAN SERVER COMPONENTS

Within the BladeCenter chassis, servers are populated by function and capacity requirements. The following server types are populated within the chassis:

- Application Server (AS) – provides call processing, feature logic, user management, call detail records and service management. Deployed as Active / Standby.

- Network Server (NS) – provides policy based translations and routing, subscriber location directory and media server selection. Deployed in pool architecture.

- Media Server (MS) – provides specialized media resources, including media recording, media playback, DTMF digit detection, N-way conferencing, Meet-me conferencing and media relaying. Deployed in pool architecture.

- Profile Server (PS) – provides configuration files to soft clients and manages Meet-me recordings. Deployed in pool architecture.

- XSP Server (XSP) –supports Clearspan system web interfaces and additional external interfaces. The XSP Server supports the Clearspan Personal Web Portal and Call Manager via HTTP(S), as well as the Clearspan Open Client Interface for the Receptionist application. Deployed in pool architecture.

- CORE SBC – also known as a Core Session Border Controller (SBC). Provides topology hiding, SIP and RTP session management, DDOS prevention, and NAT traversal. Deployed in high-availability configuration.

- Unified Messaging (UM) – provides unified messaging features on Clearspan, including message store and retrieval. Deployed in high-availability configuration.

The following server types are typically deployed on discreet servers:

- Element Management Server (EMS) – monitors the health, performance and reliability of the Clearspan system. It also supports the provisioning, backup and restoration of the system. Deployed in active/standby configuration.

- Database Server (DBS) – provides database and call center reporting. Deployed in high-availability configuration.

- VoIP Monitoring – an optional application to monitor and report on MOS scoring problems.

- Billing – an optional application to manage call detail records and user accounting.

In certain cases, Clearspan applications may be installed on discreet servers rather than within the BladeCenter chassis in order to address specific issues with scalability, or redundancy, or to address specific physical deployment requirements.

DETAILED SERVER DESCRIPTIONS

The following section will describe the server complex in detail and illustrate the main interconnect and protocols used.

CORE SBC

The CORE SBC servers are Session Border Controllers (SBCs) that are the secure (SIP/RTP) gateways to the system. In the Clearspan architecture, all endpoints are "untrusted" and must traverse the CORE SBCs to gain access to the platform. The figure below shows the CORE SBCs.
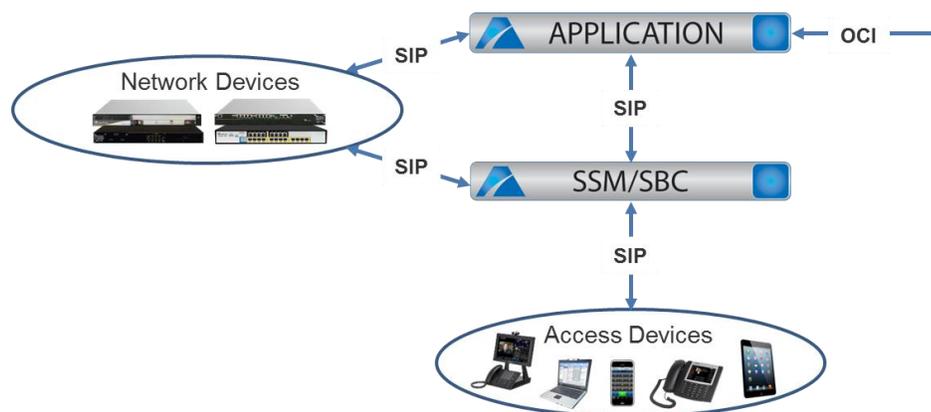

Figure 4. CORE SBC Platform Interaction.

The CORE SBCs are deployed as high-availability clusters and their purposes are:

- VoIP/SIP firewall

- SIP session security management

- NAT traversal

- Topology hiding

- DoS and intrusion prevention

- Header manipulation

- Registration proxy

The CORE SBCs participate in the registration and authentication of all endpoints, whether those endpoints reside in the LAN or WAN. As endpoints register with the Clearspan platform, the CORE SBCs filter and check these registrations to prevent unauthorized access. Assuming the first phase of filtering is passed, the registrations are then passed to the AS for authentication, and the CORE SBCs wait for a response before binding the source IP address of the endpoints. Once binding occurs, the endpoints are granted access to service.

While the primary function of the CORE SBCs is to service access devices (terminals), they may also be used to service network devices (PSTN gateways, SIP trunks, etc.). Network devices may be trusted or untrusted depending on the deployment model. In general, network devices such as PSTN or SIP trunks are considered untrusted and must also traverse the CORE SBC/SBC clusters. The deployment model may dictate additional CORE SBC licensing.

Application Server (AS)

The Application Server (AS) is shown in Figure 4 (previous page). The AS is a service delivery platform responsible for the execution and management of enhanced personal and group services. This server maintains the user database and features assigned to those users. The AS functions also include management of network traffic, handling of signaling interfaces, and logical execution and management of services. The AS comprises a database, the ServiceOS™ abstraction layer, and protocol stacks.

There are multiple layers of service configuration for services delivered from the AS. Secure web access is provided by the Clearspan XSP/Web Server, described in the XSP Server section, which enables management, administration, provisioning, and configuration. The associated web portals can be customized for different user groups, based on the services of those groups.

The Clearspan database maintains user and group profiles, as well as service and subscription data. Updates and access are performed in real time. The ServiceOS manages the sessions, which are the network connections associated with a user.

The Clearspan Open Client Interface (OCI) is the API used to manage the AS servers.

XSP/Web Server

Alongside the CORE SBC, the XSP is the secure proxy for web access to the Clearspan platform. The XSP server is a hardened web server built upon Red Hat Linux and runs Apache Tomcat to support http and https requests. System administrators deploy XSP servers to support system web interfaces and additional external interfaces. The XSP Server supports the Web Interface using HTTP(s) and the Clearspan Open Client Interface (OCI). This pooled resource is used for many purposes, including:

- User client interfaces

- Web portal for feature control

- Microsoft Skype for Business integration

- Simplified API for custom integration

User client interfaces include Clearspan Communicator soft client, Call center agent and supervisor clients and receptionist clients. These clients will be discussed in detail in later sections.

The web portal gives end users easy ability to control their calling features. Through this portal, users can turn on and turn off many key features including Clearspan Anywhere (a find me – follow me service), Do Not Disturb, Remote Office and many more.

The simplified API (called XSI) runs on this server type and supports custom integration of call control. This API is RESTful and uses http PUTs and GETs to interface to the platform.

The following figure shows the XSP server architecture.
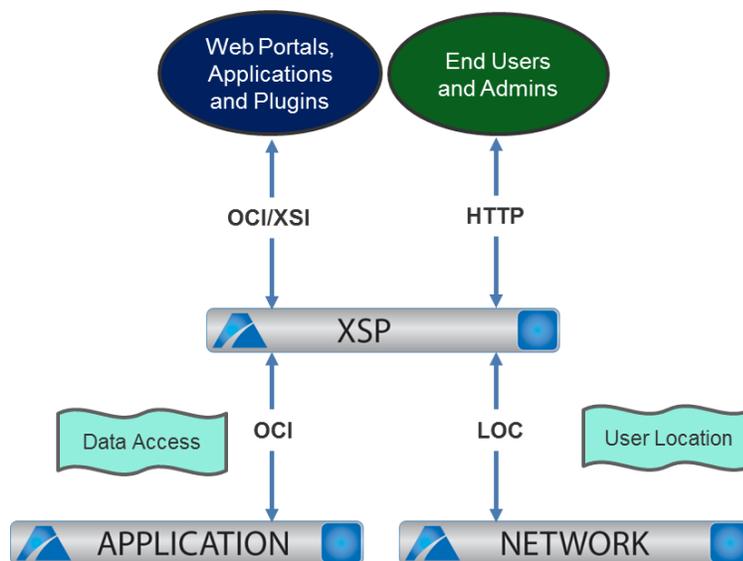
Figure 5. XSP Platform Interaction.

The XSP server is also used to support other client integration such as Microsoft Skype for Business.

Media Server (MS)

The Media Server (MS) enables enhanced services, such as Auto Attendants, Video Auto Attendants, Meet-Me Conferencing, Multimedia Messaging, video advertisements in Call Center queues, capture and play DTMF tones and other treatments to callers. The MS uses standard interfaces with interconnections to the Application Server and end devices as shown in the following figure.

Figure 6. MS Platform Interaction.

In the architecture, SIP and HTTP are used as standard protocols for communication between the Application Server, Network Server, and the Media Servers. When a media service is required, the Application Server sends a media request message to the MS using the SIP interface. Once the MS has allocated the requir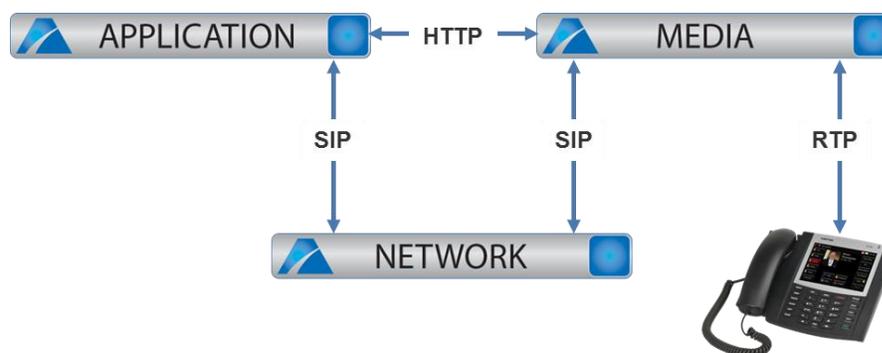ed resources, the Application Server directs the endpoint(s) in the call to the appropriate MS ports. The MS uses the RTP protocol to send and receive audio/video. The HTTP interface is used to pull media files from a storage area.

Media Servers should be geographically distributed, which will minimize call latency and bandwidth utilization.

Enterprise administrators can choose from multiple codecs that are supported on the Clearspan Media Servers. Configurable classes of multimedia service can also be assigned to groups and individual users, restricting callers to the codecs in their assigned set. Enterprise administrators can opt for lower bit-rate codecs to increase the number of simultaneous calls that can be provided on an access link to end users. The Media Server supports G.711, G.722 and G.729 codecs.

In addition, the Clearspan system can be configured to route calls differently depending on the codecs they use, eliminating network elements that do not support included media, or prioritizing network elements that offer better support for included media.

Network Server (NS)

The Clearspan Network Server (NS) enables system administrators to centrally manage network-related applications within their network. This includes public translations and routing capabilities such as least-cost routing, as well as enterprise-focused network applications such as voice virtual private networks (VPNs).

The Network Server allows construction of massive next-generation voice networks by assisting with the scaling of IP telephony networks and offloading user-specific routing functions. The Network Server also acts as a platform for network-based enterprise applications such as dial plans, and supports passing of non-numerical characters like * and # to the network so they can be used to trigger functionality in other networks.

The Network Server optimizes network resource utilization by providing the capability to selectively route calls to geographically dispersed resources, thus maximizing network bandwidth utilization. For example, the Network Server can manage Media Servers as a single network-wide pool of resources and at the same time, select an appropriate Media Server for the location of the requesting user. The Network Server also performs a central role in supporting Clearspan redundancy.

Provisioning new users can occur via synchronization of the group and user data between Application Servers and Network Servers. The Network Server functions with the Application Server as shown in the following figure.
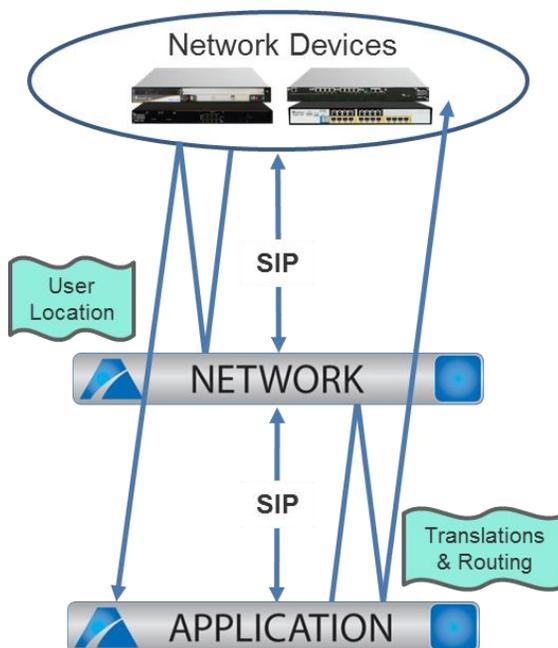

Figure 7. NS Platform Interaction.

The policy database provides routing and dialing policies, to manage access to enterprise network services. It also maintains user location information to track where users are hosted within the network. The policy database contains translation processing and a routing engine that is driven by a flexible policy approach. Dialing plans, call typing, route selection, and network services configuration are policy-driven and can be updated "on-the-fly."

The ServiceOS manages the sessions, which are the network connections associated with a user or network element.

Unified Messaging (UM) Server

The Unified Messaging (UM) server acts as a message store for voice messages stored as .wav formatted attachments to emails. Received messages may be forwarded to the user's email inbox or played back through the Telephone User Interface (TUI) utilizing the voicemail portal. The following figure shows the integration of the UM servers.
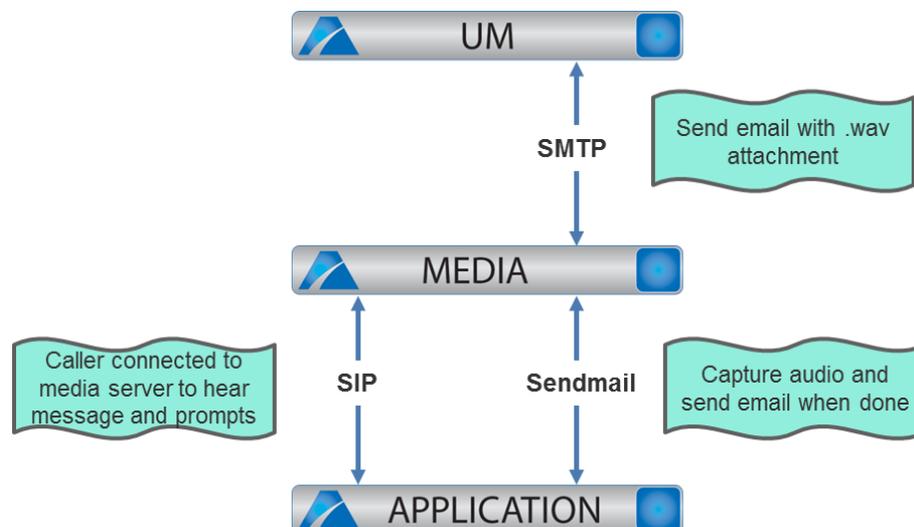
Figure 8. UM Platform Interaction.

If a called party is unavailable, the calling party will be connected to the MS. The AS sends the users voicemail prompt which is played to the calling party. The calling party may take action using DTMF keys, which are decoded on the MS, or leave a voice message for the called party. Once the message is captured and the calling party hangs up, the AS instructs the MS to send the captured message as a .wav file attachment.

When voice messages are retrieved by users through their telephone, the AS notifies the MS of a count of how many voice messages are new and old, which is played to the user. Based on DTMF actions by the user, the stored voice messages are delivered to the MS from the UM and played for the user as retrieved voice messages.

Profile Server (PS)

The Profile Server (PS) provides a central repository for configuration files for phone devices, Clearspan Communicator, and Meet-me conferencing recordings. The PS is not exposed to the untrusted network; instead, external end-user web and client requests are front-ended by the XSP server. The following figure shows the architectural position of the PS.
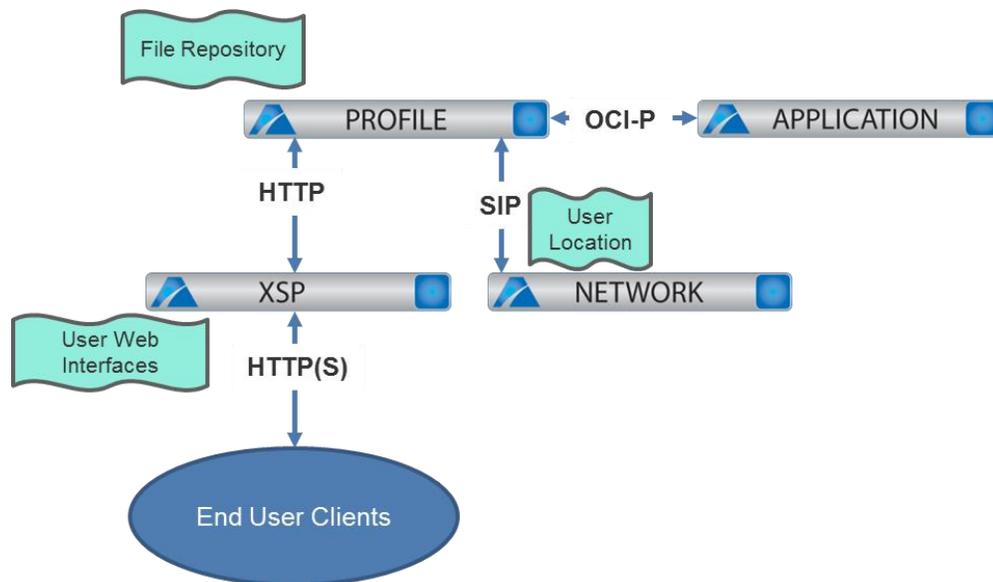
Figure 9. PS Platform Interaction.

Database Server (DBS)

The Database Server (DBS) acts as a centralized database for Clearspan where one Database Server complex (physical database) can be shared by multiple applications (logical database). This server is deployed as a discreet server and integrates the Oracle 11g or later database. It takes full advantage of the Oracle Carrier Grade Framework (CGF). This feature-rich environment is made of various components including Automatic Storage Management (ASM) and Data Guard. It also provides many layers of high availability to prevent single points of failure. Both local and geographic redundancy options are supported.

Clearspan's standard configuration is the single-instance mode with each server utilizing RAID 10 for redundancy. The single instance mode consists of multiple servers, each with their own database instance. Each server is using its local disks to store and retrieve database files. One of the servers functions as the primary. This database is accessed by most applications. Other servers act as standby servers maintained by the primary server as consistent copies. Those standby databases can be used for data protection, reporting, and database software upgrades. Note that standby databases can be both local and geographically remote.

The primary function of the DBS is in support of call center reporting and enhanced call logs, both optional features. The following figure shows the interfaces of the DBS.
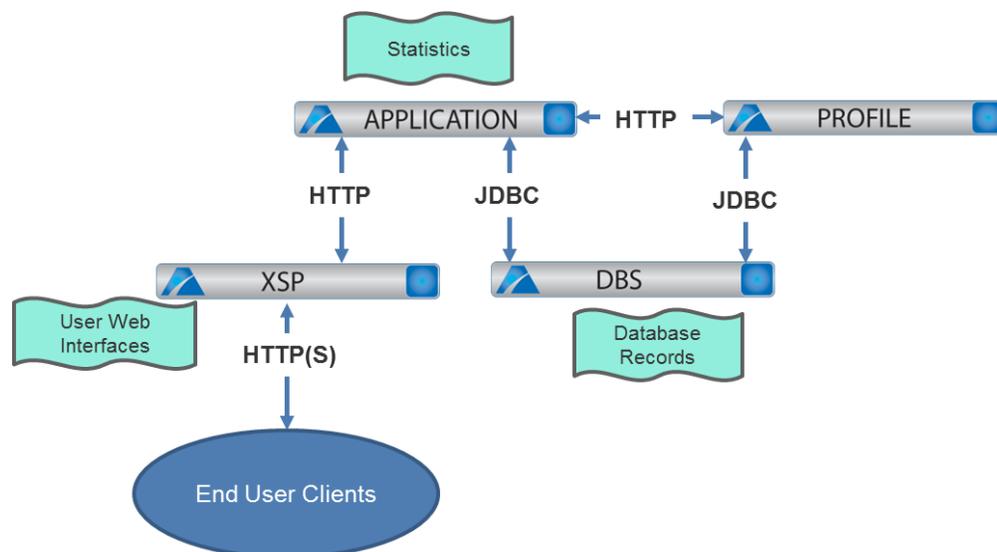
Figure 10. DBS Platform Interaction.

Referencing the figure, this example shows an application involving call center reporting. The call center supervisor client requests, via http, a call center report. That request is serviced by the XSP server, which messages the AS of the request. The AS has been filling the database, within the DBS, with call center statistics via JDBC. The AS dispatches the PS to generate the report and when complete, messages back through the server complex that the report is ready and displayed on the supervisor client.

Element Management System (EMS)

The EMS is the Fault, Configuration, Accounting, Performance, and Security (FCAPS) platform for Clearspan. As such, the EMS hosts many applications to facilitate and support the FCAPS functions, including:

- Administration

- Fault management

- User management and provisioning

- Administrator management and provisioning

- Phone tools and provisioning

- Reporting

- CDR management

- Performance and system monitoring

- Phone configuration files

Many of these functions are encapsulated within an Clearspan tool called OpEasy, which will be discussed in a later section. The EMS is deployed on discreet servers in a primary/secondary redundant configuration with each Clearspan core.

CORE REDUNDANCY AND FAULT TOLERANCE

True system reliability is achieved through a combination of software engineering, server redundancy, and networking capabilities. Recognizing this, Clearspan has gone to great lengths to address issues at every layer in the system architecture to achieve the highest levels of reliability, redundancy, and performance.

The Clearspan Core contains no single points of failure. A fully redundant Clearspan system incorporating all components delivers over 99.999% availability. There are several layers of redundancy within the Clearspan Core, and they include:

- Hardware Redundancy

- Software Application Redundancy

- Network Redundancy

- Software Reliability

- Geographic Redundancy

Each of these elements play an important role in the overall architecture and are explained further in the following sections.

HARDWARE REDUNDANCY

Within the IBM BladeCenter, hardware components are replicated and have the following features:

- Dual processors, redundant memory channels, redundant hard disk drives, and quad Network Interface Cards (NICs) for each blade server

- Redundant power supplies

- Redundant Gigabit Ethernet switches

- Redundant layer 1 / layer 2 interface modules

- Redundant fan assemblies

The high-level block diagram of the BladeCenter is shown in the following figure. Utilizing the multiple NICs, each blade has several paths for redundancy and fault tolerance.
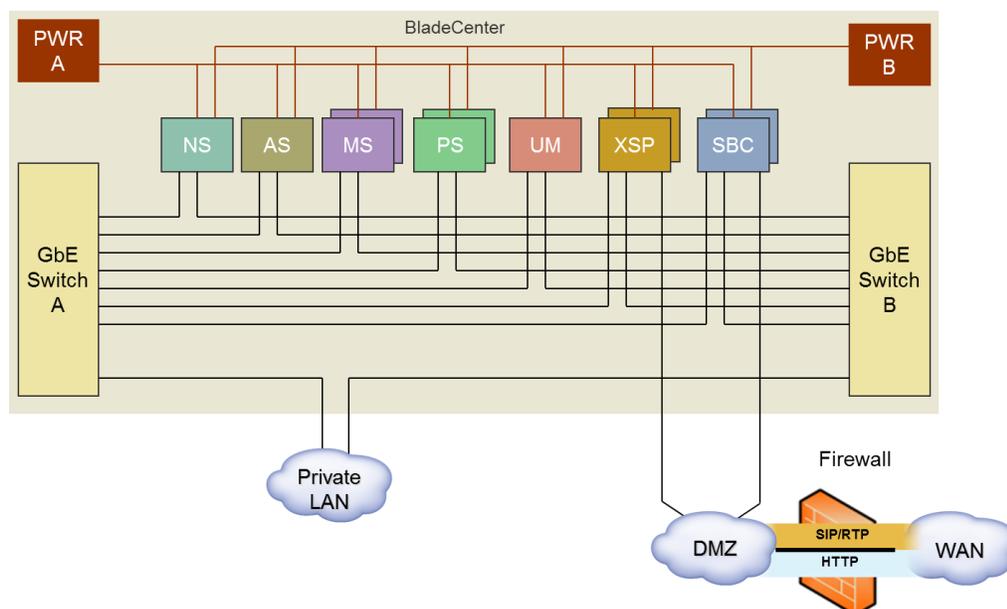
Figure 11. Typical High-level BladeCenter Architecture.

Each discreet server has dual power supplies, quad NIC interfaces and RAID disk drives.

SOFTWARE APPLICATION REDUNDANCY

System reliability is the result of more than just hardware compliance. Clearspan provides a total system solution for redundancy that addresses potential points of failure in *both* the Clearspan servers *and* the enterprise's IP network. This architecture, as described in the following section, is designed to ensure that service is maintained in the event of a network and/or server failure.

Application Servers Redundancy

Application Servers are deployed in primary/secondary cluster mode. Under normal operation, the primary Application Server handles all traffic. When there is a server or network failure, users are automatically rolled over to the secondary Application Server on the next call (either originating or terminating) that involves a subscriber. This ensures continuous access to normal calling for users.

The primary and secondary Application Servers are synchronized using the following mechanisms:

- Cluster Data Replication: The Application Server TimesTen database is replicated between the primary and secondary servers using TimesTen replication capabilities. Subscriber data-sharing ensures proper behavior upon rollover of an access device to the secondary Application Server.

- Cluster File Synchronization: Announcements, voice mail greetings, web branding, and other file-based configuration are synchronized using RSYNC, which is an open-source utility commonly used to mirror Internet web sites.

Media Server Pools Redundancy

Media Server redundancy is accomplished through N+1 pooling. All Media Servers are independent. A failure of a Media Server results in the Application Server timing out on attempts to reach that server, and then routes to the next available Media Server.

Network Server Redundancy

Network Servers are deployed in true cluster-server farm mode. A Network Server cluster can contain from two to twenty nodes. The primary/secondary concept does not exist in a Network Server cluster. Any Network Server in a cluster can be used to process a call in a load-balancing or fixed-order fashion. When there is a network or server failure, any Network Server in the cluster can take over.

The Network Server cluster is synchronized using the following mechanisms:

- Cluster Data Replication: The Network Server TimesTen database is replicated across the cluster using TimesTen replication capabilities.

- Cluster File Synchronization: Web branding and other file-based configuration is synchronized using RSYNC.

Profile Server Redundancy

Profile Servers are deployed in true cluster-server farm mode. The primary/secondary concept does not exist in a Profile Server cluster. Any Profile Server in a cluster can be used to process a request in a load-balancing or fixed-order fashion. When there is a network or server failure, any Profile Server in the cluster can take over.

The Profile Server cluster is synchronized using the Cluster File Synchronization. Using this, all the device file resources and file-based configuration are synchronized using RSYNC.

Xtended Services Platform (XSP) Server Redundancy

The XSP servers operate in a stateless farm, which means that any XSP in a farm can process any request. For example, an administrator can create a cluster fully qualified domain name (FQDN) representing the XSP farm. This FQDN resolves to all of the XSPs in a round-robin fashion where any of the XSPs can handle any request.

Database Server (DBS) Redundancy

Database Server (DBS) redundancy is supported at two different levels, locally and geographically. Local redundancy is achieved using clustering techniques (N+1), where each node shares a common database and services client requests using load balancing algorithms. Geographic site redundancy is achieved using a primary/standby model (2N), where client requests are processed by the primary site and replicated to the standby site. The Clearspan standard deployment is the 2N model.

Core SBC Redundancy

CORE SBCs are essentially Session Border Controllers (SBCs) and are deployed in 1:1 clusters within each core. Though the SBCs reside in the same chassis as the core hardware, logically they are connected to each core as shown in the figure below.

All endpoints and CPE gear register with the SBCs to obtain service. This cross-coupling of SBC clusters enables the Clearspan architecture to withstand single cluster faults. Typically, this cross coupling is routed over the private network.
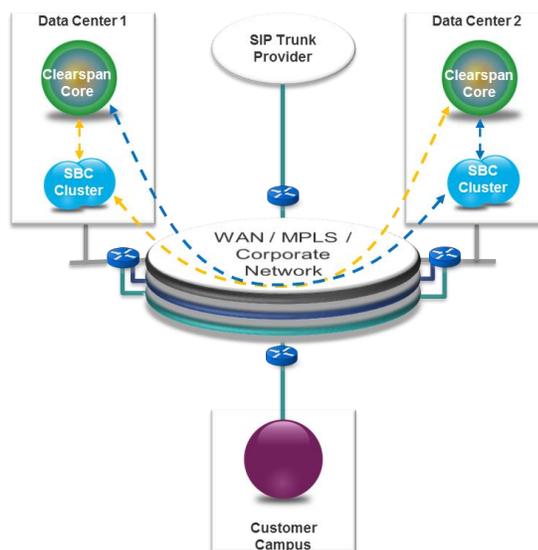

Figure 12. SBC Cross Coupling.

NETWORK REDUNDANCY

Clearspan offers network-level redundancy, which is a capability not possible with most circuit-switched equipment. Using various schemes, Clearspan can offer continued service in the event of floods, massive electrical outages, or any other disasters that affect a particular data center, central office, or geographic region. This enhanced service availability is achieved through common signaling interface redundancy, separate access and network interface redundancy, and redundant path topology.

Clearspan makes a clear distinction between signaling events from "network devices" (for example, soft-switches, network gateways, proxy servers, management systems) and signaling events from "access devices" that interface with the system from the user premises (for example, IADs, access gateways, IP phones, web browsers). Administrators can choose to deploy both access and network elements on the same physical interface plane, or they can choose to separate them, for security purposes, onto separate physical interfaces.

In either configuration, administrators can also choose the redundant addressing scheme that best fits the topology of their network. Clearspan supports two IP addressing topologies: *redundant paths,* whereby each redundant network interface cards pair is configured on the same IP subnet; or *redundant routes*,

whereby each network interface card is configured with unique routable IP addresses on separate IP subnets.

GEOGRAPHIC REDUNDANCY

It is not enough to simply deploy redundant network elements. Clearspan assembles these elements into a cohesive, highly available solution.

One problem that arises when providing end-user services is the management of persistent profile data and run-time session states. Conventional redundancy solutions usually solve this problem with proprietary hardware, which make the solutions expensive and do not offer any level of geographic redundancy.

The solution for these problems in a Clearspan system begins with database replication technology that keeps data in sync across servers in the network. Secondly, through a proven technology called "Dynamic User Hosting", a user's endpoint binds to any appropriate Application Server in the network. Once the endpoint has connected to Clearspan, the rest of the network discovers which Application Server is hosting the associated user's services through the Network Server. This forces all subsequent user transactions to be sent to the hosting Application Server. This solution is ideal for deploying geographic network solutions.

SOFTWARE RELIABILITY

A system controller manages each Clearspan server by monitoring the health of the server and keeping its processes up and running. Alarms are generated in the event of a software failure. Internally, each process contains a "watch-dog" thread to keep all subsystems alive and functioning and to minimize service interruptions. This means a software failure results in a maximum of one lost call. Call processing session audits are performed by the Application Server to tear down any hung sessions caused by malfunctioning endpoints in the network.

CORE SECURITY

Platform security is of prime importance within the Clearspan architecture. The following figure highlights the fact that only a few interfaces are exposed to the untrusted network: The XSP server and the CORE SBC, which is also known as a Session Border Controller (SBC).
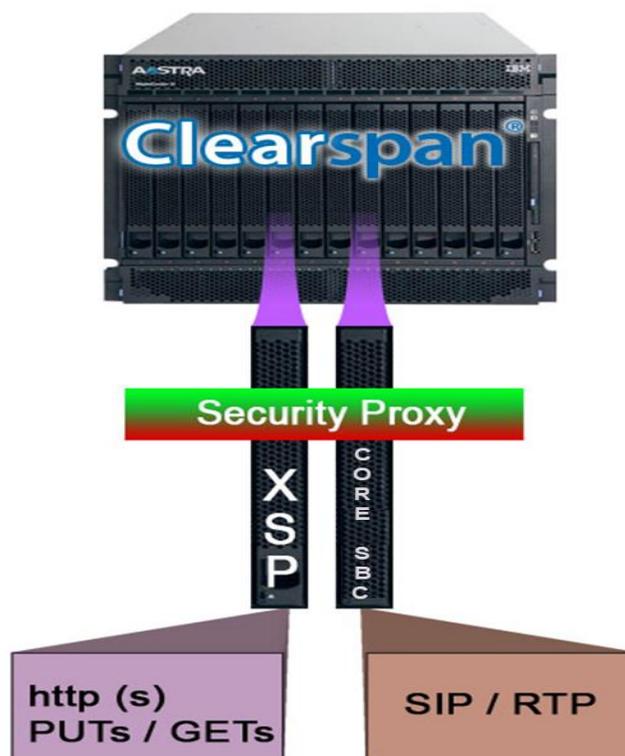
Figure 13. Security Interfaces.

XSP SERVER SECURITY

The XSP is a hardened web server built upon Red Hat Linux and runs Apache Tomcat to support http and https requests. This pooled resource is used for many purposes, including:

- User client interfaces

- Web portal for feature control

- Microsoft Skype for Business integration

- Simplified API for custom integration

User client interfaces include Clearspan Communicator soft client, call center agent and supervisor clients and receptionist clients. These clients will be discussed in detail in later sections.

The web portal gives end users easy ability to control their calling features. Through this portal, user can turn on and turn off many key features including Clearspan Anywhere (a find me – follow me service), Do Not Disturb, Remote Office, and many more.

The simplified API (called XSI) runs on this server type and support custom integration of call control. This API is RESTful and uses http PUTs and GETs to interface to the platform.

CORE SBC SERVER SECURITY

The CORE SBC Server type is a fully function SBC from the leading vendor of SBCs. The SBCs are deployed as high-availability clusters and their purposes are:

- VoIP/SIP firewall

- SIP session security management

- NAT traversal

- Topology hiding

- DoS and intrusion prevention

- Header manipulation

- Registration proxy

The CORE SBCs participate in the registration and authentication of all endpoints, whether those endpoints reside in the LAN or WAN. As endpoints register with the Clearspan platform, the CORE SBCs filter and check these registrations to prevent unauthorized access. Assuming the first phase of filtering is passed, the registrations are then passed to the AS for authentication, the CORE SBCs wait for a response before binding the source IP address of the endpoints. Once binding occurs, the endpoints are granted access to service.

WEB PORTAL AND CLI ACCESS

Based upon the login identity and password, the appropriate Application Server or Network Server portal is entered by the system administrator (or provisioning administrator), enterprise administrator, group administrator, or end user. SSL support provides a secure link for logins on the web server.

Clearspan has five tiers of password management (system administrator, enterprise administrator, provisioning administrator, group administrator, and user), the format of each determined by the next higher level of user. For instance, user passwords may or may not be required to be of a certain length, contain numeric or special characters, be different than the user ID, and expire at regular intervals. Group administrators determine which of these format requirements to impose upon users. In turn, system administrators can specify the password requirements of the group and provisioning administrators.

For added security, Clearspan provides a password wizard. Using the wizard, system administrators can force users to change passwords on an incremental basis. Administrators can also set up password rules that remove trivial patterns and repeated passcodes. A specified number of unsuccessful login attempts blocks users or administrators from entering the system, protecting against password guessing. When a user is blocked from the system, an e-mail message is sent to an administrator, warning of the login attempt and subsequent block.

For the Application Server, Media Server, and Network Server, the *web interface* permits secure access for the following:

Application Server	Media Server	Network Server
System administrator	Not accessible by any user type (CLI access only)	System administrator
Enterprise administrator		Group provisioning administrator
Group provispoint administrator		Enterprise administrator (manages dial plan information for specific groups)
Group administrator		
End user		

Clearspan inspects the source IP address of the packet and compares it to the IP address or resolved hostname in the endpoint identifier contained in the message. If they match, the packet is allowed and processed by the system. Otherwise, the packet is ignored and no further processing is performed.

As a secondary level of security, Clearspan only allows hostnames or IP addresses in the endpoint identified that have been configured in the access device list for a group. Therefore, if a packet is received where the source IP address and the IP address or resolved hostname match, but the IP address of endpoint identifier is not provisioned in the access device list for any of the groups, the packet is discarded.

System administrators can use the command line interface to enable or disable this security feature.

CAMPUS ARCHITECTURE

In either premises-base or hosted PBX deployments, support for the remote campus or remote office is largely the same. The campus may range from a couple of endpoints to over 10,000 endpoints. The figure below shows a simplified architectural view of the campus equipment.
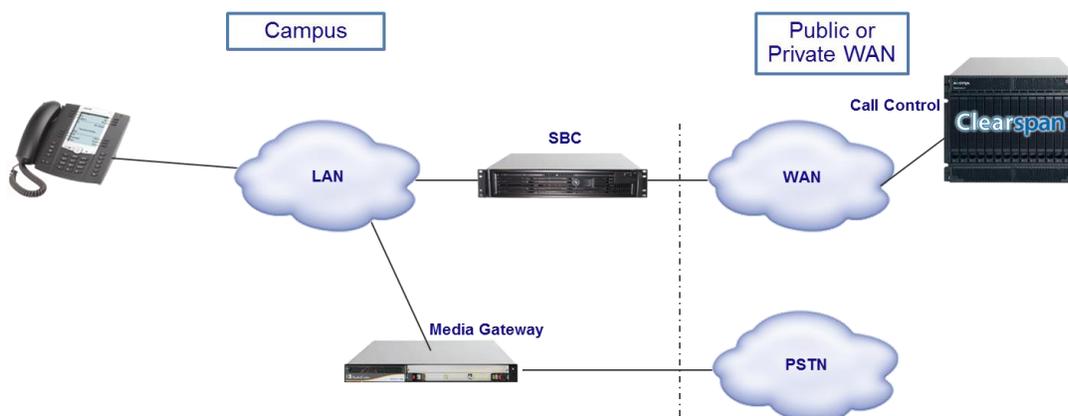

Figure 14. Simplified Remote Campus Architecture.

The campus SBC, also known as the Enterprise SBC (ESBC), establishes a point-of-service within the site. The SBC is usually paired with one or more media gateways that connect the campus to the Public Switched Telephone Network (PSTN). Finally, one or more SIP endpoints (desktop or soft clients) are deployed within the site.

The ESBC is a critical element and performs the following functions:

- Serves as a service demarcation for hosted PBX service as well as SIP trunks from a carrier
- Monitors health of the WAN connection
- Acts as a registration proxy
- Maintains Address-of-Record (AOR) for all campus endpoints
- Provides survivability features when the WAN is down
- Routes calls to the media gateway for off-net calls or in support of E911
- Throttles registration

Endpoints register with the local ESBC, which then registers with the SBCs in the core call platform. The SIP Option method is used to ensure the WAN is available and if not, the ESBC may be configured to pass calls to the local media gateway. See the E911 section for an overview of the deployment option and support for 911/E911.

In addition to SIP terminals, the basic campus architecture can expand to include the following items:

- Analog phones

- Fax machines

- Overhead paging systems

- Credit card processing machines

- Existing PBX infrastructure

DESIGN CONSIDERATIONS FOR CAMPUSES

There are many factors to consider when choosing Customer Premise Equipment (CPE). An entire document, *New Site Requirements*, is devoted to the subject and provides much greater detail. Here are just some of the decisions to consider:

- What is the number of users at the site?

- What is the amount of bandwidth available to reach the site?

- What is the concurrent call capacity?

- What are the future growth requirements?

- Is a compressed CODEC (e.g. G.729) required?

- Will video conferencing be used?

- How many simultaneous video calls to be expected?

- What are the call patterns of the users?

- Does the campus equipment need to be redundant?

- Does the campus need to be survivable such that station-to-station calls continue to function?

- Does the campus need to be survivable in reaching the PSTN – being able to dial emergency services if the core call control is not reachable?

- Does the campus equipment need to support a fail-over or backup network?

- How will remote and teleworker users connect to the service?

- How will SIP phones obtain their configuration information?

- Can the correct ports be opened on the firewalls?

Answering these questions will help Clearspan and its partners design and deploy the optimum Clearspan solution components for campus locations.

CLEARSPAN SERVER INTERWORKING

Up to this point we have introduced the servers and peripheral elements required to implement a Clearspan solution, and also reviewed the high-level "Campus" deployment architecture. This section examines how these servers interact, and what role they play during the typical call setup situations. The cases for outbound, inbound, and internal calls are addressed. In the examples seen on the following pages, while SIP endpoints are being used, other endpoints (Analog, Digital, etc.) may also be used as part of the solution, provided that any additional equipment required to interface to the IP network is also added.

Outbound Call Flows

The first case examines the situation where a Clearspan SIP user initiates a call to a user outside of the Enterprise, which is delivered from the Clearspan node out to the service provider network. The following figure shows the signaling and media paths which are followed when a Clearspan SIP user initiates the call:
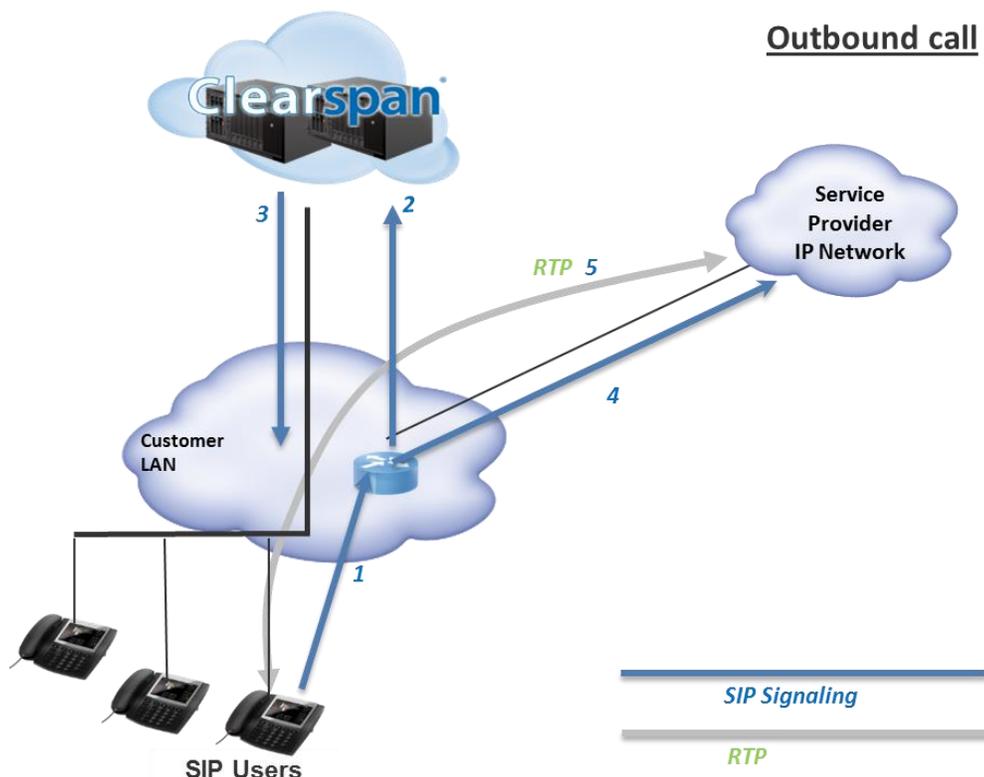

Figure 15. Outbound Signaling and Call Flows.

- The SIP signaling traverses the customer LAN (and potentially WAN if this is a hosted solution) to reach the Clearspan node (1) and (2).

- Upon being processed internally by the Clearspan servers, the signaling messages are forwarded out to the service provider network to route to the remote endpoint for delivery and acknowledgement (3) and (4).

- Upon completing the call set-up process, the RTP media stream is routed directly between the initiating Clearspan SIP endpoint (the calling party) to the remote user (the called party). The only Clearspan server that the RTP will traverse is the CORE SBC (5).

Examining how the call set-up is handled internally within the Clearspan server complex, we see in the following diagram (Figure 16) that the process involves interworking between the following servers:
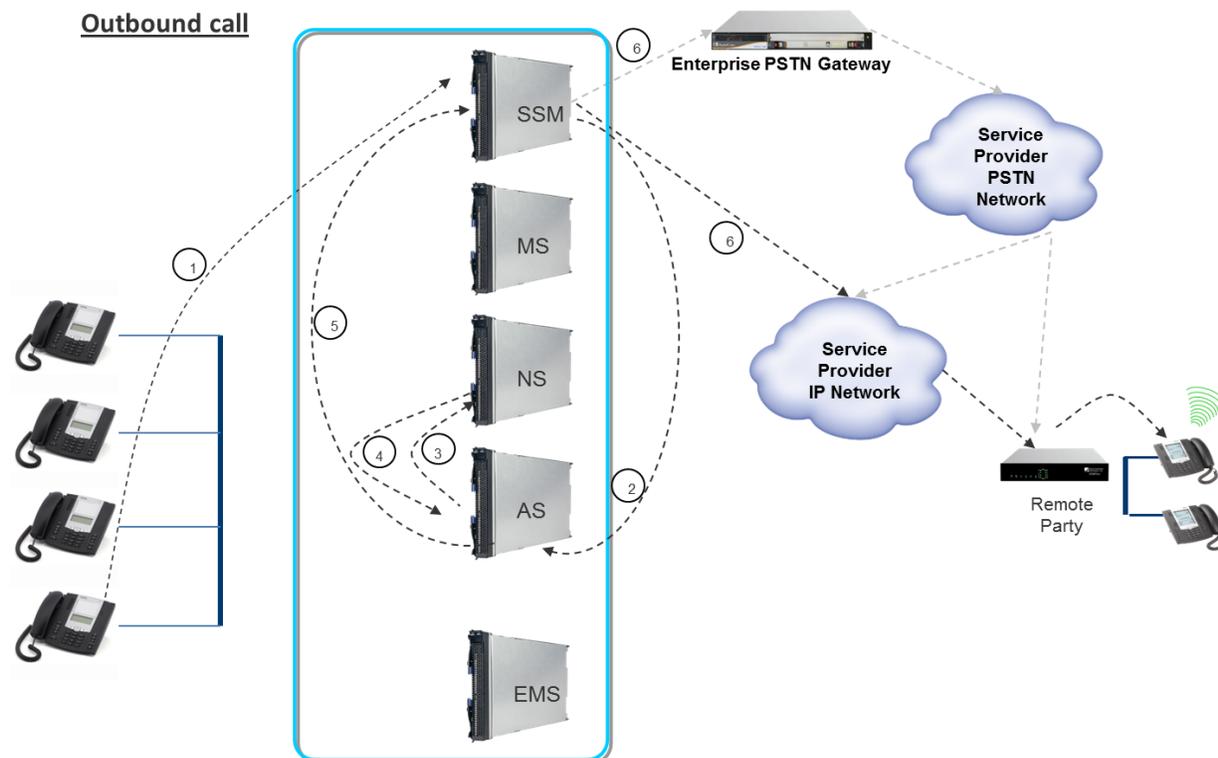
Outbound call

Figure 16. Outbound Call setup Call Flows.

1. Upon going "off-hook" and dialing the remote party, the initial SIP signaling is sent to the Clearspan node's CORE SBC server which provides the SBC functionality and authenticates the source SIP endpoint as a trusted source.

2. The CORE SBC forwards the request (now identified as being from a trusted source), to the Application Server (AS) to perform the call processing.

3. The AS queries the Network Server (NS) to obtain any required routing and translating information required to direct the call setup request. The AS also initiates a CDR for record-keeping/accounting purposes.

4. The NS provides the AS with the information on where to route the signaling – either to another internal endpoint, or else outside the Enterprises' Clearspan node for an external call.

5. Upon receiving the required information, the AS forwards the signaling request back to the CORE SBC to further direction outside of the Clearspan node.

6. The CORE SBC directs the signaling request out to the service provider for forwarding to the remote party. The request can be sent out either over the IP network, or else through the PSTN network in the case of a failure of the IP connection if there is an optional PSTN gateway in place.

Upon completing the call setup, the RTP flows directly from the SIP endpoint, through the CORE SBC, out to the service provider network to the remote party, without further intervention from the other Clearspan servers.

Inbound Call Flows

The second case examines an inbound call which is a call received by a user serviced by the Enterprise Clearspan node. The signaling and call flows are reversed from those followed for the outbound calls described in the previous section.

- The SIP Signaling request is received by the Clearspan node from the service provider network (1) and (2).

- Upon being processed by the Clearspan server complex, the signaling is forwarded over the customers' LAN to the SIP endpoint that is being called (3) and (4).

- Upon the called SIP endpoint accepting the inbound call, the Clearspan node will send the appropriate signaling acknowledgments and responses back through the service provider network to the calling party to complete the call setup.

- Upon completing the call setup, the RTP media stream is routed directly between the remote party (via the service provider network) and the user's SIP terminal. The only Clearspan server that the RTP would traverse after the call setup process is completed is the CORE SBC (5).
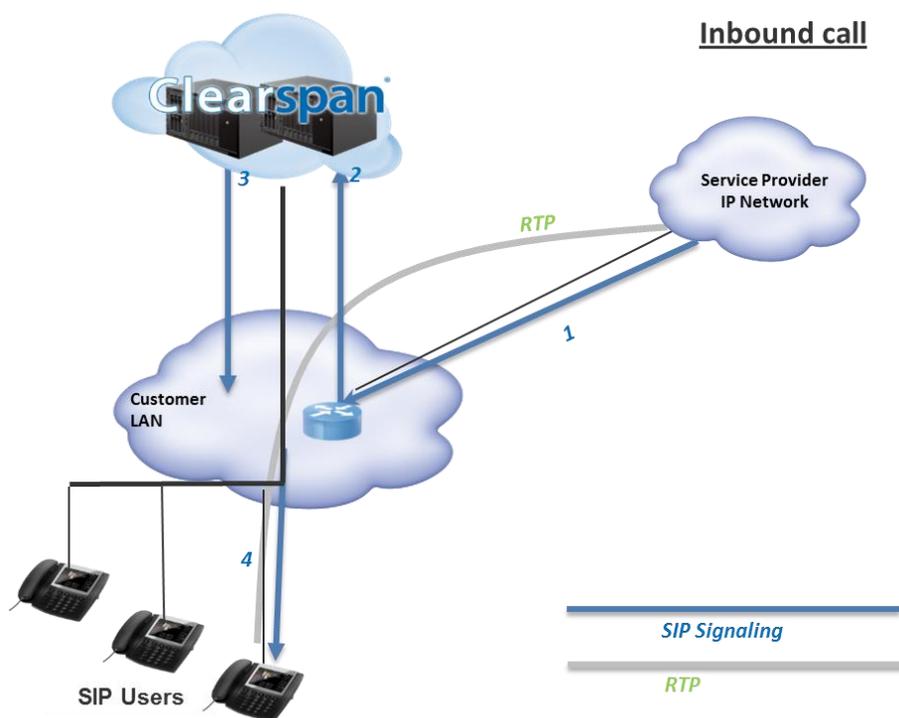

Figure 17. Clearspan Inbound Signaling and Call Flows.

Examining how the inbound call setup is handled within the Clearspan server complex, we see in the following diagram (Figure 18), that the process involves interworking between the following servers:
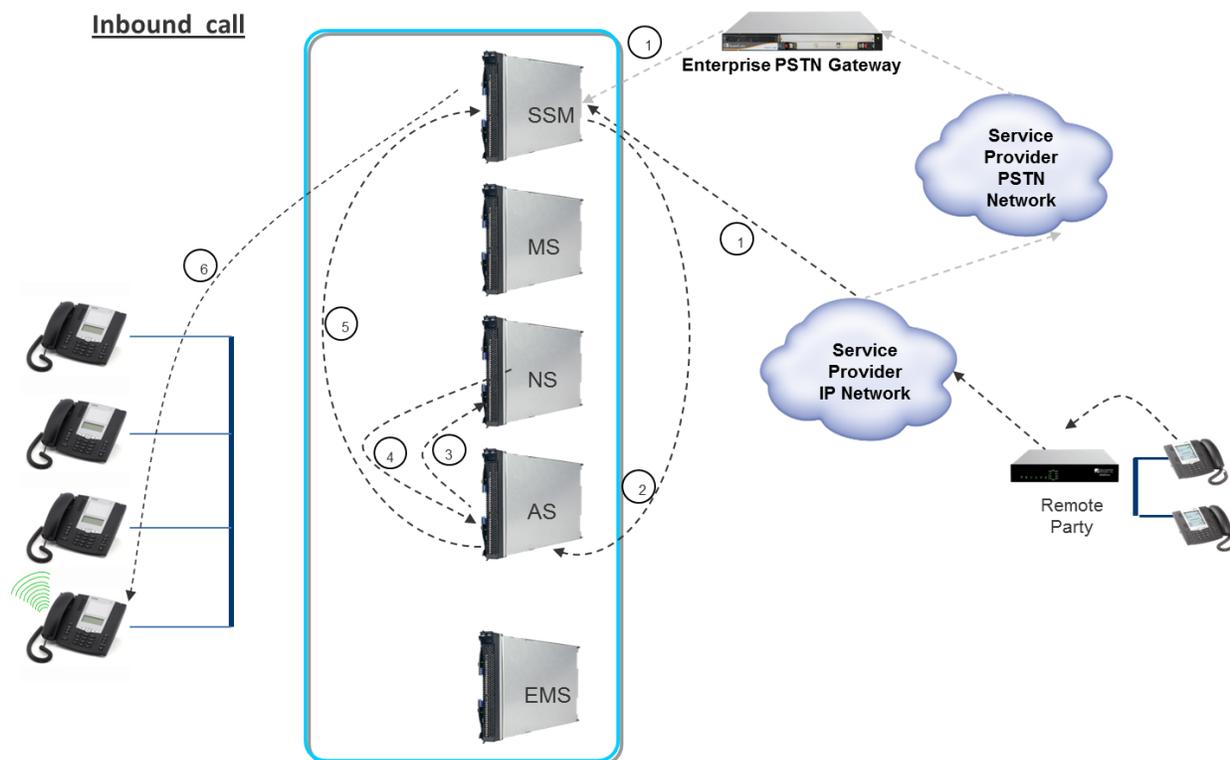
Inbound call

Figure 18. Inbound Call setup Call Flows.

1. For an inbound call, the entry point into the Clearspan node is the CORE SBC, which would determine whether to provide access (based upon the request being received from a trusted source) to the signaling request. The request could be received over either the service providers' IP network or via the PSTN network if there is a PSTN gateway in place to handle calls in case of failure of the service providers' IP network link.

2. The CORE SBC forwards the incoming request to the Application Server (AS) to perform the call processing function.

3. The AS queries the Network Server (NS) to obtain the required routing and translating functions required to direct the call setup request to the appropriate SIP endpoint. The AS also initiates a CDR for record-keeping/accounting purposes.

4. The NS provides the AS with the information on where to route the signaling – which internal SIP endpoint the external calling party is attempting to call.

5. Upon receiving the required routing information, the AS forwards the signaling request back to the CORE SBC to further direct the signaling request to the SIP endpoint.

6. The CORE SBC directs the signaling request to the SIP endpoint to accept the received call.

Upon completing the call setup, the RTP flows directly from the service provider network, through the CORE SBC, directly to the SIP user's terminal, without further intervention from the other Clearspan servers.

Internal Call Flows

Shown in the following diagram (Figure 19), the last situation is where a Clearspan SIP user places an "internal" call to another user serviced by the same Clearspan node. Please note that this is not to imply

that the users must be collocated at the same physical site, because as mentioned earlier, the Clearspan solution supports the ability to service dispersed sites. The flows for the internal calls are naturally somewhat simpler than those for either Outbound or Inbound calls, since there is no need to involve the service provider (assuming that the calls are routed over the internal network even if both "internal" parties are at different physical locations).

- The SIP Signaling traverses the customer LAN to reach the Clearspan node (1) and (2).

- Upon being processed by the Clearspan server complex, the signaling is forwarded over the customers' LAN to route to the remote endpoint (3) and (4).

- Upon completing the call set-up, the RTP media stream is routed directly between the two endpoints, without having to traverse through the Clearspan server complex. Also, as previously mentioned, the two endpoint need not both be SIP endpoints.
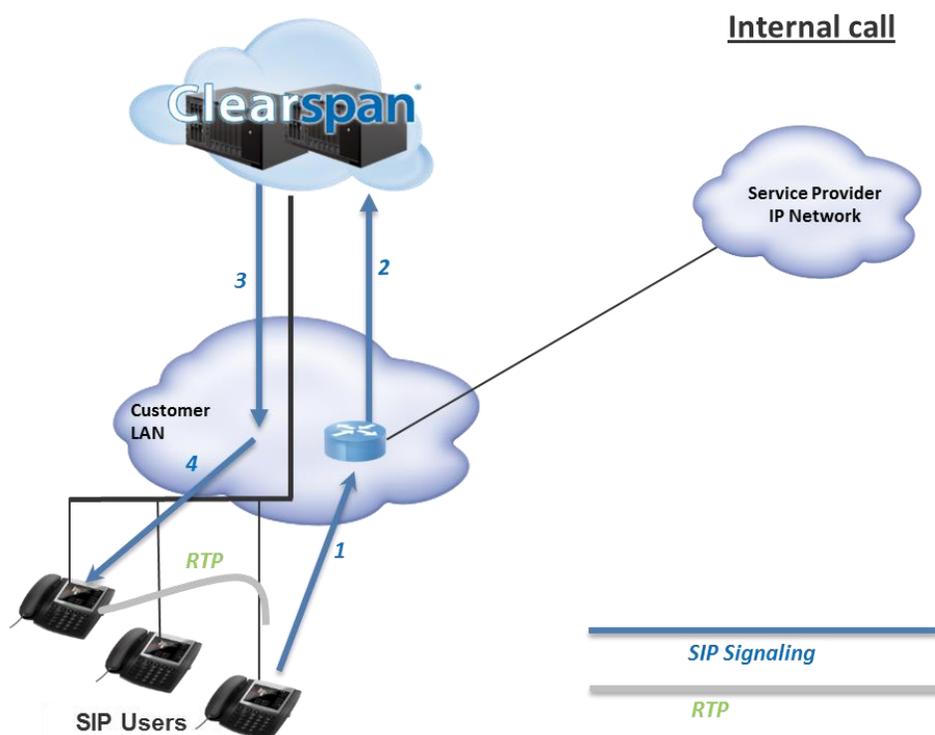

Figure 19. Clearspan Internal Signaling and Call Flows.

Shown in the following diagram (Figure 20), for internal calls, the call set-up is handled within the Clearspan node itself, and we see that the process involves the following servers:

Upon completing the call setup, the RTP flows directly from the initiating SIP endpoint, to the called party SIP endpoint.
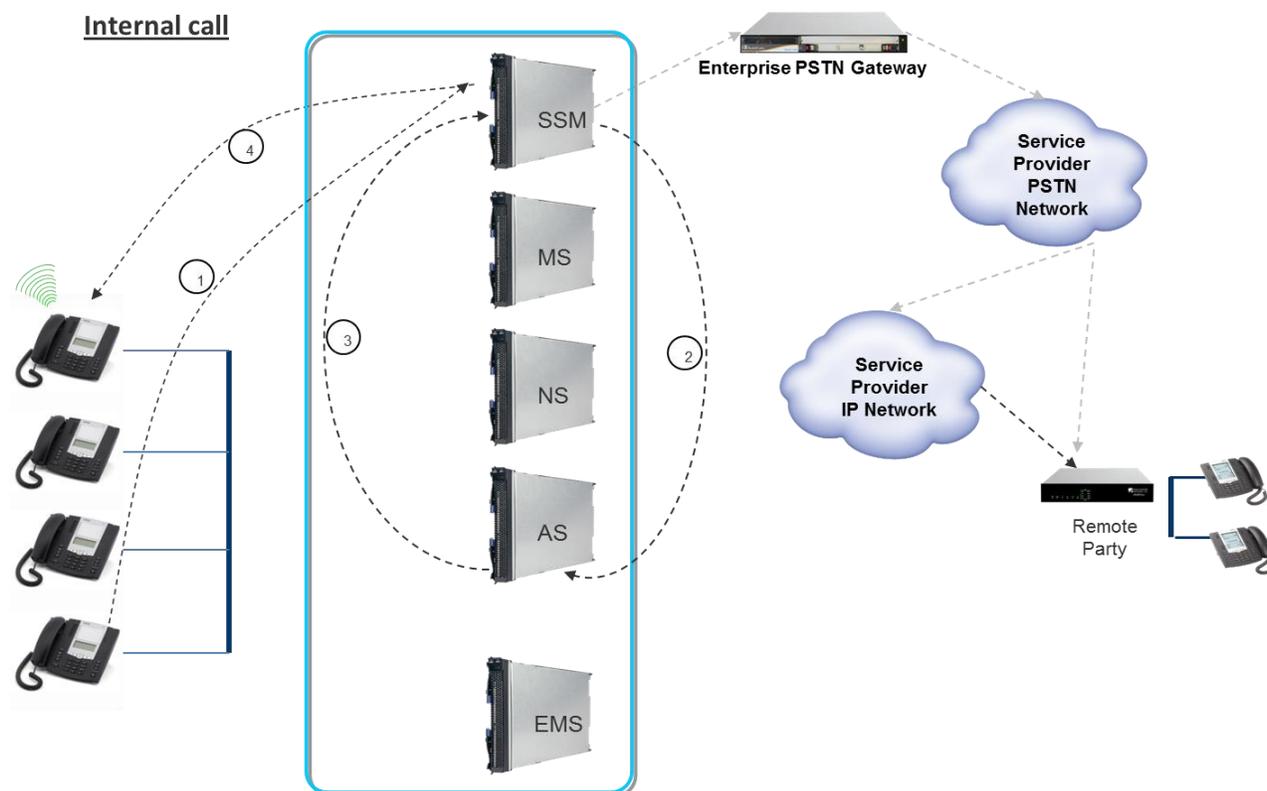
Internal call

Figure 20. Internal Call setup Call Flows.

1. After dialing and pressing dial (or waiting for the digit timeout), the initial SIP signaling is sent to the Clearspan node's CORE SBC server, which serves the SBC functionality.

2. The CORE SBC forwards the request (from a trusted source), to the Application Server (AS) to perform the call setup.

3. Unlike either the Inbound or Outbound calls, the AS does not need to query the NS to obtain the required routing and translating functions required to direct the call setup request. The AS simply forwards the signaling request back to the CORE SBC for forwarding. The AS also initiates a CDR for record-keeping/accounting purposes.

4. The CORE SBC directs the signaling request to the other internal SIP endpoint to complete the call setup request.

911 AND E911 CONSIDERATIONS

Clearspan provides a level of support for 911 and Enhanced 911 (E911) emergency dialing and routing services by default. This basic level of support can be further extended through the addition of optional third party products and services to provide a more robust solution with enhanced notification capabilities for administrators.

The Clearspan platform can support multiple emergency call number sequences, and complete the call appropriately for these different numbers. Clearspan can replace the dialed sequence of digits defined for emergency purposes (for example, 911) with a fully specified directory number when call originators may be in an area that does not support enhanced emergency call routing.

Upon dialing, the call may be transferred to local PSAP, Emergency Routing Services (ERS), or local emergency offices. Global and flexible routing options are also supported. Global routing may be used when all emergency calls from an enterprise are sent to the same location. Flexible routing lets system administrators define a unique method to deliver emergency calls from each office/site.

In addition to the completion and routing of the emergency calls, the Clearspan system also provides some additional features to augment the 911/E911 service capability:

- Call Recording – All emergency calls may be optionally recorded. The recordings may be accessed by system administrators or local emergency office personnel.

- Notifications – Integration with e-mail systems or with third party desktop alerting software.

- Callback – From either local PSAP or to a fixed number.

- CDR – Call Data Records are available for all emergency calls.

Clearspan 911/E911 Deployment Options

In all 911 scenarios, it is important that the customer premises be configured with a survivable Session Border Controller (SBC). Clearspan supports the emergency service configurations, capabilities, and constraints described in the following sections.

Basic 911/E911 Emergency Services Limitations

While the Clearspan platform provides a default level of support for 911/E911 services, there are some limitations with the basic Clearspan deployment including:

- No additional premises-based equipment required for the basic capability.

- A preprogrammed, user account-based ELIN/ANI is presented during an emergency call allowing the PSAP operator location information of the caller.

- Customers may partition ELIN/ANIs by group or by individual user.

- No automatic location tracking for moving phones (phones may not be moved).

- Callback to a fixed party (i.e. local emergency office).

- Limitation upon 911/E911 support for mobile workers.

The following figure outlines the call flow associated with the standard Clearspan offering under normal operation.
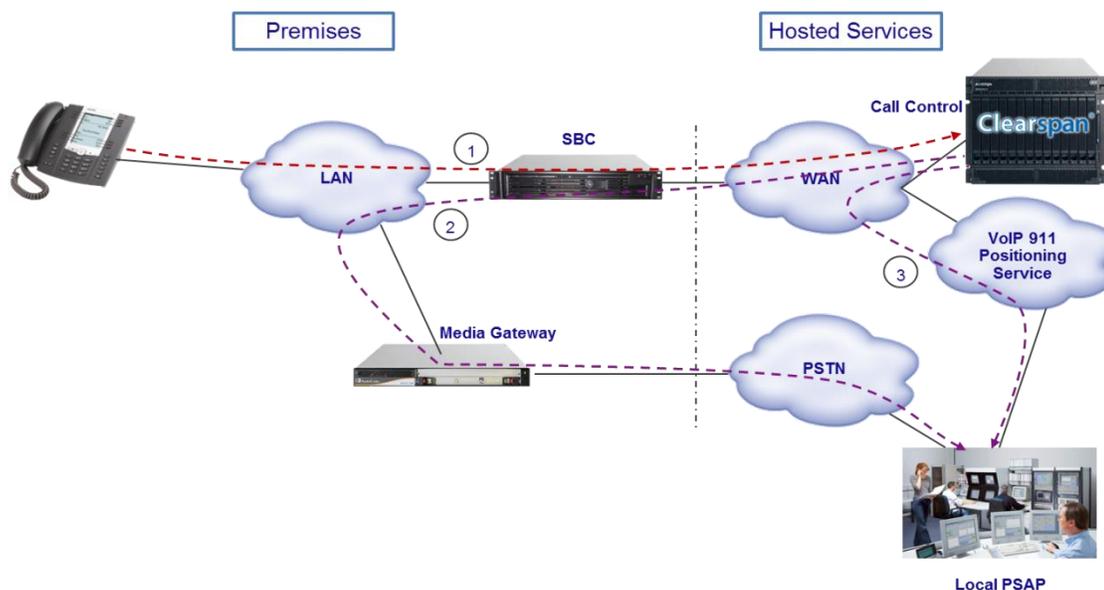
Figure 21. Basic Clearspan E911 Call Flow for Normal Operation.

1. A 911 call is detected by the premises SBC and is configured to pass the call directly to the hosted service call control. The ELIN/ANI is modified per the user's account or group configuration.

2. The call is routed to the premises and out of a local media gateway to the PSAP. Note the gateway has the ability to overwrite the ELIN/ANI also.

3. Calls with the updated ELIN/ANI can also be sent directly to a VPC or SIP Trunk provider and subsequently to PSAP.

Advanced 911/E911 Services (with optional EGW) Service Limitations

In addition to the basic default capabilities inherent to the Clearspan platform, customers can also deploy Clearspan with an optional Emergency Gateway (EGW) to offer a more robust, survivable solution. There are some constraints when deploying Clearspan with a redundant pair of EGW premises-based appliances:

- Media gateways are required in each applicable PSAP region for survivability.

- Provides support for emergency calls from Share Call Appearance lines.

- Supports automatic location tracking for SIP phones moving within the enterprise network when Layer-2 discovery is enabled.

- An ELIN/ANI is presented based on the physical location of the endpoint.

- Multiple callback options (911 caller, emergency desk, etc.).

- Extended notification/alerting support.

- As with the case for the basic deployment option, workers with soft clients or moving desk phones will be able to dial 911 services; however, it is incumbent upon the customer to ensure that users' locations are correctly updated in the appropriate databases.

The following figure outlines the typical call flows associated with the advanced Clearspan offering. An enterprise Session Border Controller (ESBC) is required to make this approach work and is critical in the

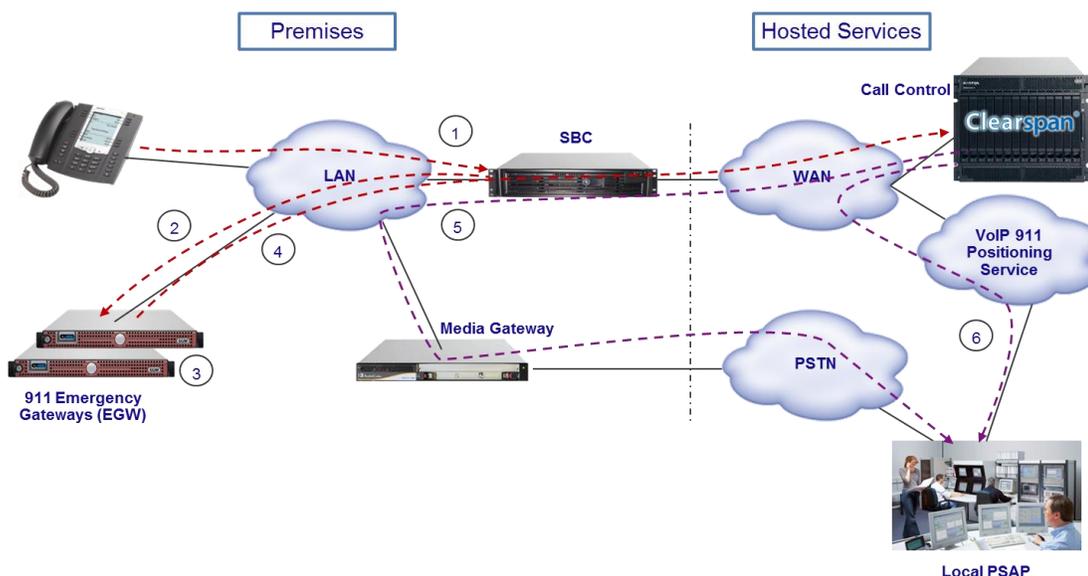realization of a survivable enterprise location. In addition, Emergency Gateways (EGWs) are also required.

Figure 22. Advanced Clearspan E911 Call Flow for Normal Operation.

1. A 911 call is detected by the SBC (911@domainname detected in the Request URI).

2. Call gets routed directly to the EGW from the SBC.

3. The ELIN/ANI is placed into the From Header and a prefix is added to the Request URI (e.g. 3911@domainname).

4. The call is routed to the SBC. The SBC filter detects a different Request URI and routes the call to the Hosted Call Control.

5. A local media gateway may be used to route the call to an in-region PSAP.

6. Other SIP-based 911 routing options may be used instead of the local media gateway to reach the PSAP (VPC, etc.).

Optional Third-Party 911 Emergency Positioning and Routing Services

For customers requiring an all-VoIP solution which includes support for 911, Clearspan provides an Emergency Routing Service (ERS) as an overlay to the capabilities provided by the advanced 911 service. It includes these features/constraints:

- Redundant Emergency Gateway (EGW) units required.

- Two options for ERS support –with calls being handled by a third-party emergency service provider via the SBC and EGW, or via a dedicated Enterprise PSTN gateway.

- Supports emergency calls from Share Call Appearance lines.

- Automatic location tracking for phones moving within the enterprise network when Layer-2 discovery is enabled. Additionally, location updates for phones moving outside the enterprise network depending on the third-party services selected.

- Desktop alerting with optional desktop alerting software.

CLEARSPAN UNIFIED COMMUNICATIONS

Clearspan Unified Communications (UC) is a complete solution, providing a comprehensive suite of services addressing business needs. The overall solution includes the following features:

- Audio Calling and Video Calling

- Integrated Conferencing

- Instant Messaging and Presence

- Service Management (call settings)

- Desktop Sharing

- Address Books/Contact Management

- Fixed Mobile Convergence

The user experience is centered around the Clearspan Communicator client application, which is deployed on Windows PCs, Mac OS X, as well as Apple iOS and Google Android operating system based platforms. End users use Clearspan Communicator to access all their communication services provided through Clearspan. The overall architecture of the Clearspan UC solution is shown in the following figure.
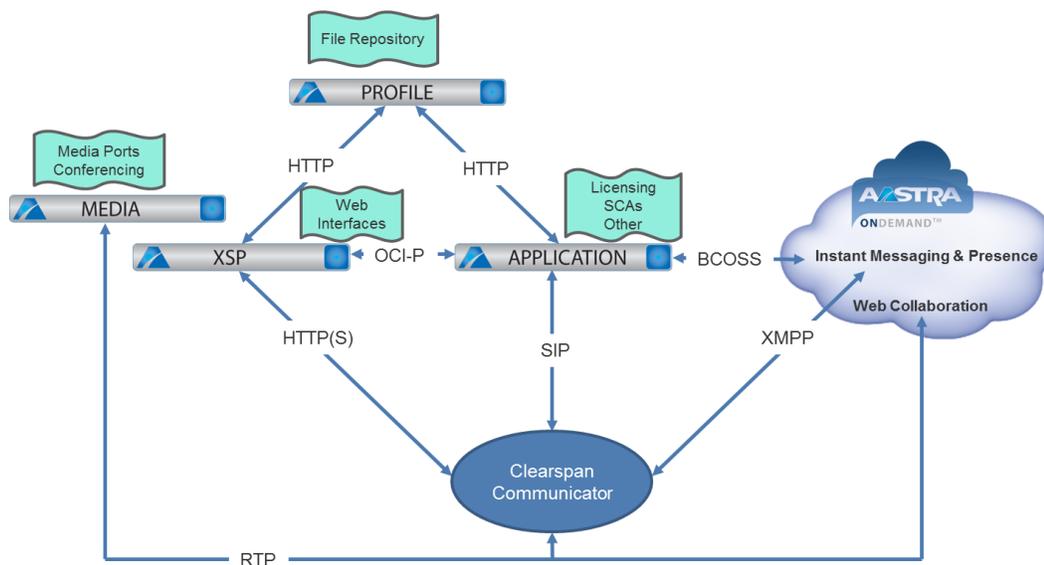

Figure 23. Clearspan UC High-level Architecture.

Focusing on the Clearspan Communicator clients, the primary components in the solution include the following:

- Clearspan Communicator user clients for Windows, Mac, iOS and/or Android

- Clearspan services:
    - Clearspan Communicator Client Licenses

- o Integrated Instant Messaging and Presence (IM&P)

  o Clearspan user licensing (including Shared Call Appearance)

  o Meet-Me Conferencing

- Clearspan Servers

  o Profile Server (PS):

    ▪ File Repository web application

  o Xtended Service Platform (Xsp):

    ▪ Web Interfaces

  o Application Server (AS):

    ▪ Clearspan Communicator Desktop/PC and mobile identity device profile types

  o Media Server (MS)

    ▪ Meet-Me Audio Conferencing

These items and their features and service interactions will be described in the following sections.

CLEARSPAN COMMUNICATOR CLIENT

Clearspan Communicator Client features include:

- High Definition Audio and Video calling using any available network connection, including Wi-Fi, 3G/4G/LTE or even legacy circuit switched mobile networks

- Instant Messaging with both enterprise and federated contacts

- Rich presence capabilities based on many inputs, including telephony status, user selected status, or Microsoft Exchange status

- Desktop sharing

- My Room, an always-on collaboration space, enabling a cohesive experience for chat, audio and/or video conferencing and desktop sharing

- User to user communications or group based communications, for calling, chat, and desktop sharing

- Tight integration with Microsoft Outlook and Exchange

- Service Management, call settings (for example, Call Forwarding or DND)

- Fully configurable in real-time from a centralized Device Management interface

The following product distinctions exist within the Clearspan Communicator:

- **Communicator Basic** – A PC and Mac application that provides call control integration with the user's desktop telephone.

- **Communicator Audio** – Adds an audio softphone to the Communicator Basic application. Platforms supported include PC, Mac, iOS devices and Android smartphones.

- **Communicator Video** – Adds point-to-point video to the Communicator Audio application.

Refer to further information in the following sections for details and features.

CLEARSPAN CALL CONTROL INTERACTION FOR UC

The Clearspan system supporting portions of the Unified Communications functionality will be deployed and managed by the end customer or Clearspan, depending on the business model. This Clearspan system will support the following UC capabilities:

- All call control including point-to-point audio and video sessions

- Multiparty Audio Conferencing (Meet-Me, optional)

- Support of mobile users and clients with various Fixed Mobile Convergence (FMC) strategies

- Licensing of the Clearspan Communicator clients

- Clearspan Device Management for automated client provisioning

- Enterprise Directories

- Call Logs (Missed/Placed/Received)

- Centralized Service Configuration (Call Forwarding, DND, etc.)

CLEARSPAN UC CLIENTS DETAILS

In addition to web-based portals provided for administrator and user self-configuration purposes, Clearspan offers a range of client applications to access the features associated with the Clearspan services, designed to address the varying needs of different user types. These products are integrated with Clearspan server-based features and offer enhanced functionality for users. In addition to hardware based options, the Clearspan solution provides the following software based end-user UC client options:

- *Clearspan Communicator* - A software-based SIP client providing access to voice and UC services to users on a variety of computing and smartphone platforms. Clearspan Communicator provides access to the complete UC feature set, regardless of the platform upon which is it installed. The Clearspan Communicator is available in the following three configurations:

  o *Clearspan Communicator Basic* – A PC and Mac application that provides call control integration with the user's desktop.

  o *Clearspan Communicator Audio* – Adds an audio softphone to the Communicator Basic application. With the Clearspan R19 release, the platforms supported include PC, Mac, iOS and Android.

  o *Clearspan Communicator Video* – An extension to the Clearspan Communicator Audio client, this client option adds point-to-point video to the basic voice only application.

- *Clearspan Receptionist* – Thin client attendant console application that provides group member call status, directory integration, presence and click-to-transfer functionality.

- *Clearspan Call Center* – Thin client application for call center agents and supervisors to participate in call center queues, manage calls, wrap calls, and generate reports.

CLEARSPAN COMMUNICATOR

The Clearspan Communicator is a set of software-based SIP clients available on a number of platforms. Clearspan Communicator provides an evolution of the original BroadSoft UC-ONE client and combines access to the voice and video call control capabilities provided by the native Clearspan platform, and the optional Instant Messaging and Presence capabilities provided through the Clearspan Service.

Figure 24. Clearspan Communicator Platform Evolution.

Initially available as a desktop client on the PC platform, Clearspan Communicator support has been extended to now include deployment on Apple and Android OS based smartphones. Future releases will extend the supported platforms further to include iOS and Android based tablets and the MAC platforms.

Clearspan Communicator Basic

The Clearspan Communicator Basic offers the ability for users to control their services. The client supports the following service management features allowing supplementary services to be managed using the native Client Preferences window:

- Clearspan Anywhere

- Clearspan Remote Office

- Call Forwarding

- Do Not Disturb

- Hide Number (Calling Line Identification Presentation [CLIP]/Calling Line Identification Restriction [CLIR])
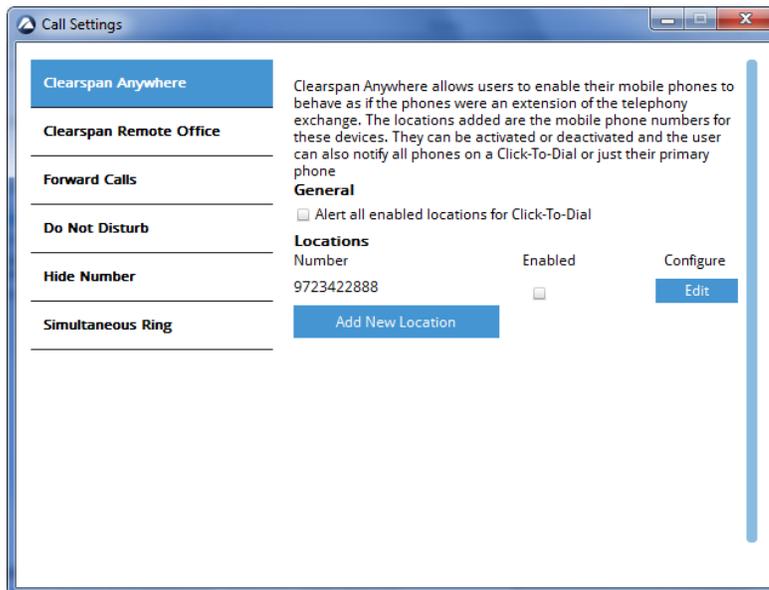
- Simultaneous Ring Personal

Figure 25. Communicator Basic Service Management.

Clearspan Communicator Audio

The Clearspan Communicator Audio client is an audio softphone that provides users a feature-rich desktop interface to make and receive calls as well as execute enhanced features. The Communicator has access to the many Clearspan advanced VoIP features including screening and messaging/voice mail integration.

As an integrated device with the Clearspan platform, enterprise administrators are able to auto provision the client, provide automatic updates, and maintain version control seamlessly through the Clearspan Application Server. Clearspan Communicator Audio is capable of supporting both G.711 and G.729a protocols. Clearspan Communicator Audio allows users to use the client as a primary or secondary phone device. Clearspan supports this via server features that enable both devices to register to the same user account and directory number (DN)/direct-inward dialing (DID) number.

Clearspan Communicator Video

The Clearspan Communicator Video provides all the capabilities of the audio-only Clearspan Communicator Audio, and adds high quality multimedia transmission. With Clearspan Communicator Video, a user's desktop computer can function as a full-feature multimedia communications platform.
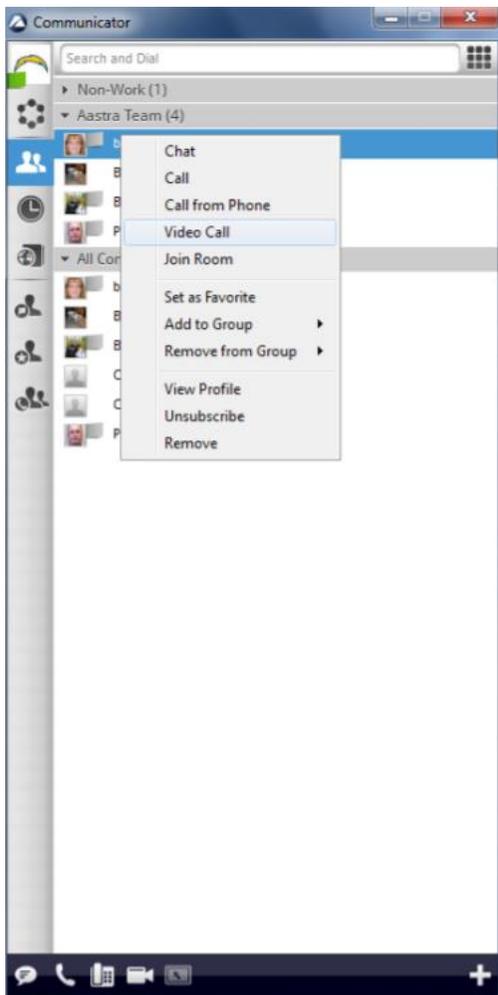
Figure 26. Clearspan Communicator Video.

While Clearspan integration offers considerable value for the audio-only client, the benefits are even further expanded with the addition of video. First, the video codec negotiation is somewhat more complicated than audio-only codec negotiation. Clearspan pre-integration limits the issues associated with video codec negotiation, simplifying deployment and reducing support calls and user issues. Second, pre-integration with the video client enables separate routing of voice streams over traditional handsets while the video signal is connected to the video client. Thus, users can enjoy features of their desk handsets such as a high-fidelity speakers and microphone, along with the multimedia experience available from the desktop client.

CLEARSPAN RECEPTIONIST

Clearspan Receptionist is a carrier class IP telephony attendant console for use by receptionists, or telephone attendants, who manage and screen inbound calls for the enterprise. Clearspan Receptionist is a feature-rich desktop application that is fully integrated with the Clearspan platform that delivers the following benefits to users:

- Easy-to-use design that follows the natural work "flow" of a call from the top to the bottom of the screen.

- Intuitive business processes, as only "valid" options are presented to the attendant.

- Professional call handling as critical information is available in real time.

- Accurate delivery of messages via a one-step process when people are unavailable.

- The Clearspan Receptionist can be used under a number of different operational scenarios. These scenarios include:

  o After Hours – Allows operators to automate switching from day to night mode.

  o Call Center Queue – Allows operators to monitor and control calls in a Call Center queue, and to manage their availability status.

  o Hoteling – Allows multiple part-time operators to share a single log-in sequence when they change shifts.

  o Low Traffic – Allows single receptionist answering one or more dedicated main line numbers.

  o High Traffic – Allows more than one attendant console managing multiple dedicated main line numbers.

  o Network Attendant Console – Allows geographically dispersed operators to support each other in an enterprise configuration.

  o Multi-tenanted Offices – Allows one or more operator to answer calls on behalf of different organizations.

  o Optional Voice Mail Transfer – Allows operator to transfer calls to voice mail for contacts in a group/enterprise that are busy or unavailable.
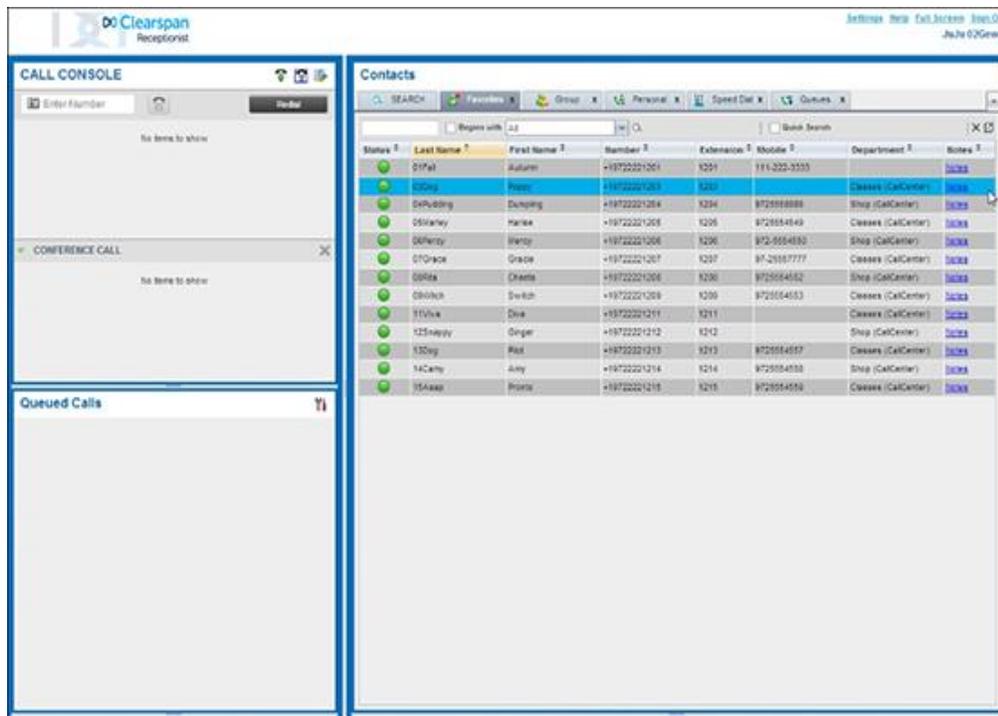
Figure 27. Clearspan Receptionist Main Window.

CLEARSPAN CALL CENTER

The Clearspan Call Center application provides an intuitive, thin-client graphical interface for managing calls and queues in a Call Center. It has two modes of operation: one for Call Center agents, and one for Call Center supervisors. The mode is determined when a user logs in according to the license the user has been granted on the Clearspan Application Server.

The agent mode allows users to answer calls in the queue, to transfer calls back to the queue, to make outbound calls, and to manage their availability. Agents can also escalate calls to a supervisor on duty.

Supervisors have the additional abilities to monitor the status of all agents in their Call Center, to barge in silently on active calls, and to examine statistical reports on Call Center activity and queue size.
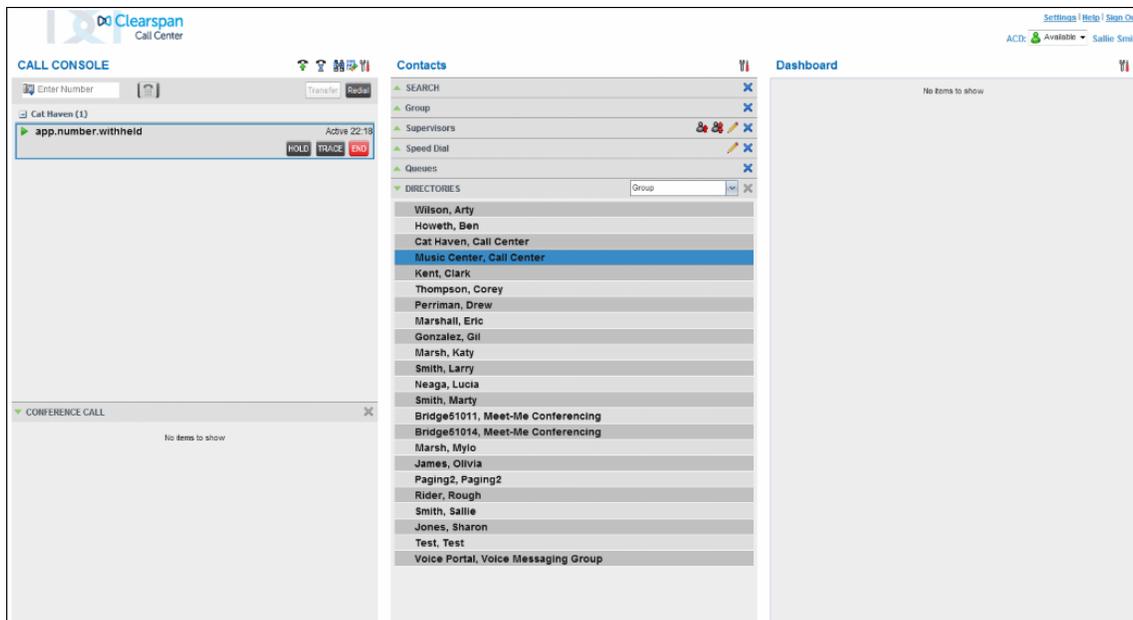
Figure 28. Clearspan Call Center (Agent Mode).

The following elements are available from the Call Center interface:

- **Logo pane** – The Logo pane displays information about you and contains links to other pages and functions.

- **Call Console** – You use the Call Console to view and manage your current calls.

- **Contacts pane** – The Contacts pane contains your contact directories, the list of your supervisors, and the list of the call centers to which you belong. It allows you to use your contacts to make and manage your calls.

- **Dashboard pane** – The Dashboard pane provides real-time summary information about up to 50 call centers selected from the list of call centers to which you are assigned.

- **Call History dialog box** – You use the Call History dialog box to view your past calls and make calls from history.

- **Chat windows** – You use Chat windows to chat with your IM&P contacts.

- **Report window** – You use the Report window, accessed via the Reporting link, to generate reports about your activity and performance in the call centers you are staffing.

- **Settings pages** – You use the Settings pages, accessed via the Settings link, to configure various aspects of Call Center.

CLEARSPAN-BASED APPLICATIONS AND SOLUTIONS

CLEARSPAN SOLUTION SETS

Clearspan provides each of the following solution sets. Note that all of these solution sets are fully integrated within Clearspan – they share a common web portal, have fully integrated management capability, are fully integrated in Clearspan accounting and CDRs, and so on.

- *Call Centers and Call Distribution* – Clearspan allows enterprise administrators to offer Call Center and virtual Call Center functionality, and also supports a wide variety of Hunting and automatic call distribution (ACD) services.

- *Executive/Assistant Support* – Clearspan supports a variety of executive/assistant solution sets, including dedicated assistants, assistant pools, and multiple executives-multiple assistant administrators "sharing".

- *Remote Office and Teleworkers* – Clearspan allows enterprises to offer full "virtual user" functionality. Users can carry their services with them wherever they go. Clearspan supports a variety of personal mobility services, including remote office, hoteling, soft clients, PC and web clients, and mobile clients.

- *Flexible Seating* – With the release of R20, Clearspan introduces a new user service called Flexible Seating Guest service to allow multiple "Guest" users to use a common "Host" device, and utilize their personal (Guest) user profile, rather than the profile determined by the Host device.

- *Virtual Front Office Attendants and Switchboards* – Clearspan supports fully-virtual software-based attendant console functionality, Automated Attendant functionality, hardware attendants, and the ability for carriers and enterprises to design the look, feel, and operations of their front office.

- *Productivity Clients* – Clearspan supports a variety of PC, Mac, mobile, and web clients that provide personal productivity enhancement, and also supports specialized clients for applications like Call Centers and Receptionists.

- *PBX Integration* – Enterprise administrators can "meld" users on legacy PBXs with users on IP phones or mobiles. PBX-based users can receive overlay services, disaster recovery and business continuity services, and unified dial plan functionality from Clearspan.

KEY APPLICATIONS

The flexibility of the Clearspan solution, coupled with Clearspan's technology and partners, enables enterprises and service providers to address a wide range of applications. In addition to the following applications, enterprises may easily develop their own applications, features and integrations with a commercially available software development environment.

The applications most often considered are:

- *Unified Communications* – Maximize end-user productivity by providing them a fully integrated communications environment, enabling smooth interaction across individuals and groups. With its tight integration with Outlook, click-to-dial, voice and video, unified

messaging, call center and conferencing, Clearspan provides a ubiquitous communication experience, independent of the endpoint device used.

- *Fixed/Mobile Convergence (FMC)* - Whether users are using mobile or stationary phones, they share the same experience. Because the features are separated from the endpoints, Clearspan can easily integrate any type of device, without additional user licensing expense. With Clearspan's FMC solution, there is no reason to involve the cellular carrier as all features supplied to the mobile client are independent of carrier used.

- *Business (SIP) Trunking* - Allows enterprises to provide "IP Trunking" connectivity to existing PBXs. Enterprises may deploy next-generation trunking and overlay features while preserving legacy PBX investments and slowly transition all locations to VoIP.

- *Meet-Me Conferencing –* Provides a Meet-Me Audio Conferencing service that runs within the Clearspan Application Server. The audio mixing is performed by the Clearspan Media Server. The Meet-Me Conferencing service includes the following capabilities:

  o Up to 294-way conferencing

  o Scheduled and reservation-less conferences

  o Recording of conferences

  o Muting participants and inviting new participants (by moderator)

  o Web interface to control the conference

  o High definition (HD) audio

- Migration tool to convert users who are using the existing Audio Conferencing solution *Multi-Party Video Conferencing –* With Release R20, Clearspan also supports a video conference capability in addition to the Meet-Me Audio conferencing available in releases prior to R20. The native Video conferencing service includes N-Way Calling and Call Recording (of video) with combined output. The calling and called parties are presented with unique images as if they were directly connected. The monitoring party is presented with a tiled image of the calling and called party. A total of up to 15 participants may be conferenced using the feature.

- *Web Collaboration* -– Provides users with a feature-rich web and video conferencing tool for hosting online meetings, webinars and training. With Web Collaboration, users are offered face-to-face, multi-person video capability, can broaden their collaborative toolset and deepen engagement by doing more – from call scheduling, demonstrating products, and hosting targeted webinars, to using desktop applications or region sharing to work more closely with remote parties.

- *Call Center* – A carrier-class, communications management product for Call Center agents and supervisors used with the Clearspan platform, on which call centers are hosted. Clearspan Call Center delivers the following real benefits to users**:**

  o Efficient call handling and automatic call distribution (ACD) state management by Call Center agents

  o Integration of online directories with Click-To-Dial capability

  o Real-time monitoring of agent and queue activity by Call Center supervisors

  o Real-time and Historical reporting on agent and queue activity by Call Center supervisors

    Along with this focus on design, Clearspan Call Center employs the latest technology platforms and communications facilities.

- ***Clearspan Receptionist*** - A carrier-class Internet Protocol (IP) Telephony Attendant Console, specifically developed for hosted environments. It is used by "front-of-house" receptionists or telephone attendants, who screen inbound calls for enterprises. Clearspan Receptionist realizes the promise of IP telephony by enhancing business processes and delivering rich services in a user-friendly way.

UNIFIED COMMUNICATIONS

The key advantage of a converged large enterprise solution with Clearspan is that all enterprise communications, regardless of location or premise equipment, are managed by a network-hosted system. This means that all enterprise users benefit from a common set of features, a common directory, common enterprise dialing plans, and most importantly, a common end-user experience, no matter what their equipment or geographic location.

Consider the following real-world example – a large enterprise may have:

- A large PBX serving corporate headquarters

- Other PBXs or IP PBXs serving regional or country headquarters

- Branch offices or new sites using IP phones

- Sales or mobile workers with only a mobile phone as their corporate handset

- Sales, mobile, or executive workers with both a mobile and a fixed handset (and administrative assistants who share their lines)

- Home or contract workers who work from a home office over a residential line

The following figure shows an example of how a heterogeneous enterprise is served by an enterprise administrator's network-hosted FMC solution.

Figure 29. The Connected Enterprise.

Key Functionality

This section highlights some of the key functionality provided by converged enterprise solutions, as powered by Clearspan. This list is not exhaustive, but is meant to introduce applications that can be used to help enterprises maximize the use of their system.

- Abbreviated dialing between PBX sites, IP phone sites, and 2G, 2.5G, 3G and 4G mobile users (both intra-country and inter-country).

- Abbreviated dialing within the enterprise from mobile stations.

- Click-to-Call dialing (with a common look and feel) from PBX stations, IP phones, home offices, or mobile phones.

- Call Centers that span sites, or span countries—for example, a technical support line with a 24-hour "follow-the-sun" strategy can have support calls go to Western Europe, North America, or Asia, based on the specific time blocks within the day. Supervisors can monitor the Call Center from anywhere in the world.

- Mobile/Landline Call Park and Pickup – executives can take a call on their mobile, "park" the call, and then re-establish it from a wireline phone in their office or in a conference room.

- Network-based voice and video mail.

- Simultaneous Ringing and single number – calls to users ring on their enterprise landline and mobile handsets.

- Multiple phone numbers – executives with a worldwide presence can have multiple phone numbers, for example, a Frankfurt number, a New York City number, a Tokyo number, and so on.

- The all-mobile branch office – a small enterprise or a small branch office can choose to only use mobile stations as their enterprise phones. All business features are supported on 2G, 2.5G, and 3G handsets, including enhanced business services like Mobile Receptionist.

FIXED-MOBILE CONVERGENCE

When Clearspan is coupled together with Clearspan's optional mobility solution, Clearspan Communicator mobile, the corporate communications suite takes Unified Communications a step further to offer users full freedom to choose how and where to perform their business irrespective of device and geographical location.

The Clearspan Communicator mobile solution, a client residing on portable platforms such as cellular phones or tablets, allows users to access their Clearspan services via either Wi-Fi or cellular connections, and to switch between the two depending upon their location and preferences. Clearspan Communicator mobile is a SIP User Agent (UA) client, supported on the Apple OS and Google Android operating systems, and has been verified on a number of portable devices.

Key Functionality

Some of the key functionality provided by the Clearspan Communicator mobile application may include the following:

- Initiate and receive voice and video calls, instant messages, and file transfers.

- Maintain a contact list in the client, which shows the presence status of friends, family, and colleagues.

- Integrate with Clearspan to provide Instant Messaging, Group Chat, and Conferencing capabilities.

Figure 30. Clearspan Communicator (on iPhone) Screens.

MEET-ME CONFERENCING

Clearspan offers a full suite of conferencing solutions, from simple ad-hoc conferences such as N-Way calls, to full-featured Meet-Me Audio Conferencing, which can support hundreds of participants and includes moderator controls, web-based clients, and scheduling options.

With Clearspan Meet-Me Audio Conferencing, an administrator creates conference bridges (which include a DID number in its definition such as 222-555-1212) and designates Clearspan users as "conference hosts". The host can create conferences on the conference bridge that has been assigned to them, with a unique conference ID created for each conference. Participants dial the bridge number, enter the conference ID, and are joined together on the conference. The conference can be scheduled as a one-time event, a recurring event, or a reservation-less conference that is available at any time.

Key Benefits of the Clearspan Solution:

- ***Reduce costs*** – The solution runs on existing Clearspan servers, eliminating the need to introduce additional platforms or third-party applications.

- ***Enhance the experience with high definition (HD) voice*** – The solution supports HD Voice (G.722 codec), so that participants with HD-capable devices can experience the benefits of clear HD communication.

- ***Reduce distractions during calls*** – The solution blocks Music On Hold from other Clearspan participants if they put the call on hold during a conference, and supports Lecture Mode which automatically mutes all participants when they join a conference.

- ***Simplify notifications*** – The Clearspan Meet-Me Conferencing Add-in for Microsoft Outlook allows hosts to quickly add a Clearspan Meet-Me Conference to an Outlook meeting.

Key Functionality

The solution supports the following key functionality:

- Reservation-less and scheduled conferences

- Outlook add-in for participant notifications

- HD (G.722) audio support

- Dual-tone multi-frequency (DTMF) controls for moderators and participants

- Web-based Conferencing Moderator client

- Participant "Call Back" option

- Blocking Music On Hold from other Clearspan participants

- Conference Options:
  - Play tone or name when participants arrive or depart
  - Roll call
  - Lecture Mode
  - Mute or unmute lines

o Lock or unlock conference

o Recording

o Escape to Operator

o Outdial to add participants

NATIVE VIDEO CONFERENCING

With the introduction of release R20, Clearspan offers a built-in Video Conferencing service. The feature adds video capabilities in addition to the existing Clearspan voice conferencing capabilities. Such services include N-Way Calling and Call Recording (of video) with combined output.

With this service, Video conferencing is supported for devices with resolution up to 720p HD. The Media Server mixes the audio stream and the video stream from multiple participants and sends back a single video stream and a single audio stream to each participant. For conferencing services such as N-Way Calling, the same tiled video image of up to six parties is sent to each participant. For monitoring services such as Call Recording (of video), with combined output, the calling and called parties are presented with unique images as if they were directly connected. The monitoring party is presented with a tiled image of the calling and called party.

Audio-only participants are also supported. They send and receive audio, but do not send or receive any video; therefore, they do not affect what is displayed in the tiled image. Their audio is mixed with the audio from the other conferencing participants.

The most recent active speaker is always shown at the top left

Up to 5 of the "most recent" additional participants are tiled around the active speaker

Active Tiles grow & re-size as parties are added to the conversation

Participant "Tiles" move as the participants arrive/leave

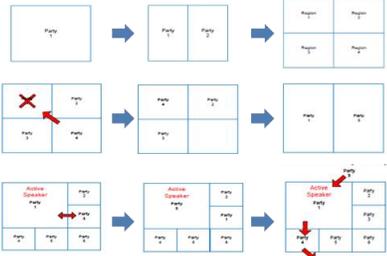Can link up "conferenced" parties to form a larger conference.

Figure 31. Clearspan Native Video Conferencing.

The multi-party Video conferencing service can support up to 15 video participants. Of the connected video participants, at most six are displayed in a tiled layout. The same tiled layout is presented to all video participants connected to the conference. Only active video participants (that is, participants who are not "video-muted") affect the display. Audio-only participants also do not affect the display.

Additionally, the Active-Talker feature always displays the most recent active participant (the last party to have spoken) in the top-left window of the display as the largest tile, with the next five "most recent" participants tiled around the main display tile.

WEB COLLABORATION

The Clearspan Web Collaboration service provides users with a simple-to-use, secure set of web collaboration tools. The service allows service providers and enterprises to deploy web collaboration solutions quickly and easily with limited technical investment, since the majority of the infrastructure is maintained and operated by Clearspan.

The Clearspan Web Collaboration service provides users with the ability to meet online and collaborate, share documents and applications, view participant video feeds, chat, and communicate via an audio bridge or using VoIP. For small and medium-sized businesses (SMBs) and enterprises, the Clearspan Web Collaboration service enables them to deploy a cost effective, web collaboration service and immediately benefit from increased productivity and efficiencies that it provides.

There are two clients available for the Web Collaboration service:

- A native client for Windows and Mac platforms - Used by session leaders and optionally participants, it provides all web collaboration features. It is automatically downloaded and installed the first time a session leader joins a collaboration session.

- Web Client on Windows, Mac, iPad, and Android tablets - Participants can join web collaboration sessions using a browser. No software is installed on the participants' PC, Mac, or tablet. Participants can optionally join a session using the native client.

Key Functionality

Some of the key features delivered by the Web Collaboration service include:

- **Multi-point video** – This feature is used to view session leader's and participants' video with an unlimited number of video feeds. The video can be adjusted to 30 frames per second (FPS) and window size can also be adjusted. Video can be streamed and occupy the entire screen, if desired.

- **Public and private chat** – Share instant messages with all participants collectively or individually. Public chats are recorded; however, private chats are not.

- **Internet and integrated audio** – Audio can be transmitted via an Internet connection (VoIP) or through an integrated teleconference bridge. An integrated teleconference bridge allows users to control audio functions via the software's interface. It also enables the system to call back participants to join a teleconference.

- **Desktop, Region, and Application sharing** – Session leaders can share their entire desktop, a portion of their desktop, or a specific application.

- **In-session File Transfer** – Send files from their computer to participants on the conference in real time.

- **Synchronized Web Browsing** – Participants can view a web site in real time during a meeting.

- **Interactive whiteboard** – An open space to create content, share ideas, outline projects, and perform other tasks.

- **Annotation and pointers** – Session leaders can focus participants on certain areas with pointers, and can annotate on live screens, stored documents, and whiteboards, including embedding images and adding text.

- **Recording and editing** – Sessions can be recorded and edited. They can then be posted to various sites for viewing. Recordings come in various formats that allow for greater editing scope and greater portability.

- **Feedback and polling** – Participants can provide real-time feedback during the session on the pace or content, and the session leader can post polling questions periodically to solicit feedback. Polling reports are available later to review results.

- **Tests and surveys** – Leaders can create tests and surveys, containing multiple-choice single answers, multiple-choice multiple answers, fill-in-the-blank, essay, and formula questions. Test and survey reports are available to review results later.

The following figures show the interface for the Web Collaboration service for both the desktop and mobile platforms:
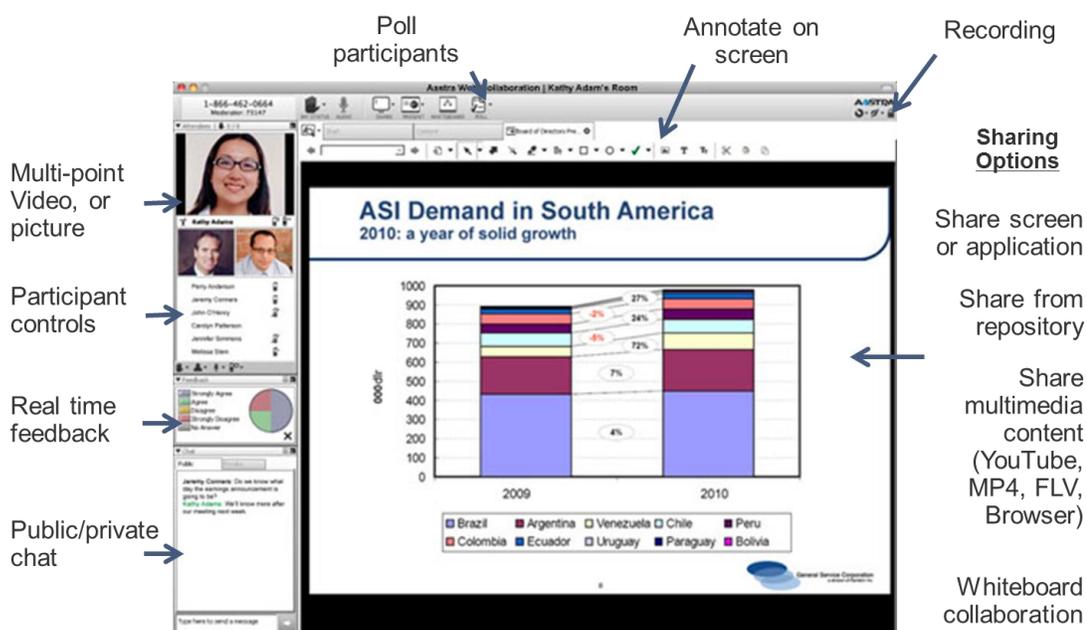

Figure 32. Desktop Web Collaboration Screen Example Shown with Document Shared.

Figure 33. Same Web Collaboration Example Shown on Tablet Screen.

In addition to the actual in-session interface, the Web Collaboration service provides a number of intuitive setup and summary screens allowing for system personalization.
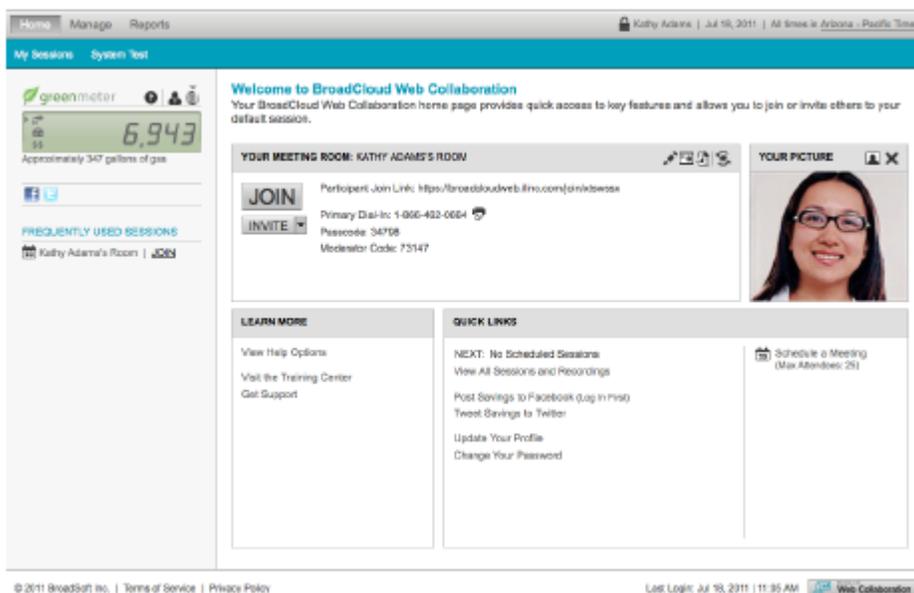

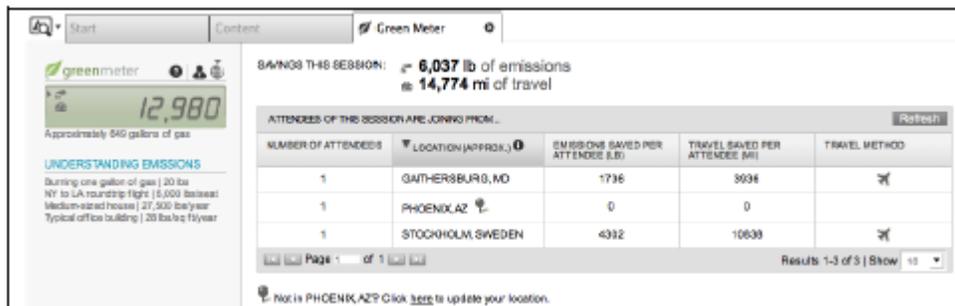**Figure 34. Web Collaboration "Home" Screen Example.**

Figure 35. Web Collaboration "Green Meter" Screen Sample.

The screen shown above summarizes some of the benefits and savings that have been afforded through the use of the Web Collaboration service.

BUSINESS TRUNKING

Business Trunking, also called SIP Trunking, provides SIP-based network services to interconnect user premises equipment (CPE) such as legacy PBXs or key telephone systems (KTS). Each business trunk represents a concurrent call or voice channel for premises equipment. Businesses require a certain number of trunks based on call traffic and the rate of oversubscription for their CPE.

Business Trunking is transport neutral and can be delivered through multiple types of access, including T1/E1, DSL, and Ethernet. A single integrated access device (IAD) is used to connect the access line to both user voice equipment and an Ethernet switch.

Business Trunking provides a platform for personal and group enhanced services that can overlay the feature-functionality existing premises equipment. These differ from TDM or other VoIP trunks. Enhanced services may include Unified Messaging, Find-Me/Follow-Me (Mobility), Virtual Call Center, Interoffice Auto Attendant, Web Conferencing, and Voice VPN.

Users can access and configure these services in real time through the CommPilot Personal Portal. For multi-site businesses, overlay services can offer a consistent set of feature-functionality to all users. These services can help to integrate multi-site operations and increase staff contact hours and mobility.

The range of applications offered by Clearspan enables enterprises to offer an attractive migration. In addition to Business Trunking, the enterprise can overlay their existing PBX or KTS with enhanced feature-functionality and inter-office Voice VPN. When the CPE is scheduled for its end-of-life time, the entire enterprise can be converted to the Clearspan platform. All users, regardless of application and throughout the transition, are managed in the same group with a common dial plan, feature set, and management interface.

BUSINESS SERVICES

There are a number of business focused services available to enterprises offering UC services using the Clearspan platform. These services allow business users to control where, when, and how they communicate. In addition to the clients available to users, and collaboration tools as addressed in the previous section,

Clearspan offers services such as the Executive/Assistant and Flexible Seating services to further expand the business users' communication flexibility.

Executive Assistant Services

The Clearspan Executive/Assistant service allows "Executive" type users to control how their incoming and outgoing voice services can be directed or controlled in conjunction with an Executive Assistant. With release R20, the Clearspan Executive/Assistant service has been extended to go beyond the traditional 1-1 relationship that might exist between an Executive and an Executive Assistant user.

The enhanced service allows the creation of "pools" of both Executive type users and Assistant type users. From these pools of users, associations can be made based upon:

- 1 Executive user to 1 Executive Assistant user

- 1 Executive user to multiple Executive Assistant users

- Multiple Executive users to a single Executive Assistant user

- Multiple Executive users to multiple Executive Assistant users
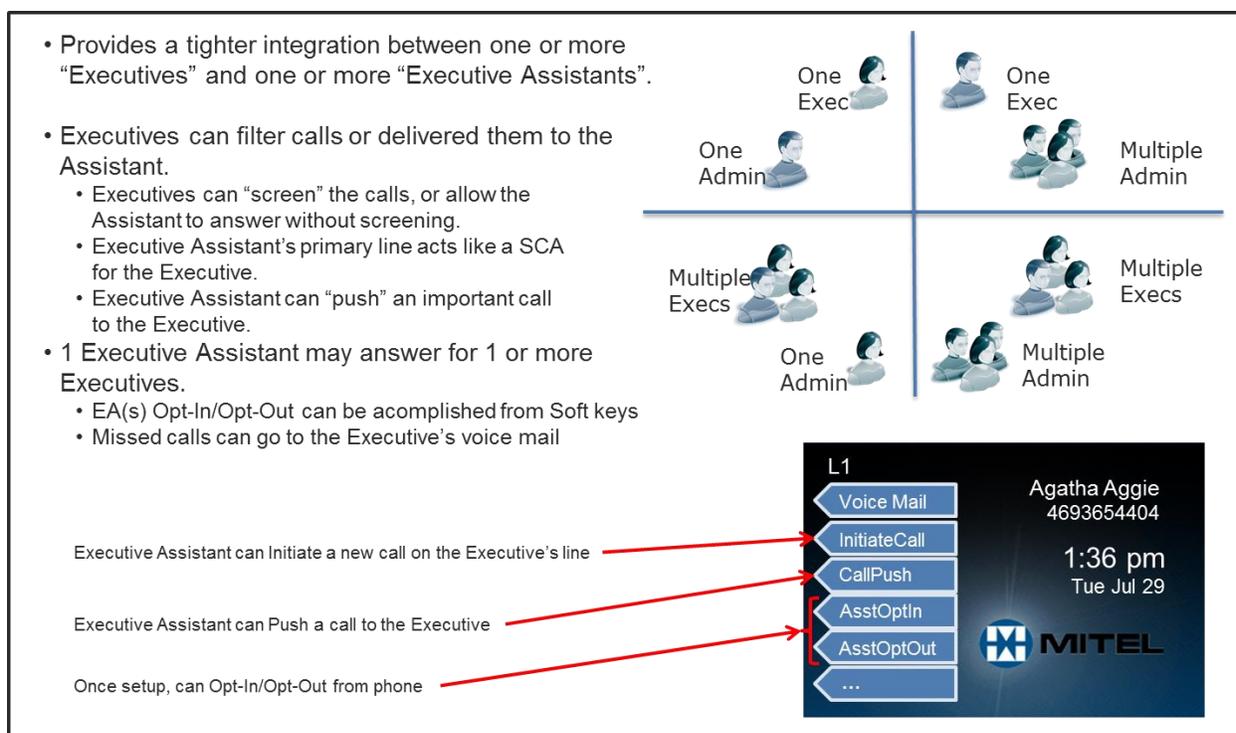
Figure 36. Clearspan Executive Assistant service.

Once these pools of users (Executives and/or Executive-Assistants) have been provisioned, and the services assigned, the users can make use of the applicable call management features such as Call Forward, Call Pull, SCA…etc. for managing the voice communications of the Executive user. Executive-Assistant users can opt-in and opt-out of this service from either the voice portal or the phone client interface, without requiring additional support or configuration from system administrators.

Executive User Provisioning

Users become executive users when they have been assigned the Executive service. The executive user can then configure the following via the Executive service:

- **Assistants** – The executive can configure the list of assistants that are assigned to the executive, and can set whether or not the assistants can opt in or opt out. The list of assistants is ordered for sequential alerting purposes, and all assistants must be within the executive's group/enterprise.

- **Filtering** – The executive can configure whether filtering is enabled, the filtering mode to use for filtering, the filter type to use for the simple filtering mode, and the criteria to be used for the advanced filtering mode.

- **Screening** – The executive can configure whether screening is enabled, the alert type to use for screening, and whether to alert specific types of locations for screening.

- **Alerting** – The executive can configure the alerting mode for filtered calls, the contents of the Calling Line ID (CLID) name and number for filtered calls, the timer for advancing to the next assistant for filtered calls using the sequential alerting mode, the timer for triggering the rollover action for filtered calls, the rollover action to apply for filtered calls, and the timer to use for call push recalls.

Executive-Assistant User Provisioning

Users become assistants when they have been assigned the Executive-Assistant service. The assistant can then configure the following via the Executive-Assistant service:

- **Divert** – The assistant can configure whether the divert option is enabled, and the address to divert filtered calls to.

- **Opt-in/Opt-out –** For any executive the assistant is assigned to that has the Executive service's Allow Assistants to Opt-in/Opt-out of Pool option enabled, the assistants can configure whether they have opted in or opted out for that executive.

- **Executive Settings** – For any executive the assistant is assigned to, the assistant can access and modify the filtering, screening, and alerting components of the Executive service configuration for the executive. However, the assistant's component of the Executive service configuration for the executive cannot be accessed or modified by the assistant.

Additionally, this feature makes the Clearspan Anywhere E.164 Dialing feature access code (FAC) available for use when a user has been assigned either the Clearspan Anywhere service or the Executive-Assistant service. The default for the feature access code remains as *14. For more information on the original Clearspan Anywhere E.164 Dialing feature access code, see the *Clearspan Service Guide Document.*

Flexible Seating Guest Service

This feature introduces a new Clearspan user service called Flexible Seating Guest service to Clearspan. When this service is authorized to a group, the Clearspan administrator can provision a list of Flexible Seating Hosts which can be shared across multiple users as needed. A Flexible Seating Host is a virtual subscriber provisioned with a phone device.
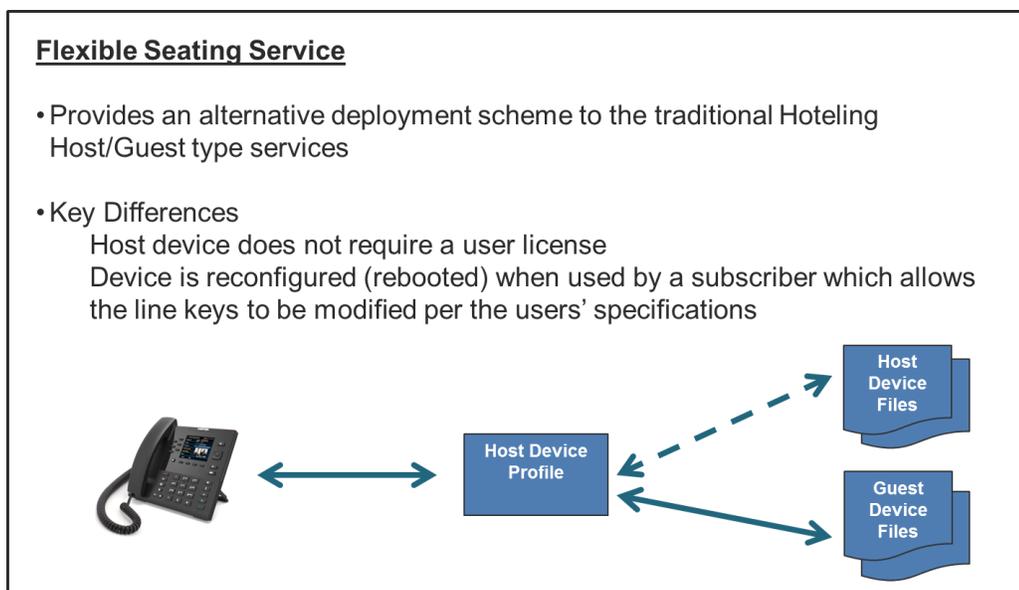
Figure 37. Clearspan Flexible Seating service.

A Clearspan user with the Flexible Seating Guest service enabled can create an association with the Flexible Seating Host in the same group (or enterprise depending on the access level of the Flexible Seating Host). After the Host-Guest association is established, the Host-phone device is reconfigured with the guest user's device settings and becomes the guest's alternate device.

The Flexible Seating feature has similar functionality to the Hoteling features. However, the Flexible Seating Guest feature is different from the Hoteling feature in some ways. The main differences between the common Hoteling feature and the Clearspan Flexible Seating Guest feature are as follows:

- **Reconfiguring host's phone with guest's device files** - With a Hoteling feature, the Hoteling Host's phone device is always configured with the host's profile settings. When a Hoteling Guest uses the Hoteling Host's phone device, the device settings, for example, line key settings, contact directory, and so on, are for the host, and not the guest.

- **With the Flexible Seating feature** - The Flexible Seating Host's phone device downloads and is reconfigured with the Flexible Seating Guest's device files when the guest is associated with the host. The device settings are for the guest, not the host.

- **Alternate device** - In the Hoteling feature, when a Hoteling Guest is associated with a Hoteling Host, the host device is treated as a replacement of the guest's primary device. The call originations from guest's primary device are not allowed except for emergency calls. The guest's primary device is not alerted on incoming calls to the guest.

In the new Flexible Seating feature, when a Flexible Seating Guest is associated with a Flexible Seating Host, the host device is reconfigured with the guest's device settings and is treated as an alternate device of the guest. The call originations from guest's primary device are also allowed. The guest's primary device is also alerted on incoming calls to the guest.

To use the Flexible Seating feature, a Clearspan user with the Flexible Seating Guest service enabled comes to the physical location where a common-use Host phone device is provided for guests. The

Guest Clearspan user creates the Host-Guest association by logging in to the phone or via voice/web portal, and the phone becomes a leased phone for the time duration restricted by the Flexible Seating Guest service and the Flexible Seating Host.

The flexible seating association is not completed until all the following prerequisites are met:

- The guest user has the Flexible Seating Guest service assigned and enabled.

- In the enterprise model, the access level (enterprise or group) of the Flexible Seating Host allows the guest user to associate with the host.

- The device profile type of the Flexible Seating Guest service matches the device profile type of the Flexible Seating Host.

CLEARSPAN CALL CENTER

The Clearspan Call Center solution provides customers with a highly flexible, feature-rich, fully integrated Automatic Call Distribution (ACD) and Call Center service that addresses the requirements of demanding business customers. The service includes simple hunting and queuing for individuals and work groups to sophisticated call distribution and routing, conditional announcements, agent availability states, Interactive Voice Response (IVR), desktop clients, and monitoring and reporting for more complex call center environments.

Here are some of the key capabilities which make the Clearspan-based solution superior to an alternative ACD platform.

Some of the key features and benefits:

- *Virtual call centers* – A call center group can include any user, regardless of location. Inbound calls can efficiently reach a broader set of agents, including agents at different locations, home-based workers, and agents working from temporary locations.

- *On-demand service* – Organizations can deploy the service in days instead of months, since the only activity is to configure and activate the Call Center service for the enterprise. There are no platforms to install and integrate.

- *Carrier-class availability* – Because the same solution is also available to service providers, Enterprises deploying the solution benefit from the additional resilience and fault tolerance demanded by carriers compared to platforms traditionally targeted to the enterprise market. With the proper configuration, if a physical site is unreachable due to either power or transmission issues, inbound calls can be routed to alternate locations or callers can receive an announcement, instead of a busy signal and unanswered calls.

- *Supports both small/simple and large/complex environments* – The Clearspan Call Center solution can be configured to support any environment, from the most simple queuing to complex call centers, allowing even the smallest organization to obtain access to features that were previously out of their reach.

Some of the key components of the Clearspan Call Center solution are the hosted web applications that are used by agents and supervisors. The clients, referred to in this document as the Clearspan Agent client and the Clearspan Supervisor client are described in the *Clearspan Hosted Thin Call Center User Guide*.

Key Features

The following are some of the key features provided by the Clearspan Call Center solution:

- *Inbound Interactive Voice Response* – Callers can use an Automated Attendant to get routed to the most appropriate set of agents, with different routing options for business hours and non-business hours.

- *Automatic Call Distribution (ACD)* – Intelligent call distribution selects an available agent using a combination of the agent's line state, availability setting, and skill level, or a combination of the agent's line state, availability setting, and a call distribution algorithm (direct agent hunt, most idle hunt, simultaneous ringing, weighted distribution).

- *Queuing* – Calls are queued when all the agents are busy, with the associated entrance announcement, music, or video on hold, and periodic comfort messages played to the caller while they wait.

- *Queued Call Prioritization* – Calls in queue can be prioritized based on their time in the queue and the dialed number (DNIS).

- *Customized Audio and Video Greetings and Announcements* – Callers can receive custom greetings and announcements based on the dialed number (DNIS) when they reach a call center, when they are waiting in a queue, or when they are rerouted to alternate locations.

- *Customized Whisper Announcements* – Agents answering ACD calls can hear a custom whisper announcement before being connected to the caller. This allows customers to provide specific call instructions prior to the call based on the dialed number (DNIS).

- *Time and Schedule-based Routing* – Inbound calls are routed to alternate destinations during non-business hours and holidays.

- *Conditional Routing –* Calls can be rerouted based on various conditions, such as bounced calls, stranded calls, calls that have waited too long, and calls that reach a call center with an excessive number of queued calls.

- *Temporary Forced Routing –* Calls can be automatically rerouted to alternate locations due to a temporary condition in the call center.

- *Outbound Calling –* Outbound calls from agents can be associated with a call center, to support outbound dialing campaigns.

- *Agent and Supervisor Clients –* Intuitive interface provides greater agent productivity and management oversight.

- *Dashboard –* Real-time monitoring of agents and queues tracks current state and current performance of agents and queues.

- *Reporting –* Real-time and historical reports track key performance indicators (KPIs). Users have capability to schedule reports and system providers have the ability to customize reports.

- *Extension Mobility using Clearspan Remote Office or Clearspan Anywhere –* Agents can receive or make calls from remote locations (home, alternate location) or their mobile device.

- *Shared Workstations using Clearspan Hoteling –* Agents can easily log in at a shared workstation and/or phone while maintaining their user settings.

- ***Unified Messaging for Voice, Video, and Fax –*** Clearspan Unified Messaging can be used with a call center supporting voice messages, video messages, and fax messages, with the message forwarding to an e-mail address or alias.

- ***Conferencing –*** Agents can quickly escalate calls to a supervisor or engage other subject matter experts within the organization using the integrated Clearspan Conferencing services.

Clearspan Call Center interfaces

The Clearspan Call Center solution provides agent and supervisor users with intuitive graphical user interfaces (GUIs), which facilitates the users' ability to perform their respective tasks.

Clearspan Call Center Agent Users

The Clearspan Call Center Agent client provides users with a rich set of features designed to support the needs of a call center Agent user including:

- ***In-bound Call Information*** - When an inbound call arrives, the Agent client has a *Global Message Bar* that provides the user with the information about the call.

- ***Active Call Management*** - The client provides intuitive buttons for the common call handling functions, such as answer, hold, transfer, conference, and end, plus the ability to initiate outbound calls.

- ***Set Availability States*** - The client includes buttons and drop-down options to set availability states, including *Available, Unavailable, Unavailable Reasons* (lunch, training, break, and so on), *Wrap-up*, and *Sign-in/Sign-out*.

- ***Online Directories with Click-to-Dial*** - Online directories are available in the client, including the enterprise or group directory, personal directories, speed dials, and the user's Outlook directory (includes the ability to use Click-to-Dial to initiate an outbound call).

- ***Call Escalation*** - Agents can quickly escalate a call to a supervisor using the Escalate or Emergency Escalate buttons on the client. This is designed to quickly involve a supervisor on a customer call.

- ***Auto-answer Options*** - Agents with phone headsets can have inbound calls automatically answered (auto off-hook) using settings in Clearspan or on the client.

- ***Enhanced Reporting*** - The Clearspan Agent client provides a set of reports that shows the agent's activity over a specified period of time.
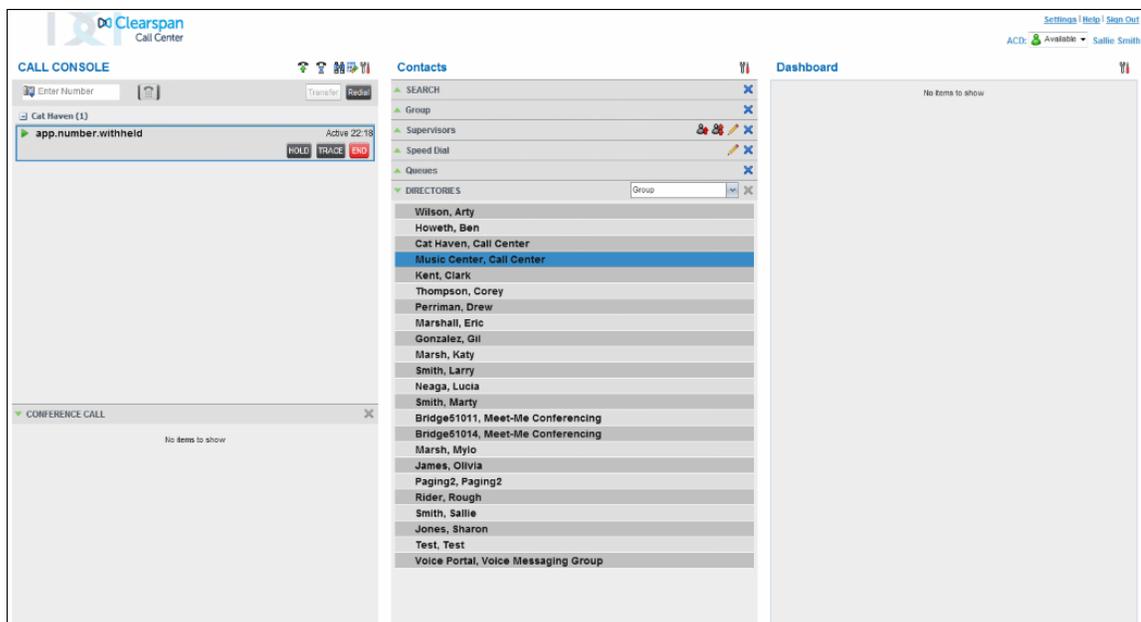
Figure 38. Clearspan Call Center Agent Thin Client.

The main elements of the Call Center Agent client window are broken down into the following components:

- **Logo Pane** - The Call Center main window interface contains a logo pane that displays the Call Center client or company logo, global messages, links to other interface elements or Call Center functions, and information about the logged-in user. The links that are provided include:

  o Reporting –Provides access to Call Center Reporting.

  o Settings –Provides access to client configuration pages.

  o Help – Opens the Clearspan Hosted Thin Call Center – Agent/Supervisor User Guide.

  o Sign-Out – Signs you out of the call center and allows you to save your workspace.

- **Global Message Area –** This is located to the right of the Call Center name. The Global Message Area is used by Call Center to display various information, warnings, and error messages to the user. A message is displayed for several seconds and then it disappears.

- **Call Console –** This is located on the left side of the Call Center main page. It allows users to manage their current calls.

The main area of the *Call Console* displays your current calls and allows you to take actions on them. In addition, the *Call Console* contains the following panels:

  o *Dialer* – This is where you dial ad hoc numbers.

  o *Conference Call* – This is where you manage conference calls.

- **Contacts Pane –** This is the middle pane of the Call Center main page. The Contacts pane provides users with contact directories and allows users to use their contacts to make or manage calls. The Contacts pane contains the following areas:

- o *Search Panel* – Used to search for contacts.

- o *Enterprise/Group Panel* – Contains the contacts in users Clearspan group directory (if your group is part of a service provider) or enterprise directory (if your group is part of an enterprise.

- o *Common Pane* – Contains the contacts in user's group's common phone list configured by their administrator.

- o *Personal Panel* – Contains contacts from the user's Clearspan Personal Phone List.

- o *Supervisor's Panel* – Provides the list of user's supervisors. The main purpose of this directory is to allow you to contact a supervisor quickly.

- o *Speed-Dial Panel* – Allows users to manage Speed Dial 8 and Speed Dial 100 contacts. It is available to users who have been assigned Speed Dial 8 and/or Speed Dial 100 services.

- o *Queues Panel* – The *Queues* panel, available to both agents and supervisors, it lists the call centers users are staffing as an agent.

- o *Custom Directories Panel* – A custom directory containing a subset of the contacts in a user's Clearspan group or enterprise directory.

- o *Instant Message Panel* – Displays IM&P contacts a user is subscribed to along with presence states. Users can chat with any contact that has an IM&P service assigned on Clearspan, but users can only see the presence state of the contacts to which they are subscribed.

- o *Outlook Panel* – Contains a user's Outlook contacts. This panel is available to users only if they have the Outlook Integration service assigned.

- o *Directories* panel – Consolidates the contacts from the following directories: Enterprise/Group, Custom, Personal, Outlook, and Speed Dial. This panel is always visible. Users can choose which directories to display in the Directories panel and can collapse the panel, but they cannot close it.

- **Dashboard Pane –** This is located on the right-hand side of the Call Center main page. The Dashboard pane allows agents to monitor the call centers to which they are assigned and provides key indicators for each. Some fields are color-coded to provide visual indicators of threshold severity.

Figure 39. Dashboard Pane (Agents).

The following information is provided for each monitored call center:

- o *Call center name* – The name of the call center.

- o *Service Mode (Premium call centers)* – The mode in which the call center currently operates. This field can have one of the following values: *Night Service, Night Service Override, Holiday Service, Forced Forwarding, and None.*

- o *Current Calls in Queue* – This is the number of queued calls expressed as a ratio of the total queue capacity for that call center. For example, "6/10" means that there are six calls in the queue, which can queue a maximum of ten calls.

- o *Longest Waiting Call* – This is the waiting time of the call that has been in the queue the longest.

- o *EWT (Expected Waiting Time)* – This is the estimated time a caller has to wait in this queue before their call is answered.

- o *AHT (Average Handle Time)* – This is the average time it takes to process a call in this queue.

- o *ASA (Average Speed of Answer)* – This is the average time a caller spends in the queue before the call is offered to an agent.

- o *Staffed* – This is the number of agents that are in Sign-In, Available, Unavailable, or Wrap-Up ACD state, as a ratio of all agents assigned to this call center.

The fields that provide color-based visual indicators are Current Calls in Queue, Longest Waiting Call, EWT, AHT, and ASA.

Clearspan Call Center Supervisor Users

Supervisors are Clearspan Call Center users who are responsible for managing the call center and the agents who service those call centers. Additionally, Supervisors can also perform Agent functions when needed. Each Supervisor may be assigned the Clearspan Supervisor client that provides them with the ability to perform the tasks demanded by the role at the click of a button.
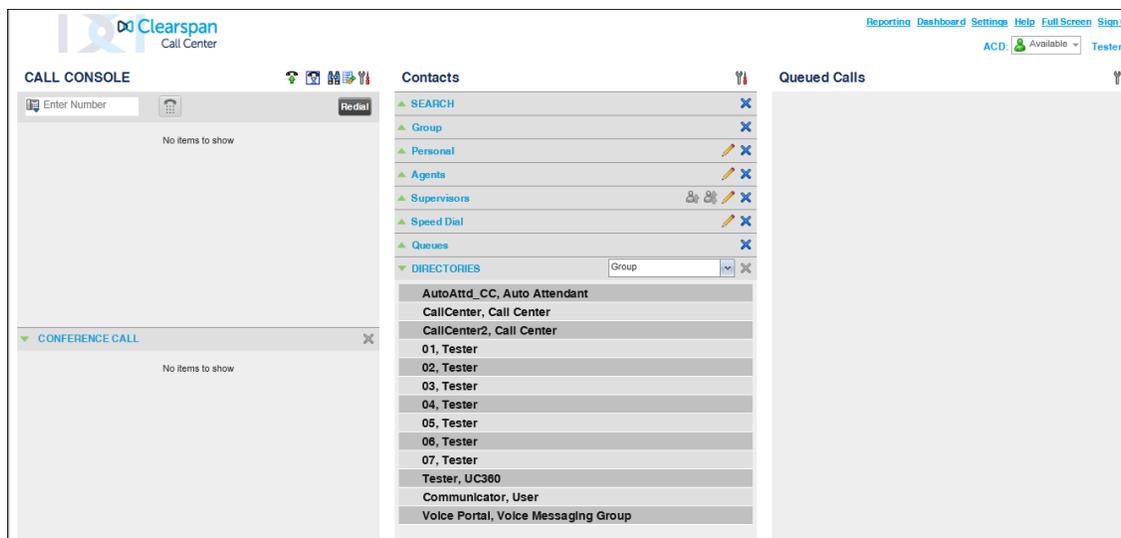
Figure 40. Clearspan Call Center Supervisor Thin Client Main Window.

The Logo Pane, Global Message Area, and Contacts Pane will be similar in layout and function between the Supervisor and Agent user type. However, in the Contacts Pane, Supervisor users will be provided with a list of the Agents that they are monitoring and their current activity status as follows:

Figure 41. Supervisor's Contacts Pane – Agents Panel.

In addition to the Agent tasks that they can perform, Call Center Supervisor users can also perform the following tasks:

- *Retrieve a Call* – Retrieve calls from the queue and answer the calls themselves. This effectively transfers the call out of the queue to the Supervisor.

- *Transfer a Call* – Transfer calls from one Call Center queue to another. This type of activity would be useful in scenarios in which a supervisor notices a particular call center is swamped with calls and calls coming into the queue are not serviced effectively. The supervisor has the ability to transfer those calls from the busy call center to another call center or any other destination to ensure that the calls are serviced in an effective manner.

- *Promote a Call* – Promote a lower priority call to a higher priority. For example, the supervisor may recognize a caller within the number and may promote the call to a higher priority to ensure the call is answered more quickly.

- *Reorder Calls* – The supervisor has the ability to reorder existing calls in a queue. Calls toward the end of the queue can be moved to the front of the queue and vice versa. The

supervisor can make a decision to move important calls, based upon selective criteria, to the front of the queue so that these calls are serviced with a higher priority.

- *Monitor Next Call* – The supervisor can monitor the next call received by a call center or a particular DNIS in a call center.

One area where the clients for Agents and Supervisor differ is in the Dashboard Pane. Unlike the window for Agent users, where the Dashboard is a pane within the main window, Supervisors can access the Supervisor Dashboard window through a link provided at the top right of the Logo Pane of the main window.

Figure 42. Supervisor's Dashboard Window.

The supervisor *Dashboard* is divided into two parts with queue information in the top half and agent information in the bottom half. The information is updated at a configurable refresh rate. The default is 5 seconds.

- *Queue Information* – The Supervisor *Dashboard* displays each call center queue on a separate line and provides the following information about each queue:

  o *Name* – This is the name of the call center.

  o *Status (Premium call centers)* – This identifies the service mode in which the call center is currently operating, which can be one of the following: Night Service, Night Service Override, Holiday Service, Forced Forwarding, and None.

  o *Calls in Queue* – The number of queued calls expressed as a ratio of the total queue capacity for that call center. For example, "6/10" means that there are six calls in the queue, which can queue a maximum of ten calls.

- o *Long Waiting Call* – This is the waiting time of the call that has been in the queue the longest.

- o *EWT (Expected Waiting Time)* – The expected waiting time of calls in the queue.

- o *AHT (Average Handle Time)* – The average handling time for calls in the queue.

- o *ASA (Average Speed of Answer)* – The average amount of time a caller spends in the queue before the call is offered to an agent.

- o *Staffed (Agents)* – The number of agents managed by you that are in Sign-In, Available, Unavailable, or Wrap-Up ACD state, as a ratio of all agents managed by you for this call center.

- o *Idle (Agents)* –The number of agents who are in the Available ACD state but presently not on a call.

- o *Unavailable* –The number of agents who are signed in to the call center but not available to take calls.

- o *Show Agents* –When this check box is selected, the agents who are joined in the call center are displayed in the Agents area of the Dashboard.

- • *Agent Information -* Information about the agents for the selected queues. Supervisor agents select the queues for which they want to view agents' information by checking the Show Agents box on the lines for the queues in the Queues area of the Dashboard. The following information is provided for each displayed agent:

- o *Name* - The agent's name.

- o *Queues (total)* - The total number of queues to which the agent is assigned. This number is a link, which when clicked, opens a dialog box that lists the agent's queues.

- o *Sign-In Time* - The agent's most recent sign-in time.

- o **Sign-In Duration** - The amount of time that the agent has been signed in.

- o *Call State (Time)* - The call state and time on the current call. The call state can be Idle, Ringing, or On a call. If an agent is in multiple calls, the call time reflects the time of the longest running call. When a call is released, then the call time reflects the time on the remaining calls.

- o *Agent State (Time)* - The agent ACD state and time. If an agent is unavailable, the unavailable code is shown.

- o *% Available* - The time that the agent was available to take calls shown as a percentage of the duration of the current sign-in.

- o

- o *Avg. Busy In* - The average time spent by the agent on an incoming ACD call.

- o *Avg. Busy Out* - The average time spent by the agent on an outgoing ACD call.

- o *Avg. Wrap-Up* -The average time spent by the agent in a post call wrap-up.

Fields that provide visual indicators are Call State (Time), On Call, Idle, Agent State (Time), Unavailable, Avg. Busy In, Avg. Busy Out, and Avg. Wrap-Up.

Clearspan Call Center Reporting

The Clearspan Call Center Reporting facility provides users with a comprehensive set of reports on agents, queue activity, and the key performance indicators (KPIs) of the call center as a whole. Reports can be generated in real time in the Clearspan Agent and Supervisor clients for various time frames and intervals. Alternatively, reports that are required to be generated frequently may also be scheduled by administrators and supervisors and then delivered via e-mail at the appropriate time.

The reports only allow visibility to the data that the user has permission to see. Agents can only view reports on themselves, while supervisors can only view reports on call centers or the agents they supervise. Administrators can run reports on all entities within the enterprise.

The Call Center reports are designed to provide supervisors with a clear understanding of the performance of the call center as a whole, or individual agents. Agents, supervisors, and administrators use reports to obtain the key performance indicators from either a real-time or historical perspective. There are over a dozen pre-created canned reports provided as part of the solution, and additional reports may be added by creating custom reports.

- Real-time reports can provide performance data up to the current time. In these cases, the users select the time period (start-time and end-time) of the interval of interest. When not provided, the end time is assumed to be the current time (that is, the time at which the report request is executed).

- Historical reports provide data up to a specified time that occurred in the past. In these cases, the user must select the start time and the end time of the report time interval.

The data collected by the reports can be presented in either tabular or graphical form. A sampling of some of the available reports is shown in the following figure. The number of Calls by Call Type can be displayed in a pie chart showing the percentage and counts for each type of call handled by the agent(s) for the reporting period.

Number of Calls by Call Type

Internal Calls, 2, 6.9%
Outbound Calls, 1, 3.4%
Inbound Calls, 1, 3.4%
Outbound Route Point Calls, 3, 10.3%
ACD Calls, 22, 75.9%

Figure 43. Call Center Reporting Pie Chart View.

Alternatively, the Number of Calls by Call Type can be displayed in tabular form. The table includes a row per interval for each agent who is active over the interval. It also includes the following summary rows:

Number of Calls by Call Type

Date and Time	Name	Calls Presented	ACD Calls	Outbound ACD Calls	Route Point Calls	Outbound Route Point Calls	Inbound Calls	Outbound Calls	Internal Calls
10/04/2010, 10:30 PM	Jones, Mike	8	4	0	0	3	0	0	1
	Smith, John	5	3	0	0	0	0	0	1
	Summary	13	7	0	0	3	0	0	2
10/04/2010, 10:45 PM	Jones, Mike	1	1	0	0	0	0	1	0
	Smith, John	0	0	0	0	0	0	0	0
	Summary	1	1	0	0	0	0	1	0
10/04/2010, 11:00 PM	Jones, Mike	4	4	0	0	0	1	0	0
	Smith, John	3	3	0	0	0	0	0	0
	Summary	7	7	0	0	0	1	0	0
10/04/2010, 11:15 PM	Jones, Mike	2	2	0	0	0	0	0	0
	Smith, John	5	5	0	0	0	0	0	0
	Summary	7	7	0	0	0	0	0	0
Report Summary	Jones, Mike	15	11	0	0	3	1	1	1
	Smith, John	13	11	0	0	0	0	0	1
	Summary	28	22	0	0	3	1	1	2

(*) Indicates an Agent that no longer exists

Figure 44. Call Center Reporting Table View.

The Agent Call by Skill Report template is a real-time report template that can be used by administrators, agents, and supervisors to request real-time or historical reports. It is an interval-based report template. The report provides information about the number of ACD calls an agent has received at different skill levels.
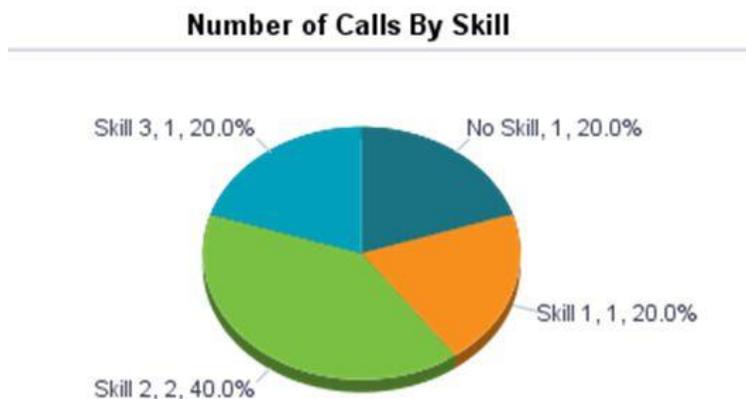

Number of Calls By Skill

Skill 3, 1, 20.0%
No Skill, 1, 20.0%
Skill 1, 1, 20.0%
Skill 2, 2, 40.0%

Figure 45. Call Center Reporting Skill Level Utilization.

The Agent Duration Report template is a real-time report template which can be used by administrators, agents, and supervisors to request real-time or historical reports. This is an interval-based report template. The report provides information related to the duration of calls handled by agents.
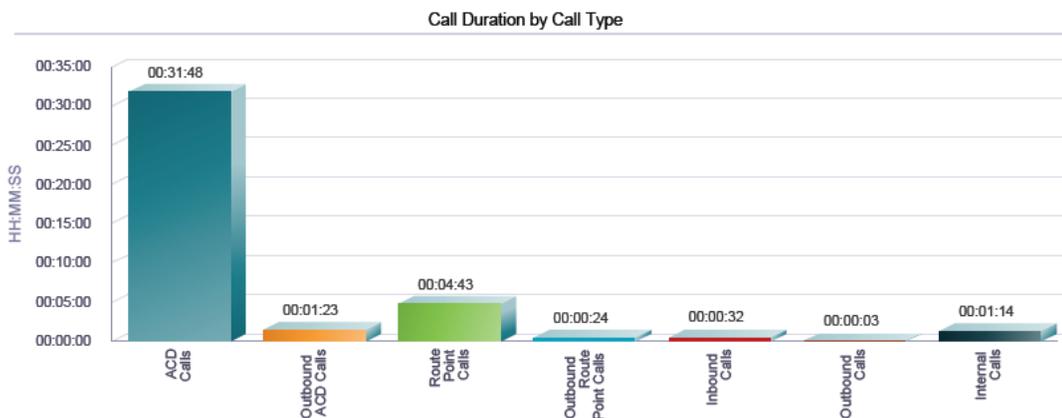
Figure 46. Call Center Reporting Agent Duration.

Call Center License Offerings

The Clearspan Call Center solution is offered with three licensing options designed to enable a wide range of deployment environments. The call center licenses are assigned at the user level. Therefore, there is no restriction on the number of call centers that can be created. Any user with an appropriate call center user license can be assigned to a call center.

Basic Call Center

A Basic call center is designed to support a simple call distribution and queuing scenario, such as a front-office receptionist or a small work group. Inbound calls are distributed based on the agent's line state and "join" status. Callers receive appropriate entrance and queue messages, and calls can overflow to alternate locations if they wait too long in queue or if the queue is beyond capacity. This type of call center does not support Agent ACD states, Clearspan Agent client, or Reporting.

Any user with a call center license can be assigned to a Basic call center.

Standard Call Center

A Standard call center is designed to support a normal call center environment where flexible routing options are needed and the agent's workflow dictates the need for ACD states such as Available, Unavailable, and Wrap-up. In addition, Standard call centers are designed to support deployments that require clients such as the Clearspan Agent client and Reporting.

Any user with a Standard or Premium call center license can be assigned to a Standard call center.

Premium Call Center

A Premium call center is designed to provide the most advanced set of routing and call management options to support a formal call center environment. It supports such capabilities as multiple dialed number identification service (DNIS) numbers being assigned to a single call center, agent skill levels for

directing calls to more skilled agents, additional unavailable codes for when agents are not able to take calls, and disposition codes to associate with ACD calls, outbound calling, and silent monitoring of agents.

Only users with a Premium call center license can be assigned to a Premium call center.

CLEARSPAN RECEPTIONIST

Clearspan Receptionist is a carrier-class Internet Protocol (IP) Telephony Attendant Console, specifically developed for hosted environments. It is used by "front-of-house" receptionists or telephone attendants, who screen inbound calls for enterprises. Clearspan Receptionist realizes the promise of IP telephony by enhancing business processes and delivering rich services in a user-friendly way.

Clearspan Receptionist delivers the following real benefits to users:

- An elegant design that is aesthetically pleasing

- An ergonomic design that follows the natural work "flow" of a call from the left to the right of the screen

- Improved business processes as only "valid" options are presented to the attendant

- Professional call handling as critical information is available in "real time"

- Accurate delivery of messages through a one-step process when people are unavailable

- Web-based interface, accessible from a web browser

Clearspan Receptionist can be used under a number of different operational scenarios. These scenarios include:

- *After Hours* – Allows operators to automate switching from day to night mode.

- *Call Center Queue* – Allows operators to monitor and control calls in a Call Center queue, and to manage their availability status.

- *Hoteling* – Allows multiple part-time operators to share a single log-in sequence when they change shifts.

- *Low Traffic* – Single receptionist answering one or more dedicated main line numbers.

- *High Traffic* – More than one attendant console managing multiple dedicated main line numbers.

- *Network Attendant Console* – Geographically dispersed operators supporting each other in an enterprise configuration.

- *Multi-tenanted Offices* – One or more operator answering calls on behalf of different organizations.

- *Optional Voice Mail Transfer* – Operator has the added ability to transfer calls to voice mail for contacts in a group/enterprise that are busy or unavailable.
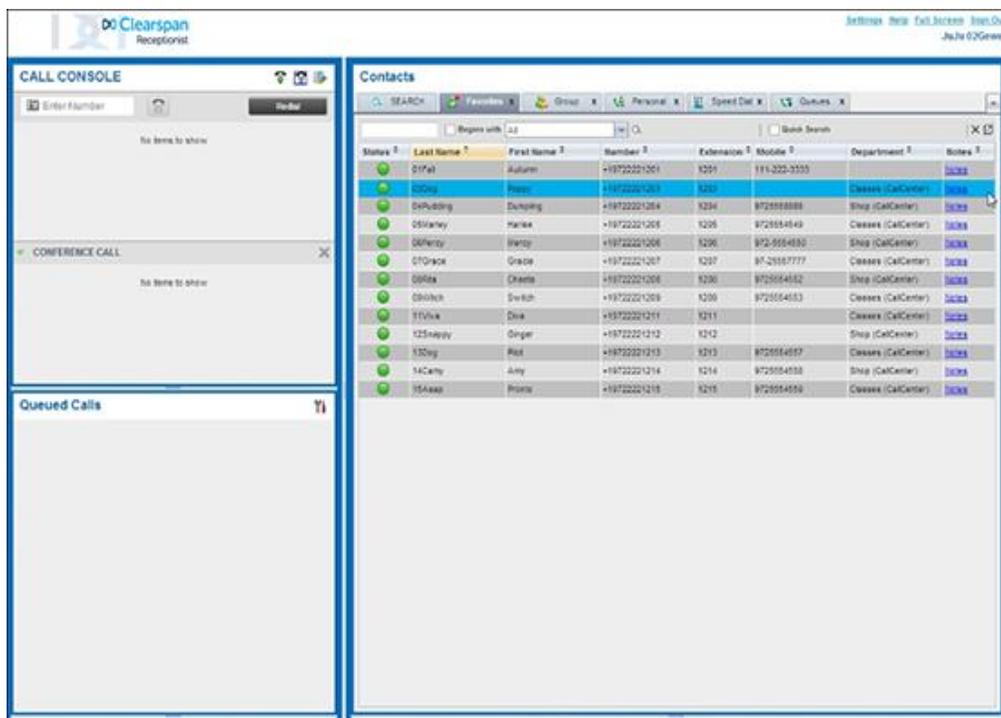
Figure 47. Clearspan Receptionist Console.

The Clearspan Receptionist Console interface contains the following main work areas:

- ***Logo pane*** – The *Logo* pane displays links to other pages or functions of Receptionist and provides information about the logged user. It also displays error, warning, and information messages to the user.

- ***Call Console*** – This is where users view and manage their current calls.

- ***Queued Calls pane*** – This is where users manage queued calls. Users will need to have the Clearspan Supervisor service assigned to have access to this feature.

- ***Contacts pane*** – This pane contains the user's contact directories, which are used to make calls to contacts and monitor selected contacts.

- ***Settings pages*** – Users use the *Settings* pages, accessed via the Settings link, to configure various aspects of Receptionist.

- ***Call History dialog box*** – Users use the *Call History* dialog box to view and return their past calls.

- ***Chat windows*** – Users use a *Chat* window to chat with Instant Messaging and Presence (IM&P) contacts.

There are multiple contact directories that are available to the user, and these may include:

DIRECTORY NAME	CONTENTS	COMMENTS
Favorites	This consists of the contacts whose phone status the user is currently monitoring. The list of contacts to monitor must be configured for the users or by them directly on the web portal.	Monitoring is limited to 200 static contacts enterprise-wide.
Group/Enterprise	This consists of all contacts in the user's Clearspan group or enterprise directory. This is the same directory that can be accessed through the web portal. However, if the enterprise administrator has restricted the access to the enterprise directory, the user can only see the contacts in their group.	Users can dynamically monitor contacts in their Group/Enterprise directory. The maximum number of contacts they can dynamically monitor is configured by their administrator and cannot exceed 100.
Group/Enterprise Common	This consists of all contacts in the user's group/enterprise's common phone list configured by their administrator on Clearspan.	The directory may be empty if the administrator has not configured any contacts.
Personal	This consists of all contacts in the user's personal directory on the Clearspan web portal.	
Speed Dial	This consists of all speed dial codes configured for or by the users for their Speed Dial services.	Users will need to have Speed Dial 8 and/or Speed Dial 100 services assigned.
Instant Message	This consists of the IM&P users that the user is subscribed to.	Users will need to have the Integrated IM&P or Third-Party IM&P service assigned.
Queues	This consists of the call centers and associated DNIS numbers that users are staffing as an agent or supervising. It allows the user to transfer calls into queues quickly.	Users will need to have Call Center service assigned.

DIRECTORY NAME	CONTENTS	COMMENTS
LDAP (search only)	This consists of all users found in the configured LDAP directory. Receptionist provides the user with search access to LDAP and results are displayed in the *Search* tab.	The directory needs to be configured by the system administrator. Otherwise, it is not visible. Users also need to have the LDAP Integration service assigned.
Custom: <custom contact directory name>	This consists of all contacts in the user's custom contact directories configured by the administrator on the web portal. Each custom directory is displayed in a separate tab.	Users may not have any contact directories or they may have several.
Outlook	This consists of all of the user's Outlook contacts.	Users will need to have Outlook Integration service assigned.

SYSTEM MANAGEMENT

Clearspan provides two methods of Clearspan system management: standard web portals and OpEasy. Web portals come standard with the product, while OpEasy simplifies the provisioning, reporting and MACD activity and is purchased as an option. Most administrators would use both the web portals and OpEasy to most effectively manage the Clearspan platform. Each is described in the following sections.

OPEASY

OpEasy is a suite of applications that provide enhanced functionality for users, administrators, and operations personnel for the Clearspan system. These applications include Auto Install and XML features for Clearspan phones, Bulk Provisioning and Template Builder for configuration and provisioning of the system, and SNMP Manager for monitoring and system error notification. The following figure shows the main screen after the OpEasy login.
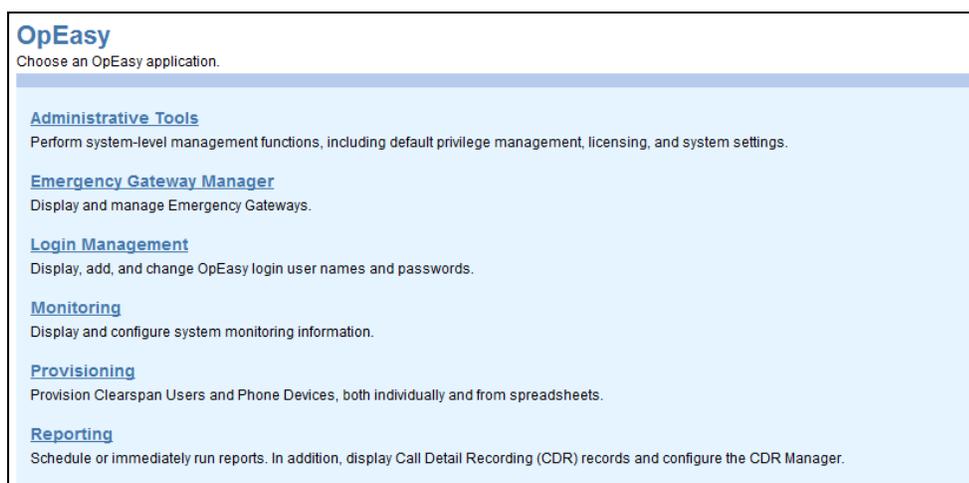

Figure 48. OpEasy Main Screen.

The OpEasy management suite provides users with the following capability:

- *Administrative Tools* - A web application that allows access to System Administrative type activities.

- *Emergency Gateway Manager* - A web application that provides configuration for the 911 Enable Emergency Gateway servers equipped on the Clearspan system. The Emergency Gateway Manager service automatically updates, creates, and deletes endpoint records in the 911 Enable Emergency Gateway on a periodic basis for all users configured in the Clearspan system.

- *Login Management* - A web application to add, edit and delete OpEasy administrator accounts. This application also provides the ability to customize privileges per administrator.

- *Monitoring* – A set of web applications that provides configuration for components to be monitored by the system. The status for all configured devices is displayed in the System Status application.

- ***System Status*** - A web application that provides a view of various statuses including status of system services, components and last database audit. The system service display shows status for all services on both EMS servers and indicates if a service is active on the primary or secondary (in case a failure has caused the secondary to take over as active for a given service). The ability to run an on-demand database audit is also provided.

- There is also an **SNMP Manager** application that manages, displays, and reports received SNMP traps (event notifications) sent by Clearspan devices. The SNMP traps identify both normal and failure events that have occurred at the sending Clearspan device. The SNMP Manager records traps in an OpEasy database and controls the subsequent reporting of those traps. Traps can be displayed, forwarded to other SNMP managers, and/or reported in e-mail messages to select users. Using the SNMP Manager, the user can display both recent and historical traps. In addition, the reporting of traps can be throttled to prevent over-notification.

- ***Provisioning*** - A web application that provides a more simplified method of manipulating Clearspan users and their associated devices than the original Bulk Provisioning application. This application also provides the ability to add certain features to users and to create templates.

- Additionally, a **Bulk Provisioning** application provides functions to bulk insert provisioning data for users, phones and SurgeMail voicemail using Excel spreadsheets. It also provides an export function to extract user and phone information into a spreadsheet for review.

- ***Reporting*** - A web application that provides reporting capabilities. Currently three reports can be generated at an Enterprise level – the Inventory Report, the Enhanced Inventory Report and the License and Optional Services Report. In addition, the System License Report can be generated at a System level. These reports are generated in Excel spreadsheet format.

- In addition to the built-in reporting capability, the OpEasy Reporting facility administrators can search for and display CDR records meeting a specific set of criteria. Administrators can then initiate a download of the search results as a file containing CDR records in the Broadsoft AS standard CDR file format. The display of the CDR records on the CDR Query page of Reporting displays the numeric codes in a human readable form. In addition to displaying a numeric code in fields, OpEasy displays a text mnemonic that describes that code to make it understandable.

OpEasy Additional Features:

- ***Auto Install*** - A system service that works in conjunction with Clearspan SIP terminals to greatly simplify the set, test and detail of the desktop phone.

- ***Configuration File Manager*** - A system service that automatically encrypts phone configuration files as they are updated from the Clearspan system.

- ***DB Optimizer*** - A system service that periodically optimizes the database tables and prunes (the SNMP trap information) to configured limits.

WEB PORTALS

The web portals provide multiple tiers of secure, web interfaces that enable configuration and management of features for the end-user, group/enterprise administrator, and enterprise administrator. Specific layers in the administrative hierarchy are described as follows:

- System Administrator Web Portal - Allows access to all levels and pages in the system. These web pages permit offsetting responsibilities to enterprise administrators or user service representatives (provisioning administrator).

- Enterprise Administrator Web Portal - Allows enterprise administrators access to system-level set-up and monitoring functions, as well as group and personal management. The enterprise administrator web portal differs from the system administrator access in that only tasks related to an enterprise administrator are accessible, rather than functions for monitoring and maintaining Clearspan.

- Group Web Portal - For business group administrators, distributes some of the enterprise administrator responsibilities and management to the group administrator, empowering the company to provision features to users and to manage group-related activities. Group administrators have the option of establishing an additional department layer of administration (for example, Sales or Engineering). This capability is especially useful for larger enterprises that want to distribute responsibilities for day-to-day administration to department administrators.

- Personal Web Portal - Grants easy access to feature configuration and management to individual users. Activating and customizing services such as Call Forwarding and Call Notification is simple and intuitive.
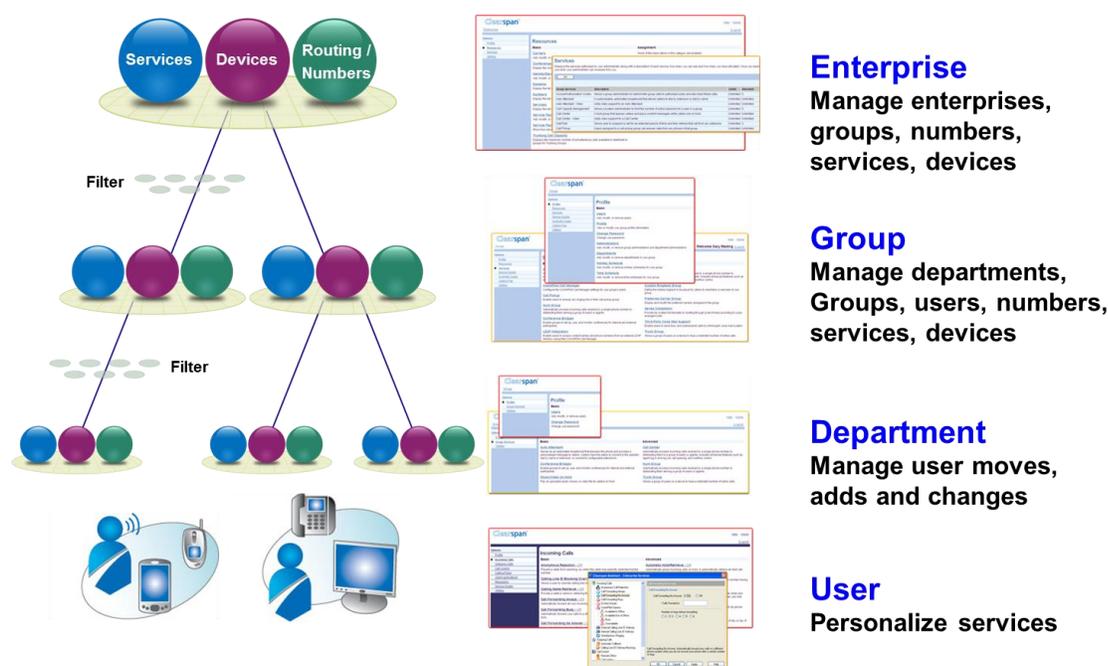

Enterprise
Manage enterprises, groups, numbers, services, devices

Group
Manage departments, Groups, users, numbers, services, devices

Department
Manage user moves, adds and changes

User
Personalize services

Figure 49. Hierarchy of the Clearspan Web Portal.

Clearspan web portals are delivered from the XSP/Web Server. The XSP Server interfaces with the Application Server and the Network Server. A command line interface (CLI) also exists for quick execution of configuration functions on the Application, Media, and Network Servers. Moves, Adds, and Changes for users and groups on the Application Server are automatically propagated to the Network Server via a synchronous API tool. The CLI provides common commands in an easy-to-understand syntax for administration of the routing and translations functions. Each level of the web portals (System, Enterprise, Group, and Personal) will be described in the following sections.

SYSTEM ADMINISTRATOR WEB PORTAL

The system administrator web portal provides access to all of the system monitoring, maintenance, and configuration functions of Clearspan via a web interface. System administrators can also access the provisioning and monitoring functions via a command line interface. The system administrator web pages differ from those of the enterprise administrator web portal in that system administrators can access the system monitoring and maintenance functions of Clearspan, while enterprise administrators have access to only those web pages that affect their users.

Clearspan integrates seamlessly with existing operations support systems and networks even through system upgrades and core network changes. Management of the Clearspan network gives enterprises a system that remains simple through the growth and changes of the network.

Use of industry-standard interfaces and protocols such as HTML (Hyper-Text Markup Language), HTTP (Hyper-Text Transfer Protocol), SNMP (Simple Network Management Protocol), and XML (eXtensible Markup Language) allows enterprise administrators to make use of existing tools and skills, without compromising ease of use or results of system management. In addition, Clearspan provides configuration audit trails to log all changes made by the system administrator, including adds, changes, and deletions.

Accounting Management

Clearspan accounting information is generated in the form of call events. The call events are atomic pieces of information generated during the calls upon call origination, termination, service invocation, and other events that can have an impact on the billing of a call. Additionally, a long duration call accounting option provides the ability to generate a separate accounting event for calls of a specified duration (for example, one day).

The Clearspan call detail record (CDR) contains information about each call, including called party, calling party, call origination time, originating tag, billable call duration, call type, media codecs used, conference data, dialed digits (prior to any translations), and IP address of access device. If a call consists of multiple legs, due to a transfer, the CDR contains a record of all related calls and the reason for the call spanning multiple legs. The CDR also identifies which feature a user invoked as a result of dialing a feature access code. Since feature codes are configurable per group, this enhancement simplifies the billing of usage-sensitive services.

On a periodic basis, an external mediation system retrieves the accounting files from Clearspan and correlates the call events to aggregate them in a call detail record that can be processed by the enterprise administrator's downstream billing system. This enables a system administrator to control the size of the internal CDR buffer to allow generation of CDRs in real-time, if required.

RADIUS Interface

The Clearspan Application Server uses the optional RADIUS interface to send call detail records to the Call Detail or Database Server, which provides "real-time" call data for third-party accounting applications such as pre-paid calling. Requests are authenticated by the RADIUS shared secret for security.

The Application Server can also deliver real-time call detail records using the optional Radius Accounting protocol (RFC 2866), which is done by sending multiple call detail records per call. The content of a call's call detail record is cumulative; that is, each call detail record contains all available call information at the time it is generated. The call detail record information is conveyed in a number of vendor specific attributes (VSAs).

Configuration Management

Upon log in to the system using an ID and password, system administrators have instant access to a user list, by enterprise or group name, as shown in the following figure. Links provide quick retrieval of user, service, interface, or system information.

Figure 50. System Administrator's Profile.

System administrators have the ability to add, delete, and modify users, groups, services, and interfaces to meet the user needs, as well as perform system maintenance and management, maintain system and user security, and monitor system events. With the introduction of enterprise administrators and group or company administrators to attend to the details of user requests, system administrators are able to focus on performance and monitoring issues.

Tiered System Administrator Privileges

System administrators can create two levels of access privileges for different levels of service. The provisioning administrator web interface allows access to a subset of the functionality enabled by the system administrator web portal interface. Specifically, the provisioning administrator level has full functionality with regard to users and groups, but does not permit access to system-level service or

interface parameters, profiles of other administrators, or access device or server configuration information. Group provisioning administrators can view, add, modify, and delete the groups and users created by other provisioning administrators.

Portal Support

Portal support of the Application Server provides an API that allows the Clearspan web interface to be integrated into an enterprise administrator's portal. Users who access Clearspan via the web site of an enterprise or other portal do not require re-authorization.

Command Line Interface

Clearspan has a command line interface for system configuration tasks such as adding, modifying, and deleting users, interface, and service information. Using simple, common commands, data can be reviewed or edited by system and enterprise administrators. Some of the functionality of the command line interface includes:

- **Configuration** – Provides a subset of the group, user, service and interface parameters, and system configuration functionality of the system administrator web interface. Individual user features cannot be assigned or edited using the command line interface.

- **Alarms** – Provides access to system generated alarms and events (SNMP traps). The display is real time.

- **Audit Trails** – Provides access to all changes made by the enterprise administrator, including, adds, changes and deletions. Also provides the ability to view the data.

- **Service Performance Measurements** – Provides access to service-level operational measurements.

- **System Performance Measurements** – Provides access to system-level operational measurements. Enables enterprise administrators to use the command line interface to query and display reports on performance measurements. Both real-time and historical (for example, last day, month, and year) reporting is available, and information can be viewed from a web page or a file.

The Clearspan command line interface is available on the Application Server, Web Server, Media Server, Network Server, Element Management System, and Call Detail Server, in various forms with relevant commands. For more information about the command line interface for a particular server, refer to the appropriate *Command Line Interface Administration Guide*.

Service Quantities

This feature allows system or enterprise administrators to set a maximum number of instances for each feature assigned to the group. When features are purchased from Clearspan, the number of desired instances of a feature is assigned. The system permits assignment of the feature to the desired number of users or the desired number of times for a group. For example, a group administrator can issue a limited number of users a feature such as Selective Call Forwarding, as well as limit the number of Auto Attendants used by the company.
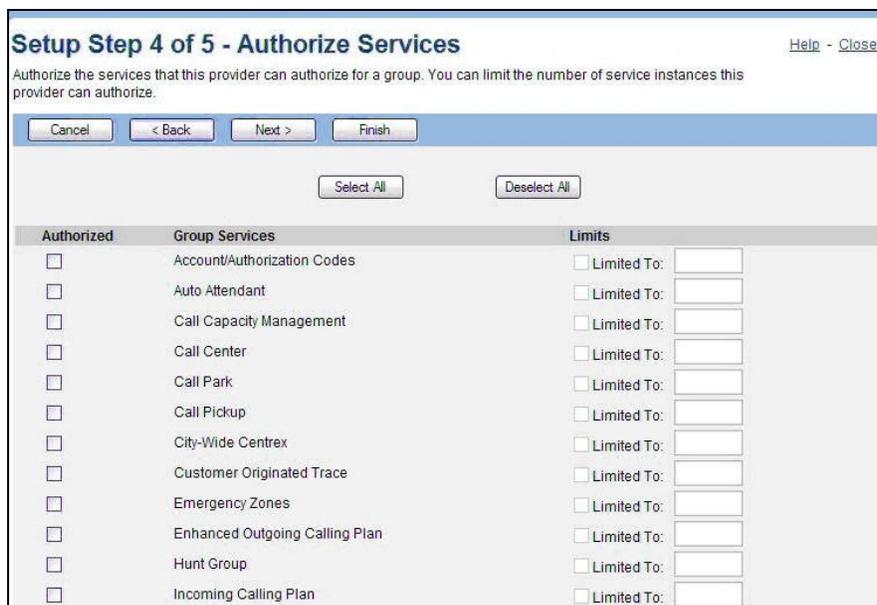
Figure 51. Service Quantity Allocation.

User Quantities

Setting the user quantities enables system administrators to set a maximum number of users that a group, or enterprise administrator, can have. Enterprise administrators also have the ability to place a limit on the number of users in each of their groups.

Feature Access Codes

Enterprise administrators can specify their own default set of feature access codes. New groups created by the enterprise administrator start with this default set of codes. Group administrators can subsequently specify their own set of custom feature access codes and prefixes.

Call Control Interface

Clearspan provides an external call control interface for users who would prefer to use third-party applications for call management. The interface is open and XML-based, and can be used to develop a wide range of applications for such purposes as communication, collaboration, business process integration, and user interface customization.

For example, enterprises may want to deploy a customized attendant console that is tailored to a particular vertical segment. Alternatively, enterprises may deploy an entirely different type of application that can perform call management functions, including answer, hold, retrieve, transfer, conference, dial, and release.

Call control functionality can also be integrated into existing web applications (for example, CRM) to provide value-added collaborative applications. Applications can also leverage the call control interface to support call logs and group directories, as well as retrieve user call status for presence.

ENT**E**RPRISE WEB PORTAL

The Enterprise Web Portal provides an optional layer of administration above the group layer to facilitate the management of large enterprises spanning multiple groups and sites.

Enterprise administrators can use this administrative layer to manage selected services across their business groups and sites. For example, a Voice VPN private dialing plan can be configured to enable users to call one another using location codes and extensions instead of full phone numbers.

Configurable Default Feature Access Codes

Enterprise administrators can configure a default feature access code (FAC) set. When new groups are created under that enterprise, their FAC table is initialized based on the enterprise administrator's defaults.

Restricted Administrative Access

System and enterprise administrators can define what level of control is granted to administrators and users through their web portals. Access rights are defined as "read only" or "read and write". Read-only access makes functions viewable, but not modifiable. For example, a group administrator can be created without the ability to add or remove users.

Service (Feature) Packs

Enterprise administrators have the option of creating packs of user services that can be authorized and assigned according to the enterprise's policy. Service or feature packs are authorized and assigned by enterprise administrators and do not affect the manner in which system administrators authorize services to enterprise administrators. Rather than assign individual features to each user, this capability provides an option to streamline the process by assigning a pack of features all at once.

A tool is provided to automate the process of migrating to Clearspan service packs. Individual services can be converted to service packs for a large group of users all at once. In addition, enterprise administrators who are already using service packs can use the tool to repackage services into different service packs.

Shared Device Support

Certain devices and/or network elements can be shared across groups of users. Shared devices can be configured by the enterprise administrator and would be accessible by group administrators when service is assigned to a user.

For example, an enterprise administrator can deploy a single 24-port access device in an office building to support multiple users. In another example, if Clearspan is being used to provide voice mail only, an enterprise administrator could configure the "host" system as a shared access device for the purpose of delivering MWI notifications.

Voice Portal Customization

Voice Portal Customization enables system administrators to customize the keys and prompts that are used to navigate through their voice portal menus and submenus. A key is either 1 digit (0 through 9), *, or #. Administrators can choose from a list of valid keys that are free to use. If no key is chosen for an optional menu selection, the menu option is disabled. The association of keys to actions (choices of each menu) is configurable for most menus and submenus. The system introduces one announcement per menu option and one announcement per key value. Typically, prompts are automatically constructed to list the options and their matching keys.

GROUP WEB PORTAL

The Group Web Portal empowers companies to configure and manage their telephony services with instant results. Administrator interaction is minimized and the time and expense required to make moves, adds, and changes is significantly reduced. Each group service is set up and configured by the group administrator through intuitive web pages. For example, calling plans can be set up and modified for each member of the business group (shown in the following figure), without having to call an administrator or wait for the requested changes to take effect. The group administrator simply selects the various call types to activate and deactivate them for a particular user.
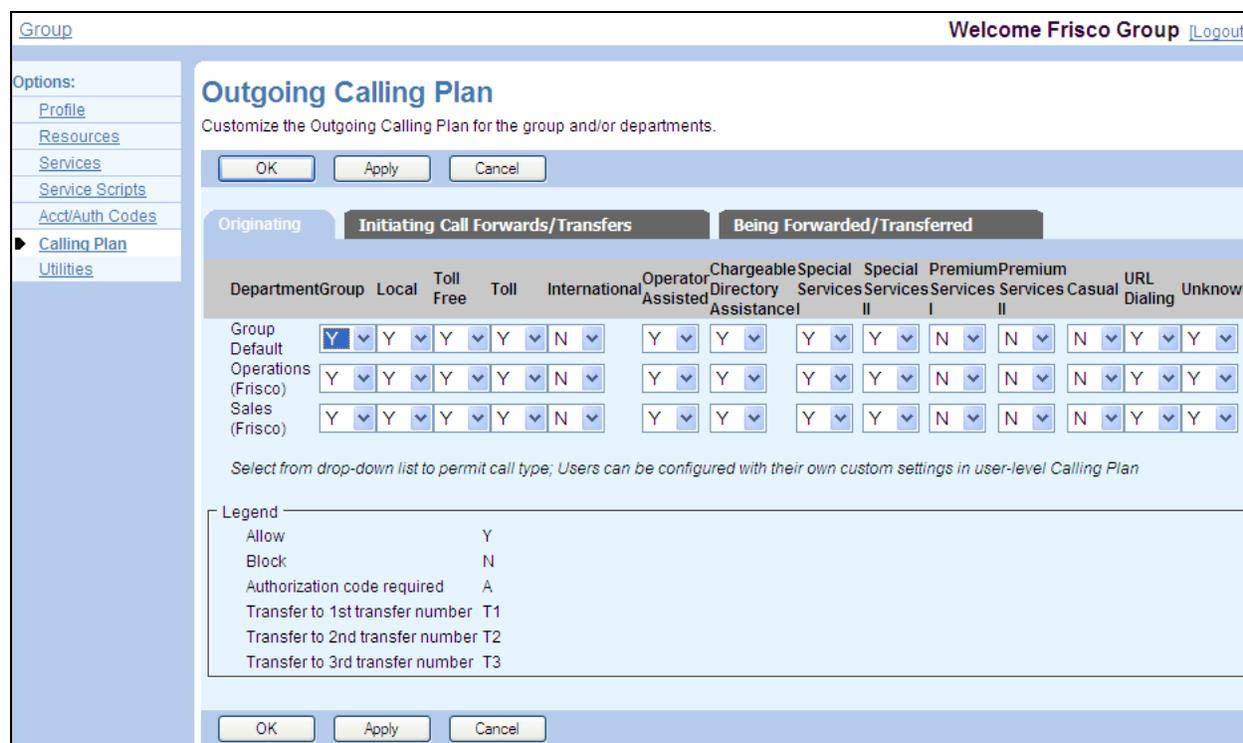
Figure 52. Outgoing Calling Plan.

In another example, the web-based Auto Attendant (shown in the following figure) enables group administrators to configure hours of operation, greetings, and transfer options.
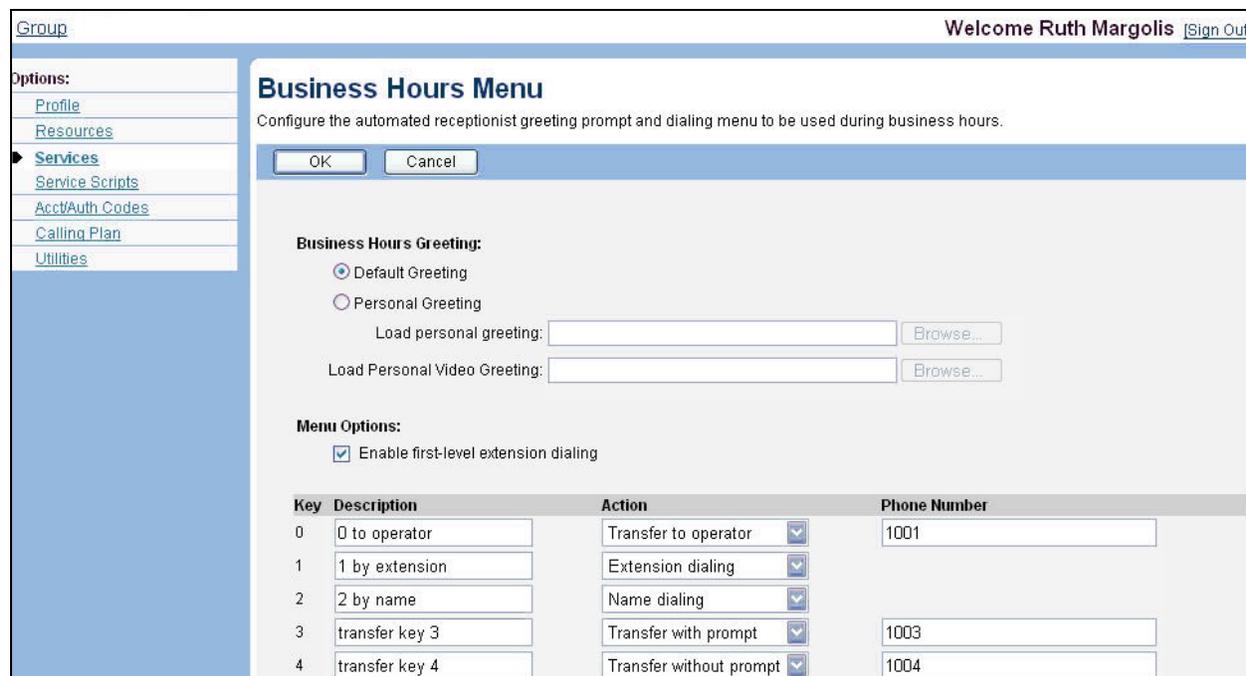
Figure 53. Auto Attendant Business Hours Screen.

Similar web pages are provided to manage a host of group services, including Account Codes, Authorization Codes, Call Centers, Call Park and Pick-Up, Device Inventory, Hunt Groups, and Voice Portal. The group web portal also enables companies to perform administrative functions, such as setting up users and provisioning their personal telephony services and devices.

Group administrators have the option of establishing an additional layer of administration for individual departments within their overall business group (for example, Sales, Engineering). This is especially useful for larger enterprises that want to distribute responsibilities for day-to-day administration. Department administrators can be authorized to manage the users and services within their respective departments using the group web portal.

PERSONAL WEB PORTAL

The CommPilot Personal web portal provides individual users with the ability to configure and manage a host of traditional and advanced telephony services. Users are empowered with the control and flexibility to easily configure their services to meet their unique needs. Users no longer have to remember any star codes or complex procedures to configure their services, as is often the case with legacy systems. Rather, Clearspan improves personal productivity by leveraging the web to make services understandable and actually useable.

Users can customize their services to follow them anywhere, whether at work, at home or on the road. For example, the Call Notify service (shown in the following figure) enables users to indicate which incoming calls they want to be notified of, and during which hours of the week. They can also choose to have their notifications sent to their mobile phone or e-mail address.
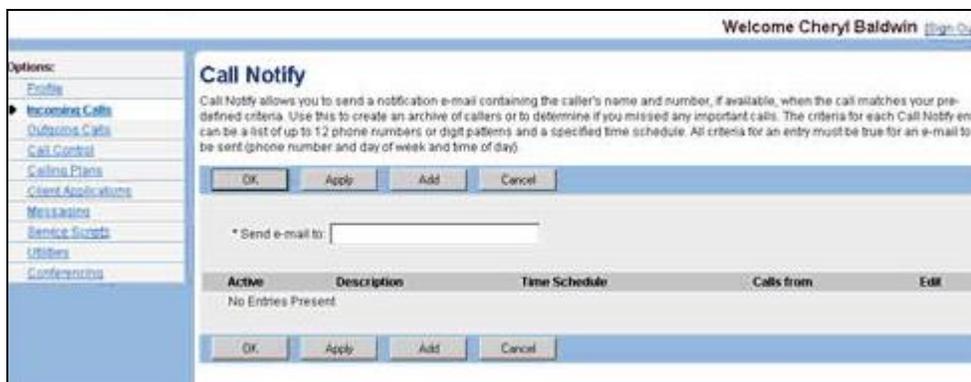
Figure 54. Call Notify.

After logging in to the personal web portal with his/her user identity and password, a user can activate, deactivate, and modify the parameters of his/her own services, including Call Forwarding (Always, Busy, No Answer, Selective), Simultaneous Ring, Do Not Disturb, Selective Call Acceptance and Rejection, Anonymous Call Rejection, Priority and Distinctive Ringing, Calling Line ID Blocking, Voice Messaging Notification, Voice Messaging to E-mail, Personalized Name Recording, and Remote Office. The left navigation area lists services and features available to the user.

The Web Portal updates features and configurations in real-time, providing utility and convenience. Convenience is important for features that are frequently updated by users such as the call-forwarding suite. The web interface also provides a means for making sophisticated entries and configurations, which are difficult to replicate through a standard voice portal. For example, in addition to specifying phone numbers for service treatments, Clearspan enables users to provide SIP URLs, feature access codes, and/or speed codes. Selective call treatments can be defined for parameters that include line ID status such as PRIVATE, and UNAVAILABLE, along with the more common IDs such as ANONYMOUS.

DEVICE MANAGEMENT

Clearspan provides an industry-leading device management solution that allows system administrators to address the most challenging aspect of deploying VoIP solutions – simplified provisioning of the end devices. Clearspan provides an end-to-end solution for managing, configuring, and monitoring the endpoints.

Supported access devices include many analog terminal adapters (ATAs), IP phones, integrated access devices (IADs), and IP PBX equipment. Service access devices connect to Clearspan to download their configuration profiles, firmware, and other file resources required to deliver the services. Using the Device Management feature, administrators can manage and control all aspects of device configuration centrally for their Clearspan solution.

The device management functionality makes use of the Clearspan Xtended Services Platform (XSP) and the Profile Server (PS). The PS serves as a central repository for the storage of device files. It offers an HTTP and webdav interface for file operations, and it supports authentication and file replication with other PSs for scalability and redundancy. The configuration files can be populated to the PS using the Clearspan management tools such as OpEasy or loaded from external tools such as BSS/OSS systems through the available programmatic interfaces.

- The XSP hosts the access URL and authenticates all requests made by the access devices. Once authenticated, the XSP will request the device-specific configuration file from the PS and download it to the device over HTTP(S).

- Access devices can use the Xtended Services Platform to access setup and configuration files, using HTTP or HTTPS (the choice of HTTP or HTTPS is per device type).

- Clearspan provides mechanisms to authenticate GET requests coming from devices, using MAC authentication or user name/password.

The Clearspan server supports ongoing device management by generating notifications to trigger the end device to synchronize its settings, and to provide inventory control of devices in the field which are shown in the following figure:
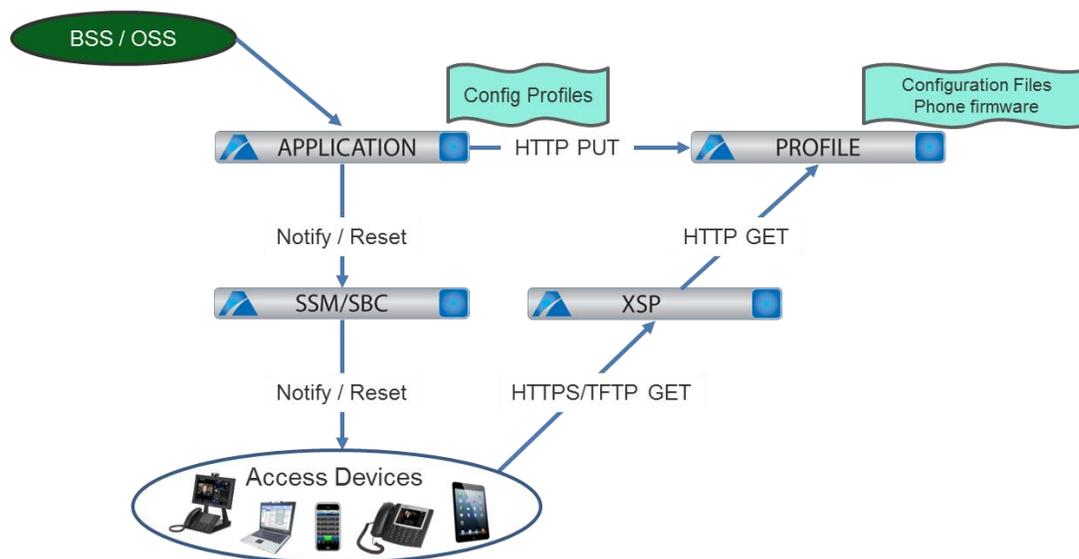
Figure 55 Device Management for Access Device Configuration Files.

The following subsections further detail the operation of the Device Management functionality.

ACCESS PROFILES

Before an access device can connect to Clearspan, a corresponding "access profile" must be defined for that device. An access profile specifies the signaling and media capabilities of the device. This allows Clearspan to tailor service delivery to match the specific capabilities of each device in the network. For instance, one device may support dynamic registration, while another may need to have its contact address provisioned statically. Another device may support multiple call appearances, while another may require waiting calls to be managed in the network. By defining unique access profiles for each of these device types, Clearspan can adjust the way it signals to each device accordingly. The access profile also defines the number of "ports" or unique line addresses that the device supports. As ports are assigned to line addresses, Clearspan keeps track of which port is allocated and which port is free. This helps operators manage not only the inventory of devices in the network, but also the number of ports that are in use.

CONFIGURATION PROFILES

To simplify deployment, Clearspan allows "configuration profiles" to be defined for each device it is managing. A configuration profile defines the attributes and settings required for the device to connect to the network and deliver service. Configuration profiles are optional. If Clearspan is not responsible for the configuration profile of the device, then this part of Device Management can be disabled.

When enabled, Clearspan uses the configuration profile to generate configuration files. Configuration files are stored on the Profile Server and made accessible to the devices over the access network. The Clearspan Application Server uses either File Transfer Protocol (FTP) or Hypertext Transfer Protocol (HTTP) to deposit files in the repository. File transfers occur on the private side of the Clearspan server complex.

SERVICE INTEGRATION

One of the most powerful features of Device Management on Clearspan is the ability to easily integrate Clearspan user services with features on the access device. This is most applicable for advanced business services, such as Shared Call Appearances (SCA) and Busy Lamp Field (BLF), which require attribute values to be set in both Clearspan and the access device before the service operates properly. For instance, the Busy Lamp Field service on Clearspan requires the use of the Session Initiation Protocol (SIP) dialog event package. To access the service, the device must SUBSCRIBE to a specific SIP URI representing the specific user's Busy Lamp Field state. This SIP URI must be provisioned on both the user's service profile as well as any device he or she wishes to use to access the service. When using Device Management, the provisioning system only needs to set this value once on the user's service profile. This triggers Clearspan to update any corresponding device configuration files and deposit them in the configuration file repository on the PS. If the changes are to take effect immediately, the administrator can initiate a remote reboot of the affected access devices to force a reload of modified the configuration files.

Clearspan supports a long list of service attributes that can be integrated with device profile settings, including, but not limited to:

- Shared Call Appearances

- Busy Lamp Field

- Any service using a feature access code

- Voice Portal and Voice Mail

- Language and Locale

RESOURCE MANAGEMENT

In addition to configuration files, an access device may require one or more resource files before it can deliver the service. The most common type of resource that must be managed is the firmware files that represent the current version of software embedded in the access device. Device Management provides methods and procedures that can be used to manage which device uses which version of a resource file. This allows administrators to easily control which version of firmware is deployed in the network, and to easily roll out new versions of firmware in a controlled and predictable manner. Specific group resources can be deployed to subsets of users in the network by customizing resources at the corresponding group

level. This allows administrators to present specific backgrounds or logos to the liquid crystal display (LCD) display on Internet Protocol (IP) phones or provide custom ring tones tailored to specific customer requests.

INVENTORY MANAGEMENT

Clearspan maintains a list of all devices that are provisioned in the network. This is integrated into the same database that manages all users, lines, and services in the network. This means Clearspan can easily track relationships between devices, the ports that are free, the ports that are in use, and the corresponding users who are associated with each port on the device. This type of information is invaluable when tracking the state of devices in the network and troubleshooting problems on the access network. Clearspan also provides basic inventory management reporting tools that can be used either by themselves or integrated with a broader inventory management system.

CLEARSPAN LICENSING

Licensing on Clearspan is simple and straight-forward. The following figure presents a high level view of the license structure.
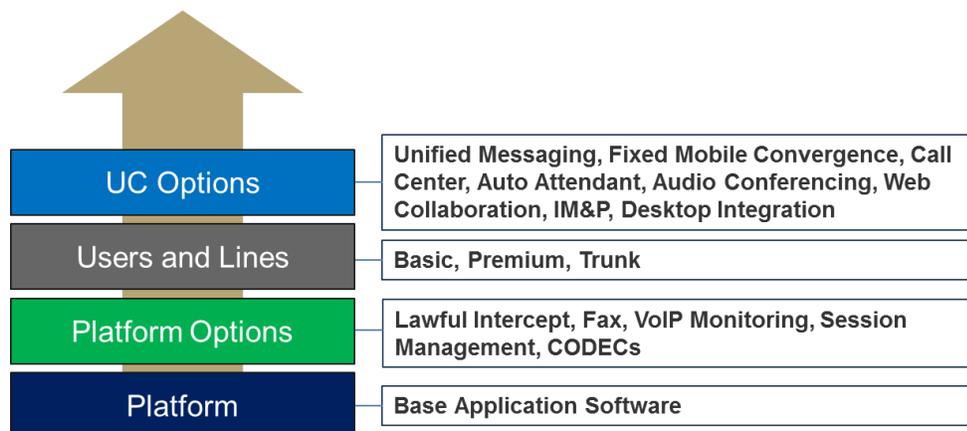
Figure 56. High Level View of Licensing.

The platform licensing includes all of the Clearspan applications required to perform all of the PBX and UC functions. This level of licensing typically involves the core server complex where server identities are define, their UUIDs collected and a license file generated and stored on the AS.

The next level of licensing, platform options, are system-wide options and typically include Lawful Intercept (CALEA), inbound FAX to email, VoIP active and passive quality monitoring, and SBC or session management licenses.

Next, users are licensed. A user may be assigned a device (SIP or analog phone registered to Clearspan) or may be assigned to a trunk group (a phone connected to a legacy PBX). Any user, whether connected directly to Clearspan with a phone or configured in a trunk group behind a legacy PBX, may be given feature packages. Directly connected users may be assigned basic or premium features, while trunk users may be assigned trunk, basic or premium features. The following figure highlights the various feature packages.
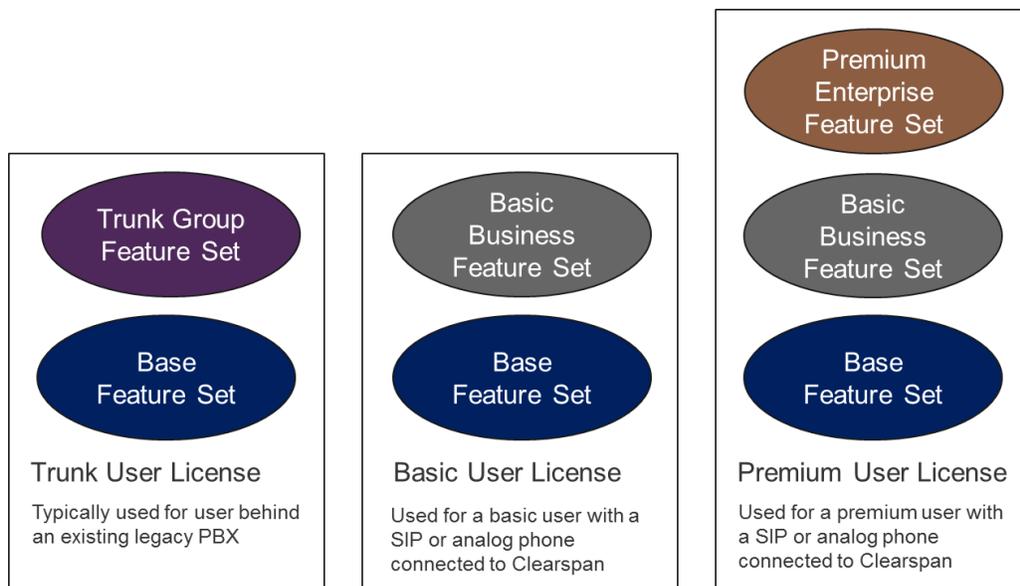
Figure 57. Feature Packages.

Finally, licensed users may be give a wide variety of Unified Communication packages including but not limited to Call Centers, Fixed Mobile Convergence (FMC), Audio Conferencing, Web Collaboration and Desktop integration.

SUMMARY

Clearspan architecture and features enable enterprises to deploy robust, resilient and scalable VoIP telephony solutions. Whether a slow migration or wide spread deployment, the Clearspan solution offers the flexibility for any enterprise or service provider to reap the benefits of VoIP. For migration candidates, overlaying existing systems with Clearspan business or SIP trunking enables users to have a unified feature set and dial plan. For wide-spread deployment, the system is easily configured and operational within days or weeks.

The integration of telephony, the web, presence, and messaging makes it possible for enterprises to enhance productivity, while driving down operating and support costs. End users enjoy more flexibility and control over their telephony options and the self-service features reduce the support burden for IT and telecom support staff. Through the web-based management tools, administrators enjoy decentralized control and provisioning. Finally, the geographic redundancy and fault tolerant architecture ensure the system is always up and providing service.

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