Understanding Unified Communications for Service Providers

Session 2004
Agenda

- Introduction, Features, and Benefits
- Architecture and Components
- Typical Call Flows
- Deployment in a Service Provider Environment
- Redundancy and Load Balancing
Unified communications is an enhanced voice over IP solution that provides the ability to manage voice mail, e-mail and fax under a common message store, on an existing IP infrastructure.

Multiple Device Types and Media

Non Real-Time Message Exchange
Unified Communications Features

Voicemail

- Multiple personalized greeting
- Handle all messages with a single call
- Designate and prioritize messages
- Leave messages for multiple subscribers
- Forward Voice messages as e-mail attachments
- Locate subscribers using name or phone number
- Message waiting indication by pager, stutter dial tone or indicator light

Unified Communications Features

E-Mail Messaging

- Ability to identify voice, e-mail and fax messages in mailbox
- Play voice messages as streaming audio
- Listen to e-mail messages over the phone using text to speech processing (TTS)
- Respond to an e-mail message over the phone as an audio attachment to the original sender
- Message waiting indication on arrival of new e-mail messages
- Print e-mail to a local fax machine
Unified Communications Features

Fax Messaging

- Ability to redirect fax messages to a local fax machine when ready
- Determine the time of arrival and sender of a fax message using a telephone
- View faxes as a (.tiff) attachment to an e-mail message
- Forward faxes as e-mail attachments to other users
- Message waiting indication on arrival of new fax messages

Unified Communications Features

Single Number Reach

- Callers can dial one number to reach user at work, home or on mobile phone
- Callers can choose to locate subscribers or leave a message
- Subscribers can choose to accept the call based on the caller or transfer to voice mail
- Users can define different reach numbers based on the time of the call
- Users can choose to be notified of incoming calls
Service Provider Benefits

- Brand services for greater recognition
- Drive minutes of use on the network, increasing total revenue per subscriber
- Reduce churn by strengthening customer relationships with value added services
- Reduce cost of ownership by utilizing a common platform to introduce new applications and services

End User Benefits

- Users can manage and access all of their messages regardless of the media type
- Remote users can access all of their messages with one phone call into their unified messaging system
- Voice mail, e-mail, and fax messaging are non-real-time means of communications, allowing users to access their messages at any time
- Media conversion allows users to access their messages in the media of their choice
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Unified Communications Network Components
Network Components
Access Services

- Edge devices that provide telephony and data access to the network
  
  Cisco AS5300/5800 with Cisco IOS 12.0.5(T2) and vcw-vfc-mz.c542.4.04 as VoIP H.323 gateways which provide access to the network from traditional telephony devices
  
  Cisco AS5300 Onramp and Offramp fax gateways that provide access to and from the network for group three fax machines
  
  Access servers for dial in data access from PC’s

Network components
Application Services

- Message management logic and H.323 call termination point

- Gateserver
  
  Sun Netra T 1125 Dual processor, 300 MHz, 512MB RAM, 9.1G hard drive with Solaris 2.6
  
  uOne gate server software version 4.2S
  
  RadVision rel 2.1.2.3 H.323 Stack (Included with uOne)
  
  L&H Telecom TTS (Text to Speech) V.100 for Solaris with American English, French and Spanish language sets
  
  SNMP master agents (optional)—Solstice enterprise agents runtime V1.03
Network Components
Backend Services

- Netscape Directory server 4.0 (LDAP)
- Netscape Messaging server 4.1
- Hylafax paging server 4.0, patch 1
- Apache Web server 1.3.6
- Network management workstation

Backend Services
Directory server

- Storage of user profile information in a hierarchical tree like structure based on organizational or geographic boundaries
- Tuned to give quick response to high volume search operations
- LDAP (lightweight directory access protocol) used to manage user information on directory. Uses TCP port 389
Backend Services
Messaging Server

- Common message store for uOne with open access (IMAP4, HTTP, SMTP)
- Uses directory service for user account information/authentication
- Messages stored using SMTP in MIME format
- Retrieved using IMAP4, POP3 or HTTP (Web-based e-mail client)

Backend Services
Paging Server

- HylaFax paging server—interfaces with uOne using SNPP (Simple Network Paging Protocol)
- Solaris 2.6 based
- Connects to a modem server using a single ended SCSI 2 cable
Gateserver Architecture

• Distributed object-based framework
• Based on new and non-proprietary voice and information standards
• Several major components that can be distributed across multiple systems

Gateserver Components

• Agent Manager and Monitor (AMM)
  - Scheduling, routing, launching, monitoring, and terminating services
  - Service libraries to access non proprietary services (IMAP, SMTP)
• Call Control/Media Agent (CMA)
  - Provides all H.323 services (H.225, RAS, H.245)
  - Media services such as playing and recording messages
• Application agents
  - Launched by AMM to provide specific tasks such as fax, notification
  - Provide access to back-end servers by using service library APIs
Gateserver Component Overview

- PSTN
- SMDI Resource
- H.323 Resource
- CMA
- Gateway
- Gatekeeper
- DS Routing Table
- Schedule Table
- SNMP Agent
- SNPP API
- LDAP API
- SMTP API
- IMAP API
- Log API
- OCM
- ICM
- Agent Manager Monitor
- Log Subsystem
- Services Libraries
- Application Agents
- MWI OnOff
- MWI Notify
- SMS Notify
- Log Remover
- Fax
- Print
- UM

Unified Communications Protocol Overview

- Services
- Call Control
- Trunking GW
- H.323 RAS
- H.323, H.225, H.245
- Bearer Control
- Q.931
- LEC Call Forward on Busy or No Answer
- RTP
- Application Server (uOne)
Call Flows
Identifying Callers

- Presence of RDN (Redirected Number) indicates call to subscriber
- UM searches for subscriber profile using 6018881234, retrieves and plays personal greeting
- Unpopulated RDN field indicates call from subscriber to retrieve messages
- UM requests subscriber to enter phone number or simply press #
- If subscriber enters phone number, it is used in directory search (LDAP)
- If subscriber enters # 6016661234 is used to search directory for profile
Call Flows Notification

Incoming Message

- SMTP
  - 21
- MWI_Plugin
  - 22
- FIFO Queue
  - 23
- MWI_PassOff
  - 24

Messaging Server

Notification Access Server

- RS232
  - 28
- SMSI
  - 29
- CMA
  - 27
- AMM
  - 27
- MWI_OnOff
  - 25
- MWI_Notify
  - 26

Notification Access Server

- SNPP
  - 30

Paging Server

- LDAP Server
  - 31

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UM creates an alias on messaging server mapping assigned fax number to e-mail address

UM does not participate in inbound fax to subscriber

Fax delivered to subscriber mailbox by onramp fax gateway
Call Flows
Onramp Function

- Demodulate fax call
- ITU-T T.30 fax protocol handling
- Turn fax image into TIFF file
- Create MIME message with TIFF attachment
- Optionally re-write to: address
- Create call history record
- Forward to ESMTP mail server

Call Flows
Inbound Fax

1. DNIS=6019991234
2. On Ramp Fax Gateway
3. T.37 (ESMTP)
4. Messaging Server
   msgsvc.abc.com
   fax=6019991234:user1
1. User sends a fax to the subscriber's telephone number (6019991234). The fax connects to a fax gateway (AS5300)

2. Incoming call is determined to be a fax call because the DNIS matches dial peer with information type set to fax. The gateway converts T.30 Group 3 fax to a .tif file.

3. The gateway creates a mail message, attaches the .tif file and delivers it using ESMTP to the messaging server. Destination e-mail:
   fax=6019991234@msgsvc.abc.com

4. Messaging server deposits fax message in user’s mailbox

   UM has created an alias on the messaging server that maps fax=6019991234@msgsvc.abc.com to user1@msgsvc.abc.com at setup time.

   The receipt to e-mail address is maintained as the alias fax=6019991234@msgsvc.abc.com.

   The “fax=“ alias in the “to:” address defines this message to be a fax message at retrieval time.
Call Flows
Offramp Function

- Authenticate sender against AAA (optional)
- Rasterize text portions of e-mail (text->fax)
- Rasterize TIFF-F into fax pages
- Re-write fax destination number (optional)
- ITU-T T.30 fax protocol handling
- Modulate fax call
- Create call history record
- Delivery status notification

Call Flows
Outbound Fax

- 6019991234
- 2
- Off Ramp Fax Gateway
- 5
- T.37 (ESMTP)
- 4
- FaxPrint Process
- 3
- FaxAdmin Mailbox
- 1 (IMAP)
- UM Server
- 2
- Messaging Server
- 2
- IP Network
- 6
- T.30 Group 3 Fax
- 6
- PSTN
- Fax Machine
Call Flows
Outbound Fax

1. UM agent retrieves the fax or e-mail message from the messaging server using IMAP

2. Subscriber chooses the option to print the message and keys in the phone number of the fax machine where the message is to be sent, example 6019991234

3. UM agent adds destination fax information to the message and forwards it to subscriber’s faxadmin e-mail account using SMTP

4. FaxPrint application constantly monitors faxadmin’s mailbox for new messages. It retrieves message sent in the previous step using IMAP

5. FaxPrint application sends the message to off Ramp fax gateway (ESMTP) addressed to (fax=6019991234@gw.abc.com)

6. Fax gateway extracts the destination phone number from e-mail address, converts any text to .tif format and sends the fax to the destination as T.30 Group 3 fax
Call Flows Summary

PSTN Gateway Gate Keeper uOne Backend Servers

- Setup
- Call Proceeding
- Alerting
- Connect
- Connect Ack
- Disconnect
- Release
- Release Complete
- Call Proceeding
- Alerting
- Connect
- H.245 Capabilities Exchg
- Open Logical Channel
- Open Logical Channel Ack
- Audio Stream Logical Channel
- Close Logical Channel
- Close Logical Channel Ack
- End Session
- Release Complete
- DCF
- DRO
- DRO
- DCF
- Bind Request
- Bind Response
- Search Request
- Search Response
- Connect
- Service Ready
- Login
- Login Complete
- Select
- Select Response
- Select Complete
- Fetch
- Fetch Response
- Fetch Complete
- Logout
- Bye
- Unbind Request
- LDAP IMAP

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- Deployment in a Service Provider Environment
- Redundancy and Load Balancing
Service quality depends on where uOne components are placed in the network.

Inherent delays across WAN’s.

Better quality and service by minimizing traffic across WAN’s.
Deployment Overview
Service Quality

- uOne server
  Call setup times, voice quality
- Directory server
  Authentication, message response (has to be centralized)
- Messaging server
  Message retrieval and response times

Dial Internet Access
Fully Centralized

No uOne Components at POP
Dial Internet Access
Partially Distributed

PSTN
Gateway
Gate Keeper
uOne
Backend Servers

Setup
ACF
Connect
Alerting
Call Proceeding

ARQ
Setup
ACF
H.245 Capabilities Exchng
Open Logical Channel

Connect
Alerting
Call Proceeding
ARQ

Connect Ack
H.245 Capabilities Exchng
Open Logical Channel

End Session
DRQ
Close Logical Channel

Open Logical Channel Ack
Audio Stream Logical Channel
Close Logical Channel

Release
ACF

Close Logical Channel Ack
Audio Stream Logical Channel

Unbind Request
WAN
LAN
RAS H.225 H.245
LDAP IMAP

Dial Internet Access
Fully Distributed

CPE
POP
CORE

Voice GW (H.323)
Message Server
uOne

Directory Service
IP Core
Core Router

PSTN
Dial Platform
Fax
AAA Billing

Local GK Zone for Each POP
Dial Internet Access
Fully Distributed

Dial Internet Access
Deployment Summary

<table>
<thead>
<tr>
<th>Quality Feature</th>
<th>Fully Centralized</th>
<th>Partially Centralized</th>
<th>Fully Distributed</th>
<th>Partially Distributed</th>
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</thead>
<tbody>
<tr>
<td>Call Setup Time</td>
<td>Long</td>
<td>Good</td>
<td>Best</td>
<td>Good</td>
</tr>
<tr>
<td>Voice Quality</td>
<td>Average</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Authentication</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Message Response</td>
<td>Acceptable</td>
<td>Acceptable</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

Call Setup Time: Time taken to setup call and hear ringing at the far end
Voice Quality: Quality of messages being played back from uOne
Authentication: Time subscriber has to wait for the system after entering user ID and pin
Message Response: Time subscriber has to wait to hear message after that message has been selected.
Dedicated Internet Access

Corporation Share uOne and Gateway Resources in POP

Corporation Share uOne Resources in POP and Has Local Number Access
Dedicated Internet Access

Corporation Has Dedicated uOne Resources

Traffic Analysis

Traffic Distribution
Transport Layer

TCP 27%
UDP 73%

TCP Traffic Distribution

H.225/H.245
LDAP 2%
IMAP 97%
Traffic distribution based on retrieving a 30 second voice message listening to all menu prompts in full. Total call lasted 1 minute and 54 seconds.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Bytes</th>
<th>Packets</th>
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</thead>
<tbody>
<tr>
<td>RAS</td>
<td>4173</td>
<td>34</td>
</tr>
<tr>
<td>H.225/H.245</td>
<td>3034</td>
<td>39</td>
</tr>
<tr>
<td>LDAP</td>
<td>7889</td>
<td>39</td>
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<tr>
<td>IMAP</td>
<td>384421</td>
<td>391</td>
</tr>
<tr>
<td>RTP</td>
<td>1058052</td>
<td>4986</td>
</tr>
</tbody>
</table>
WAN Bandwidth Calculations

CASE1: One server at each POP with centralized backend services

Total traffic across WAN = IMAP+LDAP+RAS = 396483 bytes
Total traffic in bits = 3171864
Bandwidth to sustain 1 session = 3171864/114 = 27832 bits/sec
For 30 simultaneous sessions, bandwidth = 834690 bits/sec or 835K

CASE2: One server and messaging server at each POP with centralized gatekeeper and directory service

Total traffic across WAN = LDAP+RAS = 12062 bytes = 96469 bits
Bandwidth to sustain 1 session = 96469/114 = 846 bits/sec
For 30 simultaneous sessions, bandwidth = 25380 bits/sec or 26K

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Load Balancing and Redundancy

Gatekeeper
Zone prefix gk-zone 408 gw-priority 10 server3
zone prefix gk-zone 415 gw-priority 10 server1
zone-prefix gk-zone 415 gw-priority 10 server2

Priority = 10 for 408
Priority = 5 for 415

Handle Calls for 408
Server3

Gateway1
Point of Presence (POP)

Gateway2

Handle Calls for 415
Server2

Server1

Load Balancing and Redundancy

Gatekeeper
Zone prefix gk-zone 408 gw-priority 10 server3
zone prefix gk-zone 415 gw-priority 10 server1
zone-prefix gk-zone 415 gw-priority 10 server2

Priority = 10 for 408
Priority = 5 for 415

Handle Calls for 408
Server3

Gateway1
Point of Presence (POP)

Gateway2

Handle Calls for 415
Server2

Server1

Load Balancing and Redundancy
uOne Redundancy Across POP's

Gatekeeper

Zone prefix gk-zone 408 gw-priority 10 server3
zone prefix gk-zone 415 gw-priority 10 server2

Priority = 10 for 408
Priority = 5 for 415

Handle Calls for 408

Server3

Gateway3

Point of Presence (POP)

Handle Calls for 415

Server2

Gateway2

Point of Presence (POP)

WAN

Gateway Load Balancing and Redundancy

resource threshold high 70 low 60

Gateway 2

RAI

PSTN

Gate Keeper

Zone prefix gk-zone 408 gw-priority 10 Gateway1
zone prefix gk-zone 408 gw-priority 10 Gateway2

Gateway 1

resource threshold high 70 low 60
Redundant Gatekeepers with HSRP

HSRP IP Address
10.1.1.3

GK2
10.1.1.2

GK1
10.1.1.1

interface ethernet 0
ip address 10.1.1.2 255.255.255.0
standby 1 ip 10.1.1.3
standby 1 priority 110

Gateway

PSTN

GK1
interface ethernet 0
ip address 10.1.1.1 255.255.255.0
standby 1 ip 10.1.1.3
standby 1 priority 100

Redundancy and Load Balancing with SLB

PSTN

Virtual Server

Real Fax Gateways

Cisco IOS SLB

uOne Servers

FaxPrint Application
Fully Redundant Configuration

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