Sun Microsystems, Inc

JavaMail API Specification

This is the JavaMail 0.4 API specification.

It describes features and architecture for the JavaMail API.

Please send feedback to *javamail@sun.com*

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1

Introduction

In early 1995, the prerelease version of the Java™ programming language took the computer world by storm. A platform-independent language with syntax similar to C and C++ and including an extensive class library, interested developers widely downloaded the JDK from the Sun web site and applied it to thousands of programming tasks, large and small. Java worked.

In the two years since Java's first release, Java has matured to become a complete platform. Java now can provide a complete operating system, a distributed computing with RMI and the CORBA bridge, and a component architecture including JavaBeans, the server toolkit, and the WebTop environment. Having proven successful, many Java-based applications have matured with the language, and now require a Java-based mail and messaging framework. The Java Mail API described in this specification answers that requirement.

The Java Mail API provides a set of abstract classes defining objects which comprise a mail system. The API defines classes like Message, Store and Transport. The API is designed to be extended and can be subclassed to provide new protocols and functions, when necessary. In addition, the API provides subclasses of the abstract objects that can be considered a part of the Java Mail package. These subclasses (including MimeMessage and MimeBodyPart) implement widely-used Internet mail protocols and specifications (RFC822, RFC2045) and are ready to be used in application development.

1.1 Target Audience

The JavaMail API is designed to serve several audiences:

- Developers interested in building Java-based mail and messaging applications, whether client, server or middleware.
- Application developers who want to "mail-enable" their applications.
- Service Providers who want to implement specific protocol implementations. For example; a telecommunications company can use the Java Mail API to implement a PAGERTransport protocol, which sends mail messages to alphanumeric pagers.

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Goals and Design Principles

The Java Mail API must satisfy a wide range of needs - from allowing simple applications to be "mail enabled" easily, to enabling the creation of sophisticated mail user interfaces. The API must be easy to learn and begin to use. The API must include appropriate convenience classes, which encapsulate common mail functions and protocols. Integration with other parts of the Java platform also makes it easier to use the Java Mail API in combination with other Java APIs.

The Java Mail API is therefore designed to satisfy the following development and runtime requirements:

- Simple, straightforward class design is easy for a developer to learn and implement.
- Use of familiar concepts and mechanisms support code development that interfaces well with other Java APIs.
- Lightweight classes and interfaces make it easy to enable any application to handle basic mail-handling tasks.
- Also supports the development of robust, transport-intensive networking applications which can handle a variety of complex mail message formats.

The Java Mail API strikes the right balance between simplicity and sophistication. It draws heavily from IMAP, MAPI, CMC, c-client and other messaging system APIs - many of the concepts present in these other systems are also present in the Java Mail API. The Java Mail API is familiar to users of these other systems. The Java Mail API is simpler to use, however; because it uses Java language features not available to these other APIs, and because it uses the Java object model to shelter applications from implementation complexity.

Java Mail API design is driven by the needs of the applications it supports - but it is also important to consider the needs of API implementors. It is critically important to enable the implementation of Java-based messaging systems that interoperate with existing messaging systems-- especially Internet mail. It is also important to anticipate the development of new messaging systems. The Java Mail API needs to conform to current standards while not being so constrained by current standards that it stifles future innovation.

The Java Mail API supports many different messaging system implementations - different message stores, different message formats, different message transports. The Java Mail API provides a set of base classes

and interfaces that define the API for client applications. Many simple applications will only need to interact with the messaging system through these base classes and interfaces.

Java Mail subclasses can expose additional messaging system features. For instance, the InternetMessage subclass exposes and implements common characteristics of an Internet mail message, as defined by RFC822 and MIME and other Internet standards. JavaMail base classes can be further subclassed to provide the implementations of particular messaging systems, such as IMAP4, POP3, and SMTP.

The base Java Mail classes include many of the convenience APIs that simplify their use. The implementation subclasses of the Java Mail API is therefore not required to provide implementations for all of the Java Mail API, and is left to concentrate on the core classes that provide the required functionality for that implementation.

Alternately, a messaging system can choose to implement all of the Java Mail API directly, allowing it to take advantage of performance optimizations possible, perhaps through use of "batched" protocol requests. The IMAP4 protocol implementation takes advantage of this approach.

The Java Mail API uses the Java language to good effect to strike a balance between simplicity and sophistication. Simple tasks are easy, and sophisticated functionality is possible.

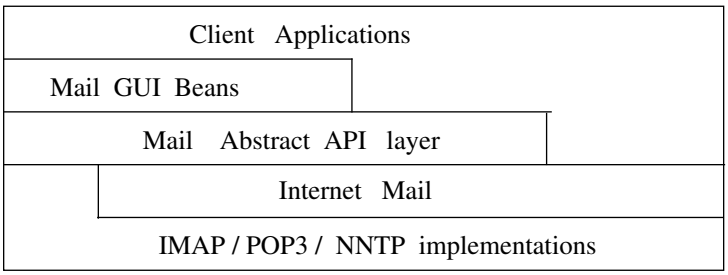
3

Architectural Overview

This Section describes the JavaMail architecture.

This Specification defines an interface to a messaging system, including system components and interfaces. It does not define any implementation. However; the JavaMail API includes a package that implements RFC822 and MIME Internet messaging standards and protocols, and can be considered part of the JavaMail class package.

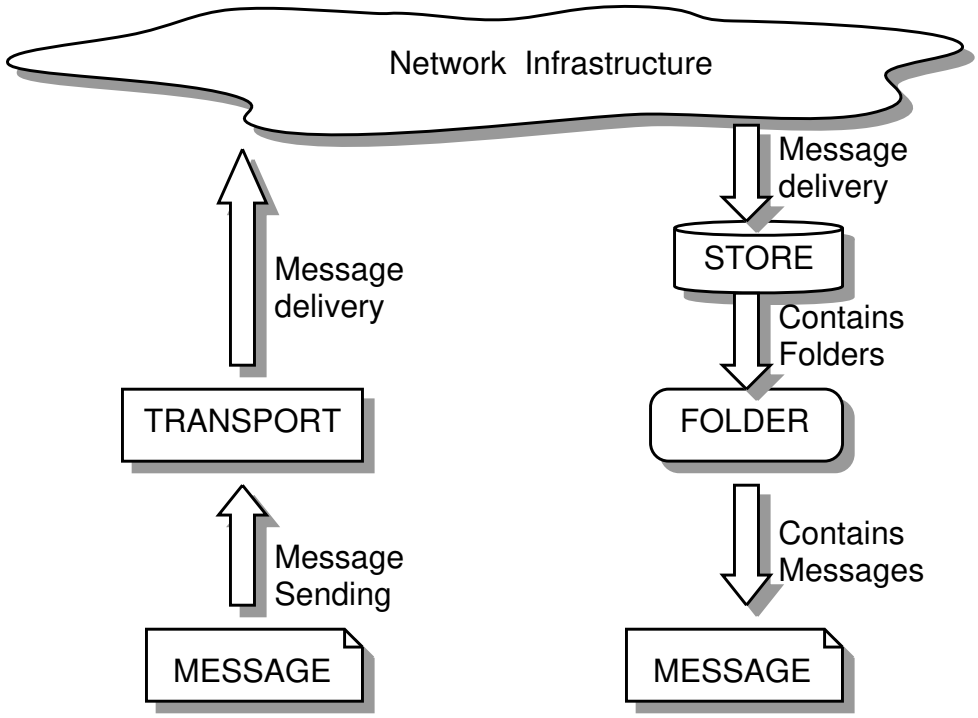
The JavaMail architectural components are layered as shown below:



Clients use the Mail API and Service Providers implement the API. The layered design architecture allows clients to use the same JavaMail API calls to send, receive and store a variety of messages using different data-types, from different message stores, and using different message transport protocols.

3.1 The JavaMail Framework

This figure illustrates the JavaMail Architecture framework.



The framework supports all the key operations of a typical messaging system:

- Storing and retrieving messages
- Composing and sending messages
- Transporting messages

Note: This framework does not support a message delivery function.

The JavaMail framework also does not define Security, Disconnected operation, Directory services or Filter functionality. Security, Disconnected operation and Filtering support will be added in future releases.

3.2 Major JavaMail API Components

This Section reviews the major components comprising the JavaMail architecture.

3.2.1 The Message Class

Message is an abstract class implementing the Part interface. Message defines a set of standard attributes used as message headers, and a content block. Defined attributes include the sender and recipient addresses, structural information about the Message, and the content-type of the Message body. The JavaMail API also provides Message subclasses which support specific messaging implementations.

interacts with its content though an intermediate layer - **the DataTyping framework**. Separating content from its formatting information allows a Message object to handle any arbitrary content and to transmit it using any appropriate transmission protocol, by using calls to the same API methods. The Message recipient usually knows the content data type and format, and knows how to handle that content.

The JavaMail API also supports multipart Message objects, where each Message part defines its own set of attributes and content.

3.2.2 Message Storage and Retrieval

Messages are stored in Folder objects. A Folder can contain subfolders in addition to messages, thus providing a tree-like folder hierarchy. The Folder class declares methods which fetch, append, copy and delete Messages. Folder can also fire events to components registered as event listeners.

The Store class defines a database that holds a folder hierarchy together with its messages. The Store also specifies the *access* protocol which accesses folders and retrieves messages stored in folders. Store also provides methods to establish a connection to the database, to fetch Folders and to destroy a transport connection. Service providers implementing Message Access protocols (IMAP4, POP3 etc.) start off by subclassing Store. A user typically starts a session with the Mail system by connecting to a particular Store implementation.

3.2.3 Message Composition and Transport

A client creates new Message by instantiating an appropriate Message subclass. It sets attributes like the recipient addresses and Subject, and then inserts content into the Message object. Finally, it sends the Message by invoking it's `send()` method.

The Transport class models the transport agent that routes a message to its destination addresses. This class provides methods to send a Message to a list of recipients. Typically, a mail client does not have to know about transports, invoking the `send()` method on a Message object identifies the appropriate transport based on its destination address.

3.2.4 The Session Class

The Session class defines global and per-user Mail-related properties which define the interface between a mail-enabled client and the network. JavaMail system components use the Session object to set and get specific properties. The Session class also provides a default authenticated session object which desktop applications can share. Session is a final concrete class. It cannot be subclassed.

The Session also acts as a factory for Store and Transport objects which implement specific access and transport protocols. By calling the correct factory method from a Session object, the client can obtain Store and Transport objects that support specific protocols.

3.3 The JavaMail Event Model

The JavaMail event model conforms to the Java JDK 1.1 Event model specification, as described in the JavaBeans Specification. The JavaMail API follows the design patterns defined in the Beans Specification

for naming events, event methods and event listener registration.

All events are subclassed from MailEvent. Clients listen for specific events by registering themselves as listeners for those events. Events notify listeners of state changes as a session progresses. During a session, a JavaMail API component fires a specific event-type to notify objects registered as listeners for that event-type. The JavaMail Session, Message, Store, and Transport classes are event sources. This Specification describes a specific event in the Section which describes the class which fires that event.

3.4 Using the JavaMail API

This Section defines syntax and lists the order in which a client application calls JavaMail methods, in order to use the JavaMail API to perform several basic Mail operations.

A JavaMail API client typically begins a mail handling task by obtaining the default JavaMail Session object.

```
Session session = Session.getDefaultInstance(props);
```

The client uses the Session object `getStore()` method to connect to the default Store. The `getStore()` method returns a Store object subclass that supports the access protocol defined in the user preferences file.

```
Store store = Session.getStore();
store.connect();
```

If the connection is successful, the client can list available folders in the Store, and then fetch and view specific Message objects.

```
Folder inbox = store.getFolder("INBOX");// get the INBOX
folder
inbox.open(Folder.READ_WRITE);          // open the INBOX
folder
Message m = inbox.getMessage(1);        // get Message # 1
String subject = m.getSubject();        // get Subject
Object content = m.getContent();        // get content
..
..
```

Finally, the client closes all open Folders, and then closes the Store.

```
inbox.close();                           // Close the INBOX
store.close();                          // Close the Store
```

See “Examples Using the Mail API” for a more complete example.

4

The Message Class

The Message class is an abstract class that implements the Part interface. The Message class defines the protocol which handles electronic messages exchanged between JavaMail API components and mail system consumers.

Message Subclasses can implement several standard message formats. For example; the MimeMessage class extends Message in order to implement the RFC822 and the MIME standard for Internet messages. Implementations typically can construct themselves from bytestreams and generate bytestreams for transmission.

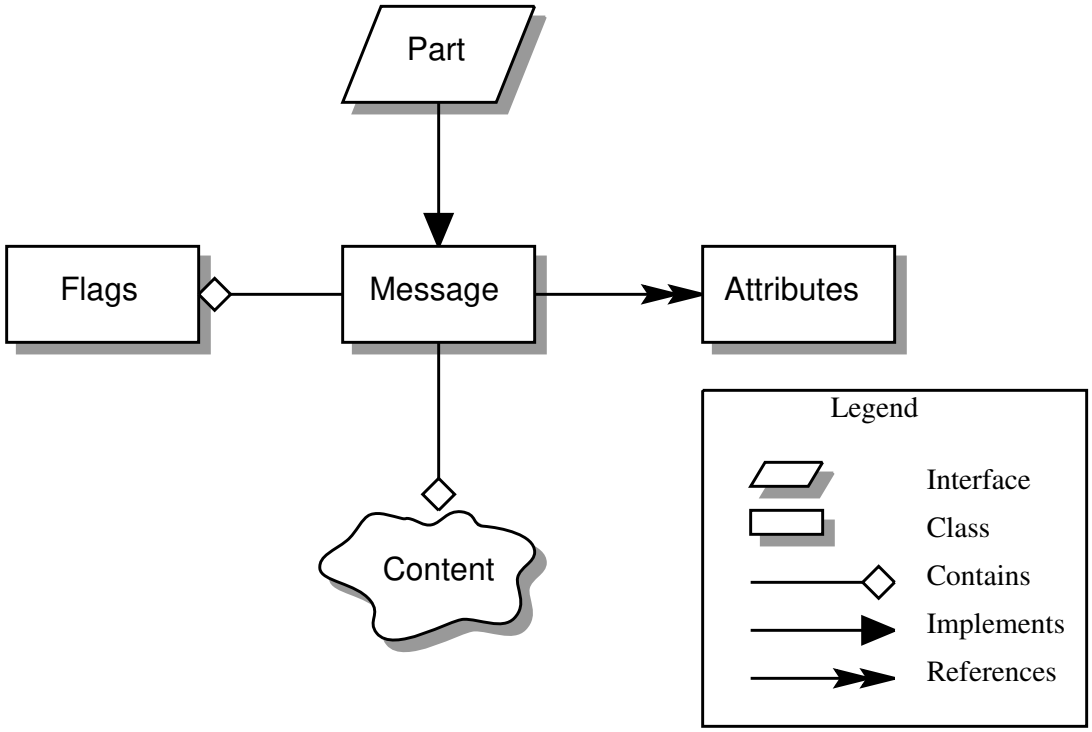
A Message subclass instantiates a container object which holds message content, together with attributes which specify addresses for the sender and reipients, structural information about the message, and the content type of the message body. Messages placed into a Folder also have a set of flags that describe the state of the message within the folder.

The structure of a Message object does not vary with its content type. The Message object has no direct knowledge of the nature or semantics of its content. This separation of structure from content allows the message object to contain any arbitrary content.

Message objects are obtained either from a Folder or by constructing a new Message object of the appropriate subclass. Messages stored within a Folder are sequentially numbered, starting at one. An assigned message number can change when the folder is expunged, since the expunge operation removes deleted messages from the folder and also renumbers the remaining messages.

A Message object can contain multiple parts, where each part contains its own set of attributes and content. The content of a multipart message is a Multipart object that contains BodyPart objects representing each individual part. The Part interface defines the structural and semantic similarity between the Message object and the BodyPart class.

The figure below illustrates a Message instance hierarchy, where the Message contains attributes, a set of flags and content. See “MimeMessage Object Hierarchy” for an illustration of the MimeMessage object hierarchy.



The Message class provides methods to perform the following tasks:

- Get, Set and Create its attributes and content:

```
public String getSubject() throws MessagingException;
public void setSubject(String subject) throws
MessagingException;
public String[] getHeader(String name) throws
MessagingException;
public void setHeader(String name, String value)
                  throws MessagingException;
public Object getContent() throws MessagingException;
public void setContent(Object content, String type)
                  throws MessagingException
```

- Send itself to its recipients:

```
public void send() throws MessagingException;
```

- Save changes to its containing folder.

```
public void saveChanges() throws MessagingException;
```

This process also ensures that the Message header fields are updated to be consistent with the changed message contents.

- Generate a bytestream for the Message object.

```
public void putByteStream(OutputStream os) throws Exception;
```

This bytestream can save the message or send it to a transport object.

4.1 The Part Interface

The Part interface defines a set of standard headers common to most mail systems and a content block, and defines set and get methods for each of these members. It is the basic data component in the JavaMail API and provides a common interface for both the Message and the BodyPart classes. See the JavaMail API documentation for details.

- Message implements the Part interface, and adds From:, To:, and Subj: header attribute definitions with their corresponding set and get methods. Clients can create, send, receive and store individual messages.
- BodyPart implements the Part interface without headers defined by the Message class, and is intended to define a single message element included within a message object that includes a multipart type ContentType: header. Clients must embed BodyPart objects into multipart Message objects in order to create, send, receive or store them.

4.1.1 Message Attributes

The Message class adds its own set of standard attributes to those it inherits from the Part interface. These attributes include the sender and recipient addresses, and the Subject. The Message class also supports non-standard attributes in the form of Headers. See the JavaMail API Documentation for the list of standard attributes defined in the Message class.

Mail systems can also support other Part attributes. Custom attributes are represented as Header objects. Each object is a name-value pair where both the name and value are Strings. These are typically added to Message subclasses.

4.1.2 The ContentType Attribute

The ContentType attribute specifies the content data type, following the MIME typing specification (RFC 2045). A MIME type is composed of a primary type which declares the general type of the content, and a

subtype which specifies a specific format for the content.

JavaMail API components can access a content block via these mechanisms:

As an input stream	The Part interface declares the `getInputStream()` method, which returns an input stream to the content. Note that Part implementations must decode any mail-specific transfer encoding before providing the input stream.
As a DataHandler object	The Part interface declares theThe `getDataHandler()` method, which returns a `javax.activation.DataHandler` object that wraps around the content. The DataHandler object allows clients to discover the operations available to perform on the content, and to instantiate the appropriate component to perform those operations. See "The Data Typing Framework" for details describing the DataTyping framework
As a java object	The Part interface declares the `getContent()` method, which returns the content as a Java object. The type of the returned object is dependent on the content datatype. If the content is of type multipart, the returned object will be a Multipart object, or a Multipart subclass object. The JavaMail API returns an input stream for unknown content-types. Note that `getContent()` uses the DataHandler internally to obtain the native form.

The `setDataHandler(DataHandler)` method specifies content for a new Part object (as a step towards the construction of a new Message). Part also provides some convenience methods to setup most common content types.

Part provides the `putByteStream()` method that streams its bytestream in mail-safe form suitable for transmission. This bytestream is typically an aggregation of the Part attributes and the bytestream for its content.

4.2 The Address Class

The Address class formats addresses. Address is an abstract class. Subclasses provide implementation-specific semantics.

Address selects the addressing protocol identified by the String returned by its `getType()` method. For example, passing an InternetAddress object to `getType()` returns 'RFC822.' Similarly, an NNTPAddress object returns 'nntp.' The `Session` class uses this return value to identify the `Transport` subclass supporting the addressing protocol required by the Message to be sent.

4.3 The BodyPart Class

BodyPart is an abstract class that implements the Part interface, in order to implement the attribute and content body definitions which Part declares. It does not declare attributes which set From:, To:, Subj:, Reply-To:, or other address header fields, as a Message object does.

A BodyPart object is intended to be inserted into a Multipart container, later accessed via a multipart message.

4.4 The Multipart Class

The Multipart class implements multipart messages. It is an abstract class defining a container intended to hold bodypart objects. It is not itself related to the Part interface. It is intended to be called via a Message object, where the ContentType header of the Message object was set to "Multipart." Subclasses provide implementations.

Typically, the client calls `getContentType()` to return the ContentType of a message. If `getContentType()` returns "multipart," then the client calls `getContent()` to return the Multipart container object.

Multipart supports several methods which which get, create, and remove individual BodyPart objects.

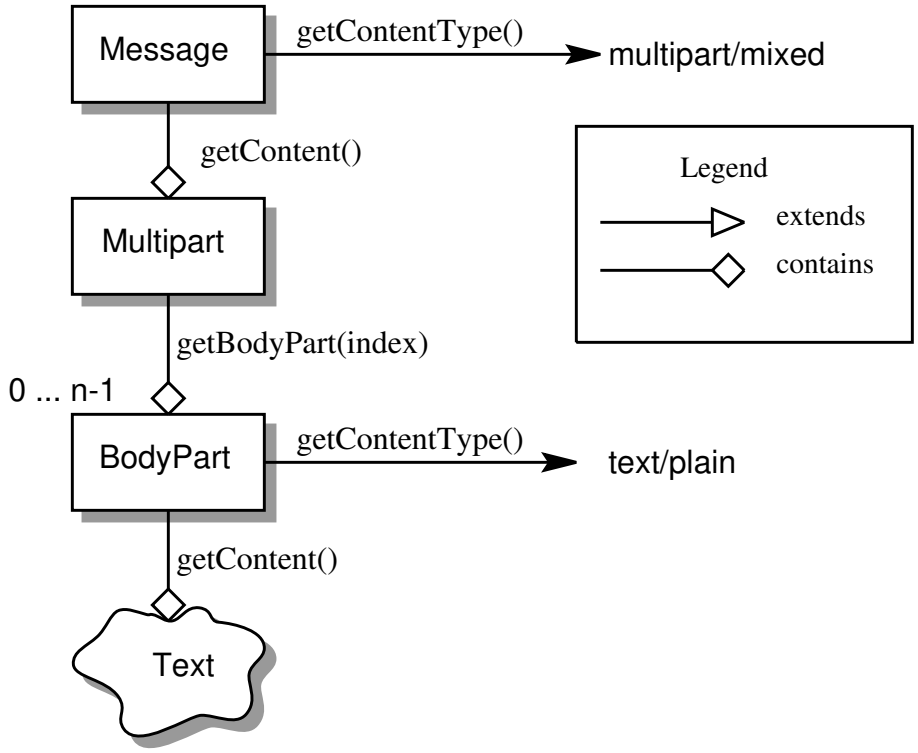
```
public int getCount() throws MessagingException;
public Body getBodyPart(int index) throws MessagingException;

public void addBodyPart(BodyPart part) throws
MessagingException;
public void removeBodyPart(BodyPart body)
                  throws MessagingException;
public void removeBodyPart(int index) throws
MessagingException;
```

Note that Multipart containers can be nested to any reasonable depth. Therefore, it is important to check the ContentType header for each BodyPart element stored within a Multipart container.

Multipart implements the `javax.beans.DataSource` interface. It can act as the DataSource object for `javax.beans.DataHandlers` and `javax.beans.DataContentHandlers`. This allows message-aware content handlers to handle Multipart data sources more efficiently, since the data has already been parsed into individual parts.

This diagram illustrates the structure of a multipart Message.



In this figure, the ContentType attribute of a Message object indicates that it holds a multipart content. Use the `getContent()` method to obtain the Multipart object.

This code sample shows the retrieval of a Multipart object. See "Examples Using the Mail API" for examples which traverse a multipart message and create new multipart messages.

```
Multipart mp = (Multipart)message.getContent();
int count = mp.getCount();
BodyPart body_part;
for (int i = 1; i <= count; i++)
      body_part = mp.getBodyPart(i);
```

4.5 The Flags Class

Flags describe the state of a Message within its containing folder. The Flags class defines flag settings for a Message. The `getFlags()` method in a Message returns a Flags object that holds all the flags currently set for that message. The `setFlags(Flags f)` method sets the specified set of flags for that Message.

The Flags class defines a group of flags. Each flag is represented as a String. The `set(String s)` method on a Flags object sets the specified flag; the `isSet(String s)` method returns whether the specified flag is set.

ANSWERED	Clients set this flag to indicate that this Message has been answered
DRAFT	Indicates that this Message is a draft.
FLAGGED	No defined semantics. Clients can use this flag to mark a message in some user-defined manner.
RECENT	This Message is newly arrived in this Folder. This flag is set when the message is first delivered into the folder and cleared when the containing folder is closed. Clients cannot set this flag.
SEEN	Marks a message that has been opened. A Client sets this flag implicitly when the message contents are retrieved.
DELETED	Allows undoable message deletion. Setting this flag for a message marks it 'deleted' but does not physically remove the message from its folder. The client calls `expunge()` on a folder to remove all deleted messages in that folder.

Note that a Folder is not guaranteed to support either standard system flags or arbitrary user flags. The `getPermanentFlags()` method in a Folder returns a Flags object that contains all the system flags supported by that Folder implementation. The presence of the special USER flag indicates that the client can set arbitrary user-definable flags on any Message belonging to this folder.

4.6 Message Creation And Transmission

Message is an abstract class, so an appropriate subclass has to be instantiated to create a new Message object. A client creates a message by instantiating an appopriate Message subclass.

For example, the MimeMessage subclass handles conventional email messages. Typically, the client application creates an email message by instantiating a MimeMessage object, and passing required attribute values to that object. In an email message, the client defines Subject, From, and To attributes. The client then passes message content into the MimeMessage object by calling a suitably configured DataHandler object. See “Message Composition” for details.

After the Message object is constructed, the client calls the MimeMessage `send()` method to route it to its specified recipients. See “Transport Protocols and Mechanisms” for a discussion of the Transport process.

5

The Mail Session

A mail session object manages the configuration options and authentication information used to interact with messaging systems. The JavaMail API supports simultaneous multiple sessions. Each session can access multiple message stores and transports.

Any desktop application that needs to access the current primary message store can share the default session. Typically the mail-enabled application establishes the default session, which initializes the authentication information necessary to access the user Inbox folder. Other desktop applications then use the default session when sending mail on behalf of the user.

For example:

A Session object is created using a static factory method:

```
Session session = Session.getInstance(props, authenticator);
```

to create an unshared session, or

```
Session defaultSession = Session.getDefaultInstance(props,
authenticator);
```

to access the default session.

The Properties object which initializes the session contains default values and other configuration information. See “Environment Properties" for a list of properties used by the JavaMail API.

The Authenticator object controls security aspects for the session object. The messaging system uses it as a callback mechanism to interact with the user when a password is required to login to a messaging system. It also indirectly controls access to the default session, as described below.

Messaging system implementations can register PasswordAuthentication objects with the Session object for use later in the session, or for use by other users of the same session. Because PasswordAuthentication objects contain passwords, acess to this information must be carefully controlled. Applications that create Session objects must restrict access to those objects appropriately. In addition, the Session class shares some responsibility for controlling access to the default session object.

The first call to `getDefaultInstance()` creates a new Session object and associates it with the

Authenticator object. Subsequent calls to `getDefaultInstance()` compare the Authenticator object passed in with the Authenticator object saved in the default session. Access to the default session is allowed if both objects have been loaded by the same class loader. Typically, this is the case when both the default session creator and the program requesting default session access are in the same "security domain." Also; if both objects are null, access is allowed. Using null to gain access is discouraged, because this allows access to the default session from any security domain.

Some messaging system implementations may use additional properties. Typically the properties object contains user-defined customizations in addition to system-wide defaults. Mail-enabled application logic determines the appropriate set of properties. Lacking a specific requirement, the application can use the system properties object retrieved from `System.getProperties()`.

A mail-enabled client can use the Session object to retrieve a Store or Transport object to read or send mail. Typically, the application retrieves the default Store object, based on properties loaded for that session:

```
Store store = session.getStore();
```

The client can override the session defaults and access a message store supporting a different type:

```
Store store = session.getStore("imap");
```

Implementers of Store and Transport objects will be told which session to which they have been assigned. They can then make the Session object available to other objects contained within this Store or Transport using application-dependent logic.

The Session class provides a factory mechanism for obtaining appropriate Store and Transport implementation objects, based on their protocol names.

TBD: A registry based mechanism that implements the Factory.

The Session class allows messaging system implementations to use the Authenticator object that was registered when the session was created. The Authenticator object is created by the application and allows interaction with the user to obtain a user name and password. The user name and password is returned in a PasswordAuthentication object. The messaging system implementation can ask the session to associate a user name and password with a particular message store using the setPasswordAuthentication method. This information is retrieved using the getPasswordAuthentication method. This avoids the need to ask the user for a password when reconnecting to a Store that has disconnected, or when a secon application sharing the same session needs to create its own connection to the same Store.

Messaging system implementations can register PasswordAuthentication objects with the Session object for use later in the session, or for use by other users of the same session. Because PasswordAuthentication objects contain passwords, access to this information must be carefully controlled. Applications that create Session objects must restrict access to those objects appropriately. In addition, the Session class shares some responsibility for controlling access to the default session object.

The first call to getDefaultInstance() creates a new Session object and associates the Authenticator object with the Session object. Subsequent calls to getDefaultInstance compare the Authenticator object passed in, to the Authenticator object saved in the default session. If both objects have been loaded by the same class loader, access to the default session will be allowed. Typically, this is the case when both the creator of the

default session and the code requesting access to the default session are in the same "security domain." Also, if both objects are null, access is allowed. This last case is discouraged because setting objects to 'null' allows access to the default session from any security domain.

In the future, JDK 1.2 security Permissions could control access to the default session. Note that the Authenticator and PasswordAuthentication classes and their use in JavaMail is similar to the classes with the same names provided in the java.net package in JDK 1.2. As new authentication mechanisms are added to the system, new methods can be added to the Authenticator class to request the needed information. The default implementations of these new methods will fail, but new clients that understand these new authentication mechanisms can provide implementations of these methods. New classes other than PasswordAuthentication could be needed to contain the new authentication information, and new methods could be needed in the Session class to store such information. JavaMail design evolution will be patterned after the corresponding JDK classes.

To simplify message folder naming and to minimize the need to manage Store and Transport objects, folders can be named using URLs. The Session class provides methods to retrieve a Folder object given a URL for the folder:

```
Folder f = session.getFolder(url);
```

Not all messaging systems are required to support URL naming of folders. For a system that does support URLs, the URL format is specific to that messaging system.

6

Message Storage And Retrieval

Messages are contained in Folders. New messages are usually delivered to folders by a transport protocol or a delivery agent. Clients retrieve messages from folders using an access protocol.

6.1 The Store Class

The Store class defines a database that holds a Folder hierarchy and the messages within. The Store also models the access protocol used to access folders and retrieve messages from folders. Store is an abstract class. Subclasses implement specific message databases and access protocols.

Clients gain access to a database of messages (a message store) by obtaining a Store object that implements the database access protocol. Most message stores require the user to be authenticated before they allow access. `connect()` performs that authentication.

For many message stores, a host name, user name, and password are sufficient to authenticate a user. The JavaMail API provides a `connect()` override that takes this information as input parameters. Store also provides a default `connect()` method. In either case, the client can obtain missing information from the session object's properties, or by interacting with the user by accessing the session's Authenticator object.

The default implementation of the connect method in the Store class uses these techniques to retrieve all needed information and then calls the protocolConnect method. The messaging system implementation must provide an appropriate implementation of this method. The messaging system can also choose to directly override the connect method.

By default, Store queries the following properties for the user name and host name:

```
mail.user, or user.name if not set
mail.host
```

These global defaults can be overridden on a per-protocol basis by the properties:

```
mail.<protocol>.user
mail.<protocol>.host
```

Note that Passwords can not be specified using properties.

Clients initiate a session with a message database by obtaining a Store object that implements the database access protocol. The `connect()` method connects a client to that database. Some Store implementations may require user authentication; in those cases, the `connect()` method can display a dialog window to conduct the authentication process. Invoking `connect()` on an already connected Store is an error.

The Store presents a default namespace to clients. Typically, this namespace is located in the connected user's default folder. Store implementations can also present other namespaces. The `getDefaultFolder()` method on Store returns the root folder for the default namespace.

Clients terminate a session by calling the `close()` method on the Store object. Once a Store is closed (either explicitly using the `close()` method; or externally, if the Mail server dies), all Messaging components belonging to that Store become invalid. Typically, clients will try to recover from an unexpected termination by calling `connect()` to reconnect to the Store object, and then fetching new Folder objects and new Message objects.

6.1.1 Store Events

Store sends the following events to interested listeners:

ConnectionEvent	Generated when a connection is successfully made to the Store, or when an existing connection is terminated or disconnected.
StoreEvent	Communicates alerts and notification messages from the Store to the end user. The `getMessageType()` method returns the event type, which can be one of: **ALERT** or **NOTICE**. The client must display **ALERT** events in some fashion that calls the user's attention to the message.
`FolderEvent`	Communicates changes to any folder contained within the Store. These changes include creation of a new Folder, deletion of an existing Folder, and renaming of an existing Folder.

6.2 The Folder Class

The Folder class represents a folder containing messages. Folders can contain subfolders as well as messages, thus providing a hierarchical structure. The `getType()` method returns whether a Folder can hold subfolders, messages, or both. Folder is an abstract class. Subclasses implement protocol-specific Message Folders.

The `getDefaultFolder()` method for the corresponding Store object returns the root folder of a user's default folder hierarchy. The `list()` method for a Folder returns all the subfolders under that folder. The `getFolder(String name)` method for a Folder returns the named subfolder. Note that this subfolder

need not exist physically in the Store. The `exists()` method in a folder indicates whether this folder exists. A folder is created in the Store by invoking its `create()` method.

A Folder instantiates in the closed state. A closed folder allows certain operations; they include deleting the folder, renaming the folder, listing subfolders, creating subfolders and monitoring for new messages. The `open()` method opens a Folder. All Folder methods except `open()`, `delete()`, and `renameTo()` are valid on an open Folder. Note that the `open()` method is applicable only on Folders that can contain messages.

The messages within a Folder are sequentially numbered, from one through the total number of messages. This ordering is referred to as the "mailbox order" and is usually based on the arrival time of the messages in the folder. As each new message arrives into a folder, it is assigned a sequence number that is one higher than the previous number of messages in that folder. The `getMessageNumber()` method on a Message returns its sequence number.

The sequence number assigned to a Message is valid within a session, but only as long as it retains its relative position within the Folder. Any change in message ordering can change the Message object's sequence number. Currently this occurs when the client calls `expunge()` to remove deleted messages and renumber messages remaining in the folder.

A client can reference a message stored within a Folder either by its sequence number, or by the corresponding Message object itself. Since a sequence number can change within a session, it is preferable to use Message objects rather than sequence numbers as cached references to messages. Clients using the JavaMail API are expected to provide light-weight Message objects that get filled 'on-demand', so that calling `getMessages()` on a Folder object is an inexpensive operation - both in terms of CPU cycles and memory. For instance, an IMAP implementation could return Message objects that contain only the corresponding IMAP UIDs.

6.2.1 The FetchProfile Method

The Message objects returned by a Folder are expected to be light-weight objects. Invoking get methods on a Message cause the corresponding data items to be loaded into the object, on demand. Certain Store implementations support batch fetching of data items for a range of Messages. Clients can use such optimizations, for example; when filling the header-list window for a range of messages. The `FetchProfile()` method allows a client to list the items it will fetch in a batch, for a certain message range.

The following code illustrates the use of a FetchProfile when fetching Messages from a Folder. The client fills its header-list window with the Subject, From, and X-mailer headers for all messages in the folder.

```
Message[] msgs = folder.getMessages();
FetchProfile fp = new FetchProfile();
fp.set(FetchProfile.ENVELOPE);
fp.add("X-mailer");
folder.fetch(msgs, fp);
```

```
for (int i = 0; i < folder.getMessageCount(); i++) {
      display(msg[i].getFrom());
      display(msg[i].getSubject());
      display(msg[i].getHeader("X-mailer"));
}
```

6.2.2 Folder Events

Folders generate events to notify listeners of any change in either the folder or in its Messages list. The client can register listeners to a closed Folder, but the notification event fires only after that folder is opened.

Folder supports the following events:

`ConnectionEvent`	This event fires when a Folder is opened or closed. When a Folder closes (either because the client has called `close()` or from some external cause), all Messaging components belonging to that Folder become invalid. Typically, clients will attempt to recover by reopening that Folder, and then fetching Message objects.
`FolderEvent`	This event fires when the client creates, deletes or renames this folder. Note that the Store object containing this folder can also fire this event.

`MessageCountEvent` This event notifies listeners that the message count has changed. The following actions can cause this change:

- **Addition** of new Messages into the Folder, either by a delivery agent or because of an `append()` operation. The new Message objects are included in the event.
- **Removal** of existing messages from this Folder. Removed messages are referred to as expunged messages. The `isExpunged()` method on removed Messages returns true and the `getMessageNumber()` method returns the original sequence number assigned to that messge. All other Message methods throw a `MessageRemovedException`. See “The Folder Class” for a discussion of removal of deleted messages in shared folders. The expunged Message objects are included in the event. An expunged message is invalid and should be pruned from the client's view as early as possible. See “The Expunge Process” for details on the `expunge()` method.

6.2.3 The Expunge Process

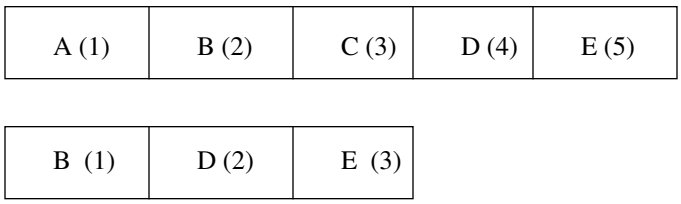
Deleting messages from a Folder is a two-phase operation. Setting the **DELETED** flag on messages marks them as deleted, but it does not remove them from the Folder. The deleted messages are removed only when the client invokes the `expunge()` method on that Folder. The Folder then notifies listeners by firing an appropriate MessageEvent. The MessageEvent contains the expunged Message objects. Note that the `expunge()` method also returns the expunged Message objects. The Folder also renumbers the messages falling after the expunged messages in the message list. Thus, when the `expunge()` method returns, the sequence number of those Message objects will change. Note, however, that the expunged messages still retain their original sequence numbers.

Since expunging a folder can remove some messages from the folder and renumber others, it is important that the client synchronize itself with the expunged folder as early as possible. The next Sections describe a set of recommendations for clients wanting to expunge a Folder:

- Expunge the folder; close it; and then reopen and refetch messages from that Folder. This ensures that the client was notified of the updated folder state. In fact, the client can just issue the `close()` method with the "`expunge`" parameter set to true to force an expunge of the Folder during the close operation, thus even avoiding the explicit call to `expunge()`.
- The previous solution might prove to be too simple or too drastic in some circumstances. This paragraph describes the scenario of a more complex client expunging a single access folder; for example, a folder that allows only one read-write connection at a time. The recommended steps for such a client after it issues the `expunge()` command on the folder are:

- Update its message count, either by decrementing it by the number of expunged messages, or by invoking the `getMessageCount()` method on the Folder.
- If the client uses sequence numbers to reference Messages, it must account for the renumbering of Messages subsequent to the expunged messages. Thus if a Folder has 5 messages as shown below, (sequence numbers are within parenthesis), and if the client is notified that Messages A and C are removed, it should account for the renumbering of the remaining Messages as shown in the second figure.

.



  - The client should prune expunged messages from its internal storage as early as possible.
- The Expunge process becomes compex when dealing with a shared folder that can be edited. Consider the case where two clients are operating on the same folder. Each client posesses its own Folder object, but each Folder object actually represents the same physical folder.

If one client expunges the shared folder, any deleted messages are physically removed from the folder. The primary client can probably deal with this appropriately since it initiated this process and is ready to handle the consequences. However, secondary clients are not guaranteed to be in a state where they can handle an unexpected Message removed event-- especially if the client is heavily multithreaded or if it uses sequence numbers.

To allow clients to handle such situations gracefully, the the JavaMail API applies following restrictions to Folder implementations:

- A Folder can remove and renumber its Messages only when it is explicitly expunged using the `expunge()` method. When the folder is implicitly expunged, it marks any expunged messages as expunged, but it still maintains access to those Message objects. This means that the following state is maintained when the Folder is implicitly expunged:
  - `getMessages()` returns expunged Message objects together with valid message objects. However; an expunged message can throw the MessageExpungedException if direct access is attempted.
  - The messages in the Folder should not be renumbered.
  - The implicit expunge operation can not change the total Folder message count.
  - The group get methods on Folder (`getFlags()`) can return null objects for expunged messages. They can not abort the operation by throwing the MessageExpungedException.

- A Folder can notify listeners of 'implicit' expunges by generating appropriate MessageEvents. However, the removed field in the event must be set to false to indicate that the message is still in the folder. When this Folder is explicitly expunged, then the Folder must remove all expunged messages, renumber it's internal Message cache, and generate MessageEvents for all the expunged messages, with each removed flag set to true.

The recommended set of actions for a client under the above situation is as follows:

- Multithreaded clients that expect to handle shared folders are advised not to use sequence numbers.
- If a client receives a MessageEvent indicating message removal, it should check the removed flag. If the flag is false, it can issue an `expunge()` request on the Folder object to synchronize it with the physical folder. It may also mark the expunged messages in order to notify the end-user.
- If the removed flag was set to true, the client should follow earlier recommendations on dealing with explicit expunges.

6.3 The Search Process

Search criteria are expressed as a tree of search-terms, forming a parse tree for the search expression. The Term class represents search terms. This is an abstract class with a single method:

```
boolean match(Object o);
```

Subclasses implement specific match algorithms by implementing the `match()` method. Thus new search terms and algorithms can be easily introduced into the search framework by writing the required Java code.

The search package provides a set of standard search terms that implement specific match criteria on Message objects. For example, SubjectTerm pattern-matches the given String with the subject header of the given message.

```
final class SubjectTerm extends Term {
      public SubjectTerm(String pattern);
      public boolean match(Message m);
}
```

The search package also provides a set of standard logical operator terms that can be used to compose more complex search terms. These include AndTerm, OrTerm and NotTerm.

```
final class AndTerm extends Term {
      public AndTerm(Term t1, Term t2);
      public boolean match(Object o) {
        // The AND operator
        for (int i=0; i < terms.length; i++)
            if (!terms[i].match(o))
                  return false;
```

```
            return true;
          }
        }
```

The Folder class supports searches on messages through these `search()` method versions:

```
public Message[] search(Term term)
public Message[] search(Term term, Message[] msgs)
```

These methods return the Message objects matching the specified search Term. The default implementation applies the search term on each Message object in the specified range. Other implementations may optimize this; for example, the IMAP Folder implementation maps the search Term into an IMAP SEARCH command which the server executes. Note that the IMAP implementation works only if the search Term includes only predefined standard search terms.

7

Message Composition

This Section describes the message creation process.

The JavaMail API allows a client program to create a message of arbitrary complexity. This message can then be manipulated in the same was as if it had been retrieved from a store.

7.1 Message Components

A message object contains two main components - attributes and a content. The attributes specify the address and message structure, and the content is represented by the DataHandler object. A client program creates a message by setting appropriate attributes and inserting the content.

7.2 Message Creation

`javax.mail.Message` is an abstract class which implements the Part interface. Therefore; to create a message object, we select a message subclass that implements the appropriate format and transport protocol for the message.

For example; to create a Mime message, a client uses the `javax.mail.internet.MimeMessage` class:

```
Message msg = new MimeMessage();
```

This creates an empty message that is ready to be filled in with data. Next, we will set the attributes and the content.

7.3 Setting Message Attributes

The Message class provides a set of methods that specify standard attributes. The MimeMessage class provides additional methods that set MIME-specific attributes. Also note that non-standard attributes (custom headers) can be set as name-value pairs.

The methods for setting standard attributes are:

```
public class Message {
```

```
        public void setFrom(Address addr);
        public void setFrom();   // figures out from system
        public void setRecipients(int type, Address[] addrs);
        public void setReplyTo(Address[] addrs);
        public void setSentDate(Date date);
        public void setSubject(String subject);
        ...
}
```

The following method specified by the Part interface allows setting of custom headers:

```
public void setHeader(String name, String value)
```

The `setRecipients()` method takes an integer argument as its first parameter, which specifies which recipient field to use. Currently, `setRecipients()` accepts `Message.TO`, `Message.CC`, and `Message.BCC`. as parameters.

There are two versions of the of the `setFrom()` method: The first version allows the end-user to specify the sender explicitly. The second version retrieves the username from the system.

Here is an code sample which sets attributes for the MimeMessage just created:

```
Address toAddrs[] = new InternetAddress[1];
toAddrs[0] = new InternetAddress("luke@rebellion.gov");
Address fromAddr = new
InternetAddress("han.solo@smuggler.com");


msg.setFrom(fromAddr);
msg.setRecipients(Message.TO, addrs);
msg.setSubject("Takeoff time.");
msg.setSentDate(new Date());
```

7.4 Setting Message Content

The JavaMail API supports two techniques which set message content. The first technique uses the `setDataHandler()` method. The second technique uses the `setContent()` method.

Typically, clients set message content is by using `setDataHandler(DataHandler)` on a Part object (a Message class implements the Part interface). The DataHandler is an object that encapsulates data. The data is passed to the DataHandler's constructor as either a DataSource or an Object. The InputStream object creates the DataSource. (See “The Data Typing Framework” for additional datatyping information.)

```
public class DataHandler {
      DataHandler(DataSource dataSource);
```

```
        DataHandler(Object data, String mimeType);
}
```

The code sample below shows how to place text content into an InternetMessage. First create the text as a string object, and pass the string into a DataHandler object, together with its MIME type. Then add the DataHandler object to the message object:

```
String content = "Leave at 300.";  // the text of the message
DataHandler data = new DataHandler(content, "text/plain");
msg.setDataHandler(data);
```

Alternatively, `setContent()` implements a simpler technique, which takes the data object and its MIME type:

```
String content = "Leave at 300.";  // the text of the message
msg.setContent(content, "text/plain");
```

If the client sends this message by calling `msg.send()`, the recipient will receive the message below:

```
Date: Wed, 23 Apr 1997 22:38:07 -0700 (PDT)
From: han.solo@smuggler.com
Subject: Takeoff time
To: luke@rebellion.gov

Leave at 300.
```

7.5 Creating a MIME Multipart Message

Let us now consider the case of creating a MIME multipart message. The first step is to instantiate a new MimeMultipart (or subclass thereof) object. Then MimeBodyParts for the specific message parts are created and their content is set as described in the previous section (Note that both Message and BodyPart share the Part interface). If required, the subType attribute should also be set. (The default subtype for MimeMultipart is "mixed"; subclasses of MimeMultipart might already have their subtype set appropriately.)

Once the Multipart object is created, it needs to be inserted into the Message as its content. The simplest technique to use is to use `setContent(Multipart)` method on a newly-constructed Message object. The example below creates a Multipart object and then adds two message parts to it. The first message part is a text string “Spaceport Map,” and the second contains a document of type “application/postscript.”

```
MimeMultipart mp = new MimeMultipart();// create Multipart
MimeBodyPart b1 = new MimeBodyPart(); // first bodypart
b1.setContent("Spaceport Map");       // textual content
mp.addBodyPart(b1);
```

```
MimeBodyPart b2 = new MimeBodyPart(); // second bodypart
b2.setContent(agenda,"application/postscript");
                                      // postscript data
mp.addBodyPart(b2);

Message msg = new MimeMessage();   // create the message

// set the message attributes as described above
msg.setContent(mp);               // add Multipart
msg.saveChanges();                // save changes
```

After all message parts are created and inserted, call `saveChanges()` to ensure that the client writes appropriate message headers. This is identical to the process followed with a single part message. Note that the JavaMail API calls `saveChanges()` implicitly during the `send()` process, so invoking it is unnecessary and expensive if the message is to be sent immediately.

8

Transport Protocols and Mechanisms

The Transport abstract class defines the message submission and message transport protocol. Transport subclasses implement SMTP and other transport protocols.

8.1 Obtaining the Transport Object

The Transport object is never explicitly created. `getTransport()` obtains a transport object from the Session factory. The JavaMail API provides two versions of `getTransport()`:

```
public class Session {
      public Transport getTransport(Address address);
      public Transport getTransport(String protocol);
}
```

The client can also call getTransport(`"SMTP"`) to request SMTP, or another transport implementation protocol. `getTransport(Address address)` returns the implementation of the transport class based on the address type. A user-extensible map defines which transport type to use for a particular address. For example, if the address is an InternetAddress, and InternetAddress is mapped to a protocol that supports SMTP, then SMTPTransport can be returned.

See “The Mail Session” for details.

- Transport Methods

The Transport class provides `connect()` and `protocolConnect()` methods that operate similarly to those on the Store class. See “The Store Class” for details. Note also, that some Transports, such as SMTP, do not require authentication information.

Transport fires a ConnectionEvent to notify its listeners of a successful or a failed connection. Transport can throw an IOException if the connection fails. (See “Transport Events” for details.) Once Transport establishes a successful connection to the host, the client invokes the `send()` method to initiate the transport process.

At this point, Transport implementations can ensure that the message specified is of a known type. If the

type is known, then the transport object sends the message to its specified destinations. If the type is not known, then the Transport object can attempt to reformat the Message into a suitable version using gatewaying techniques, or it can throw a MessagingException, indicating failure. For example; the SMTP transport implementation recognizes MimeMessages. It invokes the `putByteStream()` method on MimeMessage to generate a RFC822 format bytestream which is sent to the SMTP host.

Note that the `Address[]` argument passed to the `send()` method does not need to match the addresses provided in the message headers. Although these arguments usually will match, the end-user actually determines where the messages are actually sent. This is useful for implementing the Bcc: header, and other similar functions.

8.2 Transport Events

The TransportEvent is fired when the `send()` method is invoked. If the message was sent successfully, the delivered event's `getType()` method returns `MESSAGE_DELIVERED`. `getValidAddresses()` returns all the addresses to which the message was sent using this transport and `getInvalidAddresses()` returns null.

If message sending failed, TransportEvent has its `MESSAGE_NOT_DELIVERED` flag set, `getInvaludValidAddresses()` returns the addresses that were not accepted by the host, and `getValidAddresses()` returns any addresses that would have been accepted. Note that a successful send operation does not imply message delivery - only that the message submission was accepted by the relay host.

8.3 Using The Transport Class

The code segment below demonstrates use of a Transport class which uses the SMTP protocol, to send an InternetMessage. The client creates two InternetAddresses that specify the recipients, and retrieves transport object from the default Session that supports sending messages to InternetAddresses. Then the transport object sends the message.

```
Message msg = new MimeMessage();
// create the parts of the message
// create the destination addresses
Address[] addrs = Address[2];
addrs[0] = new
InternetAddress("mickey.mouse@disneyland.com");
addrs[1] = new InternetAddress("goofy@disneyland.com");
// get the transport and send the message
Session session = Session.getDefaultInstance();
Transport transport = session.getTransport(addrs[0]);
transport.connect();  // connect method determines the host
to use
transport.send(msg, addrs);
```

8.4 Transport Usage in Message.send()

The `send()` method in the Message class encapsulates the Transport class. Once a client creates a message is created and sets its attributes, invoking the `send()` method on the message object invokes the transport mechanism to send it to its destination addresses. See “Message Composition” for details. `Message.send()` performs a slightly more complicated series of steps than shown in “Using The Transport Class," yet the idea is the same.

9

The Data Typing Framework

The Data Typing Framework maps data (or "content") to commands (or "behavior"). The Data Typing Framework makes it easy for a mail message to handle data of any arbitrary type by encapsulating it in an intelligent object, called a DataHandler. The DataHandler carries type information describing the data it carries, supports a varying list of appropriate commands acting on that data, and returns a list of valid commands to its parent message object.

The Messaging Framework relies heavily on the JavaBeans Activation Framework (JAF) to determine the MIME data type, to determine the commands available on that data, and to provide a software component corresponding to a particular behavior. The JAF specification is part of the "Glasgow" JavaBeans specification. More details can be obtained from the URL: *http://java.sun.com/beans/glasgow/*. (The JAF specification is the link entitled: *A data typing and object registry mechanism/activation framework*). A brief summary of the JAF is included below.

9.1 JAF Summary

The JAF is divided into a number of distinct Sections, which when tied together map content to behavior. It provides a MIME type Specifier for data, and provides access to that data in the form of Input and Output Streams where appropriate.

9.1.1 The DataSource Interface

DataSource provides an abstraction of some arbitrary collection of data. It is responsible for providing a type (MIME type) for that data as well as access to it in the form of Input and Output streams where appropriate.

9.1.2 The DataHandler Class

DataHandler implements the JAF interface. It encapsulates the data source object and the command object binding infrastructure. The client uses a DataHandler to retrieve a list of behaviors available on a given data source, as well as the JavaBean which provides that behavior. This class uses the existing ContentHandler mechanism as well as the Transferable interface to retrieve alternate representations of the underlying data.

9.1.3 The CommandObject Interface

CommandObject is implemented by JavaBeans that are JAF-aware. JavaBeans written specifically for the framework (beans that do not implement this interface can in most cases still be used with the framework). This interface allows the bean to find out about the DataHandler through the `setDataHandler()` method. This method is normally called by the DataHandler when a new bean is created using the `getBean()` method

9.1.4 The CommandMap Interface

The CommandMap interface accesses the registry of viewer/editors/print objects available in the system. It binds MIME types to JavaBeans. The CommandMap interface is usually invisible to JAF clients, since the DataHandler object should provide all access to the data.

9.1.5 The DataContentHandler Interface

The DataHandler object uses the DataContentHandler interface to convert InputStreams into objects. The DataHandler uses the DataContentHandler interface to implement the Transferable interface. DataContentHander objects are named to reflect the MIME type of the data from a DataSource's InputStream. DataFlavors are used to represent the types accessible from a DataContentHandler.

9.2 Data Typing in JavaMail

For a client implementing the JavaMail API, arbitrary data is introduced to the system in the form of mail messages. The JavaMail Part interface allows the client to access content. A typical mail message has one or more body parts, each of a particular MIME type. The JavaMail API supports several operations on mail objects, including viewing, editing, and printing.

Message and BodyPart both implement the Part interface, which consists of a set of attributes and a Content. Parts have no semantic knowledge about their content. The content of a Part is available as a DataHander, an InputStream, or as an Object.

The client obtains an InputStream object by calling the `getInputStream()` method. The client decodes mail-specific encoding before this stream is returned.

The client uses `getContent()` to obtain the object representing the content. `getContent()` returns the content as a subclass of that object. The type of the returned object depends upon the content itself. In particular; invoking `getContent()` on an object implementing the Part interface with its MIME type set to ’multipart (together with a MIME subtype) always returns a Multipart object or a subclass of a Multipart object.

The client obtains a DataHandler object by calling the `getDataHandler()` method. The DataHandler object allows clients to discover the operations available on the content, and to instantiate the appropriate component to perform those operations. The DataHandler provides the list of commands available for the data. The DataHandler uses the data's MIME type to query the CommandMap for operations that are available on that type. The commands are returned as an array of BeanInfo objects.

```
BeanInfo[] data_handler.getAllCommands();
```

Once a command is selected, the client creates an instance of the JavaBean by calling the `getBean()` method. This instantiates the JavaBean. If it implements the CommandObject interface, it will set the DataHandler.

```
Object data_handler.getBean(BeanInfo ci);
```

A small number of JavaBeans are included as part of the data typing system, in order to provide default behavior for specific MIME types.

9.3 Examples

The following examples demonstrate one way to use the data typing mechanism.

Example 1:

Consider a Message "Viewer" Bean, which presents a user interface that displays a mail message. This example shows how a viewer bean can display the first body part in a main window and any remaining body parts as attachments. The example assumes that the message is a Multipart message, but normally the program must check the message ContentType attribute before casting the Content to a Multipart object.

```
Message msg = // message passed in as parameter
Multipart mp = (Multipart) msg.getContent();

// assume the first part is what we want to display
DataHandler dh = mp.getBodyPart(0).getDataHandler();
BeanInfo binfo = dh.getCommand("view");
Component comp = dh.getBean(binfo);
this.setMainViewer(comp);

// Remaining body parts are attachments
int count = mp.getCount();
for(int i=1; i<count; i++) {
      // Assumes the 'message_view'
      // displays a container of icons
      // representing attachments.

      message_view.addAttachment(mp.getBodyPart(i));
}
```

Example 2:

In this example, the user has selected one of the attachments added to the "message_view." The client retrieves and displays the viewer object as follows.

```
//Retrieve the BodyPart (stored when we called
// addAttachment() above)
```

```
BodyPart bp =
message_view.getSelectedAttachment().getBodyPart();

DataHandler dh = bp.getDataHandler();
BeanInfo binfo = dh.getCommand("view");
Component comp = dh.getBean(binfo);

// Add viewer to dialog Panel
myDialog.add(viewer);

// display dialog on screen
myDialog.show();
```

See “Setting Message Content” for examples which construct a message for a ’send’ operation.

10

Internet Mail

The JavaMail specification does not define any implementation. However, the API does include a set of classes that describe and implement Internet Mail standards. Although not part of the specification, these classes can be considered part of the JavaMail package. They show how to adapt an existing messaging architecture to the JavaMail framework.

The following RFCs specify the Internet Mail Standards implemented by these classes:

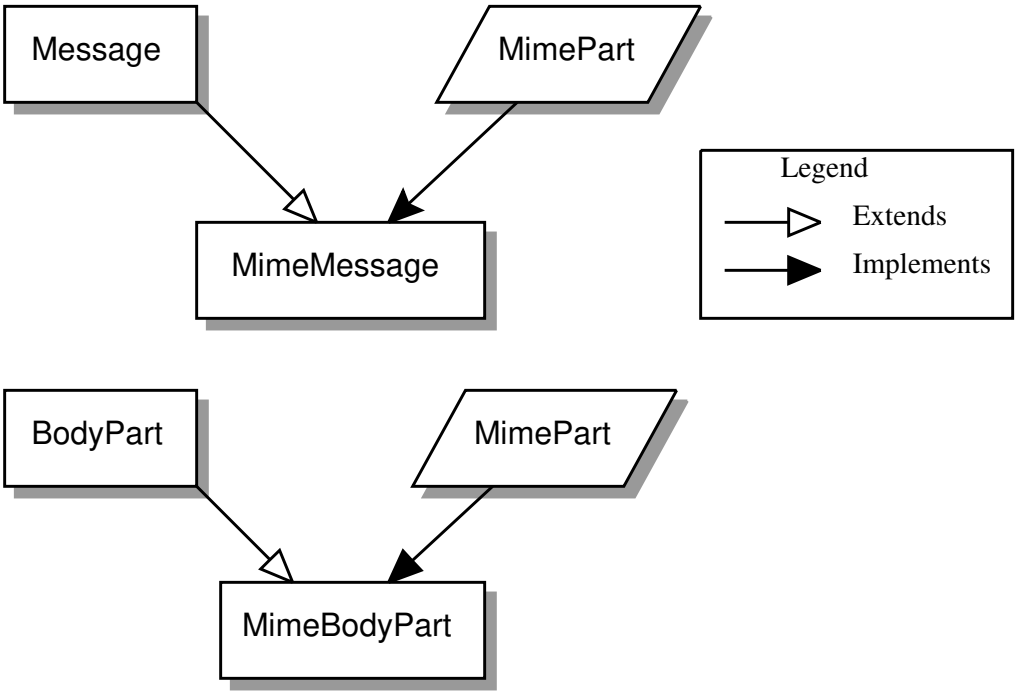
- RFC822 (Standard for the Format of Internet Text Messages)
- RFC2045, RFC2046, RFC2047 (MIME)

RFC822 describes the structure of messages exchanged across the Internet. Messages are viewed as having a header and contents. The header is composed of a set of standard and optional header fields. The header and its contents are separated by a blank line. The RFC specifies the syntax for all header fields and the semantics of the standard header fields. It does not however, impose any structure on the message contents.

The MIME RFCs 2045, 2046 and 2047 define message content structure by defining structured body parts, defining a typing mechanism for identifying different media types, and defining a set of encoding schemes to encode data into mail-safe characters.

The Internet Mail package allows clients to create, to use and to send messages conforming to the standards listed above. It gives service providers a set of base classes and utilities they can use to implement Stores and Transports that use the Internet mail protocols. See “” for a Mime class and interface hierarchy diagram.

The JavaMail MimePart interface implements the Entity defined in RFC2045, Section 2.4. MimePart extends the JavaMail Part interface to add MIME-specific methods and semantics. The MimeMessage and MimeBodyPart classes implement the MimePart interface. The following figure shows the class hierarchy of these classes.



10.1 The MimeMessage Class

The MimeMessage class extends Message and implements MimePart. This class implements an email message that conforms to the RFC822 and MIME standards.

MimeMessage provides a default constructor that creates an empty MimeMessage object. The client can fill the message later by invoking the `parse()` method on an RFC822 input stream. Note that `parse()` is protected, so that only this class and its subclasses are expected to use this method. Service providers implementing 'light-weight' Message objects that are filled on demand, can generate the appropriate byte stream and invoke `parse()` when a component is requested from a message. Service providers that can provide a separate byte stream for the message body (distinct from the message header) can override the `getContentStream()` method.

The client can also use the default constructor to create new MimeMessage objects for sending. The client sets appropriate attributes and headers, inserts content into the message object, and finally calls the `send()` method for that MimeMessage object.

The following code sample shows how to create a new MimeMessage object for sending. See "Message Composition" and "Transport Protocols and Mechanisms" for details.

```
MimeMessage m = new MimeMessage();
```

```
// Set FROM:
m.setFrom(new InternetAddress("jmk@Sun.COM"));
// Set TO:
InternetAddress a[] = new InternetAddress[1];
a[0] = new InternetAddress("javamail@Sun.COM");
m.setRecipients(Message.TO, a);
// Set content
m.setContent(data, "text/plain");
// Send message
m.send();
```

MimeMessage also provides a constructor that uses an input stream to instantiate itself. The constructor internally invokes `parse()` to fill the message. The InputStream object is left positioned at the end of the message body.

```
InputStream in = getMailSource(); // a stream of mail
messages
MimeMessage m = null;
for (; ;) {
   try {
      m = new MimeMessage(in);
   } catch (EOFException eof) {
      // reached end of message stream
      break;
   }
}
```

MimeMessage implements the `putByteStream()` method by writing an RFC822-formatted byte stream of its headers and body. This is accomplished in two steps: First, the MimeMessage object writes out its headers; then it delegates the rest to the DataHandler object representing the content.

10.2 The MimeBodyPart Class

The MimeBodyPart class extends BodyPart and implements the MimePart interface. This class represents a Part inside a Multipart. MimeBodyPart implements a Body Part as defined by RFC2045, Section 2.5.

`getBodyPart(int index)` returns the MimeBodyPart object at the given index. MimeMultipart also allows the client to fetch MimeBodyPart objects based on their Content-IDs.

`addBodyPart()` adds a new MimeBodyPart object to a MimeMultipart as a step towards constructing a new multipart MimeMessage.

10.3 The MimeMultipart Class

The MimeMultipart class extends Multipart and models a MIME multipart content within a message or a body part.

A MimeMultipart is obtained from a MimePart containing a ContentType attribute set to "multipart," by invoking that part's `getContent()` method.

The client creates a new MimeMultipart object by invoking its default constructor. To create a new multipart MimeMessage, create a MimeMultipart object (or its subclass); use set methods to fill the appropriate MimeBodyParts; and finally, use `setContent(Multipart)` to insert it into the MimeMessage.

MimeMultipart also provides a constructor that takes an input stream positioned at the beginning of a MIME multipart stream. This class parses the input stream and creates the child body parts.

The `getSubType()` method returns the multipart message MIME subtype. The subtype defines the relationship among the individual body parts of a multipart message. More semantically complex multipart subtypes are implemented as subclasses of MimeMultipart, providing additional methods that expose specific functionality.

Note that a multipart content object is treated like any other content. When parsing a MIME Multipart stream, the JavaMail implementation uses the JAF framework to locate a suitable DataContentHandler for the specific subtype and uses that handler to create the appropriate Multipart instance. Similarly, when generating the output stream for a Multipart object, the appropriate DataContentHandler is used to generate the stream. See “” for details.

10.4 The MimeUtility Class

MimeUtility is a Utility class that provides MIME-related functions. All methods in this class are static methods. These methods currently perform the functions listed below:

10.4.1 Content Encoding and Decoding

Data sent over RFC 821/822-based mail systems are restricted to seven bit US-ASCII bytes. Therefore, any non-US-ASCII content needs to be encoded into the seven-bit US-ASCII (mail-safe) format. MIME (RFC 2045) specifies the "base64" and "quoted-printable" encoding schemes to perform this encoding. The following methods support content encoding:

- The `getEncoding()` method takes a DataSource object and returns the Content-Transfer-Encoding that should be applied to the data in that Datasource object to make it mail-safe.
- The `encode()` method wraps an encoder around the given output stream based on the specified Content-Transfer-Encoding. The `decode()` method decodes the given input stream, based on the specified Content-Transfer-Encoding.

10.4.2 Header Encoding and Decoding

RFC 822 restricts the data in message headers to 7bit US-ASCII characters. MIME (RFC 2047) specifies a mechanism to encode non 7bit US-ASCII characters so that they are suitable for inclusion in message headers. This section describes the methods that enable this functionality.

The header-related methods (getHeader, setHeader) in Part and Message operate on Strings. String objects contain (16 bit) Unicode characters.

Since RFC 822 prohibits non US-ASCII characters in headers, clients invoking the `setHeader()` methods must ensure that the header values are appropriately encoded if they contain non US-ASCII characters.

The encoding process (based on RFC 2047) consists of two steps:

1. Convert the Unicode String into an array of bytes in another charset. This step is required because Unicode is not yet a widely used charset, and hence one typically needs to convert the Unicode characters into a charset that is more palatable to the recipient.
2. Apply a suitable encoding format which ensures that the bytes obtained in the previous step are mail-safe.

The `encodeText()` method combines the two steps listed above to create an encoded header. Note that as RFC 2047 specifies, only "unstructured" headers and user-defined extension headers can be encoded. It is advised that you always run such header values through the encoder to be safe. Also note that `encodeText()` encodes header values only if they contain non US-ASCII characters.

The reverse of this process (decoding) needs to be performed when handling header values obtained from a MimeMessage or MimeBodyPart using the `getHeader()` set of methods, since those headers might be encoded as per RFC 2047. The `decodeText()` method takes a header value, applies RFC 2047 decoding and returns the decoded value as a Unicode String. Note that this method should be invoked only on "unstructured" or user-defined headers. Also note that `decodeText()` attempts decoding only if the header value is encoded in RFC 2047 style. It is advised that you always run header values through the decoder to be safe.

10.5 The ContentType Class

The ContentType class is a utility class which parses and generates MIME content-type headers.

To parse a MIME content-Type value, create a ContentType object and invoke the `toString()` method.

The ContentType class also provides methods which match Content-Type values.

The following code fragment illustrates the use of this class to extract a MIME parameter.

```
String type = part.getContentType();
ContentType cType = new ContentType(type);

if (cType.match("application/x-foobar"))
      iString color = "cType.getParameter(color");
```

The following code fragment illustrates the use of this class to construct a MIME Content-Type value:

```
ContentType cType = new ContentType();
cType.setPrimaryType("application");
cType.setSubType("x-foobar");
cType.setParameter("color", "red");

String contentType = cType.toString();
```

A

Environment Properties

This section lists the environment properties that are used by the JavaMail APIs.

Property	Description
mail.store.protocol	Specifies the default Message Access Protocol. The `Session.getStore()` method returns a Store object that implements this protocol. The protocol can be explicitly specified by using `Session.getStore(String protocol)`.
mail.transport.protocol	Specifies the default Transport Protocol. The `Session.getTransport()` method returns a Transport object that implements this protocol. The client can explicitly specify the protocol by using `Session.getTransport(String protocol)`.
mail.host	Specifies the default Mail server. The Store and Transport `connect()` methods use this property (if the protocol-specific host property is absent) to locate the target host.
mail.user	Specifies the username provided when connecting to a Mail server. The Store and Transport `connect()` methods use this property (if the protocol-specific username property is absent) to obtain the username.
mail.<protocol>.host	Specifies the protocol-specific default Mail server. This overrides the mail.host property.

Property	Description
mail.<protocol>.user	Specifies the protocol-specific default username for connecting to the Mail server. This overrides the mail.user property.

B

Examples Using the Mail API

Following are some example programs that illustrate the use of the Java Mail APIs.

B.1 Example: The Basic Store Access Operation

```
import java.util.*;
import java.io.InputStream;
import java.io.IOException;
import javax.mail.*;
import javax.mail.internet.*;

public class msgshow {
  // Usage: msgshow <host> <user> <passwd> <mbox> <msgnum>
  public static void main(String argv[]) throws Exception
      String host = argv[0];
      String user = argv[1];
      String password = argv[2];
      String mbox = argv[3];
      int msgnum = Integer.parseInt(argv[4]);
      // Get the default Session object
      Session session =
            Session.getDefaultInstance(
                  System.getProperties(), null);
      // Get a Store object that implements the IMAP protocol
      Store store = session.getStore("imap");
      // Connect to 'host' as 'user'.
```

```
        store.connect(host, user, password);
        // Open the specified Folder.
        Folder folder = store.getFolder(mbox);
        folder.open(Folder.READ_WRITE);

        int totalMessages = folder.getMessageCount();

// Total messages
System.out.println("Total = " + totalMessages);

        // Fetch Envelope for all the messages ..
        Message[] msgs = folder.getMessages();
        FetchProfile fp = new FetchProfile();
        fp.set(FetchProfile.ENVELOPE);
        fp.add("X-mailer");
        folder.fetch(msgs, fp); // prefetch ENVELOPE

        // Print out headers  ...
        for (int i = 0; i < msgs.length; i++) {
            int j;
            Address[] addr;
            // "To" attribute:
            if ((addr = msgs[i].getRecipients(
                                        Message.TO)!= null) {
              for (j = 0; j < addr.length; j++)
                 System.out.println("TO: "
                                + addr[j].getAddress());
            }
            // "Subject" field :
            System.out.println("SUBJECT: "
                                + msgs[i].getSubject());
            // Sent date
            Date d = msgs[i].getSentDate();
            if (d != null)
              System.out.println("SendDate: "
                                + d.toLocaleString());
        }
        // Display a Message ...
         // The simplest way to do this would be to use the
         // Activation Framework to get the list of valid
         // commands for a Message, and apply the "view"
         // command to this Message object.
```

```
        //
        // We do this the hard way here to illustrate
        // how to obtain & display the different
        // components of a Message
        //

        dumpPart(msgs[msgnum]);
        // Close folder
        folder.close(false); // Don't expunge deleted messages
        System.exit(0);
    }

    /** Dump out the contents of this Message object. Print
     * out the headers and the content of this message
     */
    static void dumpPart(Part p) throws Exception {
        Enumeration e = p.getAllHeaders();
        while (e.hasMoreElements()){
              Header h = (Header)e.nextElement();
              System.out.println(h.getName());
              System.out.println(h.getValue());
        }
        // Print out the body & content
        dumpContent(m.getDataHandler());
    }

Object o = p.getContent();

if(o instanceof String) {
      System.out.println("This is a string");
      System.out.println((String)o);
      }
else if (o instanceof Multipart) {

      System.out.println("This is a Multipart");

      Multipart mp = (Multipart)o;

      int count = mp.getCount();

      for (int i = 0; i < count; i++){

            System.out.println("Body#" + (i + 1))));

            dumpPart(mp.getBodyPart(i)));
```

```
            }
else
      System.out.println("unknown content-type");

   }
```

B.2 Example : Listing Folders

```
import javax.mail.*;

public class folderlist {
  // folderlist <host> <user> <passwd> <root > <pattern>
  public static void main(String argv[]) throws Exception {
      String host = argv[0];
      String user = argv[1];
      String password = argv[2];
      String root = argv[3];
      String pattern = argv[4];
      // Get the default Session object
      Session session =
            Session.getDefaultInstance(
                  System.getProperties(), null);
      // Get a Store object for the IMAP protocol.
      Store store = session.getStore("imap");
      store.connect(host, user, password);
      // Get this user's Default Folder
      Folder root_folder = null;
      if (root == null)
          root_folder = store.getDefaultFolder();
      else
          root_folder = store.getFolder(root);
      Folder[] f = root_folder.list(pattern);
      for (int i = 0; i < f.length; i++)
          dumpFolder(f[i]);
  }


  // Dump out info about this Folder
  static void dumpFolder(Folder folder) throws Exception {
```

```
        System.out.println("Name: " + folder.getName());
        System.out.println("Full Name: "
                                + folder.getFullName());
        if (folder.isSubscribed())
            System.out.println("Is Subscribed");
        if ((folder.getType() & Folder.HOLDS_MESSAGES) != 0)
            System.out.println("Is Mail folder");
        if ((folder.getType() & Folder.HOLDS_FOLDERS) != 0) {
            System.out.println("Is Directory");
            // Now recurse ..
            Folder[] f = folder.list();
            for (int i=0; i < f.length; i++)
              dumpFolder(f[i]);
        }
    }
}
```

B.3 Example: Copy or Move a Message Between Folders

```
import java.util.*
import javax.mail.*;
import javax.mail.internet.*;

public class copier {
  public static void main(String argv[]) throws Exception {
      String host = argv[0];
      String user = argv[1];
      String password = argv[2];
      String src = argv[3];
      String dest = argv[4];
      int start = Integer.parseInt(argv[5]);
      int end = Integer.parseInt(argv[6]);
      // Get the default Session object
      Session session =
            Session.getDefaultInstance(
                  System.getProperties(), null);
```

```
        // Get a Store object that implements
        // the IMAP protocol.

        Store store = session.getStore("imap");

        // Connect to 'host' as 'user'
        store.connect(host, user, password);
        // Open Source Folder
        Folder folder = store.getFolder(src);
        folder.open(Folder.READ_WRITE);

        // Open destination folder, create if reqd

        Folder dfolder = store.getFolder(dest);
        if (!dfolder.exists()) // create
            dfolder.create(Folder.HOLDS_MESSAGES);

        Message[] msgs = folder.getMessages(start, end);

        // Copy messages into destination,
        // then delete them from the source

        if (folder.copyMessages(msgs, dfolder))
            folder.setFlags(msgs, Message.DeletedFlag, true);
        // Close folder, expunge it too.
        folder.close(true);
    }
}
```

B.4 Example: Folder Search

```
import java.util.*;
import java.io.InputStream;
import java.io.IOException;
import javax.mail.*;
import javax.mail.internet.*;
import javax.mail.search.*;
```

```
public class search {
  public static void main(String argv[]) throws Exception {
      String host = argv[0];
      String user = argv[1];
      String password = argv[2];
      String mbox = argv[3];
      String pattern = argv[4];
      // Get the default Session object
      Session session =
            Session.getDefaultInstance(
                  System.getProperties(), null);
      // Get a Store object that implements the IMAP
protocol.
      Store store = session.getStore("imap");
      // Connect to 'host' as 'user'
      store.connect(host, user, password);
      // Open the specified Folder.
      Folder folder = store.getFolder(mbox);
      folder.open(Folder.READ_WRITE);
      /* Search for the specified pattern in the From, To,
       * CC & Subject headers
       */
      Term t = new OrTerm(
                  new OrTerm(new HeaderTerm("From", pattern),
                              new HeaderTerm("To", pattern)),
                  new OrTerm(new HeaderTerm("Cc", pattern),
                              new SubjectTerm(pattern)));
      Message[] matches = folder.search(t);
      int num_matches = matches != null ? matches.length: 0;
      System.out.println(num_matches + " Matches found!");
      for (int i=0; i < num_matches; i++) {
         Message m = matches[i];
         // Dump out this message ...
         m.putByteStream(System.out);
         }

      // Close folder
      folder.close(false); // Don't expunge deleted messages
      System.exit(1);
  }
}
```

B.5 Example: Creating and Sending an RFC822 Message

```
import java.util.Date;
import javax.mail.*;
import javax.mail.internet.*;

public class MsgSinglepart {
  // Usage: MsgSinglepart <toaddr> <fromaddr>
  // Ex: MsgSinglepart javamail@Sun.COM max.spivak@Sun.COM

 // text used in msg body
   String text = "message text\nline 2\n";

  public static void main(String[] argv) {
      // create an empty message
      Message msg = new MimeMessage();
      try {
          // create and fill the envelope
          Address toAddrs[] = new InternetAddress[1];
          toAddrs[0] = new InternetAddress(argv[0]);
          Address fromAddr = new InternetAddress(argv[1]);
          msg.setFrom(fromAddr);
          msg.setRecipients(Envelope.TO, addrs);
          msg.setSubject("Java Mail APIs are great!");
          msg.setSentDate(new Date());
          msg.setHeader("X-Mailer", "JavaMail APIs");

          // create and fill the text body
          msg.setContent(text, "text/plain");

          // send the message
          msg.send();

      } catch (MessagingException mex) {
          mex.printStackTrace();
      }
  }
}
```

B.6 Example: Creating and Sending a MIME Multipart Message

```
import java.util.Date;
import javax.mail.*;
import javax.mail.internet.*;

public class MsgMultipart {
  // Usage: MsgMultipart <toaddr> <fromaddr>
  // Ex: MsgMultipart javamail@Sun.COM max.spivak@Sun.COM

  // text used in msg body
String text = "message text\nline 2";

  Appointment appt = new Appointment(new Date(),
                                          "Java Mail Mtg");

  public static void main(String[] argv) {
  // create an empty message
      Message msg = new MimeMessage();
      try {
          // create and fill the envelope
          Address toAddrs[] = new InternetAddress[1];
          toAddrs[0] = new InternetAddress(argv[0]);
          Address fromAddr = new InternetAddress(argv[1]);
          msg.setFrom(fromAddr);
          msg.setRecipients(Envelope.TO, addrs);
          msg.setSubject("Java Mail APIs are great!");
          msg.setSentDate(new Date());
          msg.setHeader("X-Mailer", "JavaMail APIs");

          // create the main body and the multipart object
          MimeMultipart multi = new MimeMultipart();

          // create the main text body
          MimeBodyPart b1 = new MimeBodyPart();
          b1.setContent(text, "text/plain");
```

```
            multi.addPart(b1);

            // create the appointment body and fill it in
            MimeBodyPart b2 = new MimeBodyPart();
            b2.setContent(appt, "application/cal");
            multi.addPart(b2);

           // send the message
            msg.setContent(multi);
            msg.send();
        } catch (Exception ex) {
            ex.printStackTrace();
        }
    }
}
```

C

Message Security

C.1 Overview

This is not a full specification of how Message Security will be integrated into the JavaMail system. This is a description of one way it could be implemented. The purpose of this section is to determine that it will be possible to integrate message security; not to show how it will be integrated. The final design for Message Security will change based on feedback and finalization of the S/MIME IETF specification.

This section will discuss encrypting/decrypting messages, and signing/verifying signatures. It will not discuss how Security Restrictions on untrusted or signed applets will work, nor will it discuss a general authentication model for Stores (e.g. a GSS API in Java).

C.1.1 Displaying an Encryted/Signed Message

Displaying an encrypted or signed message is the same as displaying any other message. The client uses the Datahandler for that encrypted message together with the "view" command. This returns a bean which displays the data. There will be both a multipart/signed and multipart/encrypted viewer bean (can be the same bean). The beans will need to be aware of the MultiPartSigned/MultiPartEncrypted classes.

C.1.2 MultiPartEncrypted/Signed Classes

The JavaMail API will probably add two new content classes: MultiPartEncrypted and MultiPartSigned. They subclass the MultiPart class and handle the MIME types multipart/encrypted and multipart/signed. There are many possible "protocols" which specify how the message has been encrypted and/or signed. The MPE/MPS classes will find all the installed protocols. The ContentType's protocol parameter determines which the protocol class to use. There needs to be a standard registration of protocol objects, or a way to search for valid packages and instantiate a particular class. The MultiPart classes will hand off the control

information, other parameters, and the data to be manipulated (either the signed/encrypted block) through some defined Protocol interface.

C.1.3 Reading the Contents

There will be times when an applet/application needs to retrieve the content of the message without displaying its content. The code sample below shows one possible technique, with a message containing encrypted content:

```
Message msg = // message gotten from some folder, or somehow
if (msg.getContentType().equals("multipart/encrypted")) {
      Object o = msg.getContent();
      if (o instanceof MultiPartEncrypted) {
            MultiPartEncrypted mpe = (MultiPartEncrypted) o;
            mpe.decrypt();
                  // use the default keys/certs from the user
                  // also, should be able to determine
                  // whether or not to interact with the user

      // should then be able to use the multipart methods to
      // get any contained blocks }
      }
}
```

`getContent()` returns a MultiPartEncrypted object. There will be methods on this class to decrypt the content. The decryption could either determine which keys needed to be used, or use the defaults (maybe the current user's keys) or could pass in explicitly which keys/certificates to use.

C.1.4 Verifying Signatures

Applications/applets will need to verify the validity of a signature. The code sample below shows how this might be done:

```
Message msg = // message gotten from some folder
if (msg.getContent().equals("multipart/signed")) {
      Object o = msg.getContent();
      if (o instanceof MultiPartSigned) {
            MultiPartSigned mps = (MultiPartSigned) o;
            boolean validsig = mps.verifySignature();

      // could already get the other blocks
      // even if it wasn't a valid signature
```

```
        }
}
```

If the signature is invalid, the application can still access the data. There will also be other methods on MultiPartSigned which allow setting of which keys/certificates to use when verifying the signature.

C.1.5 Creating a Message

There are two methods for creating an Encrypted/Signed message. Users will probably see an editor bean for the content types multipart/signed and multipart/encrypted. These beans would handle the UI components of allow the user to select how they wanted to encrypt/sign the message. The beans could be integrated into an application's Message Composition window.

C.1.5.1 Encrypted/Signed

The non-GUI method of creating the messages involves using the MultiPartEncrypted/Signed classes. The classes can be created and used as the content for a message. The following code shows how might work:

```
MultiPartEncrypted mpe = new MultiPartEncrypted();
// can setup parameters for how you want to encrypt the
// message otherwise it will use the user's preferences
// set the content you wish to encrypt (to encrypt multiple
// contents a multipart/mixed block should be used)
String ourContent = "Please encrypt me!";
mpe.setContent(ourContent);

MimeMessage m = new MimeMessage();
m.setContent(mpe);
```

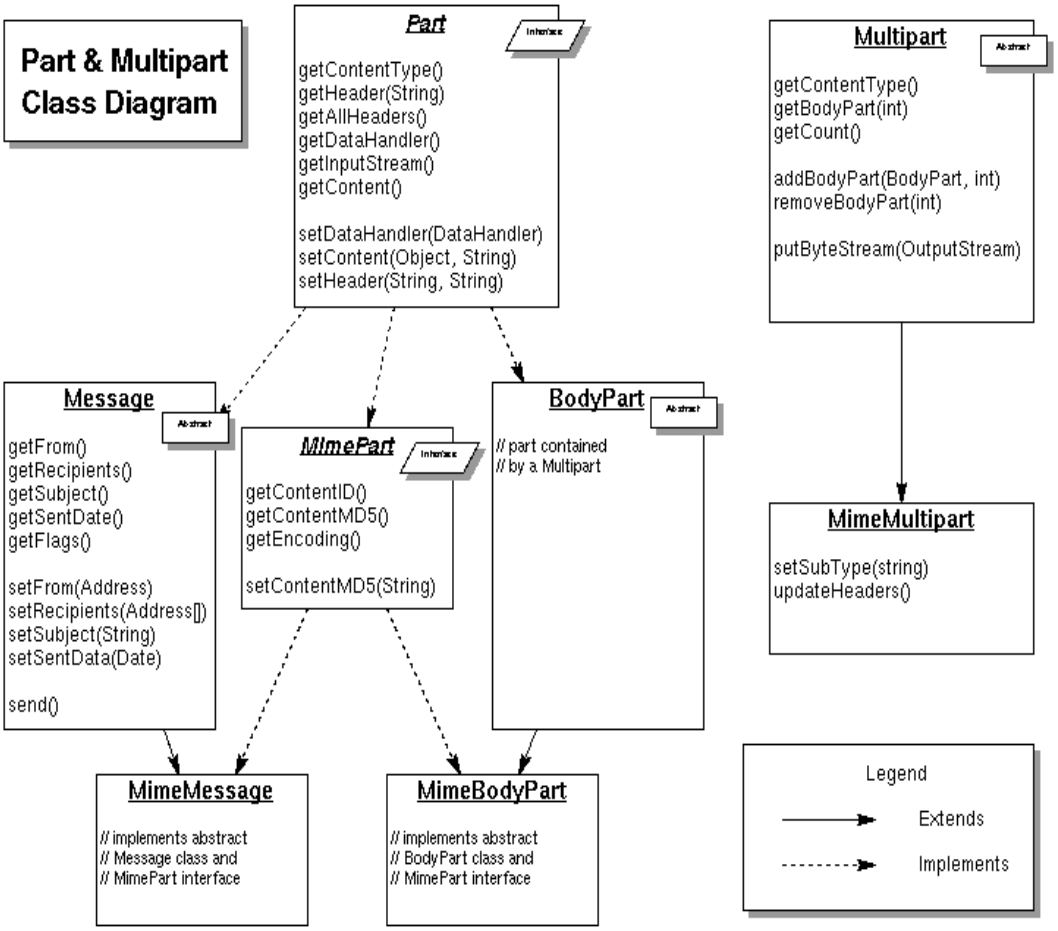
The message will be encrypted when the message is sent. There will be other methods which would allow the setting which encryption scheme is used and the keys involved.

The version of very similar to the Encrypted Message version, except that a MultiPartSigned object is created instead.

D

Part and Multipart Class Diagram

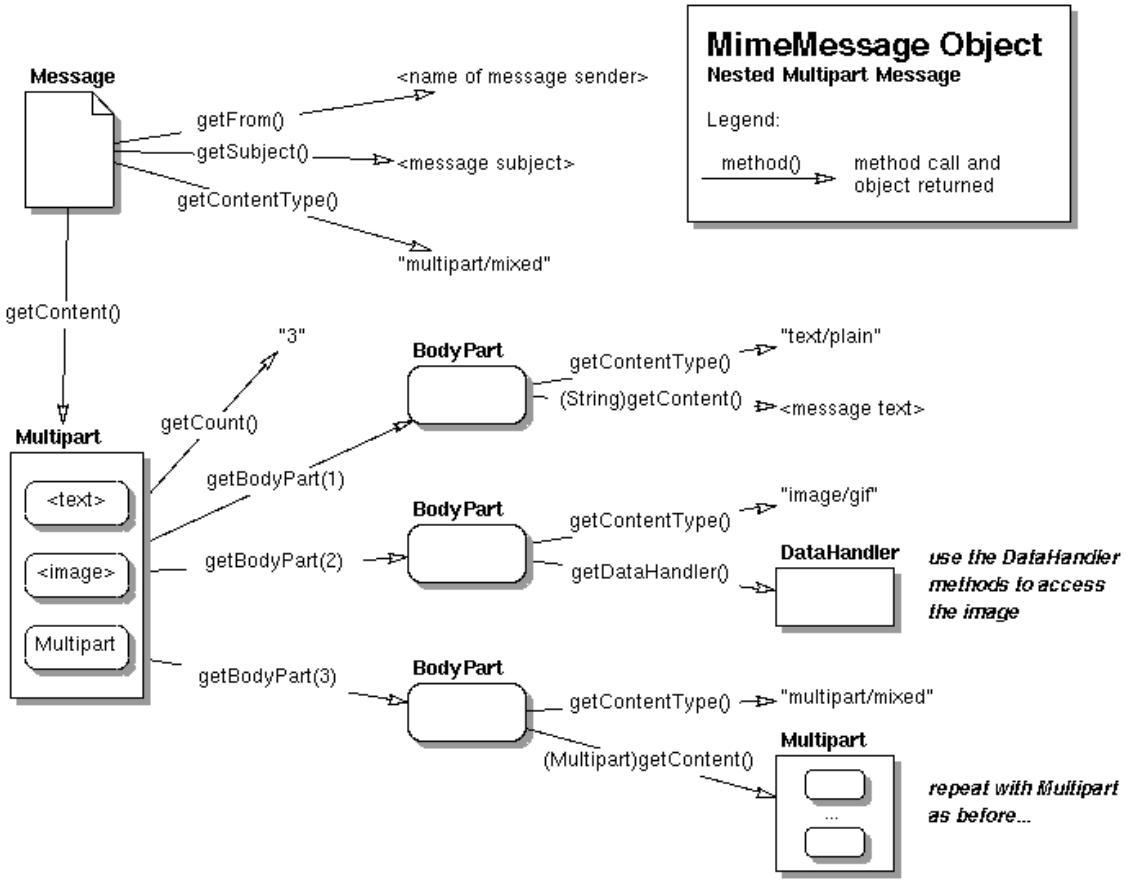
This Appendix illustrates relationships between Part interfaces and Message classes.



E

MimeMessage Object Hierarchy

This Appendix illustrates the MimeMessage object hierarchy.



Issues

This section lists issues involving the JavaMail API that have not been resolved. Later updates to this Specification will address these issues. We welcome your comments and suggestions:

- Service Provider's Appendix.
  We will release a Service Providers' Appendix shortly.

- Registry for Store and Transport.
  A registry for configuring and discovering the appropriate provider classes for Store and Transport. We will release a proposal shortly

- Unique IDs
  - Should we export Unique IDs for Messages ? How unique should this be?
  - Can implementations really support this uniqueness?
  - Are folder-specific Unique IDs (similar to IMAP UIDs) enough ? We'll need a UIDValidity mechanism as well.
  - How do we expose this in the API ? Do we want to expose an IMAP-specific concept through the APIs ?

  The main motivation for exposing Unique IDs seems to be for implementing disconnected use. This shifts the responsiblity for properly implementing disconnected support to the client.

  An alternative is to design new APIs (perhaps a Disconnectable Interface), that are rich enough to support the various modes of disconnected usage. Clients that want to provide disconnected use can use these APIs. Providers wanting to support disconnected use can implement these APIs. An IMAP provider will probably implement these using IMAP UIDs. Therefore, we don't need to expose UIDs in the API.

  We encourage you to provide your input on these choices.

- Convenience APIs
  - We need convenience APIs to create simple messages and messages with simple attachments. We are working on this. Suggestions are welcome.
  - We might also need convenience APIs to traverse simple multipart messages. Suggestions are welcome.

- Authentication
  We need an extensible authentication mechanism for implementing different authentication styles to Stores and Transports. This mechanism should allow providers to call back to clients in order to obtain required protocol-specific information. JDK 1.2 includes mechanisms to accomplish this. We are determining whether it is feasable to incorporate these mechanisms into the JavaMail APIs.

- The Activation Framework

We will release an updated Activation Framework Specification soon, including some minor fixes. This document refers some APIs described in the updated specification.