file attachment), and transmitted over the Internet to the recipient by e-mail as an attachment. VoxMail™ permits full e-mail conversions from phone-to-PC, PC-to-phone, or phone-to-phone.

Users can fully personalize VoxMail™, including changing password, selecting mail server, managing (optional) Address Book, sending pre-defined e-mail replies, filtering spam, and more. These features decrease the burden on the operator who no longer needs to administer important functions for each account

VoxMail™ user interface settings can be fully customized to replicate the existing operator user interface. Therefore, from the user's perspective, phone interaction with VoxMail™ is nearly identical to the operator's voice messaging system. A CellCentric™ module maps VoxMail™ ergonomics to the existing cellular operator's voicemail system (thereby accelerating user adoption rate).

Feature Descriptions

E-Mail Listening

Users can access VoxMail™ by pressing a pre-defined short number (like M-A-I-L). Within a few seconds, VoxMail™ retrieves messages (including access to external accounts) and reads the name of the e-mail sender, the time it was sent, and the subject. The e-mail message is then spoken to the user in its entirety and in its original language. The user can then navigate forward or backward within his mailbox for additional messages.

Caller Identification

VoxMail™ has the option of identifying the inbound mobile and landline callers and automatically initiating access to mail services without the need for the user to enter login and password information thereby streamlining user's access session. Users can provision up to three telephone numbers to access their accounts and bypass the need to enter a subscriber number and password.

Advanced Support for E-mail Attachment Listening

VoxMail™ can read e-mail attachments and support over 2,000 different file formats including most commonly used business applications (Microsoft Word®, Excel®, PowerPoint®, and PDF® documents). In addition, VoxMail™ can be configured to read or reject certain pre-defined file formats according to user preferences.

Multiple Language Detection Support

VoxMail™ "speaks" e-mail written in multiple languages and utilizes the highest-quality TTS technology available. TTS engines are added as plug-in modules so they can be upgraded (without any system downtime) with more powerful modules and additional languages as the technology evolves.

Multiple TTS Vendor Support

VoxMail™ allows mixing and matching of various Text-To-Speech (TTS) technologies. One TTS vendor can be used individually per language. This allows choosing from the best vendors, which can differ in price and quality depending on the language. TTS can be replaced on the same platform by better technology from new vendors when available.
VoxMail™ provides an abstraction layer to manage various TTS vendors as if they were only one. Consequently, typical TTS-related administration tasks, such as dictionary exceptions and language recognition, do not have to be reconfigured when upgrading TTS services.

Voice Replies

Users reply to their e-mail by voice and automatically send their reply by e-mail to the Internet recipient. Unlike other cellular based e-mail sending solutions, all that is required to send a voice reply is to press the keypad once - eliminating the need for fingertip-typing. The recipient will receive a regular e-mail message that contains a Windows sound file (.WAV) with the sender's authentic voice recording.
The .WAV file can be greatly compressed with popular compression algorithms such as MSGSM, Truespeech or MP3. Compressed sound files are supported by most Windows operating systems, which eliminates the need for new drivers.

Pre-defined Replies

VoxMail™ users can prepare a set of replies by managing their profile from a Web interface (WAP interfaces can also be used). Where pre-defined replies are already defined within an SMS or Web messaging profile, VoxMail™ uses these responses. To choose a pre-defined reply after reading a message, users press the associated key, and immediately the reply e-mail is sent with a copy of the original message included.

Forward to E-mail

After an e-mail has been spoken over the phone, it can then be forwarded to any recipient in the user's Address Book by simply pressing the corresponding number.

Forward to Fax

VoxMail™ is tightly integrated with CellCentric™ FaxMail services. Forwarding an e-mail to a fax machine enables the user to quickly receive a printed copy of the e-mail and associated attachments. The destination fax can be entered during the call process or selected from a pre-defined number. Detailed faxing information can be interfaced to the operator's billing systems or faxes can be billed like regular calls and therefore billed through the Mobile Switch Center (MSC).

Quick Send

Quick Send is an easy way to send an e-mail message to a cellular phone with very little user interaction. The mobile user dials the VoxMail™ system and records a voice message. The recording is sent as a .WAV file to any of the predefined e-mail addresses in the user's Address Book.

Support for LDAP Address Book

In those cases where the subscriber maintains Address Book entries in a database or LDAP server environment, VoxMail™ can access and use the information without the need to duplicate this information. The benefit for the user is the ability to reuse existing contact information when using VoxMail™ features (Quick Send, Forward E-mail, etc.).

LDAP User Validation Support

When the operator maintains subscriber information in an LDAP server, VoxMail™ can utilize the same server to retrieve user mail profiles. A profile can contain various parameters including user's mail server location, POP login, and password. VoxMail™ automatically retrieves all of this information; there is no need to maintain and synchronize multiple databases.

Prompts Customization

All prompts can be entirely customized to support existing voices and menu navigation. This makes usage of the new service more adaptive and identifiable.

Music-on-Hold Customization

VoxMail™ can play the Operator's selection of music while users wait for various operations to complete. This deters user hang-ups during long system processing intervals thereby improving the customer's experience and preserving the call.

International Access

Operators with multiple international locations can maintain multiple VoxMail™ nodes to permit subscribers continued service while away from the home roaming zone. This function includes the ability to share a foreign operator's VoxMail™ node for network-to-network message exchange.

Customizable Key Configuration

All navigation key numbers can be modified so they reflect the same logic as that of the operator's Voice Messaging system.

Voicemail

Incoming voicemail messages are stored in the user's mail account. Depending on the characteristics of the network interface and the level of information provided by the network, it may be possible to identify the sender's phone number (Caller ID) and to map it to an Address Book entry. The voicemail will then be converted to a mail message with the original sender's e-mail address allowing a quick reply from the recipient.

C3G

Mobile Corporate Data Access

CellCentric™ Corporate Gateway (C3G) provides mobile phone users access to their corporate data including mail messages, to do lists, calendars, address books, and new message notification services. Users also gain access to their company's enterprise-level sales force automation (SFA), customer relationship management (CRM), and enterprise resource planning (ERP) applications.

The Gateway supports most popular corporate applications (e.g., MS Exchange, Lotus Notes and Domino) and leverages existing corporate IT and enterprise software skills and platform investments. Provisioning C3G features can be done over the Web by a corporate system administrator (user rights) or by corporate users (preference settings). A transactional interface can also be used to provision C3G features from the operator's information system. CellCentric Corporate Gateway offers corporations "outsourced" yet secure voice and SMS messaging services with simple management features and full internal control of access rights. Operators benefit from the increased access and airtime of their subscribers as they are empowered with greater mobile access to their corporate groupware applications.

C3G enables access to corporate messaging and information assets such as e-mail, calendars, address books, to do lists, VoiceXML applications, event notifications (new mail, meeting reminders, news stories, etc.) and push SMS services from existing corporate applications. Access options include WAP, voice, SMS, and "Fax To" presentation and delivery services.

Delegated Administration

C3G offers three levels of service management:

- Corporate User: Filter Rules and Settings
- Corporate System Administrator: Corporate User Rights and Access Privileges
- Operator System Administrator: Corporate Account Creation and Global Access Rights

Gateway - Proxy Service Implementation

CellCentric™ presentation layer services (WAP, voice, SMS, fax) are hosted within the operator's network. As shown in Figure 2 below, all communications with corporate applications are channeled through the CellCentric™ corporate gateway and an easy-to-install proxy located on corporate premises. The C3G proxy runs on any standard JSP-enabled Web server and enables access rights to remain with corporate administrators. It receives XML requests for the C3G gateway and maps them to the appropriate proprietary request (MS Exchange, Lotus Notes). End-to-end security is provided using HTTPS/SSL between the corporate gateway and the proxy server.

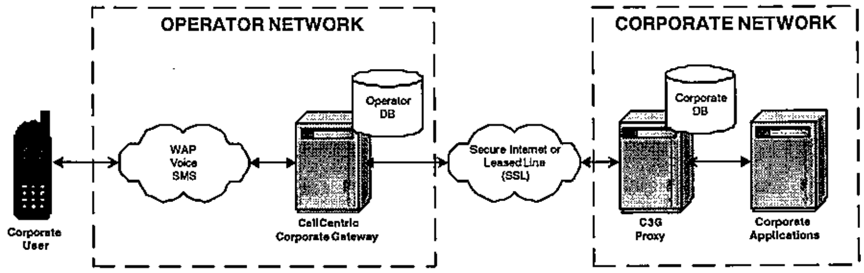


Figure 1. C3G Service Implementation

Security Features

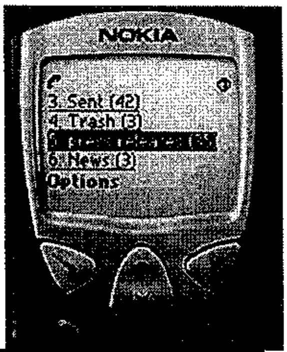
To guarantee privacy, C3G uses the Internet-standard SSL (Secure Sockets Layer) protocol for all communications between the operator's gateway and the corporate proxy server. The protocol allows client/server applications to communicate in a way that is designed to prevent eavesdropping (privacy), tampering (integrity), and message forgery (authenticity).

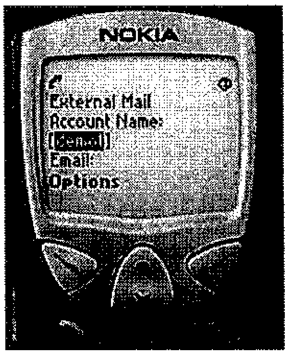
WAPMail

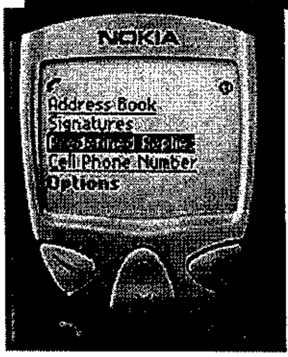
WAP-enabled handsets allow mobile operators to provide subscribers with a visual interface that can be used to access messages via a micro-browser in a handset.
This technology offers users:

- Management of e-mail and voicemail messages, Folders, and Address Book from the mobile device
- Access to external accounts
- Random access to messages (subscribers do not have to read/listen to each message in turn)

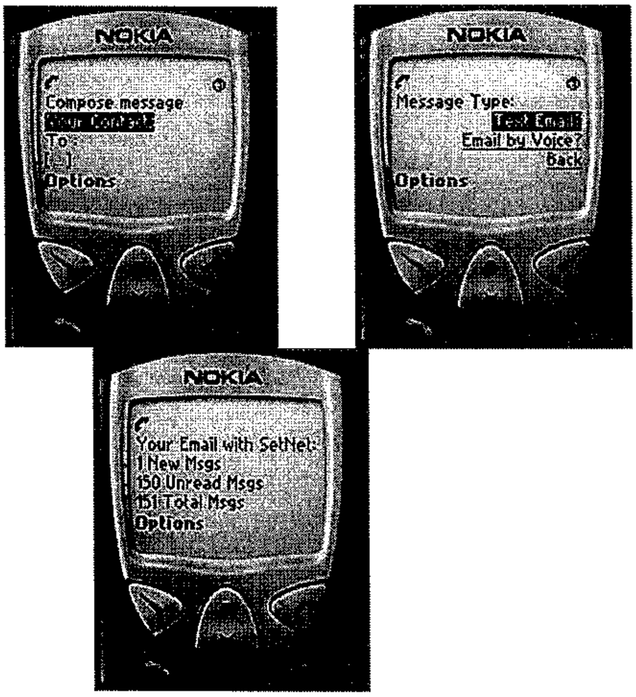
The user is given the choice to access multiple e-mail accounts (as defined in his or her profile) and to manage the different folders within these accounts as shown below:







Because WAP handsets are poorly equipped for manual input of long messages, CellCentric™ offers the user the ability to reply to mail (e-mail and voicemail) by voice or by text, as illustrated below. Switching from a WAP session to a voice session enables this feature. When selecting this option to reply to e-mail, the user ends the WAP session, initiates a new phone call to the VoxMail™ system to record a reply and is automatically transferred back to the WAP session when finished. The transfer from WAPMail to VoxMail™ is transparent to the user. The reply is then digitized as a .WAV file and attached to the mail.



Another feature of the SetNet WAP user interface is the option to switch from a WAP session to a voice session to listen to a long e-mail or to listen to a specific attached file. Also, the WAP interface enables management of PIM data stored on back-end DB servers.

Voice Portal

The Voice Portal allows users to *listen* to Web pages. Users can configure Favorite URLs, starting points (within the Web page), and Quick Phone Keys. News, sports scores, stock prices, and other information of interest can be *heard* instead of *read* using this unique feature of unified messaging.

Content can be listened to in sequence, or it can be randomly accessed using predefined, user-specified keys to immediately jump to particular sections of interest (much like a typical voicemail system). Content is read back in the language in which it was written.

CellCentric OneView™

CellCentric OneView™ presents a single, unified view of all users' messages: e-mail, voicemail, and faxes. External e-mail accounts can be rolled into the view, translated to audio format (for listening), and redirected. Emails can be filtered and re-directed to Folders other than the standard Inbox. Though any mainstream e-mail client can be used to interface with CellCentric OneView™ services, the full set of services can be more readily configured and accessed using a standard Web browser.

E-Mail Client Interface

Any e-mail client software that supports SMTP, POP3 or IMAP4 is able to access CellCentric OneStore™. This includes popular e-mail applications such as Microsoft Outlook, Eudora or Netscape Mail.

Once the e-mail client has been properly configured, users can download any new voice, fax or mail messages to their PC. In the Inbox, voice messages appear as e-mails with .WAV audio file attachments, and fax messages as e-mails with .TIFF file attachments.

The e-mail capabilities include sending messages, receiving messages and managing messages. Standard Inbox, Outbox, Sent and Deleted folders are supported, along with the possibility of creating personal folders for storage and management of messages. In the latter case, an IMAP4-compatible client is required.

Web Client Interface

Management of Messages

The Web interface allows subscribers to manage one or several mailboxes from a simple and easy to use yet powerful Web interface. It is fully customizable in a way that allows carriers to choose their own design and brand to differentiate themselves.

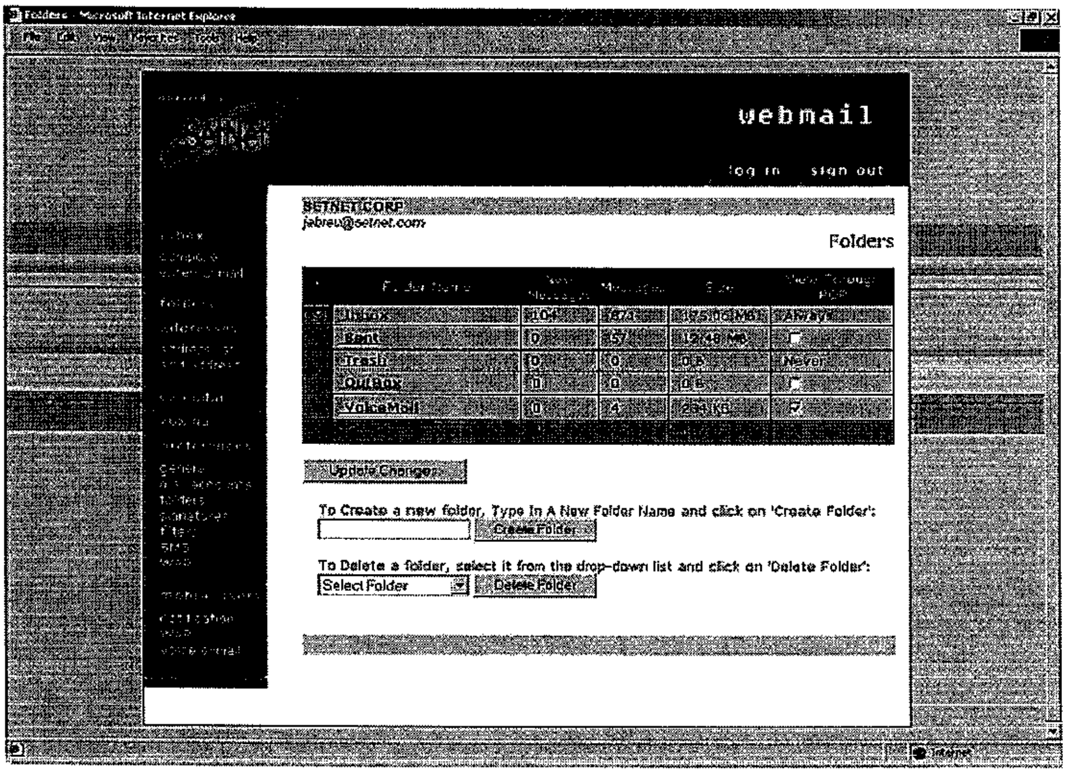
CellCentric OneView™ includes only the presentation and user side of e-mail. It communicates with a full-fledged mail server such as CellCentric™ OneStore as well as with subscriber directory services located on an LDAP or database server.

The Web interface provides even more features, scalability, performance and manageability when interfaced with CellCentric™ mail-related services for storage, relaying and SMTP listening. Nevertheless, The Web interface can be deployed with a third-party mail server and still support most of its features.

When logging in to CellCentric OneView™, users are presented with a list of folders and information related to them such as:

- Number of messages (both new and total)
- Folder sizes
- Notification of new messages (indicated by a yellow envelop icon)
- Embedded audio and video streaming capabilities

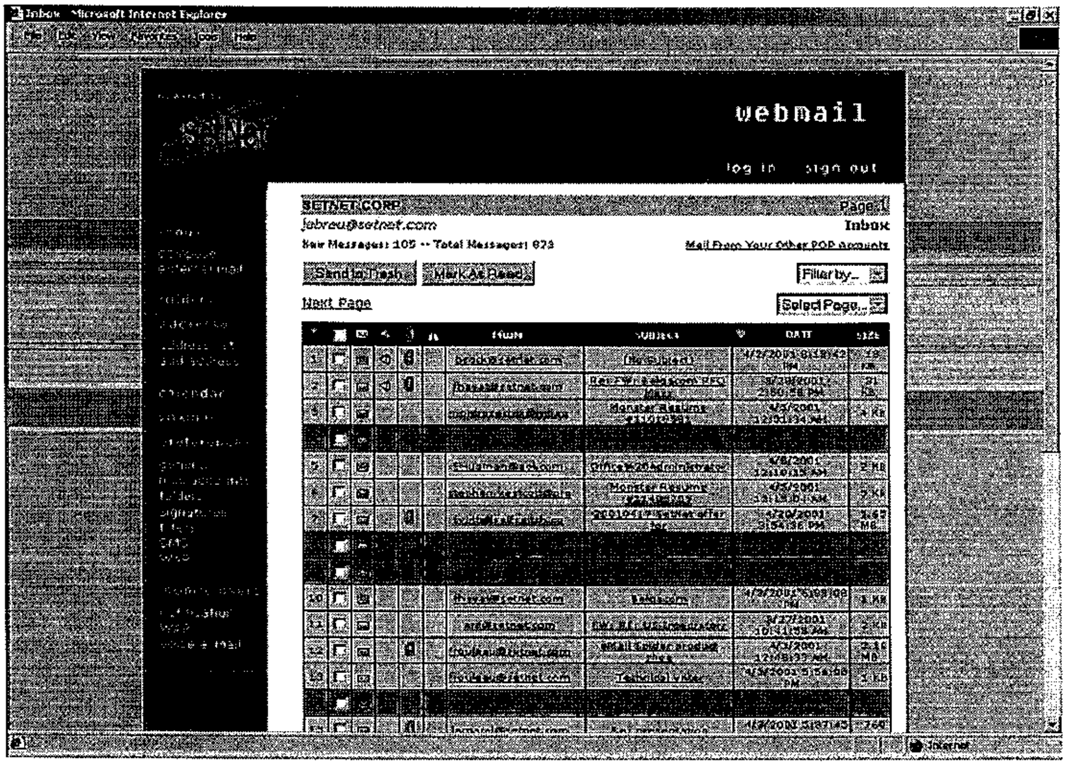
The user is given the ability to Create, Delete, Rename or View folders. Another option allows the user to specify which folders can be retrieved using a standard POP mail client.



When a folder is selected, the user is presented with the list of the messages in the folder. Messages are, by default, sorted according to the date of reception. The user is given the ability to sort them according to the sender's address.
Using a combination of text and icons (which can be customized by the operator), each message header in the folder displays the following attributes:

- Status of the message (read, unread)
- Type of message (fax, e-mail, voicemail)
- Indicator of attachment
- Importance (urgent, normal)

- Sender of the message
- Subject
- Date and Time received
- Size of the message



For handling voicemail, clicking on the speaker icon of a message opens an embedded audio java applet that streams the voice file. The entire file is downloaded to the PC so that it can be replayed without requiring any further access to the back-end server. The audio file can be saved in .WAV file using the local storage for later replay by using a standard Windows media player. The default sender's address is configurable and can be defined by the operator. If the Caller ID of the sender is registered in the user's Address Book, this address is replaced by the actual sender's email address, thereby enabling a reply by text or by voice through e-mail.

Fax messages appear as e-mails with .TIFF attachments. These can be opened and read using standard Windows applications.

The features offered by the Web client allow users to:

- Read, Reply, Forward, Delete, e-mail from multiple accounts (CC and BCC support)
- Access a unified view of e-mail from any external e-mail account such as corporate e-mail, Yahoo mail and proprietary mail systems such as Hotmail
- Implement quick page jumps for large mailboxes
- Quickly access voicemail and video-mail without the need to open the message
- Manage PIM including personal Address Book and Calendar
- Determine message importance levels
- Determine existence of Attachments
- View an attachment from the Web without the need for source program
- Manage mailing list to send e-mail to all members on the list
- Listen to audio-mail from mail reading interface
- View video-mail from mail reading interface
- View faxes from mail reading interface
- View pictures from mail reading interface
- Deliver receipts
- Send faxes
- Send voicemail

PIM

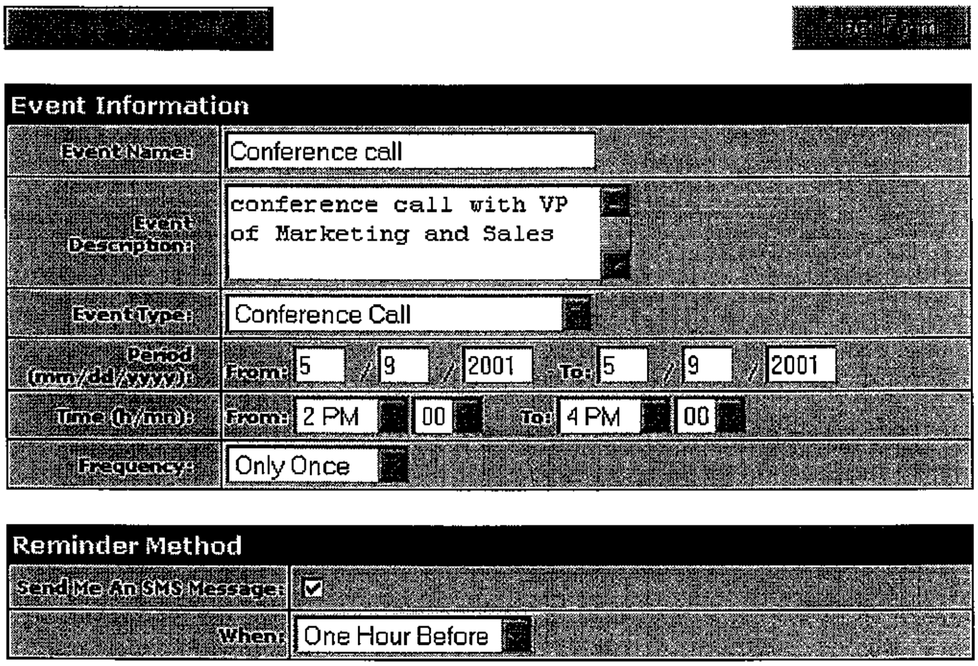
The CellCentric™ PIM is a SyncML-compliant data synchronization service that can interface with various services, devices, and applications including Palm, Motorola, Ericsson, IBM, Nokia, and Psion. It can be used in conjunction with CellCentric™ Notification to provide users with notification of important calendar events.

Management of the Address Book

The Web client interface enables subscribers to configure all their messaging options from the PC by either adding or editing information in their Address Book using a specially designed Web page. Users can import and export data from and to any external address book. Address Book contents can be stored in any SQL RDBMS (e.g., ORACLE) or in any other external DB server provided by the operator.
The user is given the capability to configure different address lists in order to manage various groups of contacts: general, private, customers, corporate, etc. This Address Book is accessible from most CellCentric™ applications.

Management of the Calendar

CellCentric™ comes with a full-featured calendar allowing the user to manage scheduled events and tasks. Users can view their calendar by day, week, month and/or year, and set on-screen alarm and reminders. Notification of events to the mobile phone via SMS or by e-mail can be configured to various times: one hour before, the day before or the week before. The notification message will contain the event name and the date/time of the event.



PIM Synchronization

As an option, CellCentric™ can integrate a powerful engine to synchronize PIM Information with SyncML-compatible devices. This enables quick and easy access to updated data from a wide variety of PIM devices and applications including Microsoft Outlook, 3Com Palm Pilot, and Psion PDA.

CellCentric Notification

Notification is a prerequisite for robust UC services. It is an important feature in managing the flow of information to subscribers who want immediate notification of any message reaching their Unified Communications systems. CellCentric Notification manages messages by sending notifications to users' mobile phones of important incoming e-mail messages, voicemail messages, faxes, and calendar events.

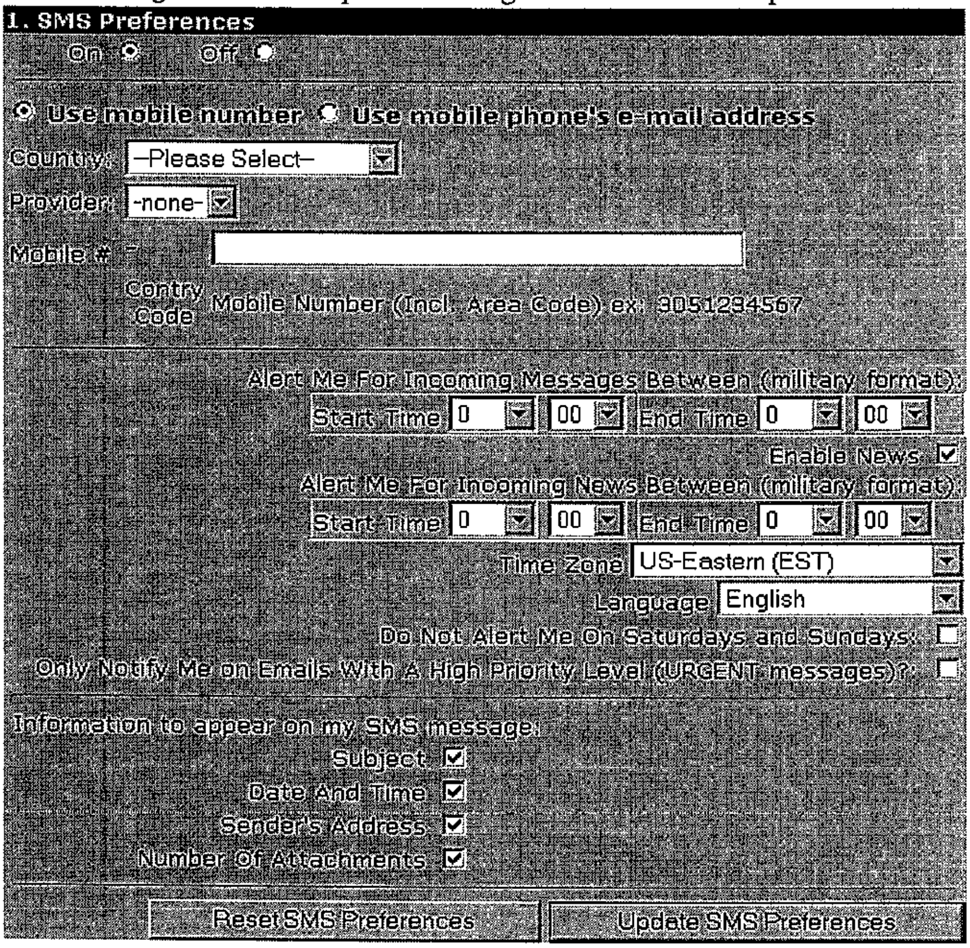
Notification Rules

Users must have the capability to define triggers on messages for which they want to be notified. The user can configure a series of rules, which are based on predefined characteristics of the message or the event initiating the notification.

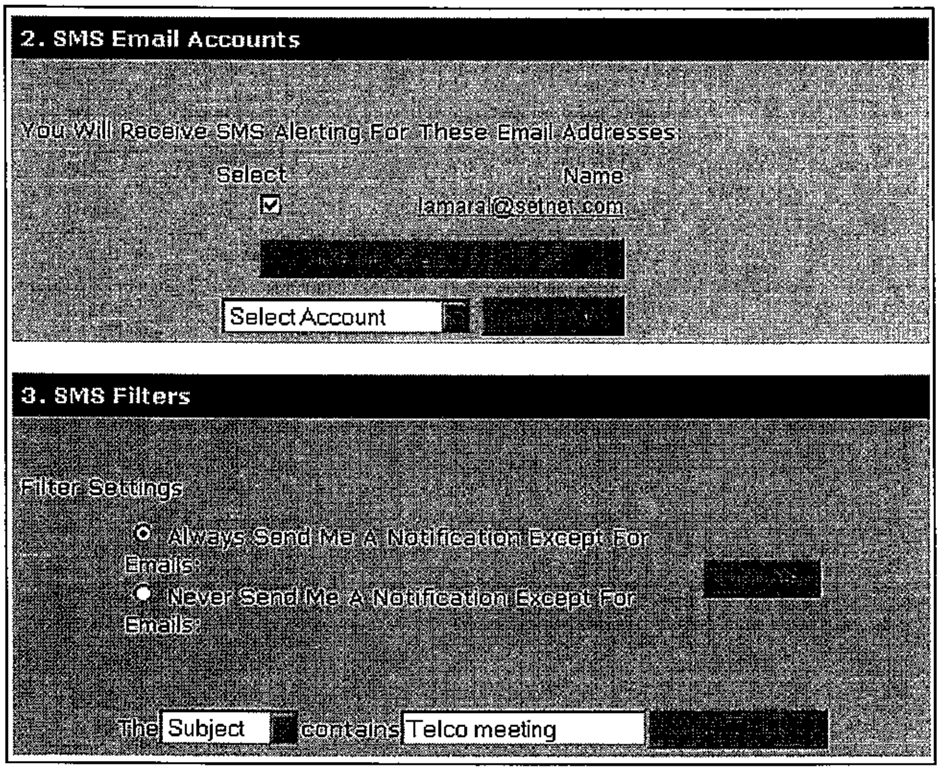
Notification configuration is done in three steps:

1. **Definition of SMS Preferences**: Notification can be delivered through e-mail or through SMS on a configured mobile phone number. The user can also select the content of the notification message (sender, date/time, subject, number of attachments). Time zones are supported.
2. **Definition of Accounts**: Users are given the capability to configure the mail accounts on which the notification will be active.
3. **Configuration of Filters**: Users can specify criteria for notification such as filtering by sender address, subject, message status (urgent, normal), time, and date.

The following screenshots depict the setting of SMS Notification preferences:



The Below figure depicts SMS Preferences



Mobile Publisher

Mobile Publisher allows a service provider to quickly and easily create and maintain content pages that will be automatically available to users on dynamically formatted Web pages. News items of interest (stories) will be "pushed" to users via SMS or voice notification. Topic categories might include Movies, News, Horoscope, Weather, Music. Topics might include short descriptions of new movies, video releases, sports scores, news headlines, or other content of interest to users that can be communicated with short, simple messages. Multiple languages and regional contexts allow the service to be highly customized for specific subscriber groups.

Content Editors

Editors are the creators of the content. They have the ability to create, modify, and delete stories as well as link them to elements of pages created by Content Producers. Regions enable editors to limit certain stories to specific regional areas.

Content Producers

Producers are the designers of the Web pages that service subscribers see when selecting the content they wish to receive. Producers can create, edit, and delete these pages and their associated topics and elements.

User Provisioning

Users select the content (channel) they are interested in from the pages created by the Content Producers. The selection is made from a Web interface displaying a menu of items of interest (news, sports, events) and other user preference options. From this menu, users can select the content for which they wish to subscribe.

FaxMail

The FaxMail service allows users to forward e-mails as faxes and forward faxes as e-mails. Email-to-fax provides the means of sending an e-mail message (and, eventually, attached files) to a fax machine.
On choosing to forward a message to a fax machine, CellCentric™ prompts for the fax number or asks the user to use his or her predefined fax number configured in the user profile. Messages are converted to .TIFF file format and support the following attachment formats: MS Word®, Excel®, PowerPoint® and Acrobat®. An e-mail notification can be sent to the user for the status of the fax (e.g., fax sent or fax not sent because of unreachable or wrong number). The user can get billed for the call.

CellCentric OneStore™

CellCentric OneStore™ is the mail store used internally by CellCentric™ to store any incoming message, providing standard SMTP, POP3 and IMAP4 interfaces. It offers a rich set of features to both subscribers and operators. Subscribers, in particular, will benefit from device independence and seamless transitioning from one technology to another.

While other CellCentric™ modules are aimed at providing subscribers with access to their third-party mailboxes, CellCentric OneStore™ stores and forwards multimedia messages on behalf of a subscriber. Operators benefit from:

- Storage for all kinds of messages, from voicemail, to e-mail, to SMS.
- High throughput distribution of messages to subscribers.
- Controlled and metered access by third parties so they can notify subscribers with customized information.

Multiple Interfaces

CellCentric OneStore™ lets subscribers access their mail through multiple devices including the Web, WAP, Voice, POP, SMTP, IMAP4 and future protocols such as Symbian-based devices.

Delegated Administration

CellCentric OneStore™ supports multiple mail domains (sms.operator.com, webmail.operator.com). Consequently, administrators can be assigned with the management of one or more domains. Corporate customers can manage their own domain independently and define available features on a per-user basis. For example, a subscriber could access his or her e-mail by phone, while another subscriber could be limited to Web mail or POP mail access only.

Per-Domain Offering

CellCentric OneStore™ allows operators to define certain sets of features available only to certain domains. For example, a domain such as pro.operator.com could automatically assign all possible interfaces for all subscriber-members of the domain. Feature-set definition can still be overridden on a per-subscriber basis, if desired.

Customer Care and Management

All account and domain management can be administered through the Web through secure connections across the operator's network. Telnet interfaces are also provided along with an open architecture allowing quick development of management bridges with existing customer care applications.
Accounts can be automatically created from an existing customer database and synchronized with the same database to avoid redundant information and duplicate entries.

Native Content Analysis

Incoming and outgoing messages, regardless of the technology used to send or receive them (WAP, SMS, Web), are analyzed before they are stored along with a message profile. Message profiles allow for more flexibility and resource savings when handling very large numbers of users and messages.
One practical example is the ability to display the number of attachments (including their types) from a native WAP interface without the need to open each message. When WAP users check their list of pending e-mails, they will know immediately which ones can be listened to (in case they where sent through an audio interface). Since audio messages are generally larger than text, subscribers would surely prefer to access the messages by

Voice (and listen to it immediately). This interaction can be done without the need to bring down the content of the message through a slow link to the phone.
Since messages are analyzed before being stored, background virus checkers can more easily scan them before being released; the virus checkers will have quicker access to their content through the message profile.

Quotas

CellCentric OneStore™ supports simple and complex user quotas. Quotas allow configuring the maximum sizes of mailboxes. They can be defined:

- By domain (with the same quota for all users of this domain).
- For the whole domain, so corporate customers or services can allocate their quotas the way they want across subscribers.
- For individual user.
- For incoming messages.
- For outgoing messages.

Content Analysis Optimization

By intelligently pre-processing messages (depending on their content) CellCentric OneStore™ allows more advanced processing for more device compatibility. For example, .GIF files can be converted to various mobile image formats, Word documents can be converted to WAP formats.

Since multi-media types are stored in their native format, they provide faster user-access when fetched by streaming enabled devices. Also, CellCentric OneStore™ is capable of immediate access to sub-parts of a multi-media message for more intelligent and efficient information retrieval

Universal Input Protocol

CellCentric OneStore™ allows messages to be submitted in one protocol and relayed in a different protocol. For example, messages can be posted using SMTP and forwarded by SMS using SMPP or the direct MAP interface.

Universal Output Protocol

A universal output protocol allows users to retrieve and send their 3rd-party mail accounts using any native messaging interfaces. A user could aggregate multiple mail accounts and access all of them through one POP account or one WAP account. This feature allows for non-standard protocol conversions (e.g., POP, IMAP access to Hotmail accounts. Also, 3rd-party mailbox manipulation would appear identical to direct access (i.e., a message deleted through the WAP interface would, in fact, get deleted).

Open Protocol Layer

CellCentric OneStore™ supports all mainstream Internet mail access protocols: IMAP4, SMTP, POP3. Non-Internet protocols are also supported including: UCP, SMPP, SS7 ISUP, SMS, WAP Push. It also features optimized multi-media access for slow networks allowing for "3G" like experience on 2G and 2.5G devices. The open protocol enables seamless 3rd-party integration (e.g., Cisco IP Transfer Point technology).

Optimized Storage Access

Unlike other mail stores based on database or flat-file (only) storage, CellCentric OneStore™ allows for channel optimization. For example, messages tables are indexed in relational database servers and message content is stored in the CellCentric™ File Server which processes large binary data significantly faster and more reliably than traditional BLOB-enabled database servers. File Server storage and retrieval is optimized for large-scale, distributed storage solutions.

Optimized Configuration

CellCentric™ provides centralized configuration with no need for local (distributed) settings on multiple hardware components. To address on-demand scalability, Kcentric technology allows deploying additional hardware and software (to meet rapidly growing demand) as required with no system downtime.

High Availability

High availability is provided at the software layer to complement hardware-based availability. CellCentric OneStore™ includes built-in (by design) fault tolerance without the need for 100% hardware doubling providing lower TCP when compared to a traditional hot standby architecture. Also, multiple routing access enables subscribers to access mail stores from backup routes when any one route is bottle-necked or disabled.

Competitive Advantage

While many UC vendors use *different* message stores for different message types (often from third-party vendors), CellCentric OneStore™ offers a truly universal message store specifically designed to address the needs of Telcos with large subscriber bases.
Without a universal message store, *multiple* messaging systems have to be installed, maintained, upgraded, and made to interoperate as a single message store. This service implementation exposes multiple points of failure and introduces inefficiencies from having to translate between disparate messaging systems to simulate a single, integrated message store. As a result, these systems do not tend to scale very well and usually require re-engineering as more users are added. Overall Total Cost of Ownership (TCO) is much higher than with single system implementations.

HotPOP Service

The CellCentric™ HotPOP module is special-purpose POP3 server that let's an e-mail client access Hotmail® mail accounts via the Internet-standard POP3 protocol. The server is designed to run on Windows NT 4.0 or Windows 2000 Server / Advanced Server environments. It is implemented as a Java application and requires a properly configured Java 1.3 runtime environment on the host machine.

Upon activation, the HotPOP server creates a socket on port 110 (user-configurable) and listens for service requests. Clients send commands to the server to query their Hotmail® account and retrieve Hotmail® e-mail messages. The commands supported include several of the standard POP3 commands

CellCentric Media Converter

VoxMail™ and WAPMail™ both use the Media Converter to convert files from various media file formats. VoxMail™ uses sound conversion to convert audio messages into universally accepted audio files (.WAV file attachments). These files can be readily transmitted over the Internet to recipients by e-mail as attachments. VoxMail™ and WAPMail™ both use document conversion to translate complex text e-mail attachments (e.g., Word docs) to simple ASCII text formats.

Process Flow

Media conversion occurs as a 4-step, client/server process:

1. The client sends the file to be converted to the server.
2. The client specifies the format the server should use for the returned file (default = text).
3. The client requests the conversion to take place
4. The client retrieves the converted file.
5. The session is terminated when the client sends a QUIT command.

Mailbox Monitor

The CellCentric™ Mailbox Monitor is part of the CellCentric™ Notification Platform that enables alerts to be sent on incoming mail (for local or external accounts), Calendar, and News events. Depending on a user's personal preferences, a new incoming e-mail, voice, or fax message in the current mailbox (or in any other e-mail account) triggers either an SMS alert on the user's wireless device or an e-mail alert to a preferred e-mail address.

The primary role of the Mailbox Monitor is to continuously poll registered POP e-mail accounts for new mail and send notifications to subscribers' mobile phones via the CellCentric™ Notification Engine.

With a large subscriber base, a single Mailbox Monitor server may not be able to process POP accounts within an acceptable amount of time. In this scenario, notifications would be generated instantaneously for some users, yet could be significantly delayed for others.

To support a large subscriber base, multiple Mailbox Monitors can be deployed. Using multiple Mailbox Monitors, the total number of users is distributed across all the registered Mailbox Monitors in the network to evenly distribute the processing load using the CellCentric™ Queue Balancer module.

Features

Retrieving POP Account Information

The Mailbox Monitor retrieves all the user information and preferences from the User Repository RDBMS along with registered POP accounts in order to poll them and generate notifications of new e-mail. The database access is implemented using ODBC and can connect to any database system that provides ODBC drivers supporting multithreaded DB access (Oracle, MS SQL Server etc.).

The Mailbox Monitor queries the tables *Mailboxes, SMS_POP*, *POP_Accounts* and *SMS_Accounts* for valid SMS accounts. All the accounts that are flagged as active and not disabled are retrieved. The data that are loaded include the SMS configuration in the *SMS_accounts* table and a few fields associated with every POP account for which subscribers have registered to receive SMS. The POP accounts registered for SMS notification have to be flagged as "*Valid*" in the *SMS_POP* table.

Processing POP Accounts

Once the list of POP accounts is loaded into memory, they are queued for processing. POP accounts may be treated dfferently based on their location and the configuration specified in the registry. Every POP account has a POP server associated with it.

When using the CellCentric Mail Server, if the POP server is defined as the local server, then the Mailbox Monitor connects directly to the CellCentric™ Mail Server storage; otherwise it uses the standard POP client interface. When the Mailbox Monitor is configured to use the POP client interface exclusively, the administrator can assign a different POP server to handle the e-mail retrieval to avoid overloading the public server. The relevant registry settings to configure these operations are: *LocalPop, Alternative Pop*, and *POPOnly* (see Registry Settings in CONFIGURATION section for more details).

The Mailbox Monitor initially retrieves all the POP accounts associated with valid SMS accounts and stores them on a global queue for processing. The way the accounts are retrieved is configurable and depends on the memory installed in the system. Configuring the registry setting *Num Pop Accounts* defines how many accounts will be loaded each time from the database. For instance, if there are 100,000 registered POP accounts and the setting has the value 1000, the Mailbox Monitor will load the accounts 1000 at a time (in memory) for processing.

Once the accounts are loaded into memory they are processed one account per thread. The number of threads that the server can launch is configured from the registry by setting the value of *Num Threads*. The administrator can configure this setting depending on the number and rating of CPUs installed in the system.

The accounts are then filtered (Poll interval for external accounts, Valid phone number, Time restrictions). If they pass the filters, they are polled for new e-mail.

Polling Accounts

After filtering is applied, accounts are polled and notifications are generated. All new e-mail notifications are stored back in the database in the *SMS_Mail* table for processing by the Notification Engine. Each entry in the *SMS_Mail* queue is a single notification pending delivery.

If accounts are external, or if the *POPOnly* flag is enabled, polling is done using the POP protocol.

Mailbox Monitor Groups

The Mailbox Monitor module is designed to run as a single instance per computer. More than one instance per machine is not supported. Configuration settings for tuning are available for improved memory and CPU utilization for a single instance i.e., throughput is adjustable

Statistics Server / Call Monitor

The Statistics Server records all information sent by the VoxMail and WAPMail servers in a SQL logging database. In addition, the Statistics Service sends real-time information to the CellCentric™ Call Monitor (client application) when it is connected to the Statistics Server.

The Statistics Server enables supervisors to see the channel activities of each VoxMail Server on the system. The Call Monitor client application provides a simple embedded statistical feature for instant viewing of usage data. Each VoxMail Server communicates with this tool by sending events that can be displayed in the Call Monitor window.

An administrator is able to define the way events are collected and how they are stored in the database. In addition, the number and contents of periodic reports can be specified.

The Statistics Server keeps track of users' session events and when it determines (using any of several criteria) that a session has ended, a new entry with summary information about the whole session is made to the database. The Statistics Server generates periodic reports by scanning the database for session entries made within a specified time interval and subsequently generating text files with statistical information.

Text-to-Speech (TTS) Server

The Text-to-Speech (TTS) Server was designed from the ground up as a standalone TCP/IP module to provide fast, reliable, and simple text-to-voice file format conversions. It functions as a helper (server) module for the CellCentric™ VoxMail application.

The TTS conversion engine is intentionally decoupled from the core functionality of VoxMail to achieve reliability, scalability, and to relieve the VoxMail application from an unnecessary processing burden: data manipulation that does not necessarily need to occur in the same process space as the parent application. VoxMail handles the main logic and dispatches any processing requirements to external modules over TCP/IP channels.

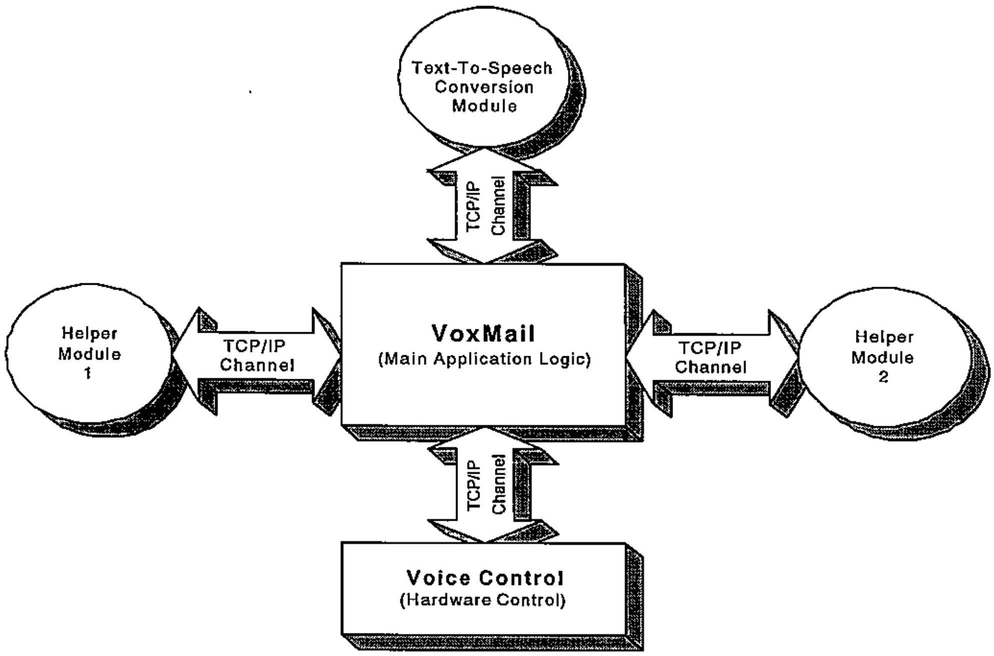
A voice application (VoxMail) can submit plain text for conversion simply by connecting to the TTS Server (over TCP/IP) and transmitting all sentences requiring conversion, one after the other. After issuing the processing command, the TTS Server converts the text into a voice file(s) that can be played by the voice application using virtually any hardware (i.e., Voice boards) available on the market.

Mainstream voice boards (with their API's) usually support most common voice formats. However, where the output voice files from the TTS Server do not match any of the voice file formats supported by the hardware, the CellCentric™ Sound Converter module can

be used to convert those voice files to the required format. (The Sound Converter is part of the CellCentric™ suite of messaging products and can function as a helper module to the VoxMail application.)

Voxmail Architecture

The below given figure illustrates the role of the TTS server as a module of the VoxMail application. Other helper modules include the Sound Converter and the Document Converter. VoxMail implements the main application logic (process sequence) and voice control (hardware control). Additional processing is delegated to other satellite modules as required.



TTS Architecture

The core of the server (that currently performs the conversion) uses the L&H™ (Lernout and Hauspie) API and Microsoft SAPI. Third-party TTS libraries that adhere to Microsoft's SAPI standard are easily integrated (with minor changes in program code).

Once a TCP session with the server has been initiated, multiple text-to-voice conversions can be processed. The generated sound files are sent back to the client application using a different implementation (depending on the needs). Files can be stored, using standard OS file transfers, on the directory configured for VoxMail. VoxMail can be installed in the same computer as the TTS server, or on a separate machine, depending on the specific deployment requirements. Files can also be dropped to a remote directory (using the CellCentric™ Streaming Engine) over a TCP/IP connection.

CellCentric Scalability

CellCentric Scalability Architecture

The CellCentric™ platform's goals are to provide significantly more scalability, processing speed, and reliability thanwith simple monolithic and semi-monolithic messaging systems. To meet these goals, CellCentric™ leverages three powerful architectural design patterns:

- Advanced Component Granularity
- Peer Component aggregation
- Service Level Component Interaction

Advanced Component Granularity

Most of the core programs within CellCentric are divided into well-defined, task-oriented modules that collaborate over the network. For example, where another messaging solution would use one program for SMTP protocol handling, CellCentric splits this functionality into multiple executable programs collaborating across the network. At the time this document was written, the SMTP process included as many as seven standalone modules -- each responsible for a very specific and well-defined task.

From an administrative point of view, all components are logically aggregated to form a few virtual servers regardless of the actual number of components required on the back end. This allows for simple administration of a massively scalable system and still preserves the ability to fine-tune the system's performance; though fortunately, tuning is generally not required as CellCentric™ is built on a self-tuning model to automatically adjust component behavior for a given operating context.

Peer Component Aggregation

In addition to software-based granularity, CellCentric™ allows manageable horizontal scalability through Peer Component Aggregation (PCA). The PCA model provides an even CPU load across multiple servers running the same components in parallel. PCA allows for true scalability since the processing load is shared across multiple servers at a very granular level.

Key to PCA is the CellCentric™ Queue Balancer (CQB) service. CQB is a CellCentric™ component whose role is to ensure that every other component in the system receives an equal distribution of work. And since each component communicates with CQB before handling any new task, a load can be optimally balanced in real-time across the entire system.

Guaranteed Component Interaction

Built-in pervasive support for scalability and reliability is provided through SetNet's CellCentric™ Resource Allocator (CRA) technology. CRA protects against component communication failure by automatically failing over to secondary components.

Service Registration

Each component providing services to other components registers itself with the CRA. When component service A requests processing from component service B (e.g., a voicemail server that needs to send a voicemail by e-mail through an SMTP relay) it queries the first available CRA server for the location of the most available network component service B (e.g., the voicemail server will query CRA to receive information on the least loaded SMTP relay that will forward the voice message to the recipient).

Dynamic Service Redirection

CRA is not only used for the initial connection of one network component to another, but also during the entire conversation between the components. This allows dynamic task redirection within the component-to-component conversation. For example, if a subscriber listens to a document through a given Text-To-Speech (TTS) server and the TTS server that processes the conversation suddenly fails, the next sentence will automatically be processed by another CRA-registered TTS server. Moreover, the faulty TTS server will be taken off-line automatically by the CRA and appropriate alerts will be sent to network monitoring components.

Kcentrik™

Kcentrik™ is a communication framework used to provide network communication between servers using a functional addressing scheme rather than traditional IP (logical) addressing. The CellCentric™ platform leverages Kcentrik™ for two purposes:

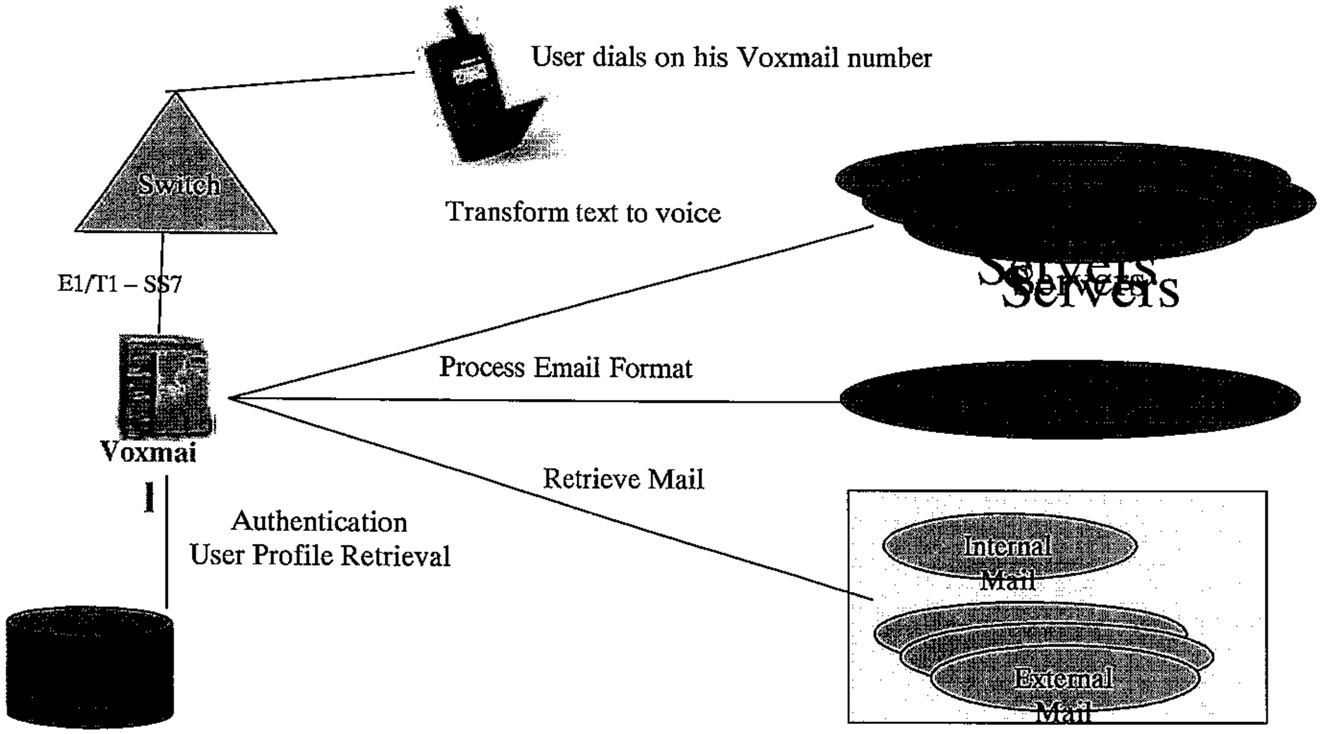
- Services configuration Management
- Services resource Allocation

Configuration Features

Kcentrik™ enables any compatible server to get its configuration from the platform without knowing anything about its environment (i.e., the location of the Configuration server).

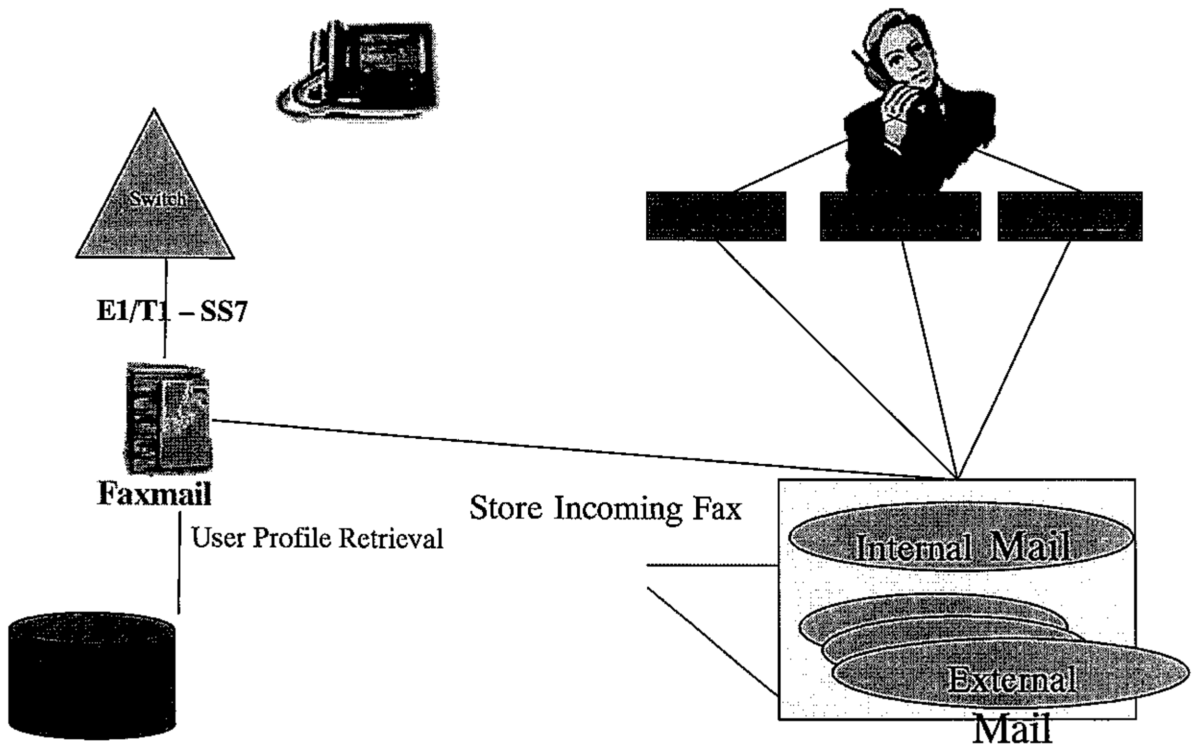
Call Flows

VoxMail Call Flow



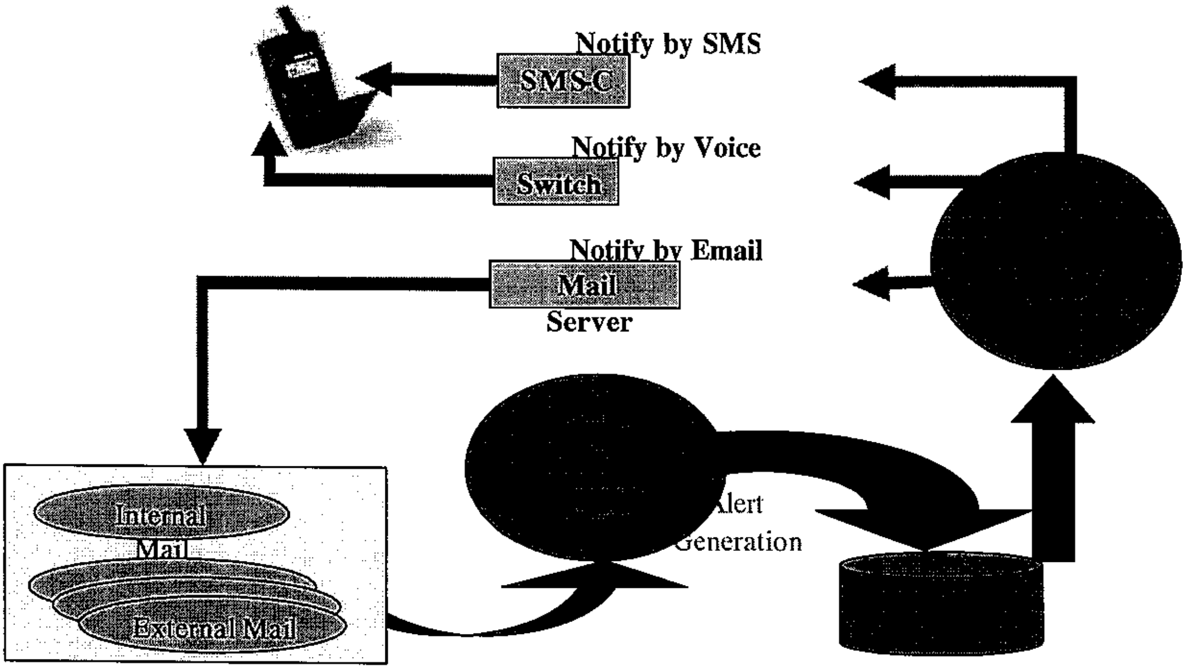
1) User Calls on a Predefined number to check his mail account.
2) The Call gets terminated on an Intel Dialogic Board, with VoxMail module running on the same machine. The Dialogic and Voxmail can be separated for High availability and scalability purpose
3) The User is authenticated and his profile is retrieved from the database (MS SQL or Oracle).
4) The Mails are retrieved from the predefined mail accounts as provisioned by the subscriber.
5) The Mails are send by Voxmail module to media converter application for conversion of email format (.doc or .rtf) into text format. Depending on the design this module may reside on the same machine or on a different machine.
6) The Converted file is send to TTS for transforming it to voice. Depending on the design this module may reside on the same machine or on a different machine.
7) The users can browse, delete, reply, reply with predefined replies, forward the mails.

FaxMail Call Flow



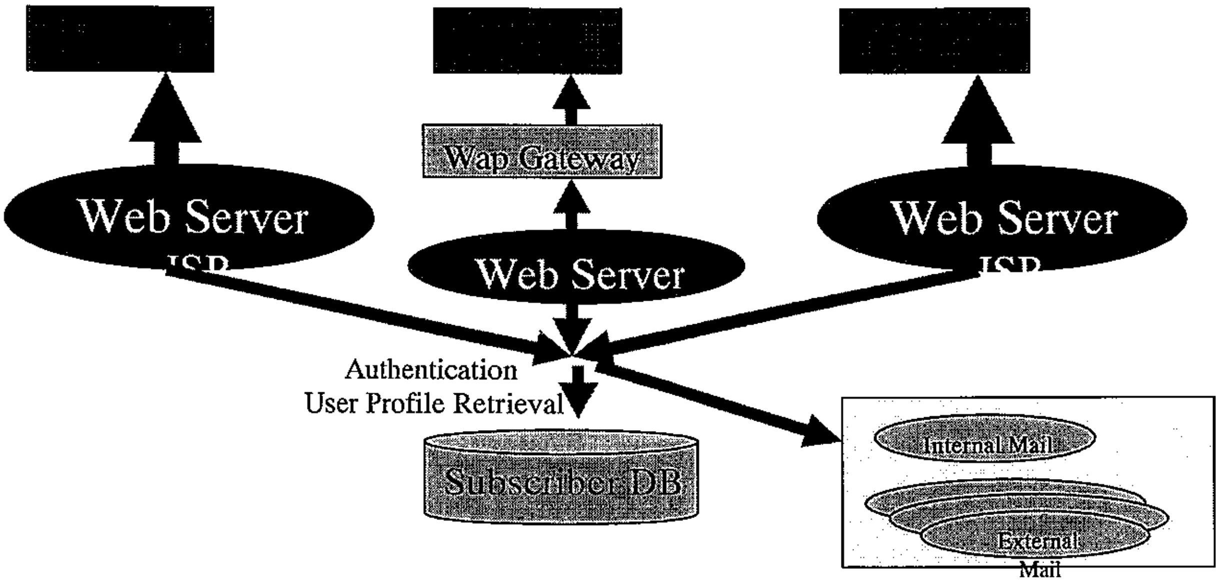
1) The Sender sends the FAX on users predefined fax number.
2) The FAX Call is terminated on an Intel Dialogic Board, with FAXmail module running on the same machine. The Dialogic and Voxmail can be separated for High availability and scalability purpose.
3) The User profile is retrieved based on the number dialed by sender.
4) The FAX is converted into an .tiff format and send to users mailbox.
5) Based on the user's preference setting and notification can be send to user.
6) User can retrieve his FAX as a mail kept in his mailbox through VoxMail, Webmail (web-based mail access) or WAPMail (using wap based phones).

Notification Call Flow



1) Mailbox Monitor constantly monitors mailboxes for predefined conditions configured by the user.
2) Generated alerts on predefined conditions are entered in the database.
3) The Notification Engine module refers to database for any new alerts delivery.
4) The User configures the notification delivery preferences.
5) Based onusers preference the alerts can be delivered to him with Voice on his phone, SMS messages or as a mail in his mailbox

Webmail, Wapmail, PDAmail Call Flow



1) The Users can check their email through Internet using Webmail module. The Webmail module is hosted on web server. Apache or any other web server with support of JSP can be used.
2) The User is prompted for username and password and authenticated against the subscriber database.
3) User profile is retrieved and mails are fetched from preconfigured mail accounts.
4) WAPmail module needs a Wap Gateway, which can be outsourced or installed in the local premises.
5) Users can check their mails through any WAP compatible phones.
6) PDA users can check their mails through PDAmail module.
7) The PDA mail module is hosted on web server.

Case Studies

BELGACOM proximus belgacom mobile

Situation

Proximus, a leading Belgian wireless operator with close to 4 million subscribers wanted additional enhanced services for their current wireless offering, which consisted only of voicemail and SMS access. In July 2000, Proximus decided to choose SetNet over the incumbent voicemail provider, which was also offering unified messaging (UM) solutions.

Concerns

Proximus, as many other operators had concerns regarding Unified Messaging (UM). A key one was the user adoption. Therefore it was critical that the operator be able to minimize its capital expenditure and select a strategic component of UM which would be "the hook" to accelerate user adoption. Because of the uncertainty in user adoption, it was necessary to have a system which although initially could service a small population of users, was robust enough to scale to millions of users. The system also needed to interface in a complex environment with disparate legacy systems, which were cost prohibitive to replace. Also imperative was to have an open system, which could interface to legacy systems but also could be upgraded to work with the new 3G networks in the future.

Solution Offered

VoxMail™ product with:

- Ability to listen to emails over the phone
- Multiple language recognition (Dutch, French, English, and German) on a per phrase basis
- Multiple attachment type recognition including MS Word, PowerPoint, and Adobe Acrobat
- Reply to an email by voice (Sound File)
- Forward email to Fax
- Fully customizable and multiple standard replies to emails

Customer Quotes

"SetNet's VoxMail™ technology automatically adapts to multiple languages to supply the correct electronic voice," said Stephan Desmit, Director Mobile Data Group, Proximus Belgacom Mobile. "This functionality is extremely important to us due to our multi-cultural customer base. Now customers can actually listen to their emails anywhere, anytime from their mobile

Conclusion

The CellCentric enhanced messaging solution provides a single multimedia mailbox for all types of messages

CellCentric solution is modular, truly scalable and fully load balanced

CellCentric operates in any size system and seamlessly integrates with existing infrastructure

CellCentric is field proven

Why HP Intel Solution Center?

SetNet's CellCentric is a complex set of multimedia and cross-media features and functions

The success of solution depends on right alignment in between the solution and business needs

HP Intel solution center with proven expertise and infrastructure work with organizations achieve the right alignment in between technology and business needs

Organizations benefit from already deployed and benchmarked configurations on HP and Intel architecture

Appendices

For Further information kindly contact HP Intel Solution Center, Further reading is available at http://www.setnet.com/