

# . Integrating Voicemail Systems

A white paper describing the integration of  
heterogeneous voicemail systems

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# 1 Introduction

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## 1.1 Background

A history of mergers and acquisitions in the telecommunications industry has left many large carriers with voice messaging networks and systems from multiple vendors and with differing generations of technology. Carriers are looking for ways to offer broader messaging capabilities to subscribers without losing the investment in these legacy voicemail systems – but these systems were rarely designed to operate in a heterogeneous environment. Their lack of interoperability means that it is often difficult to offer even basic inter-system messaging.

Integrating wireline and wireless voicemail systems presents a similar problem. As individual carriers increasingly play a role in both wireline and wireless arenas, it becomes important to present a coherent messaging interface in both spaces to present a consistent identity, and simplify the user experience.

Carriers need to find ways to reduce operating costs. It may not be viable to migrate all users to a single voice messaging system, but by integrating the current, disparate systems, the carrier can simplify the administration of the combined platforms, and this reduces the costs of administration.

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## 1.2 About this document

This white paper sets out

- the requirements for integrating voicemail systems
- a solution that Data Connection has created (in partnership with a large US carrier) that meets these requirements.

The specific requirements of any particular voicemail integration project will differ according to the carrier's objectives and according to the subset of legacy equipment. The solution presented in this white paper cannot be a comprehensive design to fit all scenarios, and the development of any integration solution will always require close consultation with the individual carrier to ensure an appropriate system is deployed.

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## 1.3 About Data Connection

Data Connection has an unparalleled level of experience in legacy voicemail integration. As well as working with large North American telecommunications companies on solutions for over 10 years, we are also a key software messaging and directory technology supplier to several of the primary voicemail equipment manufacturers.

Data Connection is the leading independent developer and supplier of conferencing and next-generation messaging platforms, including voicemail, email, and unified messaging solutions. The company is also the leader in portable protocol stacks such as IP Routing, MPLS, ATM, SIP, MGCP/Megaco, SCTP, and SNA. Customers include SBC, Verizon, Colt, Microsoft, IBM, Cisco, Fujitsu, Hewlett-Packard, Hitachi, Lucent, Nortel Networks, SGI, Siemens and Sun.

Data Connection was founded in 1981 and is privately held. It is headquartered in London UK, with US offices in Reston, VA, Alameda, CA and Dallas, TX. For the financial year to August 31, 2003, earnings were \$12M on revenues of \$39M, representing the company's 22nd straight year of strong profitability supplying telecoms technology to carrier and OEM customers.

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## 2 Requirements

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### 2.1 Why integrate messaging systems?

Many carriers find themselves in the position of operating two (or more!) messaging platforms, and it may not be viable to migrate all users to a common platform.

In heterogeneous voice messaging networks, a carrier's subscribers are spread across equipment of different types, from different manufacturers, and with varying degrees of out-of-the-box interoperability. Integrating these heterogeneous messaging systems allows inter-system messaging - the ability of one voice messaging subscriber on platform 'A' to send a message to another subscriber on platform 'B'.

- This may be desirable as a new end-user feature in itself. For example, a carrier operating both wireless and wireline networks can introduce the ability to send messages between both platforms.
- A carrier may wish to introduce a next-generation platform to offer new services. By integrating with the legacy system, only a subset of subscribers (typically those who are paying for new features) needs to be migrated to the new system, without loss of function to existing subscribers.

Integrating messaging platforms can also benefit the carrier by providing a common administration platform, simplifying operations and therefore reducing the ongoing costs.

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### 2.2 Overview of requirements

For inter-system messaging to be viable, the following features are required.

- A common transport for platform 'A' to communicate with platform 'B'.
- A way for subscribers on each platform to address messages so that they are routed across the common transport correctly.
- Either a common message format, or a mechanism to convert message formats while relaying messages between the two platforms.
- A common management platform to allow operators to manage the disparate systems from a common interface and to allow easy migration of configuration information between the systems.

In addition, an integrated voicemail system must conform to any regulatory requirements.

The remainder of this section discusses each of these items in more detail.

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## 2.3 Common transport

Legacy voicemail equipment was designed to work with the public switched telephone network (PSTN). The common interfaces are PSTN interfaces such as PRI and SMDI connections. These interfaces remain the primary way that users interact with the voicemail platform, but they are not a convenient transport mechanism for server-to-server inter-system messaging between dissimilar platforms.

Fortunately, the vast majority of the voice-messaging equipment deployed today exposes some level of IP connectivity. IP offers the following benefits.

- Carriers typically have IP backbones that can link geographically dispersed voicemail platforms.
- IP allows the use of standard general-purpose servers to integrate the legacy platforms without the need to introduce further PSTN-VoIP gateways.
- IP offers open standards for store and forward messaging.

If IP-based connectivity is not available on one of the platforms in the heterogeneous network then it is sometimes possible to migrate those subscribers who are on that ‘non-IP’ platform to an IP-enabled platform with spare capacity.

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## 2.4 Subscriber database integration

Each voicemail system will have its own subscriber database, with an associated provisioning and billing/reporting system. In a heterogeneous network, a carrier may have implemented a meta-provisioning layer that presents a common provisioning interface across all platforms. Even so, it is still usually true that the subscriber information is maintained in several segregated stores, each store associated with one platform, geographical location, or operational center.

To facilitate and control inter-system messaging in a heterogeneous environment, it is very useful to have a consolidated and unified store of all subscriber information. Typically, this is a centralized **LDAP** (Lightweight Database Access Protocol) directory service that provides a central point of provisioning and subscriber management. This directory service also ensures that when sending or receiving messages between platforms, appropriate steps are taken to

- route the message correctly in the messaging backbone
- address the message correctly for delivery on the target platform
- map the originator address correctly to allow message reply function
- perform suitable message body conversion if the message format is different between the two platforms
- apply any regulatory messaging restrictions.

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## 2.5 Message format

### 2.5.1 Messaging standards

Voicemail systems that offer IP-based connectivity typically use one of the following open standards.

- **AMIS-D** – a definition for voice messaging using the X.400 messaging protocols. It has fallen out of fashion in a similar way to the X.400 protocol itself, but a few carriers still have AMIS-D systems in their voice messaging networks.
- **VPIM** – a definition for voice messaging using the SMTP/MIME messaging protocols. SMTP is the most prevalent system for e-mail, and VPIM is becoming the protocol of choice for inter-system voice messaging. Many voicemail equipment manufacturers offer VPIM interfaces today, or at least have one in development.

If a carrier's voice messaging network includes a mix of AMIS-D and VPIM equipment then an AMIS-D <-> VPIM gateway is required (which will include an X.400<->SMTP gateway).

Even in a network comprised completely of VPIM-capable equipment from different vendors, the differing interpretation of open standards often prevents directly connecting these systems and achieving seamless interoperability. This can be due to issues such as the disjoint subscriber databases, differing addressing schemes, or even different codec support for the encoding of voice body parts.

### 2.5.2 Address transformation

The method that a voice messaging system uses to address internal mailbox-to-mailbox messages is not always the same as the scheme used when the message is to leave the platform (even in homogeneous environments). Internally the platform will typically use a subscriber's phone number as the unique identifier, as this is what the originator will typically enter, or locate via a short-code, when composing a message (or it will be available in the header of a message to which they are replying).

Mailbox-to-mailbox messages that leave the platform over an IP interface will typically have an e-mail based addressing scheme (SMTP for VPIM systems, and X.400 for AMIS-D and some other legacy platforms). This addressing scheme is usually designed to facilitate server-to-server message relay in homogeneous environments and may not be a suitable or interoperable addressing scheme for messaging between different vendors' solutions. This is clearly true when going between AMIS-D and VPIM, but it is also true in many AMIS-D only or VPIM-only heterogeneous architectures.

The message gateway used to connect the legacy systems will typically be responsible for performing transformations on the incoming 'recipient' and 'originator' addresses to accommodate any incompatibilities in addressing schemes employed on the different platforms. The 'originator' address is transformed to allow the use of this address by the recipient for message reply operations.

### 2.5.3 Body part conversion

Just as the voice message can be addressed in different ways, the actual contents of the message can be encoded in varying ways by different systems. The key differences are as follows.

- Messaging standard (e.g. VPIM which uses MIME body parts, whereas AMIS-D uses P22 body parts).
- Body part encoding (e.g. a MIME VPIM attachment may be 'binary', 'base-64', or 'quoted-printable').
- Voice encoding, i.e. the codec used (e.g. G.711, G.726, 32k ADPCM, etc).

If different systems in the voice messaging network do not have a common format then the messaging gateway will have to be able to convert the message contents during message relay. This may require on-the-fly voice message transcoding, which (depending on the codecs involved) can be a high computational overhead.

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## 2.6 Common management

In order to provide inter-system messaging, subscriber addressing information from all of the disparate messaging systems needs to be accessible from each. To achieve this, the subscriber information needs to be combined in a centralized database (or if this is not feasible, the separate databases need to be at least synchronized and accessible by all message systems

Similarly, billing systems may also need to be coordinated.

Operational costs can be reduced if all subscriber administration and billing can be handled through a single, combined system.

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## 2.7 Regulatory requirements

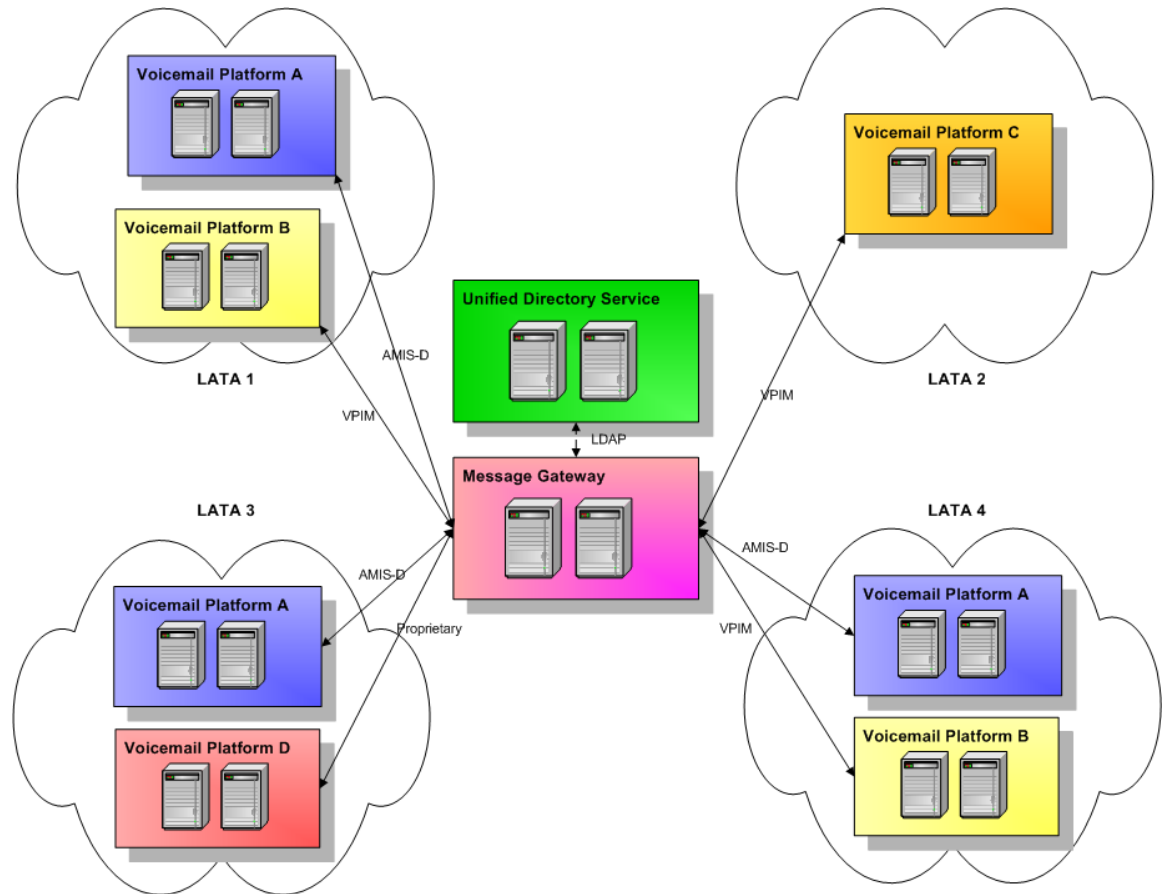
In the United States, regulatory restrictions mean that certain carriers are not allowed to provide mailbox-to-mailbox voice messaging between Local Access Transport Areas (LATAs). It is therefore a legal requirement for some carriers that, if they are allowing subscribers to send inter-system messages, they determine the LATA location of originator and recipient, and prevent message relay when they are different.

In certain areas, a carrier may have been given long-distance (LD) relief, and may be allowed to offer inter-LATA messaging. It is also true that even if a carrier is prevented from providing public inter-LATA messaging, the carrier is allowed to operate as its own long-distance provider within the organization. The legacy voicemail integration solution should therefore offer the following features:

- Correct identification of originator and recipient LATA
- Blocking of inter-LATA messages where no LD relief exists, and where either recipient or originator is not a carrier employee.

## 3 Integration solution

This section provides an overview of a voicemail integration solution developed by Data Connection.



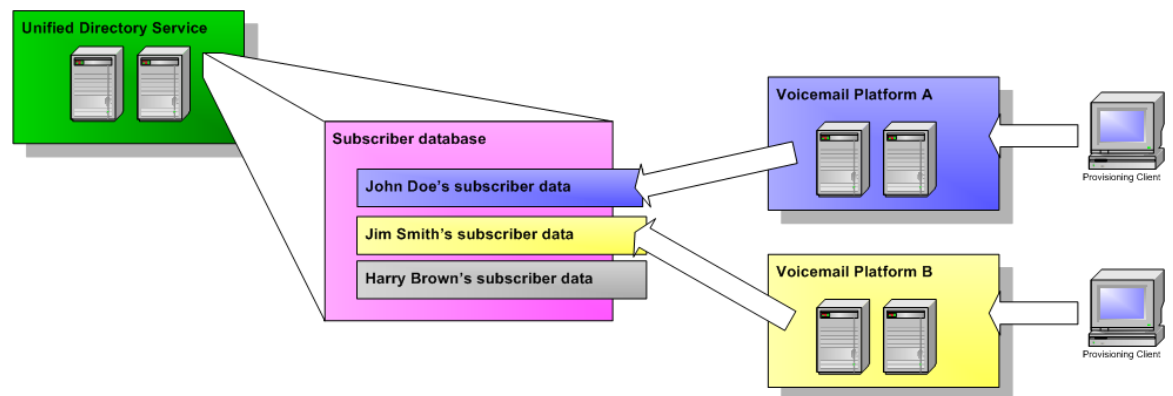
**Figure 1. Integration of Legacy Voicemail Platforms**

The two key components in the solution are:

- Unified Subscriber Directory
- Messaging Gateway

## 3.1 Unified subscriber directory

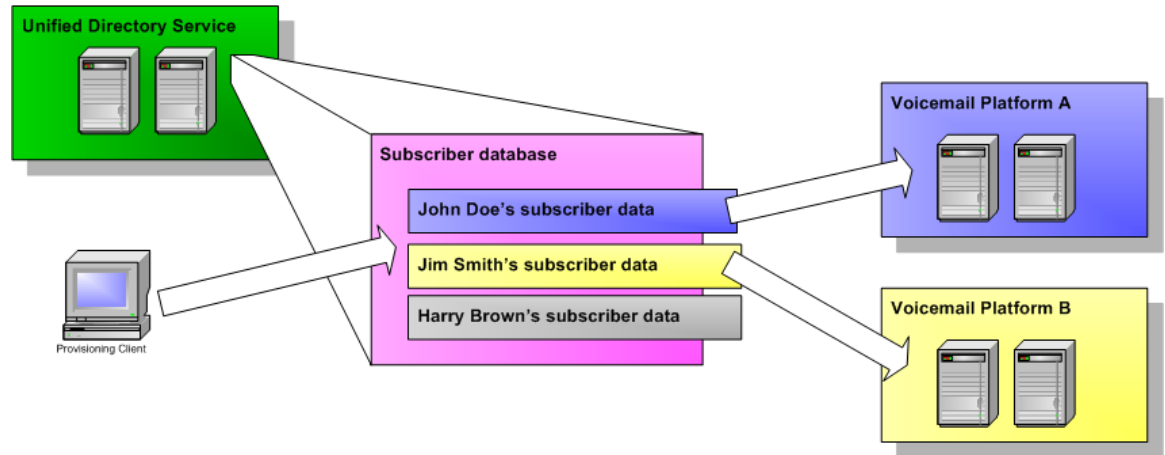
Data Connection's directory server DC-Directory is used as a central store for the collected subscriber information from all legacy voicemail systems. This can replace the subscriber store of the individual platforms, or they can co-exist using synchronization to ensure that the data is current in both locations. The method of synchronization is dependent on the interfaces that the legacy platform exposes. Initial population requires a bulk load of data into DC-Directory, and then future modifications are made by live updates, or scheduled incremental updates.



**Figure 2. Bulk Load of Unified Directory**

Bulk load requires a suitable mechanism for export of the subscriber data from the legacy voicemail platforms. This can be as simple as dumping the subscriber database to a fixed format file. This can then be pre-processed into a format suitable for import into the Unified Directory. The pre-processing step can be used to flag any data inconsistency and to normalize any variation in data formats from differing legacy systems.

One of the benefits of deploying a unified subscriber directory is that legacy platform provisioning may be centralized. By providing synchronization in the opposite direction, the unified subscriber directory may become the central point of provisioning and billing for all platforms.



**Figure 3. Centralized Provisioning through the Unified Directory**

In some situations it may even be possible to remove the legacy platforms subscriber data store and have the legacy platform contact the Unified Directory for subscriber information. This reduces data duplication, but it depends on the legacy voicemail platform having enough flexibility to support an external directory – either by using LDAP calls directly, or by exposing a proprietary API or protocol that can be mapped to a set of LDAP calls.

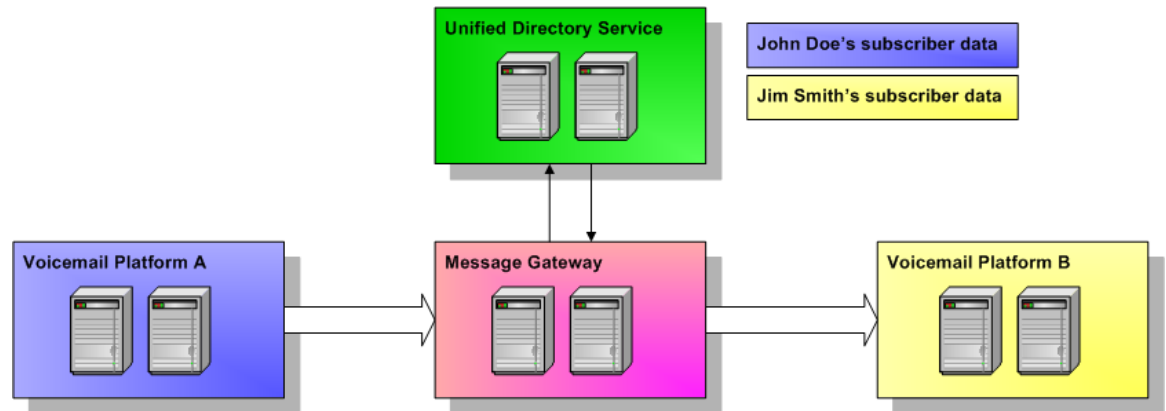
If inter-LATA messaging is under regulatory restrictions then additional subscriber information must be available in the unified subscriber directory that is not normally stored per-subscriber in the legacy platforms. These additional fields can be derived or generated from other sources:

- LATA
- Carrier employee.

In situations where long-distance relief has been granted for some LATAs, the unified directory will also be the store for the data detailing which inter-LATA restrictions are in place.

## 3.2 Message gateway

Data Connection's integrated messaging server, MailNGen/Connect, provides the message gateway function that enables inter-system voice messaging.



**Figure 4. Message Gateway Operation**

When John Doe sends a voice message addressed to subscriber Jim Smith, Platform A identifies Jim Smith as being a subscriber on a different platform, and so routes the message over IP to the message gateway. The message gateway receives the message and compares the LATA information of John Doe and Jim Smith to check that inter-system messaging is allowed.

Depending on the type of systems Platform A and B, the following steps may be performed:

- message type conversion (e.g. SMTP to X.400)
- originator and recipient address transformation, for correct message routing and reply function
- body part conversion and/or transcoding.

MailNGen/Connect can handle a range of message conversions, including:

- Voice messaging system: VPIM, AMIS-D, proprietary
- Messaging transport: SMTP, X.400
- Codec: G.711, G.726, 32kbps ADPCM, 16kbps RELP
- Encoding: base-64, binary, quoted-printable, ASN.1/binary.

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## 3.3 Key features

The key features of the MailNGen/Connect solution are as follows.

- Connectivity and interoperability
  - Supporting the key internet standards (RFCs) and ITU standards (X.400) for voice and electronic messaging
  - Seamless gatewaying and migration capability between messaging platforms from a variety of vendors including Comverse, Unisys, DigitalSound (PulsePoint) and Octel legacy platforms and multi-media internet-based messaging systems
  - Directory-enabled, using LDAP for all configuration and subscriber information
  - Mature, extensively tested protocol engines (for both conformance and interoperability)
- Multi-platform support
  - Solaris
  - HP-UX
  - Linux
- Powerful messaging services
  - Scalable
  - High performance - gatewaying many messages per second
  - Reliable - continuous operation
  - Efficient - providing single-instance store for multi-recipient messages
- Operational management
  - System monitoring

System alarms and operational statistics are generated. This information could be displayed by connecting the server to standard management workstations (such as HP OpenView).
  - Connection control and bandwidth management

Automatic throttle-back protects against DoS attacks, and protection against open relay lessens the possibility of exploitation by spammers.

- Fault reporting

A series of diagnostic logs is created to provide the information needed to accompany a fault report to ensure rapid resolution of a problem.
- System control

Local management commands are provided to control the execution of the server.
- Service management

A permanent log of the system's operation is provided for accounting and auditing, and to enable secure message tracking.
- Web management

A Java-based web console allows both system monitoring and system control.
- Configuration
  - Via a simple Windows GUI application, which defines which remote messaging servers MailNGen/Connect connects to and the set of rules it uses to map email addresses and route messages.
- Support and consultancy
  - Product wholly developed by Data Connection, so our engineers are highly knowledgeable about the system
  - Comprehensive support and maintenance service
  - Professional consultancy services

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## 4 Conclusion

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Many carriers and service providers find themselves in a position where they have a variety of different and at best semi-compatible voicemail systems which they would like to upgrade both to reduce operating expenses and to offer new services, without losing their considerable investment in these legacy systems.

One solution to this problem is to enhance the legacy systems so that they can communicate directly and be managed through common protocols, such as VPIM and LDAP. However, in practice, this can be difficult to achieve.

- Every legacy system has to be upgraded to work with every other system deployed in the network.
- Many of the common standards are open to interpretation, meaning that two implementations of the same standard may well not interoperate, which increases development and testing costs in the legacy systems.
- Vendors are reluctant to invest significant development dollars in old equipment that is at or close to being end-of-life – both because of the sheer cost and the non-strategic nature of the investment.

An alternative solution is to use a single intermediary system that is dedicated to talking the right language to each legacy system. This can provide a cost effective and timely solution to the problem.

- It reduces the number of different interconnects that have to be agreed.
- Providing that the legacy systems provide some level of inter-messaging system communications, it is possible to fully integrate the legacy systems together without requiring any changes to them. The intermediary system can provide all of the required compensations for interoperability.
- The cost of implementing an intermediary system that has been specifically designed to interoperate with a wide variety of systems is likely to be a fraction of the cost of upgrading a legacy system.
- Unifying the management of the disparate systems through the use of a master directory (for example, using LDAP) can also improve and simplify the integration with other back office systems such as those for billing and management. It also opens the way for adding other enhanced services such as subscriber self-care over a web-based interface.

Data Connection has a wealth of experience in integrating together legacy voicemail systems. Through a combination of providing both off-the-shelf products and development services Data Connection can help Service Providers develop their voicemail capabilities in a timely and cost effective manner which preserves and maximizes the use of their existing capital investments.