Habari STOMP Client for RabbitMQ

Getting started

Version 10.3-RC1

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NOTE For broker-specific notes, see Chapter 31, *Broker-specific notes*.

Part I: Getting started

Chapter 1. Installation

1.1. Requirements

1.1.1. Development environment

The library may be used with

- **Embarcadero Delphi** 2009 Update 4 or higher
- **Free Pascal** 3.2.2 or higher, on Windows and Linux (x86_64). On Linux, a minimal client was compiled and run with all three TCP/IP libraries (Ubuntu 24.04, Lazarus 3.0); see Section 27.4, “Free Pascal specific restrictions”.

1.1.2. TCP/IP communication library

This library requires one of these TCP/IP libraries:

- **Internet Direct (Indy) 10.6.2 or newer** (recommended)[1]
- **Synapse**
- **mORMot 2.4 or newer**

The source code for TCP/IP communication libraries is not included in the installer.[2]

1.1.3. Test suites

- The DUnit test suite requires the Delphi 2009 version of DUnit for compilation.
- The FPCUnit test suite requires the latest Lazarus / Free Pascal versions.

1.2. Installation steps

The installer application will guide you through the installation process.

By default Habari STOMP Client for RabbitMQ will be installed in the folder

C:\Users\Public\Documents\Habarisoft\habari-rabbitmq-10.3-RC1

[1] This is the primary adapter class being used for development and testing of the library.

[2] See chapter "Online resources" for download addresses.

Chapter 2. Directory structure

```
<inst>
\- demo                                    Demo applications
   \- ...
   \common-tests                           DUnit test project
   \- ...
   \common-tests-fpc                       FPCUnit test project
   \- ...
\- demo-brokerspecific                     Broker-specific demo applications
   \- ...
\- docs                                    Documentation
   \- HabariRabbitMQGettingStarted.pdf
   \html                                   API documentation
   \- ...
\- libraries                               Third party libraries
   \- ...
\- source                                  Library source code
   \- ...
   \optional                               Optional source code
   \- ...
license.txt                                License information
THIRDPARTYLICENSEREADME.txt                Third party license information
unins000.dat                               Uninstaller data
unins000.exe                               Uninstaller
```

Chapter 3. Breaking changes and deprecation warnings in version 10.3

3.1. Breaking changes

There are no breaking changes for applications that do not define `HABARI_BROKEN_MESSAGELISTENER`.

3.1.1. IMQConsumer interface (only with HABARI_BROKEN_MESSAGELISTENER)

With `HABARI_BROKEN_MESSAGELISTENER` defined, the `IMQConsumer` interface of the simplified API has two new methods, `GetMessageListener` and `SetMessageListener`, and the `MessageListener` property. Consumers created with `IMQContext.CreateConsumer` can now receive messages asynchronously, as `IMessageConsumer` can.

This affects only classes that implement `IMQConsumer` themselves, for example test doubles: add the two methods. Code that only uses `IMQConsumer` is not affected.

See: Chapter 11, *Asynchronous receive (IMessageListener)*

3.2. Deprecation warnings

3.2.1. HABARI_X_MAXLINELENGTH and HABARI_ENABLE_FAILOVER_PROTOCOL

Both conditional defines have been deprecated since version 10.2. The compiler reports it when they are set. **They will be removed in the next release.** A project that still defines them will then fail to compile, with a message naming the replacement. They are not simply dropped, because your setting would then be lost without notice, and the application would behave differently at run time.

Remove both defines from your project options now. The replacements have been available since version 10.2 and need no define. Set them on the connection before you call `Start`:

Define	What it does	Replacement
`HABARI_X_MAXLINELENGTH`	Removes the line length limit of Internet Direct (Indy) for very large header lines (the define sets it to `MaxInt`)	`(Connection as IMaxLineLength).MaxLineLength := 1024 * 1024;` (unit `BTCommInterfaces`): choose a limit that fits your longest header line instead of removing the limit. Indy adapter only; the other adapters have no such limit.
`HABARI_ENABLE_FAILOVER_PROTOCOL`	Allows `failover:` connection URLs	`(Connection as IFailoverProtocol).EnableFailoverProtocol := True;` (unit `BTMgmtInterfaces`)

Code example

```
Connection := Factory.CreateConnection;
// was HABARI_X_MAXLINELENGTH; the Indy default is 16,384 bytes (16 KB)
(Connection as IMaxLineLength).MaxLineLength := 1024 * 1024; // 1 MB
// was HABARI_ENABLE_FAILOVER_PROTOCOL
(Connection as IFailoverProtocol).EnableFailoverProtocol := True;
Connection.Start;
```

Do not simply use `MaxInt`, which is what the define set. A bounded limit still accepts every realistic header line, but stops a faulty or hostile peer from making the client read an endless line into memory.

With the simplified API, set them on the context, right after `CreateContext` and before the first `CreateConsumer`, `CreateProducer`, `CreateBrowser` or `Start`:

Code example

```
Context := Factory.CreateContext;
(Context as IFailoverProtocol).EnableFailoverProtocol := True;
Consumer := Context.CreateConsumer(Context.CreateQueue('orders'));
```

See: Section 5.1.4, “Maximum line length for Internet Direct (Indy)” and Section 8.2.4, “Failover connections”

3.2.2. HABARI_BROKEN_MESSAGELISTENER

The conditional define `HABARI_BROKEN_MESSAGELISTENER` will be removed in a future release. The code for asynchronous receive will then always be compiled in. The define will not be renamed.

The word “BROKEN” in the name is historical. `IMessageListener` is not deprecated: it is supported within the limits described in its chapter (one session per connection, no receipts, Indy adapter only).

When the define is removed, `IMessageConsumer` and `IMQConsumer` will always include `GetMessageListener` and `SetMessageListener`. This matters only if you have classes that implement one of these interfaces yourself.

See: Chapter 11, *Asynchronous receive (IMessageListener)*

3.2.3. HABARI_DEPRECATED_MESSAGELISTENER

The define `HABARI_DEPRECATED_MESSAGELISTENER` was renamed to `HABARI_BROKEN_MESSAGELISTENER` in version 10.2. A project that still defines the old name does not compile (“HABARI_DEPRECATED_MESSAGELISTENER is no longer usable”). Define `HABARI_BROKEN_MESSAGELISTENER` instead.

Chapter 4. Tutorials

4.1. Quick start tutorial

This tutorial is a quick introduction to Habari STOMP Client for RabbitMQ: it walks you through the creation of a "Hello world" application. Once you are done with this tutorial, you will have a general knowledge of how to create and run applications.

This tutorial takes less than 10 minutes to complete.

4.1.1. Setting up the project

To create a new project:

1. Start the Delphi IDE.
2. In the IDE, choose File > New > VCL Forms Application – Delphi.
3. Choose Project > Options ... to open the Project Options dialog.
4. In the options tree on the left, select 'Delphi Compiler'.
5. Add the source directory of Habari STOMP Client for RabbitMQ and the Indy source directories to the 'Search path'.
6. Choose OK to close the Project Options dialog.
7. Save the project as HelloMQ.

Now the project is created and saved.

You should see the main form in the GUI designer now.

4.1.2. Adding code to the project

To use the Habari STOMP Client for RabbitMQ library, you need to add the required units to the source code.

1. Switch to Code view (F12).
2. Add the required units to the interface uses list:

Code example

```
uses
  BTConnectionFactory,
  BTMQInterfaces,
  BTCommAdapterIndy,
  // auto-generated unit references
  Windows, Messages, SysUtils, ...
```

3. Compile and save the project.
4. Switch to Design view (F12), go to the Tool palette (Ctrl+Alt+P) and select TButton, add a button to the form.
5. Double-click the new button to jump to the Button1Click handler.
6. Add the following code to send the message:

Code example

```
procedure TForm1.Button1Click(Sender: TObject);
var
  Factory: IConnectionFactory;
  Context: IMQContext;
begin
  Factory := TBTConnectionFactory.Create;
  Context := Factory.CreateContext;
  try
    Context.CreateProducer.Send(Context.CreateQueue('HelloMQ'), 'Hello world!');
  finally
    Context.Close;
  end;
end;
```

7. Add a second button and double-click it to jump to the Button2Click handler.
8. Add the following code to receive and display the message:

Code example

```
procedure TForm1.Button2Click(Sender: TObject);
var
  Factory: IConnectionFactory;
  Context: IMQContext;
  Consumer: IMQConsumer;
  Msg: IMessage;
begin
  Factory := TBTConnectionFactory.Create;
  Context := Factory.CreateContext;
  try
    Consumer := Context.CreateConsumer(Context.CreateQueue('HelloMQ'));
    Msg := Consumer.Receive(1000);

    if Assigned(Msg) then
      ShowMessage((Msg as ITextMessage).Text)
    else
      ShowMessage('Error: no message received');
  finally
    Context.Close;
  end;
end;
```

9. Compile and save the project.

The example uses the simplified API (see Chapter 17, *Simplified API*). `TBTConnectionFactory.Create` without parameters connects to the broker on the local computer, with the default port and user credentials.

4.1.3. Run the demo

- Launch the message broker.
- Start the application.
- Click Button1 to send the message to the queue.
- Click Button2 to receive the message and display it.

You can run two instances of the application at the same time, and also on different computers if the factory is created with the IP address or the host name of the message broker, for example `TBTConnectionFactory.Create('stomp://brokerhost')`.

4.1.4. Check for memory leaks

To verify that the program does not cause memory leaks, insert a line in the project file HelloMQ.dpr:

Code example

```
program HelloMQ;

uses
  Forms,
  Unit1 in 'Unit1.pas' {Form1};

{$R *.res}

begin
  ReportMemoryLeaksOnShutdown := True; // check for memory leaks
  Application.Initialize;
  Application.MainFormOnTaskbar := True;
  Application.CreateForm(TForm1, Form1);
  Application.Run;
end.
```

4.1.5. Tutorial source code

The tutorial source code is included in the folder `demo\tutorial1`.

Part II: Programming guide

Chapter 5. Communication adapters

5.1. Introduction

Habari STOMP Client for RabbitMQ uses communication adapters as an abstraction layer for the TCP/IP library. All connections create their own internal instance of the adapter class.

5.1.1. Configuration of communication adapters

No configuration is required for the communication adapters. Applications specify communication and connection options in URL parameters or connection class properties or connection factory settings.

5.1.2. Registration of communication adapter class

A communication adapter implementation can be prepared for usage by simply adding its Delphi unit to the project.

Code example

```
program ClientUsingIndy;

uses
  BTCommAdapterIndy, // use Internet Direct (Indy)
  BTConnectionFactory, BTMQInterfaces,
  SysUtils;
...
```

Behind the scenes, the communication adapter class will register itself with the communication adapter manager in the BTAdapterRegistry unit.

Default adapter class

Applications typically use only one of the available communication adapter classes for all connections.

The library allows you to register two or more adapter classes and switch at run time, using methods in the adapter registry in unit BTAdapterRegistry - this feature is mainly for tests and demonstration purposes.

If more than one communication adapter is in the project, the **first** adapter class in the list will be the default adapter class. Example:

Code example

```
program ClientUsingIndyOrSynapse;

uses
  BTCommAdapterIndy, // use Internet Direct (Indy) as default adapter class
  BTCommAdapterSynapse, // and register the Synapse adapter class
  BTConnectionFactory, BTMQInterfaces,
  SysUtils;
...
```

The default adapter class can be changed at run time by setting the adapter class either by its name or by its class type.

5.1.3. Available communication adapters

The library includes adapter classes for TCP/IP libraries:

Table 1. Communication adapters

Adapter class	Unit to add
TBTCommAdapterIndy (recommended)[1]	BTCommAdapterIndy
TBTCommAdapterSynapse	BTCommAdapterSynapse
TBTCommAdaptermORMot2	BTCommAdaptermORMot2

5.1.4. Maximum line length for Internet Direct (Indy)

STOMP is a line-oriented protocol. The Indy communication adapter reads the command line and every header of an incoming frame one line at a time. By default Indy limits a single line to 16,384 bytes; if a frame carries a longer header line — for example a large authentication token, a long selector expression, or routing metadata returned by the broker — the read fails and an `EIdReadLnMaxLineLengthExceeded` exception is raised. Frame bodies are not affected, because they are read without a line-length limit.

To raise the limit, set the `MaxLineLength` property of the connection before it is started. The property is declared by the `IMaxLineLength` interface in the `BTCommInterfaces` unit and is implemented by every `IConnection` and every `IMQContext`.

Code example

```
uses
  BTCommAdapterIndy, BTConnectionFactory, BTMQInterfaces,
  BTCommInterfaces, SysUtils;
...
Connection := Factory.CreateConnection;

// raise the header line limit for this connection (in bytes)
(Connection as IMaxLineLength).MaxLineLength := 1024 * 1024;

Connection.Start;
```

With the simplified API, set it on the context, right after `CreateContext` and before the first `CreateConsumer`, `CreateProducer`, `CreateBrowser` or `Start`: `(Context as IMaxLineLength).MaxLineLength := 1024 * 1024;`

The value is interpreted as follows:

- `0` (the default) keeps the limit of the underlying TCP/IP library — 16,384 bytes for Indy.
- A value greater than zero is applied when the socket is opened, before the CONNECT frame is sent. It governs the frame command and the header lines.
- The property must be set before `Connection.Start`. Setting it on a started connection raises an `EMQException`.
- The setting is used by the Indy adapter only. The Synapse and mORMot 2 adapters accept the value but do not apply it.

NOTE Setting `MaxLineLength` to `MaxInt` removes the limit entirely; an incoming stream without a line feed can then grow the read buffer until memory is exhausted. Choose the smallest value that comfortably fits the largest header block you expect.

The conditional define `HABARI_X_MAXLINELENGTH`, which had the same effect at compile time, is deprecated and will be removed in the next release. It still works, but the compiler now emits a warning; new code should use the `MaxLineLength` property instead.

[1] This is the primary adapter class being used for development and testing of the library.

Chapter 6. The programming model

6.1. Classic and modern (simplified) API

Applications may choose between the classic API, which is based on message producers / message consumers, sessions, connections, and connection factories, and the simplified API, which moves methods of ISession and IConnection into a single IMQContext interface.

Both API versions are identical for all four brokers. This allows an easy migration between supported message brokers, as long as no broker-specific features are used.

Chapter 7. Connection factory

7.1. Overview

A connection factory is an object which holds all information required for the creation of connection objects.

A connection factory instance is usually created and configured only once. It then may be used to create actual connection objects when needed. For example, a worker thread may create the connection factory once at program start-up and use it to create a new connection object whenever a connection failure occurs.

7.2. Creation and configuration

The code example below shows a helper function which creates a connection factory, and returns it using the interface type IConnectionFactory.

The factory will be freed automatically when there are no more references to it.

Code example

```
function TExample.CreateConfiguredFactory: IConnectionFactory;
var
  Factory: IConnectionFactory;
begin
  // ------------------------------------------------------------
  // create an instance
  // ------------------------------------------------------------
  Factory := TBTConnectionFactory.Create('user', 'password',
'stomp://localhost?send.receipt=true');

  // ------------------------------------------------------------
  // return the instance
  // ------------------------------------------------------------
  Result := Factory;
end;
```

This code example is useful for most simple client applications. However, because the local factory variable is declared as IConnectionFactory, advanced configuration properties in the class TBTConnectionFactory such as ClientID and SendTimeOut are not accessible.

To access them, declare the local factory with the class type as shown in the next example:

Code example

```
function TExample.CreateConfiguredFactory: IConnectionFactory;
var
  Factory: TBTConnectionFactory;
begin
  // -----------------------------------------------------------
  // create and assign to local variable
  // -----------------------------------------------------------
  Factory := TBTConnectionFactory.Create;

  // -----------------------------------------------------------
  // additional configuration
  // -----------------------------------------------------------
  Factory.BrokerURL := 'broker.example.com';
  Factory.UserName := 'username';
  Factory.Password := 'password';
  Factory.ClientID := 'myclientId';
  Factory.SendTimeOut := 10000;
  Factory.ConnectTimeOut := 10000;

  // -----------------------------------------------------------
  // return the configured factory
  // -----------------------------------------------------------
  Result := Factory;
end;
```

WARNING If the method signature is changed to return the class TBTConnectionFactory instead, a memory leak will occur.

Code example

```
procedure TExample.Run;
var
  F: IConnectionFactory;
  C: IConnection;
begin
  // --------------------------------------------------------------
  // get a factory and use it to create a connection object
  // --------------------------------------------------------------
  F := CreateConfiguredFactory;

  C := F.CreateConnection;

  // --------------------------------------------------------------
  // start and use the connection
  // --------------------------------------------------------------
  C.Start;
  ...
  // --------------------------------------------------------------
  // close the connection
  // --------------------------------------------------------------
  C.Close;
end;
```

7.3. Connection URL parameters

7.3.1. Heartbeating support

STOMP 1.1 introduced heartbeating. Its configuration is covered in Chapter 18, *STOMP 1.2*.

7.4. Receipt support

The STOMP standard supports receipt messages since version 1.0:

> "Any client frame other than CONNECT may specify a *receipt* header with an arbitrary value. This will cause the server to acknowledge receipt of the frame with a RECEIPT frame which contains the value of this header as the value of the *receipt-id* header in the RECEIPT packet."[1][2][3]

With Habari STOMP Client for RabbitMQ, client applications may configure receipt headers for the frame types listed below.

After the STOMP frame has been sent to the broker, the client library waits for the RECEIPT frame for a defined time, which may be configured per frame type. If the broker does not send a receipt within the time-out interval, the client library will raise an exception. If the client receives a receipt with the wrong receipt-id header, it will raise an exception.

NOTE Do not use receipts on a connection with a listener. See rule 2 in Section 11.4, “Rules”.

WARNING **Known issue:** after sending, the client reads exactly one frame and expects it to be the RECEIPT. If the broker first sends a MESSAGE for a consumer on the same connection, the operation raises "No RECEIPT received", and that message is lost. Earlier versions behave the same, and a fix is planned. Request receipts only on a connection or context that does not also receive messages, for example a separate one used only for sending.

7.4.1. Receipt support parameters

STOMP frame	Parameter	Example URL
SUBSCRIBE	subscribe.receipt	stomp://localhost?subscribe.receipt=true
UNSUBSCRIBE	unsubscribe.receipt	stomp://localhost?unsubscribe.receipt=true
SEND	send.receipt	stomp://localhost?send.receipt=true
DISCONNECT	disconnect.receipt	stomp://localhost?disconnect.receipt=true

7.4.2. SUBSCRIBE receipt

To request server receipts for SUBSCRIBE frames, use the optional connection URL parameter, subscribe.receipt.

Code example

```
Factory := TBTConnectionFactory.Create('user', 'password',
'stomp://localhost?subscribe.receipt=true');
```

If the broker does not send a receipt within the time-out interval, the client library will raise an exception.

7.4.3. UNSUBSCRIBE receipt

To request server receipts for UNSUBSCRIBE frames, use the optional connection URL parameter, unsubscribe.receipt.

Code example

```
Factory := TBTConnectionFactory.Create('user', 'password',
'stomp://localhost?unsubscribe.receipt=true');
```

If the broker does not send a receipt within the time-out interval, the client library will raise an exception.

7.4.4. SEND receipt

To request server receipts for SEND frames, use the optional connection URL parameter, send.receipt.

Code example

```
Factory := TBTConnectionFactory.Create('user', 'password',
'stomp://localhost?send.receipt=true');
```

If the broker does not send a receipt within the time-out interval, the client library will raise an exception.

NOTE For additional reliability, the client can use transactional send (see section "Transacted sessions").

7.4.5. DISCONNECT receipt

To request server receipts for DISCONNECT frames, use the optional connection URL parameter, disconnect.receipt.

Code example

```
Factory := TBTConnectionFactory.Create('user', 'password',
'stomp://localhost?disconnect.receipt=true');
```

Without this parameter, the client will disconnect the socket connection immediately after sending the DISCONNECT frame to the broker.

With disconnect.receipt=true, the client will send the DISCONNECT frame and then wait for the broker receipt frame. If the broker does not answer, the client library will raise an exception. The client

application should treat its messages as undelivered.

NOTE For additional reliability, the client can use transactional send (see section "Transacted sessions"), and message receipts (see section "SEND receipt").

[1] https://stomp.github.io/stomp-specification-1.0.html

[2] https://stomp.github.io/stomp-specification-1.1.html#Header_receipt

[3] https://stomp.github.io/stomp-specification-1.2.html#Header_receipt

Chapter 8. Connections and sessions

8.1. Connections use STOMP 1.2 by default

The default protocol version is defined in the BTBrokerConsts unit. The default STOMP version may be overridden by specifying a connection URL parameter.

8.2. Step-by-step example

8.2.1. Overview

This example will send a single message to a destination queue (ExampleQueue).

8.2.2. Add required units

Three units are required for this example:

- a communication adapter unit (e.g. BTCommAdapterIndy
- a connection factory unit (BTConnectionFactory
- the unit containing the interface declarations (BTMQInterfaces)

The SysUtils unit is necessary for the exception handling.

Code example

```
program SendOneMessage;

{$APPTYPE CONSOLE}

uses
  BTCommAdapterIndy,
  BTConnectionFactory,
  BTMQInterfaces,
  SysUtils;
...
```

8.2.3. Creating a new connection

New connections are created by calling the CreateConnection method of a connection factory.

Code example

```
var
  Factory: IConnectionFactory;
  Connection: IConnection;
  ...
begin
  Factory := TBTConnectionFactory.Create('user', 'password', 'stomp://localhost');
  Connection := Factory.CreateConnection;
  ...
```

- For connection factory creation and configuration options please see section "Creation and configuration".
- Since IConnection is an interface type, the connection instance will be destroyed automatically if there are no more references to it in the program.

8.2.4. Failover connections

A failover connection uses a list of brokers instead of a single one. The client tries the brokers in turn until one accepts the connection and, after a connection loss, reconnects automatically using a configurable back-off delay.

NOTE This is an experimental or optional feature, not covered by the free basic support plan.

The failover URL

A failover URL wraps a comma-separated list of broker URLs in `failover:(...)`. Connection options for the failover behaviour are appended after the closing parenthesis:

Code example

```
failover:(stomp://host-a,stomp://host-
b)?initialReconnectDelay=1000&maxReconnectAttempts=10
```

Each entry in the list is an ordinary connection URL and may carry its own parameters (for example `connect.host`).

Enabling failover from code

Support for the `failover:` protocol is enabled per connection through the `IFailoverProtocol` interface, which is implemented by every `IConnection` and every `IMQContext` and declared in the `BTMgmtInterfaces` unit. Set the `EnableFailoverProtocol` property to `True` after creating the

connection and before starting it.

Code example

```
uses
  BTCommAdapterIndy, BTConnectionFactory, BTMQInterfaces, BTMgmtInterfaces, SysUtils;

var
  Factory: IConnectionFactory;
  Connection: IConnection;
begin
  Factory := TBTConnectionFactory.Create('user', 'password',
    'failover:(stomp://host-a,stomp://host-b)');

  Connection := Factory.CreateConnection;
  (Connection as IFailoverProtocol).EnableFailoverProtocol := True;
  Connection.Start;
```

With the simplified API, set it on the context, right after `CreateContext` and before the first `CreateConsumer`, `CreateProducer`, `CreateBrowser` or `Start`: `(Context as IFailoverProtocol).EnableFailoverProtocol := True;`

If a `failover:` URL is used while `EnableFailoverProtocol` is `False` (the default), `Connection.Start` raises an exception. The property cannot be changed once the connection has been started.

Failover options

Options are given as &-separated `name=value` pairs after `failover:(...)`.

Parameter	Default	Description
initialReconnectDelay	10	Delay in milliseconds before the first reconnect attempt
maxReconnectDelay	30000	Upper limit in milliseconds for the delay after back-off
backOffMultiplier	2.0	Factor applied to the delay after each unsuccessful pass through the list
maxReconnectAttempts	-1	Attempts before giving up; -1 retries indefinitely, 0 disables retrying
randomize	true	Start from a random broker in the list instead of the first

Deprecated compile define

Earlier versions required the conditional define `HABARI_ENABLE_FAILOVER_PROTOCOL` to be set for the whole library. This define is deprecated and will be removed in the next release. If it is still defined, every connection starts with `EnableFailoverProtocol` set to `True` and the compiler emits a warning. New code should set the property and remove the define from the project options.

8.2.5. Connection URL parameters

Connection URL parameters are documented in chapter "Connection factory" and in Chapter 18, *STOMP 1.2*.

8.2.6. Creating a session

To create the communication session,

- declare a variable of type `ISession`
- use the helper method `CreateSession` of the connection, and specify the acknowledgement mode

Please check the API documentation for the different session types and acknowledgement modes.

Since `ISession` is an interface type, the session instance will be destroyed automatically if there are no more references to it in the program.

Code example

```
    Session := Connection.CreateSession(False, amAutoAcknowledge);
```

8.2.7. Using the session

The Session variable is ready to use now. Destinations, producers and consumers will be covered in the next chapters.

Code example

```
    Destination := Session.CreateQueue('ExampleQueue');
    Producer := Session.CreateProducer(Destination);
    Producer.Send(Session.CreateTextMessage('This is a test message'));
```

8.2.8. Closing a connection

Finally, the application closes the connection. The client will disconnect from the message broker. Closing a connection also implicitly closes all open sessions.

Code example

```
  finally
    Connection.Close;
  end;
end.
```

NOTE

Close will be called automatically if the connection is destroyed. But because unclosed connections use resources, Close should be called when the connection is no longer needed. When logging is enabled, the connection class will also log a message when a connection is destroyed without calling Close.

8.3. Session types overview

The table below shows the supported parameter combinations for the Connection.CreateSession method and their effect on the session transaction and acknowledgement features.

Table 2. Session creation parameters

Parameters	Client MUST acknowledge message receipt[1]	Transaction support for		**STOMP Version**
		Send	Ack	
CreateSession(False, amAutoAcknowledge)	No	-	-	1.0
CreateSession(False, amClientAcknowledge)	Yes (cumulative effect)	-	-	1.0
CreateSession(False, amClientIndividual)	Yes	-	-	1.2
CreateSession(True, amAutoAcknowledge)	No	✓	-	1.0
CreateSession(True, amClientAcknowledge)	Yes (cumulative effect)	✓	✓ ①	1.0
CreateSession(True, amClientIndividual)	Yes	✓	✓ ①	1.2
CreateSession(True, amTransactional)	No	✓	-	1.0

① – The acknowledgement is part of the transaction (see Section 8.4.5, “Transacted message

acknowledgement”).

8.4. Transacted sessions

A session may be specified as transacted. Each transacted session supports a single series of transactions.

Each transaction groups a set of message sends into an atomic unit of work.

A transaction is completed using either its session’s Commit method or its session’s Rollback method. The completion of a session’s current transaction automatically begins the next. The result is that a transacted session always has a current transaction within which its work is done.

8.4.1. Create a transacted session

To create a transacted session, set the parameter of CreateSession to amTransactional as shown in the code example:

Code example

```
Session := Connection.CreateSession(amTransactional);
```

or (using the older API version)

Code example

```
Session := Connection.CreateSession(True, amTransactional);
```

This code will automatically start a new transaction for this session.

8.4.2. Send messages

Now send messages using the transacted session.

Code example

```
Destination := Session.CreateQueue('testqueue');
Producer := Session.CreateProducer(Destination);
Producer.Send(Session.CreateTextMessage('This is a test message'));
```

8.4.3. Committing a transaction

If your client code has successfully sent its messages, the transaction must be committed to make the messages visible on the destination.

Code example

```
try
  // send messages ...

  // commit all messages
  Session.Commit;
except
  Session.Rollback;
  raise;
end;
```

NOTE Committing a transaction automatically starts a new transaction.

8.4.4. Rolling back a transaction

If your client code wants to undo the sending of its messages, the transaction may be rolled back, and the messages will not become visible on the destination.

Code example

```
try
  // send messages ...
  Session.Commit;
except
  // error: none of the messages become visible
  Session.Rollback;
  ...
end;
```

NOTE Rolling back a transaction automatically starts a new transaction. A transacted session will be rolled back automatically if the connection is closed.

8.4.5. Transacted message acknowledgement

In a transacted session, acknowledging a received message is part of the transaction. `Rollback`, or closing the connection without `Commit`, makes the message available again.

Code example

```
// receive in a transacted session
Session := Connection.CreateSession(True, amClientAcknowledge);
Queue := Session.CreateQueue(GetQueueName);
Consumer := Session.CreateConsumer(Queue);
Msg := Consumer.Receive(1000);
// process the message
...

// acknowledge the message
Msg.Acknowledge;

...

// in case of errors, roll back all acknowledgements
Session.Rollback;
```

This is an experimental feature. It requires the STOMP 1.2 communication protocol.

[1] https://stomp.github.io/stomp-specification-1.2.html#SUBSCRIBE_ack_Header

Chapter 9. Destinations

9.1. Introduction

The API supports two models:[1]

1. Point-to-point
2. Publish-and-subscribe

In the point-to-point model, a producer posts messages to a particular queue and a consumer reads messages from the queue. Here, the producer knows the destination of the message and posts the message directly to the consumer's queue. It is characterized by the following:

- Only one consumer will get the message
- The producer does not have to be running at the time the receiver consumes the message, nor does the receiver need to be running at the time the message is sent
- Every message successfully processed is acknowledged by the receiver

The publish-and-subscribe model supports publishing messages to a particular message topic. Zero or more subscribers may register interest in receiving messages on a particular message topic. In this model, neither the publisher nor the subscriber knows about the other. A good metaphor for it is an anonymous bulletin board. The following are characteristics of this model:

- Multiple consumers can get the message
- There is a timing dependency between publishers and subscribers. The publisher has to create a topic in order for clients to be able to subscribe. The subscriber has to remain continuously active to receive messages, unless it has established a durable subscription. In that case, messages published while the subscriber is not connected will be redistributed whenever it reconnects.

9.2. Create a new destination

9.2.1. Queues

A queue can be created using the CreateQueue method of the Session.

Code example

```
Destination := Session.CreateQueue('foo');
Consumer := Session.CreateConsumer(Destination);
```

The queue can then be used to send or receive messages using implementations of the IMessageProducer and IMessageConsumer interfaces. (See next chapter for an example.)

9.2.2. Topics

A topic can be created using the CreateTopic method of the Session.

Code example

```
Destination := Session.CreateTopic('bar');
Consumer := Session.CreateConsumer(Destination);
```

The topic can then be used to send or receive messages using implementations of the IMessageProducer and IMessageConsumer interfaces. (See next chapter for an example.)

[1] See also: Wikipedia contributors. "Jakarta Messaging." Wikipedia, The Free Encyclopedia, 24 Nov. 2024. Web. 5 Jun. 2025.

Chapter 10. Producer and consumer

10.1. Message producer

A client uses a MessageProducer object to send messages to a destination. A MessageProducer object is created by passing a Destination object to a message-producer creation method supplied by a session.

Code example

```
Destination := Session.CreateQueue('foo');
Producer := Session.CreateProducer(Destination);
Producer.Send(Session.CreateTextMessage('Test message'));
```

A client can specify a default delivery mode, priority, and time to live for messages sent by a message producer. It can also specify the delivery mode, priority, and time to live for an individual message.

10.1.1. Persistent messages

The delivery mode for outgoing messages may be set to persistent in one of two ways.

Setting the default delivery mode

Code example

```
Destination := Session.CreateQueue('foo');
Producer := Session.CreateProducer(Destination);
Producer.DeliveryMode := dmPersistent;
Producer.Send(Session.CreateTextMessage('Test message'));
```

Setting the delivery mode for an individual message

Code example

```
Destination := Session.CreateQueue('foo');
Producer := Session.CreateProducer(Destination);
Producer.Send(Session.CreateTextMessage('Test message'), dmPersistent, BTBrokerConsts
.DEFAULT_PRIORITY, 0);
```

10.2. Message consumer

A client uses a MessageConsumer object to receive messages from a destination. A MessageConsumer object is created by passing a Destination object to a message-consumer creation method supplied by a session.

Code example

```
Destination := Session.CreateQueue('foo');
Consumer := Session.CreateConsumer(Destination);
```

10.2.1. Message selector

A message consumer can be created with a **message selector**[1].

A message selector allows the client to restrict the messages delivered to the message consumer to those that match the selector.

10.3. Synchronous receive

A MessageConsumer offers a Receive method which can be used to consume exactly one message at a time.

Code example

```
while I < EXPECTED do
begin
  TextMessage := Consumer.Receive(1000) as ITextMessage;
  if Assigned(TextMessage) then
  begin
    Inc(I);
    TextMessage.Acknowledge;
    L.Info(Format('%d %s', [I, TextMessage.Text]));
  end;
end;
```

10.3.1. Receive and ReceiveNoWait

There are three different methods for synchronous receive:

Receive The Receive method with no arguments will block (wait until a message is available).

Receive(TimeOut) The Receive method with a timeout parameter will wait for the given time in

milliseconds. If no message arrives within this time, it will return nil.

ReceiveNoWait The ReceiveNoWait method will return immediately. If no message is available, it will return nil.

[1] The RabbitMQ message broker does not support message selectors.

Chapter 11. Asynchronous receive (IMessageListener)

11.1. Overview

Habari offers two ways to receive messages:

- **Synchronous:** your code calls `Consumer.Receive(Timeout)` and gets the next message or `nil`. This is the recommended way for most applications.
- **Asynchronous:** you attach an `IMessageListener` to a consumer, and a background thread calls its `OnMessage` method for every message that arrives.

The asynchronous option is compiled in only when the conditional symbol `HABARI_BROKEN_MESSAGELISTENER` is defined in your project options, and it works only with the Indy communication adapter. Like all conditional symbols, it is an optional feature, not covered by the free basic support plan.

The word “BROKEN” in the define is historical. The listener works well for a simple setup: one connection, one session, one or more consumers, and handlers that finish quickly. Its limits are listed in Section 11.4, “Rules”. Stay within them, because outside them it does not just slow down: it can corrupt the conversation with the broker. Later releases are planned to lift some of these limits (see Section 11.11, “Future of the define”).

11.2. Using a listener

1. Add `HABARI_BROKEN_MESSAGELISTENER` to the conditional defines of your project, and rebuild.
2. Use the Indy communication adapter (add `BTCommAdapterIndy` to a `uses` clause).
3. Implement `IMessageListener` and assign it to the `MessageListener` property of a consumer. This works on `IMQConsumer` (simplified API) and on `IMessageConsumer` (classic API).

Code example

```
type
  TOrderListener = class(TInterfacedObject, IMessageListener)
  public
    procedure OnMessage(const Message: IMessage);
  end;

procedure TOrderListener.OnMessage(const Message: IMessage);
begin
  try
    // keep this short: put the message on your own work queue and return
  except
    on E: Exception do
      LogError(E.Message); // your own logging: nothing else reports it
  end;
end;

...
  Factory := TBTConnectionFactory.Create('stomp://localhost');
  Context := Factory.CreateContext;
  Consumer := Context.CreateConsumer(Context.CreateQueue('orders'));
  Consumer.MessageListener := TOrderListener.Create;
```

With the classic API, set the property in the same way on an `IMessageConsumer` created by `Session.CreateConsumer`.

Delivery starts as soon as the listener is set, because the connection of a context is already started. Messages that arrived before are not lost: the listener receives them. Setting the listener to `nil` does not stop delivery; the consumer's messages are then dropped. To stop receiving, close the consumer.

The consumer keeps the listener alive through reference counting. Keep a reference to the context (or connection) and the consumer for as long as messages should be delivered.

The demo `demo/delphichat-listener` (HabariChatRooms) shows several chat rooms on one `IMQContext`, each with its own consumer and listener.

11.3. How delivery works

- **One thread per connection.** All subscriptions on a connection share one socket and one receive thread. The thread reads one message, calls your `OnMessage`, waits for it to return, then reads the next one.
- **Handlers run one at a time.** A slow handler for one destination holds up every other destination on the same connection. There is no fairness between subscriptions: messages are handled in the

order the broker sends them.

- **Which thread runs `OnMessage` depends on the application type:**

	GUI application	Console application
`OnMessage` runs on	the **main thread**, handed over with `Synchronize`	the **receive thread** of the connection
Updating forms and controls in the handler	allowed directly	not allowed: use `TThread.Queue` or `Synchronize`
When the main thread is busy	messages wait until it is free	delivery is not affected
Sending and acknowledging from the handler and from your other code	all on the main thread, so they cannot interfere (see Section 11.5, “Sending messages”)	on different threads: protect them with a lock

In a GUI application this has consequences you should be aware of:

- **A slow handler freezes the user interface,** because it blocks the main thread. And the other way round: while the main thread is busy (a long click handler, a modal dialog doing work), no message is delivered.
- `Synchronize` **waits for the main thread.** If the main thread itself waits for something the receive thread must deliver first, the application hangs. Do not block the main thread waiting for a message.
- **Everything that writes to the connection is safe only as long as it stays on the main thread.** If you move sending to a worker thread, the rules for other threads apply (see Section 11.5, “Sending messages”).
- The choice is made automatically from the application type and cannot be changed through the public API in version 10.3.

11.4. Rules

Breaking one of these rules is a correctness problem, not a performance problem.

1. **One session per connection.** A context has exactly one session, so it keeps this rule by itself. With several sessions on a connection that has listeners, messages can be lost or raise “Found no

matching consumer" errors.

2. **No receipts.** Do not use the `subscribe.receipt`, `unsubscribe.receipt` or `send.receipt` connection URL parameters on a connection with a listener. Waiting for a receipt reads the socket on your thread while the receive thread reads it too.
3. **Indy adapter only.** With the Synapse or mORMot 2 adapter, setting a listener raises `EIllegalStateException`.
4. **One writer at a time.** If your handler acknowledges messages, or sends messages, while another thread sends on the same connection, serialize those calls yourself. Otherwise frames can be interleaved on the wire.
5. **Do not stop consumers while other listeners are live.** You cannot stop one listener alone. Stopping a consumer, its session or the connection stops the receive thread for every listener on the connection. To end one listener, close its consumer.
6. **Catch exceptions in `OnMessage`.** Exceptions raised by a handler are logged only if the library is built with `HABARI_LOGGING`; otherwise they disappear without a trace. With automatic acknowledgement the message is already acknowledged, so it is lost.

11.5. Sending messages

The library has no lock on the connection's socket. Two threads writing to the same connection at the same time can mix up their frames on the wire. Writing covers more than `Send`: `Acknowledge` (in client acknowledgement modes), `Commit`/`Rollback`, `SendHeartbeat`, `CreateConsumer`, closing a consumer, and closing the connection all write to the socket. And because of rule 1, sending on the listener's connection means using a producer of the same context (or session).

Where you send	Safe?
On a **separate connection or context** used only for sending	Always. It has its own socket. This is the recommended way.
Inside `OnMessage`	Yes, as long as no other thread writes to the same connection at the same time.
On the main thread of a GUI application	Yes. Handlers also run on the main thread there, so all writes happen on one thread.
On any other thread	Only if you protect **every** write to the connection with one lock of your own.
With `send.receipt=true`	Never (see rule 2).

A separate context for sending needs no coordination with the listener:

Code example

```
SendContext := Factory.CreateContext; // used only for sending
Producer := SendContext.CreateProducer;
Producer.Send(SendContext.CreateQueue('replies'), 'Order accepted');
```

Use the sending context from one thread, or protect it with a lock if several threads send.

11.6. Acknowledgement and transactions

A listener consumer uses the acknowledgement mode of its session. Call `Acknowledge`, `Nack`, `Commit` and `Rollback` from inside `OnMessage`: while the listener runs, the session belongs to the thread that calls it. All of these write to the connection, so rule 4 applies.

What happens to a message when `OnMessage` raises an exception depends on the mode:

Session mode	**Message after an exception in** `OnMessage`
`amAutoAcknowledge`	**Lost.** The broker considered it delivered as soon as it was sent to the client.
`amClientIndividual`	Not acknowledged. The broker delivers it again later, typically after the consumer or connection is closed.
`amClientAcknowledge`	As above, **but** acknowledging a later message also acknowledges all earlier messages of the same consumer, including the failed one.
Transacted	The transaction is **not** rolled back automatically. Call `Rollback` yourself.

For per-message control, use `amClientIndividual` and acknowledge each message at the end of the handler:

Code example

```
procedure TOrderListener.OnMessage(const Message: IMessage);
begin
  try
    ProcessOrder(Message);
    Message.Acknowledge; // only this message (amClientIndividual)
  except
    on E: Exception do
      LogError(E.Message); // not acknowledged: the broker delivers it again
  end;
end;
```

`Nack` tells the broker that the message was not processed. What the broker does with it is broker-specific: ActiveMQ moves it to a dead-letter queue, and RabbitMQ puts it back in the queue. It is tested with ActiveMQ and RabbitMQ.

Acknowledging inside a transaction:

In a transacted session, acknowledging a received message is part of the transaction. `Rollback`, or closing the connection without `Commit`, makes the message available again.

Transactions in general are described in chapter "Connections and sessions", section "Transacted sessions".

11.7. Connection loss

If the connection breaks (network failure, broker shutdown, or an ERROR frame from the broker), the receive thread ends **silently**. `OnMessage` is no longer called. No exception reaches your code, no event is raised, and the library does not reconnect. Failover applies only when a connection is started.

Ways to notice:

- **Server heartbeats.** Negotiate heartbeats in both directions, for example `stomp://localhost?connect.heart-beat=10000,5000` (the server sends a heartbeat every 5 seconds, the client promises one every 10 seconds). Then call `CheckHeartbeat` and `SendHeartbeat` on a timer that fires more often than the client interval, for example every 5 seconds; `IHeartbeat` is declared in the unit `BTSessionIntf`. `CheckHeartbeat` raises `EBTStompServerHeartbeatMissing` when nothing has arrived for more than twice the server's heartbeat interval, which also happens when the receive thread has ended. Checking only reads a timestamp, so it is safe from any thread; call `SendHeartbeat` from the thread that sends your messages (rule 4). Heartbeats are not available with OpenMQ.

  The client heartbeats matter for an application that only listens: Artemis closes a connection that sends nothing within its connection TTL (60 seconds by default), even when the client asked for no heartbeats (`connect.heart-beat=0,5000`). The receive thread then ends, and `CheckHeartbeat` reports the loss.

Code example

```
// on a timer, on the thread that sends
(Connection as IHeartbeat).CheckHeartbeat; // raises if the server went silent
(Connection as IHeartbeat).SendHeartbeat;  // keeps the connection alive
```

- **The next write fails.** `Send`, `Acknowledge` or `SendHeartbeat` on the broken connection raises an exception. An application that only listens may never make such a call.

- **Your own watchdog**, for example “no message for five minutes” on a destination that is normally busy.

To recover, close the broken connection, ignoring exceptions from `Close`, and create a new connection, session, consumer and listener. With automatic acknowledgement, a message that was being handled when the connection broke may be lost. A future release is planned to report connection loss and handler errors through an exception listener.

11.8. Known issue: `Close` can hang

In rare cases, closing a connection with a receive thread does not return. To stop, the receive thread suspends itself. If `Close` asks the thread to end at the same moment, the request can get lost, and `Close` then waits for the thread forever. It was seen once in a full test run of several hundred connections. Earlier versions behave the same, and a fix is planned. Without `HABARI_BROKEN_MESSAGELISTENER` there is no receive thread, so this cannot happen.

11.9. When not to use it

If you have several busy destinations, need them isolated from each other, or need more than one session, use synchronous receiving instead:

- **One context (connection) per destination.** Separate contexts have separate sockets, so a backlog on one cannot hold up another.
- **A receive loop on a thread you own**, one per context:

Code example

```
procedure TOrderReceiver.Execute; // a TThread descendant
var
  Context: IMQContext;
  Consumer: IMQConsumer;
  Msg: IMessage;
begin
  Context := Factory.CreateContext; // one context for this thread only
  try
    Consumer := Context.CreateConsumer(Context.CreateQueue('orders'));
    while not Terminated do
    begin
      Msg := Consumer.Receive(1000);
      if Assigned(Msg) then
        HandleMessage(Msg); // keep this short, or queue the work
    end;
  finally
    Context.Close;
  end;
end;
```

- **Limit how much the broker sends at once** with a prefetch option in the destination name, for example `orders?activemq.prefetchSize=10` (ActiveMQ) or `orders?prefetch-count=10` (RabbitMQ).

11.10. Changes in version 10.3

- **Artemis:** listeners now receive messages. Up to version 10.2 they were never called.
- **Synapse and mORMot 2 adapters:** setting a listener raises a clear `EIllegalStateException` ("IMessageListener requires the Indy communication adapter; ... has no receive thread"). Up to version 10.2 this was an access violation. The consumer can still be used with `Receive`.
- **Simplified API:** `IMQConsumer` has a `MessageListener` property, so consumers created with `IMQContext.CreateConsumer` can receive asynchronously too.
- **Synchronous receive:** with the define set, a session without a listener now receives exactly as without the define. Up to version 10.2, two sessions on one connection raised "Found no matching consumer" in `Receive`, and a received message lost its `subscription` property.
- **Subscription check:** `Receive` checks that a message belongs to the consumer's own subscription, and it now does so with the define set as well. `message.subscription_check=false` still turns it off.
- **Creating and closing consumers while a listener runs** is now safe, also from inside `OnMessage`. Up to version 10.2 it could end delivery silently with an `EListError` on the receive thread.

- **Receive thread:** it is named “Habari receive thread” in the debugger, and a lock is no longer freed while the thread may still run.
- **Units:** `BTThread` and `BTStompReadThreadIndy` moved from `source/optional` to `source`, so the listener needs no extra search path.
- **Compiler warning:** defining the symbol now shows “IMessageListener works within documented limits (one session, no receipts, Indy only)”.

11.11. Future of the define

`HABARI_BROKEN_MESSAGELISTENER` will be **removed** in a future release. The listener code will then always be compiled, after the remaining limitations have been addressed. The define will not be renamed. When it is removed, the `IMessageConsumer` and `IMQConsumer` interfaces will always include `GetMessageListener` and `SetMessageListener`. This matters only if you have classes that implement one of these interfaces yourself. Applications that use the synchronous API are not otherwise affected.

Chapter 12. Durable subscriptions

12.1. Description

If a client needs to receive all the messages published on a topic, including the ones published while the subscriber is inactive, it uses a durable `TopicSubscriber`.

The message broker retains a record of this durable subscription and ensures that all messages from the topic's publishers are retained until they are acknowledged by this durable subscriber or they have expired.[1]

The combination of the client ID and the durable subscriber name uniquely identifies the durable topic subscription.

After you restart your program and re-subscribe, the broker will know which messages you need that were published while you were away.

12.1.1. Creation

The Session interface contains the CreateDurableSubscriber method which creates a durable subscriber to the specified topic.

A durable subscriber MessageConsumer is created with a unique client ID and durable subscriber name.

Only **one** thread can be actively consuming from a given logical topic subscriber.

[1] https://jakarta.ee/specifications/messaging/2.0/apidocs/javax/jms/topicsession

Chapter 13. Temporary queues

13.1. Introduction

Temporary queues and temporary topics are destinations which exist only as long as the connection that created them. The application creates them with the session methods CreateTemporaryQueue and CreateTemporaryTopic, and each one gets a unique name. When the connection is closed, the broker deletes the temporary destination, together with any messages still on it.

Only consumers of the connection that created a temporary destination can receive from it. Any producer which knows the destination can send to it. This makes temporary queues the usual choice for replies in request/reply scenarios: the requester creates a temporary queue, sets it as the JMSReplyTo destination of the request message, and waits for the answer on it. The class TBTQueueRequestor in the unit BTQueueRequestor implements this pattern.[1]

13.1.1. Library support

STOMP temporary queues are supported by ActiveMQ, OpenMQ, and RabbitMQ. ActiveMQ and OpenMQ also support temporary topics.

Broker	STOMP temporary queue	STOMP temporary topic
ActiveMQ	✓	✓
Artemis	✗	✗
OpenMQ	✓	✓
RabbitMQ	✓	✗

The Habari STOMP Client for Artemis does not support temporary destinations; CreateTemporaryQueue and CreateTemporaryTopic raise an exception. Use a regular queue for replies instead. The Habari STOMP Client for RabbitMQ supports temporary queues only; CreateTemporaryTopic raises an exception.

13.1.2. Resource management

Close the connection as soon as the replies have been received, so that the broker deletes its temporary destinations.

[1] `TBTQueueRequestor` is in `source/optional` of all four products.

Chapter 14. Message options

14.1. Standard properties

The Apache ActiveMQ message broker supports some JMS standard properties in the STOMP adapter. These properties are based on the JMS specification of the Message interface.[1]

Habari STOMP Client libraries for other message brokers may support a subset of these standard properties.

NOTE If your application makes use of these properties, your application depends on a broker-specific feature which is not guaranteed to be available in the STOMP adapter of other message brokers.

14.1.1. Properties for outgoing messages

CorrelationID	The correlation ID for the message.
Expiration	The message's expiration value.
DeliveryMode	Whether or not the message is persistent.[2]
Priority	The message priority level.[3]
ReplyTo	The Destination object to which a reply to this message should be sent.

14.1.2. Properties for incoming messages

CorrelationID	The correlation ID for the message.
Expiration	The message's expiration value.
DeliveryMode	Whether or not the message is persistent.
Priority	The message priority level.
Timestamp	The timestamp the provider added to the message.
MessageID	The message ID which is set by the provider.
ReplyTo	The Destination object to which a reply to this message should be sent.

14.2. Reserved property names

Some header names are defined by the STOMP specifications, and by broker-specific extensions of the STOMP protocol. These reserved STOMP header names cannot be used as names for user-defined properties.

NOTE	The client library will raise an exception if the application tries to send a message with a reserved property name.

14.2.1. Examples

- login
- passcode
- transaction
- session
- message
- destination
- id
- ack
- selector
- type
- content-length
- content-type
- correlation-id
- expires
- persistent
- priority
- reply-to
- message-id
- timestamp
- client-id
- redelivered

14.2.2. Prefix for custom headers

A common practice to avoid name collisions is using a prefix for your own properties (example: **x-type** instead of **type**).

14.3. Selectors

Selectors are a way of attaching a filter to a subscription to perform content-based routing. For details on selectors, see the reference on javax.jms.Message[4].

14.3.1. Supported message brokers

Message selectors are supported by

- Habari STOMP Client for ActiveMQ
- Habari STOMP Client for Artemis
- Habari STOMP Client for OpenMQ

Code example

```
Consumer := Session.CreateConsumer(Destination, 'vehicle=''car'' and color=''blue''');
```

All supported brokers support string type properties and operations in selectors. ActiveMQ also allows integer properties and operations in selectors (see the ActiveMQ notes on selectors[5]).

[1] https://jakarta.ee/specifications/messaging/2.0/apidocs/javax/jms/message

[2] For sending persistent messages please see the documentation for IMessageProducer.

[3] Clients set the Priority not directly on a message, but either on the producer or as a parameter in the Send method.

[4] https://jakarta.ee/specifications/messaging/2.0/apidocs/javax/jms/message

[5] https://activemq.apache.org/components/classic/documentation/selectors

Chapter 15. Map messages

15.1. Introduction

A map message is used to exchange **a set of name-value pairs**. The names are strings, the values are also strings (but may be textual representations of other data types).

15.1.1. Usage example

Create a map message and add map entries:

Code example

```
MapMessage := Session.CreateMapMessage;
MapMessage.SetString('key', 'value');
MapMessage.SetInt('key_int', 4096);
MapMessage.SetBoolean('key_b', True);
```

Read a map message from a consumer and access its entries:

Code example

```
MapMessage := Consumer.Receive(1000) as IMapMessage;

StringValue  := MapMessage.GetString('key');
IntegerValue := MapMessage.GetInt('key_int');
BoolValue    := MapMessage.GetBoolean('key_b');
```

Enumerate map entries:

Code example

```
MapKeys := MapMessage.GetMapNames;

for I := 0 to Length(MapKeys) - 1 do
begin
  MapKey := MapKeys[I];
  MapValue := MapMessage.GetString(MapKey);
  ... // process map entry
end;
```

15.1.2. Map message transformer

To send and receive map messages, the application needs to convert incoming and outgoing map

messages from and to the STOMP message body.

The **IMessageTransformer** interface must be implemented for map message and object message transformation. This interface defines two methods, **ConsumerTransform** and **ProducerTransform**.

Interface

```
function ConsumerTransform(const Session: ISession;
           const Consumer: IMessageConsumer; const AMessage: IMessage): IMessage;


function ProducerTransform(const Session: ISession;
           const Producer: IMessageProducer; const AMessage: IMessage): IMessage;
```

Implementation guide for map messages:

1. create a class which implements the IMessageTransformer interface
   - for ConsumerTransform, the **incoming** map message is passed as the AMessage parameter, the method must **read** its body to reconstruct the map properties, and return the map message as function result
   - for ProducerTransform, the **outgoing** map message is passed as the AMessage parameter, the method must **write** its body to store a representation of the map, and return the map message as function result
2. create an instance of this class and register it as the message transformer on the IConnection instance

NOTE | Only one map message transformer may be active for one connection.

Code example

```
Connection := Factory.CreateConnection;
try
  MyMapTransformer := TMyMapMessageTransformer.Create;

  // use the helper method in unit BTConnection:
  SetMapMessageTransformer(Connection, MyMapTransformer, 'my-map-message');

  Connection.Start;

  // send / receive messages

finally
  Connection.Close;
end;
```

15.1.3. Transformation identifier

To detect that an incoming message is a map message, it needs to carry a special header property. Without this transformation identifier, the message will still be delivered but its actual type will be undefined – it may arrive as an ITextMessage or IBytesMessage.

By default, the library will set this header property to the transformation identifier passed to SetMapMessageTransformer, so setting it yourself is optional.

You may explicitly set the header property on the created message:

Code example

```
MapMessage := Session.CreateMapMessage;
... // add map entries

// add the transformation identifier
MapMessage.SetStringProperty(SH_TRANSFORMATION, 'my-map-message');

Producer.Send(MapMessage);
```

15.1.4. Example ProducerTransform implementation with TStrings

This implementation uses a TStrings to collect the map entries. The outgoing message contains the TStrings as body.

Notes:

- the method uses a method of a helper interface, IContentProvider.SetContent, to write the body content
- the method returns nil if the passed message is not a map message

Code example

```
function TMyMapMessageTransformer.ProducerTransform(const Session: ISession;
  const Producer: IMessageProducer; const AMessage: IMessage): IMessage;
var
  TmpMapMsg: IMapMessage;
  Keys: PMStrings;
  I: Integer;
  MapKey: string;
  MapValue: string;
  MapStrings: TStrings;
begin
  Result := nil;

  if Supports(AMessage, IMapMessage, TmpMapMsg) then
  begin
    MapStrings := TStringList.Create;
    try
      Keys := TmpMapMsg.GetMapNames;

      for I := 0 to Length(Keys) - 1 do
      begin
        MapKey := Keys[I];
        MapValue := TmpMapMsg.GetString(MapKey);
        MapStrings.Values[MapKey] := MapValue;
      end;

      (AMessage as IContentProvider).SetContent(Utf8Encode(MapStrings.Text));
      Result := AMessage;
    finally
      MapStrings.Free;
    end;
  end;
end;
```

15.1.5. Ready-made map transformers

The folder `source/optional` contains two map message transformers. They are outside the standard support package (see the readme.txt there), and both need Delphi:

- **TBTMessageTransformerJSONMapDataObjects** encodes the map as JSON; its transformation identifier is `jms-map-json`, the name of ActiveMQ's JSON transformation for map messages. It needs the JsonDataObjects library, which is not included.
- **TBTMessageTransformerXMLMapDocument** (experimental) encodes the map as XML with Delphi's XMLDoc unit.

See unit **MapMessageTransformerTests** for integration / unit tests.

Chapter 16. Object messages

> “Object serialization is the process of saving an object’s state to a sequence of bytes, as well as the process of rebuilding those bytes into a live object at some future time.”[1]

16.1. Introduction

In messaging applications, object serialization is required to transfer objects between clients, but also to store objects on the broker if they are declared persistent.

16.1.1. Object message transformer

To send and receive object messages, the application needs to convert incoming and outgoing object messages from and to the STOMP message body.

The **IMessageTransformer** interface must be implemented for map message and object message transformation.

This interface defines two methods, **ConsumerTransform** and **ProducerTransform**.

Code example

```
function ConsumerTransform(const Session: ISession;
           const Consumer: IMessageConsumer; const AMessage: IMessage): IMessage;


function ProducerTransform(const Session: ISession;
           const Producer: IMessageProducer; const AMessage: IMessage): IMessage;
```

Implementation guide for object messages:

1. create a class which implements the IMessageTransformer interface
   - for ConsumerTransform, the **incoming** object message is passed as the AMessage parameter, the method must **read** its body to reconstruct the object, and return the object message as function result
   - for ProducerTransform, the **outgoing** object message is passed as the AMessage parameter, the method must **write** its body to store a representation of the object, and return the object message as function result

2. create an instance of this class and register it on the IConnection instance with the helper procedure **SetObjectMessageTransformer** in unit BTConnection, together with a transformation identifier (see Section 15.1.3, “Transformation identifier”; object messages use it the same way)

NOTE	Only one object message transformer may be active for one connection.

Code example

```
Connection := Factory.CreateConnection;
try
  SetObjectMessageTransformer(Connection, TMyObjectMessageTransformer.Create,
    'my-object-message');

  Connection.Start;
  Session := Connection.CreateSession(amAutoAcknowledge);
  Queue := Session.CreateQueue('example.objects');
  Producer := Session.CreateProducer(Queue);
  Consumer := Session.CreateConsumer(Queue);

  // send
  ObjectMessage := Session.CreateObjectMessage;
  ObjectMessage.SetObject(MyObject);
  Producer.Send(ObjectMessage);

  // receive
  ObjectMessage := Consumer.Receive(1000) as IObjectMessage;
  if Assigned(ObjectMessage) then
  begin
    ReceivedObject := ObjectMessage.GetObject;
    try
      ... // use the object
    finally
      ReceivedObject.Free;
    end;
  end;
finally
  Connection.Close;
end;
```

The library does not free objects: the application frees the object it has sent, and the object that `GetObject` returns for a received message.

16.1.2. Transformer base class

Instead of implementing IMessageTransformer directly, a transformer can descend from **TBTMessageTransformer** (unit BTMessageTransformer in `source/optional`) and override only two

methods: **Encode** turns the object into the message body, **Decode** creates the object from it. The base class calls them for object messages and leaves all other messages unchanged. The units in `source/optional` are outside the standard support package (see the readme.txt there).

See unit **ObjectMessageTransformerTests** for integration / unit tests. Its transformer streams a TComponent descendant as text with ObjectBinaryToText and ObjectTextToBinary.

[1] https://www.oracle.com/technical-resources/articles/java/serializationapi.html

Chapter 17. Simplified API

17.1. Interface types

The simplified API[1] is based on three interfaces which reduce the amount of client code:

- IMQContext
- IMQProducer
- IMQConsumer

17.2. IMQContext interface

An IMQContext object encapsulates both the IConnection and the ISession object of the classic API. The connection factory interface contains methods to create IMQContext objects:

Code example

```
function CreateContext: IMQContext; overload;
function CreateContext(const AcknowledgeMode: TAcknowledgementMode): IMQContext;
overload;
function CreateContext(const Username, Password: string): IMQContext; overload;
function CreateContext(const Username, Password: string; const AcknowledgeMode:
TAcknowledgementMode): IMQContext; overload;
```

The IMQContext provides methods to create messages, producer and consumer objects, destinations (queues, topics, temporary queues, temporary topics, durable subscribers and so forth), and for transaction control (commit, rollback).

17.3. IMQProducer interface

An IMQProducer object provides methods to produce and send messages to the broker. As a shortcut, a method allows sending text or bytes messages without creating an ITextMessage or IBytesMessage object by providing the text or bytes as a parameter.

Code example

```
function Send(const Destination: IDestination;
           const Body: string): IMQProducer; overload;
function Send(const Destination: IDestination;
           const AMessage: IMessage): IMQProducer; overload;
```

17.4. IMQConsumer interface

An IMQConsumer object provides methods to consume messages from the broker.

With the conditional symbol `HABARI_BROKEN_MESSAGELISTENER` defined, `IMQConsumer` also has a `MessageListener` property, for receiving messages asynchronously. See Chapter 11, *Asynchronous receive (IMessageListener)*.

The following example is taken from the unit tests. It uses the API to create and send a text message to a broker queue destination, and then receives the message from this queue.

17.5. Source code example

Code example

```
procedure TNewApiTests.TestSendMessage;
var
  Context: IMQContext;
  Destination: IQueue;
  Producer: IMQProducer;
  Consumer: IMQConsumer;
  TextMessage: ITextMessage;
begin
  Context := Factory.CreateContext;
  Destination := Context.CreateQueue(GetQueueName);

  Producer := Context.CreateProducer;
  Producer.Send(Destination, 'Hello World');

  Consumer := Context.CreateConsumer(Destination);
  TextMessage := Consumer.Receive(2500) as ITextMessage;

  CheckEquals('Hello World', TextMessage.Text);
  Context.Close;
end;
```

[1] Since version 6.0

Part III: Advanced topics

Chapter 18. STOMP 1.2

18.1. Connection configuration

A connection string can use additional URL parameters to configure STOMP version 1.1 and 1.2.

All parameters are case-sensitive.

Parameters can be omitted to use the default value.

Parameter	Description	Default
connect.accept-version[1]	Supported STOMP versions in ascending order	Broker-specific, see below
connect.host[2]	**The name of a virtual host that the client wishes to connect to.** It is recommended clients set this to the host name that the socket was established against, or to any name of their choosing. If this header does not match a known virtual host, servers supporting virtual hosting MAY select a default virtual host or reject the connection.	Server URI
connect.heart-beat[3]	Heartbeat (outgoing, incoming)	0,0

Default STOMP version (broker-specific)[4]

If the connection URL does not contain the connect.accept-version parameter, the client library will add an accept-version header to the CONNECT frame with the value defined in the SH_DEFAULT_STOMP_VERSION constant in the BTBrokerConsts unit.

Default version (BTBrokerConsts.SH_DEFAULT_STOMP_VERSION)			
ActiveMQ	Artemis	OpenMQ	RabbitMQ
1.2	1.2	1.2	1.2

Code example

```
Factory := TBTConnectionFactory.Create(
  'stomp://localhost?connect.accept-version=1.2&connect.heart-beat=1000,0');
```

This example creates a connection factory with these connection settings:

- host and virtual host: localhost
- port: the default port (broker-specific, defined in unit BTBrokerConsts as DEFAULT_STOMP_PORT)
- accept-version: 1.2, the client requests version 1.2 of the protocol
- heart-beat: 1000,0, the client heartbeat interval is 1000 milliseconds, with no server heartbeat signals

18.1.1. Specification

For details see the specification pages at https://stomp.github.io/

18.2. Sending heartbeat signals

A client can use the **SendHeartbeat** method of the connection object to send a heartbeat byte (newline 0x0A).

SendHeartbeat is a method of the IHeartbeat interface, which is declared in the BTSessionIntf unit. A cast of the IConnection object is required to access this method.

Code example

```
(Connection as IHeartbeat).SendHeartbeat;
```

Notes:

- the client application code is responsible for sending a heartbeat message within the maximum interval which was specified in the connect parameter – the Habari Client library does not send heartbeats automatically
- client messages which are sent after the heartbeat interval expires may be lost

18.3. Checking for incoming heartbeats

The client stores a timestamp of the last incoming data. If the time which elapsed since this timestamp is greater than two times the heartbeat interval, calling **CheckHeartbeat** will raise an exception of type EBTStompServerHeartbeatMissing.

Code example

```
(Connection as IHeartbeat).CheckHeartbeat;
```

Notes:

- the method raises an exception if the connection does not use server-side heartbeats
- the method only checks the time elapsed since the last heartbeat, it does not try to read any data from the connection

18.4. Reading server-side heartbeats

If the client never needs to consume any messages, but wants to check for incoming (server-side) heartbeats, it can use the **ReceiveHeartbeat** method of the connection object.

This method takes one argument, TimeOut.

The function returns True if it found at least one heartbeat signal on the connection.

Calling ReceiveHeartbeat is only useful for applications which never call Receive, to check if the server is still healthy, and to consume the pending heartbeat signals from the connection.

If the client reads messages (using Consumer.Receive), calling ReceiveHeartbeat is not required.

NOTE	ReceiveHeartbeat raises an exception if there is anything other than a heartbeat on the socket.

[1] https://stomp.github.io/stomp-specification-1.2.html#protocol_negotiation

[2] https://stomp.github.io/stomp-specification-1.2.html#CONNECT_or_STOMP_Frame

[3] https://stomp.github.io/stomp-specification-1.2.html#Heart-beating

[4] Since version 5.1 (2017.06)

Chapter 19. Optional STOMP 1.2 features not implemented

The STOMP 1.2 specification marks some features as recommended (SHOULD) or optional (MAY, OPTIONAL). A client that leaves them out still conforms to the specification. This chapter lists the optional features that the Habari Client library does not implement, quotes the specification, and describes what the library does instead.

19.1. Text encodings other than UTF-8

The specification lets a sender name the text encoding of the body with a `charset` parameter in the `content-type` header:[1]

> The implied text encoding for MIME types starting with `text/` is UTF-8. If you are using a text based MIME type with a different encoding then you SHOULD append `;charset=<encoding>` to the MIME type. For example, `text/html;charset=utf-16` SHOULD be used if you're sending an HTML body in UTF-16 encoding. The `;charset=<encoding>` SHOULD also get appended to any non `text/` MIME types which can be interpreted as text. A good example of this would be a UTF-8 encoded XML. Its `content-type` SHOULD get set to `application/xml;charset=utf-8`
>
> All STOMP clients and servers MUST support UTF-8 encoding and decoding. Therefore, for maximum interoperability in a heterogeneous computing environment, it is RECOMMENDED that text based content be encoded with UTF-8.
>
> — STOMP 1.2 specification, Header content-type

The library supports UTF-8 only, which the specification requires. It does not support other text encodings.

19.1.1. Sending

- The library always encodes the body of text, map and object messages as UTF-8.
- With STOMP 1.1 and 1.2, it sets the `content-type` header to `text/plain`

(`application/octet-stream` for bytes messages). It does not add a `charset` parameter, because UTF-8 is the implied encoding for `text/` types.

- There is no option to choose another encoding.
- An application can set its own `content-type` as a string property (see the code example). The library sends this value unchanged but still encodes the body as UTF-8. A `charset` parameter other than `utf-8` in this value is therefore wrong.

Code example

```
Msg := Session.CreateTextMessage('<html>Hello World!</html>');
Msg.SetStringProperty(SH_CONTENT_TYPE, 'text/html');
Producer.Send(Msg);
```

19.1.2. Receiving

When the library creates a text message from an incoming frame, it checks the `content-type` header:

content-type	Result
no parameter, for example `text/plain` or `text/html`	accepted, the body is decoded as UTF-8
a parameter containing `charset=utf-8` (not case-sensitive), for example `text/plain;charset=UTF-8`	accepted, the body is decoded as UTF-8
any other parameter, for example `text/plain;charset=utf-16`, `text/plain;charset=iso-8859-1` or `text/plain;format=flowed`	`Receive` raises EMQException with the message "Unsupported content type *value*"

NOTE The check looks for the exact text `charset=utf-8`. A quoted value (`charset="utf-8"`) or the alias `utf8` raises the exception too.

To exchange text with clients in other languages, have them send UTF-8, as the specification recommends.

[1] https://stomp.github.io/stomp-specification-1.2.html#Header_content-type

Chapter 20. SSL/TLS support

20.1. SSL communication adapter classes

Habari STOMP Client for RabbitMQ includes two **experimental** adapter classes for usage with OpenSSL, one for Indy (Internet Direct) and one for Synapse. The units for these classes are in the source\optional folder.

Table 3. Communication adapters with SSL/TLS support

Adapter class	Unit
TBTCommAdapterIndySSL	BTCommAdapterIndySSL
TBTCommAdapterSynapseSSL	BTCommAdapterSynapseSSL

20.1.1. Mixed use

It is possible to use SSL and non-SSL connections in the same project:

- connections with the “stomp://” scheme will remain unencrypted
- connections with the “stomp+ssl://” scheme will use SSL

20.1.2. SSL configuration

The TBTCommAdapterIndySSL class includes very basic configuration of the Indy SSL handler. Your server or your specific security requirements may require additional configuration.

20.2. Indy SSL demo

A demo application is included in **common-producertool-ssl**.

Code example

```
program ProducerToolIndySSL;

{$APPTYPE CONSOLE}

uses
  // the Habari Client adapter class for Indy + SSL
  BTCommAdapterIndySSL,
  // required to set the default adapter
  BTAdapterRegistry,
  // the common demo unit for the producer tool
  ProducerToolUnit in '..\common-producertool\ProducerToolUnit.pas',
  // configuration support unit
  CommandLineSupport in '..\common\CommandLineSupport.pas',
  SysUtils;

begin
  BTAdapterRegistry.SetDefaultAdapter(TBTCommAdapterIndySSL);

  with TProducerTool.Create do
  try
    try
      Run;
    except
      on E:Exception do WriteLn(E.Message);
    end
  finally
    Free;
  end;
  ReadLn;
end.
```

20.2.1. Notes

- the TBTCommAdapterIndySSL class must be registered using (BTAdapterRegistry.SetDefaultAdapter(TBTCommAdapterIndySSL))
- the project must be compiled with HABARI_SSL_SUPPORT
- the connection URL must be in the form “**stomp+ssl**://server.com:*sslport*”
- the OpenSSL libraries must be in the application search path

20.2.2. Troubleshooting

Changed PassThrough mode default since Delphi 10.4

Indy supports PassThrough mode, which is related to receiving non-encrypted data on an SSL/TLS connection. With Delphi 10.4, Indy seems to assume PassThrough = True, while Indy in older Delphi versions assumes PassThrough = False.

The solution in newer Delphi versions is to explicitly set the IOHandler PassThrough := False.

20.3. Support

Support for SSL/TLS connections and the example adapter classes is not included in the free basic support plan of Habari STOMP Client for RabbitMQ.

Chapter 21. Logging with SLF4P

21.1. Introduction

Habari STOMP Client libraries include the open source “simple logging facade for Pascal” (SLF4P) as an optional dependency. SLF4P is available at https://github.com/michaelJustin/slf4p

21.2. IDE and project configuration

In order to compile with SLF4P support,

1. include the path to the slf4p library in the project search path or in the global library path
2. add the conditional symbol HABARI_LOGGING to the project options

21.2.1. Delphi

- choose Project > Options ... > Delphi Compiler > Conditional defines
- add HABARI_LOGGING

21.2.2. Lazarus

- choose Project > Project Options ... > Compiler Options > Other
- add -dHABARI_LOGGING in the Custom options field

21.3. LoggingHelper unit

A simple `LoggingHelper` unit is located in the `demo\common\` directory and can be copied to a project to add slf4p support with little extra coding.

Code example

```
uses
  LoggingHelper,
  ...
begin
  // set up logging
  LoggingHelper.ConfigureLogging;
```

The `LoggingHelper` unit may be adjusted to your configuration needs. Here is an example which uses the `SimpleLogger` implementation (included in SLF4P).

Code example

```
unit LoggingHelper;

interface

uses
  {$IFDEF HABARI_LOGGING}
  djLogOverSimpleLogger, SimpleLogger
  {$ENDIF HABARI_LOGGING};

const
  DEFAULT_LOG_LEVEL = 'info';

procedure ConfigureLogging(const LogLevel: string = DEFAULT_LOG_LEVEL);

implementation

procedure ConfigureLogging(const LogLevel: string);
begin
  {$IFDEF HABARI_LOGGING}
  SimpleLogger.Configure('defaultLogLevel', LogLevel);
  SimpleLogger.Configure('showDateTime', 'true');
  {$ENDIF HABARI_LOGGING}
end;

end.
```

Chapter 22. Conditional symbols

22.1. Experimental or optional features

All conditional symbols enable experimental or optional features, which are not covered by the free basic support plan.

Feedback (suggestions for improvements, feature requests, and bug reports) is always welcome.

22.1.1. HABARI_ALLOW_UNKNOWN_URL_PARAMS

Disables strict connection URL parameter checking.

A message broker may support proprietary headers in STOMP frames (for example in SUBSCRIBE frames). By default, the library only accepts well-known connection parameters, and raises an exception for unknown parameters. If this symbol is defined, connection URLs may contain arbitrary parameters.

22.1.2. HABARI_BROKEN_MESSAGELISTENER

Enables asynchronous receive with IMessageListener.

Compiles in the `MessageListener` property of `IMessageConsumer` and `IMQConsumer`, and the receive thread that calls `OnMessage`. Indy communication adapter only. The listener is supported within the limits described in its chapter; like the other symbols in this chapter, it is not covered by the free basic support plan. The word “BROKEN” is historical, and the define will be removed in a future release, when the listener code will always be compiled in.

See also: Chapter 11, *Asynchronous receive (IMessageListener)*

22.1.3. HABARI_LOGGING

Enables logging support.

Requires the open source SLF4P logging facade.

See also: Logging with SLF4P

22.1.4. HABARI_SSL_SUPPORT

Enables SSL/TLS support.

The directory source/optional contains example implementations of Indy and Synapse adapter classes with OpenSSL support.

Please note that these are basic implementations and not supported in the free basic support plan.

See also: SSL/TLS support

Chapter 23. Useful units

23.1. BTStreamHelper unit

This unit contains the procedure LoadBytesFromStream which can be used to read a file into a BytesMessage.

Code example

```
// create the message
Msg := Session.CreateBytesMessage;

// open a file
FS := TFileStream.Create('filename.dat', fmOpenRead);

try
  // read the file bytes into the message
  LoadBytesFromStream(Msg, FS);

  Size := Length(Msg.Content);

  // display message content size
  WriteLn(IntToStr(Size) + ' Bytes');

finally
  // release the file stream
  FS.Free;
end;
```

23.2. BTJavaPlatform unit

This unit contains some helper functions for Java dates. Java dates are Int64 values based on the Unix date.

```
function JavaDateToTimeStamp(const JavaDate: Int64): TDateTime;
```

```
function TimeStampToJavaDate(const TimeStamp: TDateTime): Int64;
```

Chapter 24. Example applications

24.1. Overview

Table 4. Example applications (in alphabetic order)

Location	Description
common-consumertool	Receive messages from broker
common-ping	Connection test tool
common-producertool	Send messages to broker
common-producertool-ssl	Send messages to broker with SSL/TLS connection
common-tests	DUnit tests
delphichat	Simple chat client
delphichat-listener	Several chat rooms on one IMQContext with message listeners (HabariChatRooms; its project defines HABARI_BROKEN_MESSAGELISTENER)
heartbeat-server	Uses server-side heartbeating to check the connection / server health
loadbalancing	File transfer from LoadServer to LoadClient applications
performance	Multi-threaded performance test application
reconnect	Send messages and reconnect on connection failure
rpc	Use temporary queues to implement request/response style communication (not supported on all message brokers)
textmessage	Simple text message example
throughput	Produces and consumes messages continuously
transactions	Transaction example
tutorial1	Tutorial one
tutorial2	Tutorial two
unicode	Sends and receives a Unicode message and shows it

24.1.1. Notes

- Unless noted otherwise, graphical programs were created using Delphi 2009
- FPCUnit tests require the latest Lazarus / Free Pascal versions, DUnit tests Delphi 2009
- Free Pascal versions of some examples are located in folders suffixed with “-fpc”
- SSL/TLS example code is complimentary and unsupported
- Shared units for the demo applications are located in the “common” folder, they are complimentary and unsupported

24.2. ConsumerTool

24.2.1. common-consumertool / common-consumertool-fpc

The ConsumerTool demo may be used to receive messages from a queue or topic. This example application is configurable by command line parameters, all are optional.

Table 5. ConsumerTool command line options

Parameter	Default value	Description
AckMode	CLIENT_ACKNOWLEDGE	Acknowledgement mode, possible values are: CLIENT_ACKNOWLEDGE, AUTO_ACKNOWLEDGE or SESSION_TRANSACTED
ClientId		Client ID for durable subscriber
ConsumerName	Habari	name of the message consumer - for durable subscriber
Durable	false	true: use a durable subscriber
MaximumMessages	10	expected number of messages
Password		Password
PauseBeforeShutDown	false	true: wait for key press
ReceiveTimeOut	0	consume messages while they continue to be delivered within the given time out
SleepTime	0	time to sleep after receive
Subject	TOOL.DEFAULT	queue or topic name

Parameter	Default value	Description
Topic	false	true: topic false: queue
Transacted	false	true: transacted session
URL	localhost	server URL
User		user name
Verbose	true	verbose output

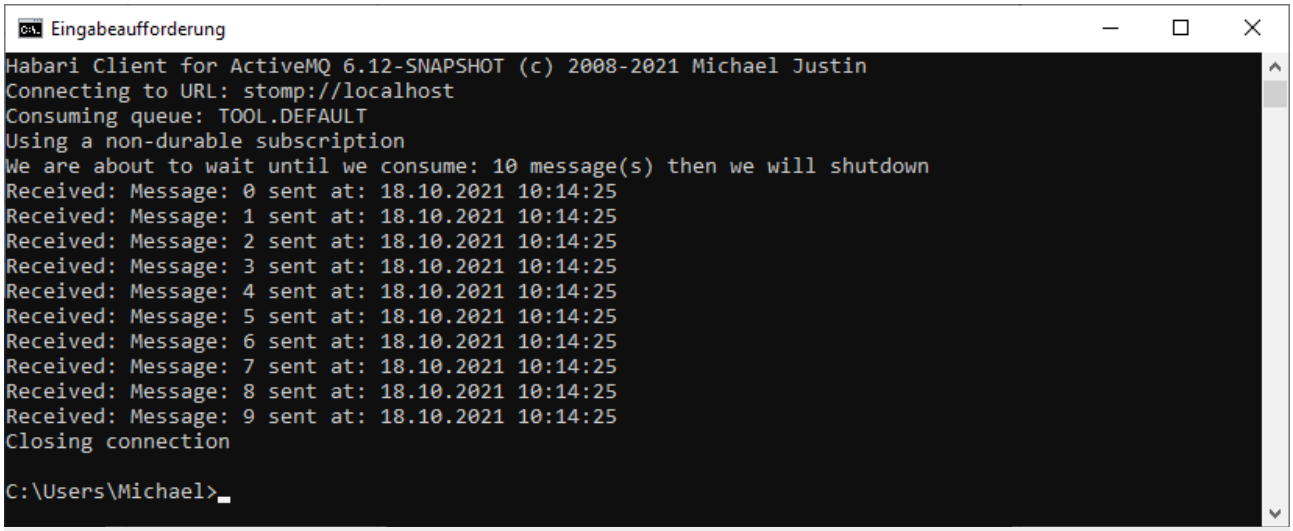


Figure 1. ConsumerTool demo application

24.2.2. Examples

Receive 1000 messages from local broker

```
ConsumerTool --MaximumMessages=1000
```

Receive 10 messages from local broker and wait for any key

```
ConsumerTool --PauseBeforeShutDown
```

Use a transacted session to receive 10,000 messages from local broker

```
ConsumerTool --MaximumMessages=10000 --Transacted --AckMode=SESSION_TRANSACTED
```

24.3. ProducerTool

24.3.1. common-producertool / common-producertool-fpc

The ProducerTool demo can be used to send messages to the broker. It is configurable by command line parameters, all are optional.

Table 6. ProducerTool command line options

Parameter	Default	Description
MessageCount	10	Number of messages
MessageSize	255	Length of a message in bytes
Persistent	false	Delivery mode 'persistent'
SleepTime	0	Pause between messages in milliseconds
Subject	TOOL.DEFAULT	Destination name
TimeToLive	0	Message expiration time
Topic	false	Destination is a topic
Transacted	false	Use a transaction
URL	localhost	Message broker URL
Verbose	true	Verbose output
User		User name
Password		Password

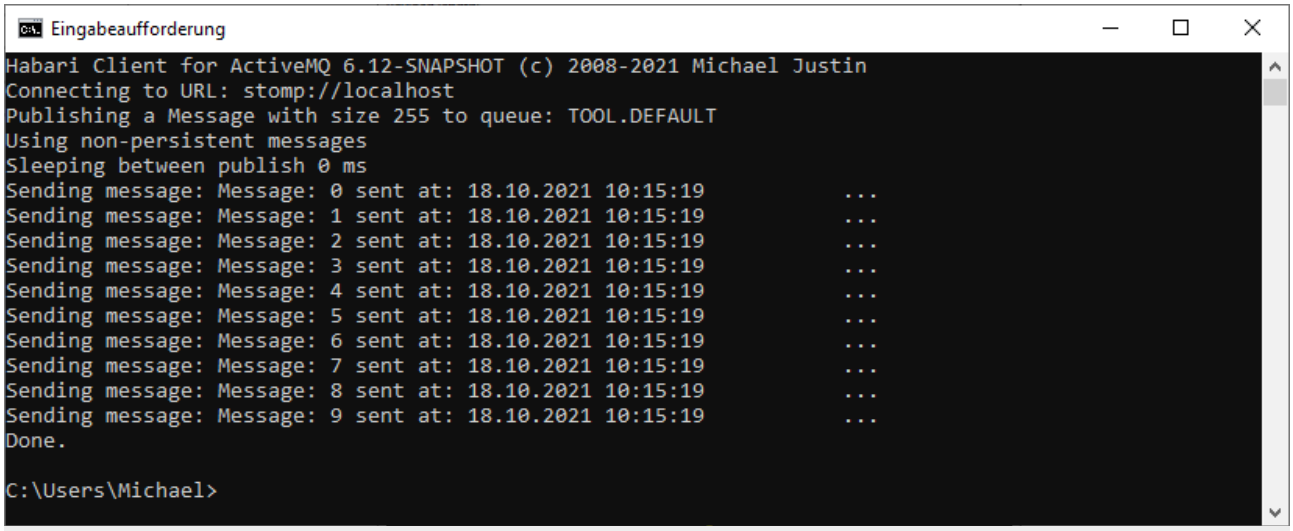


Figure 2. ProducerTool demo application

24.3.2. Examples

Send 10,000 messages to the queue `TOOL.DEFAULT` on the local broker

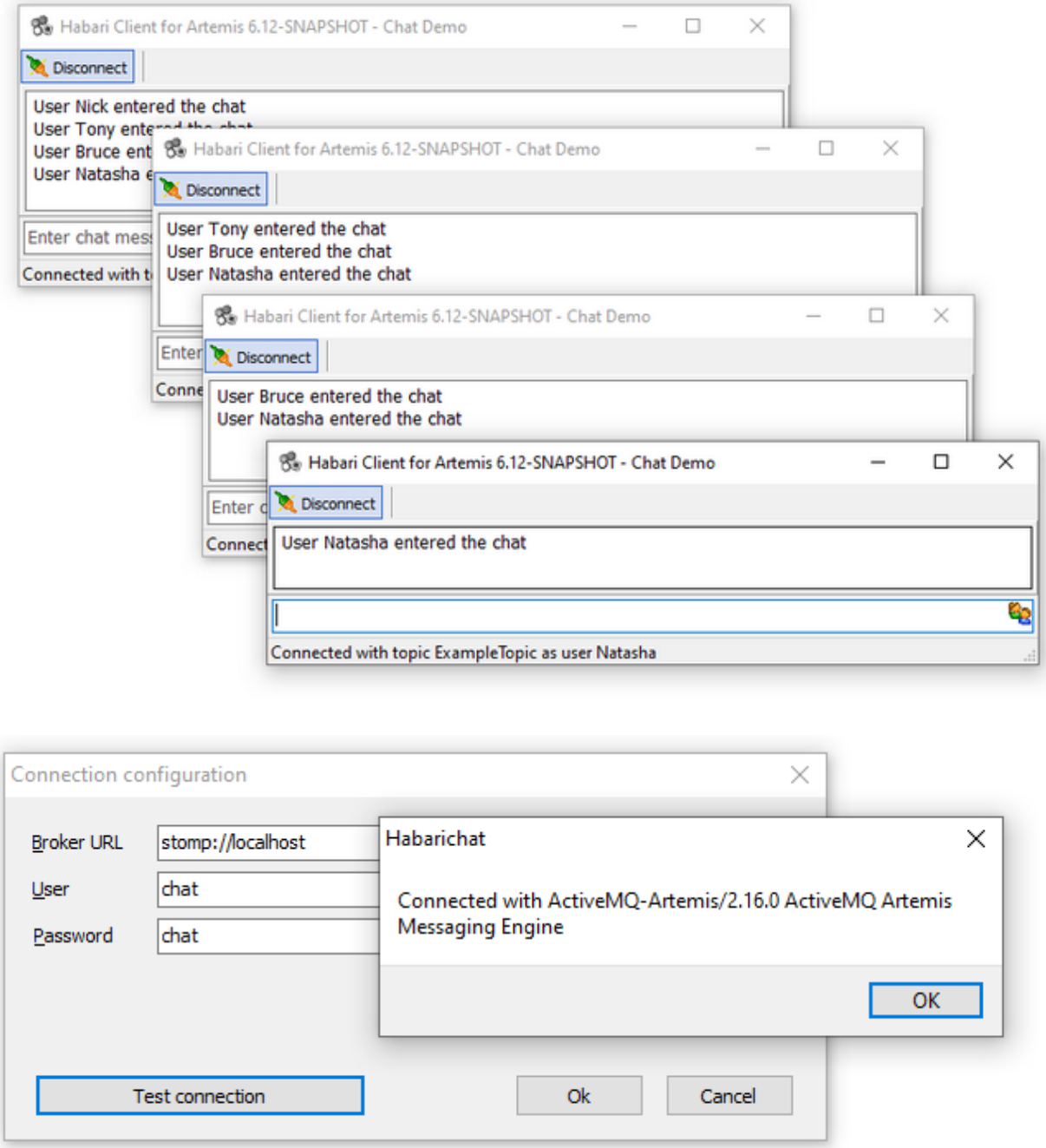
```
ProducerTool --MessageCount=10000
```

Send 10 messages to the topic ExampleTopic on the local broker

```
ProducerTool --Topic --Subject=ExampleTopic
```

24.4. Delphi Chat

The Delphi Chat application uses a Topic destination as a ‘chat room’ where many users may send messages, which then will be shown in all clients which consume messages from this topic.[1]



24.5. Performance test

The performance test application provides a GUI for multi-threaded sending and receiving of messages.

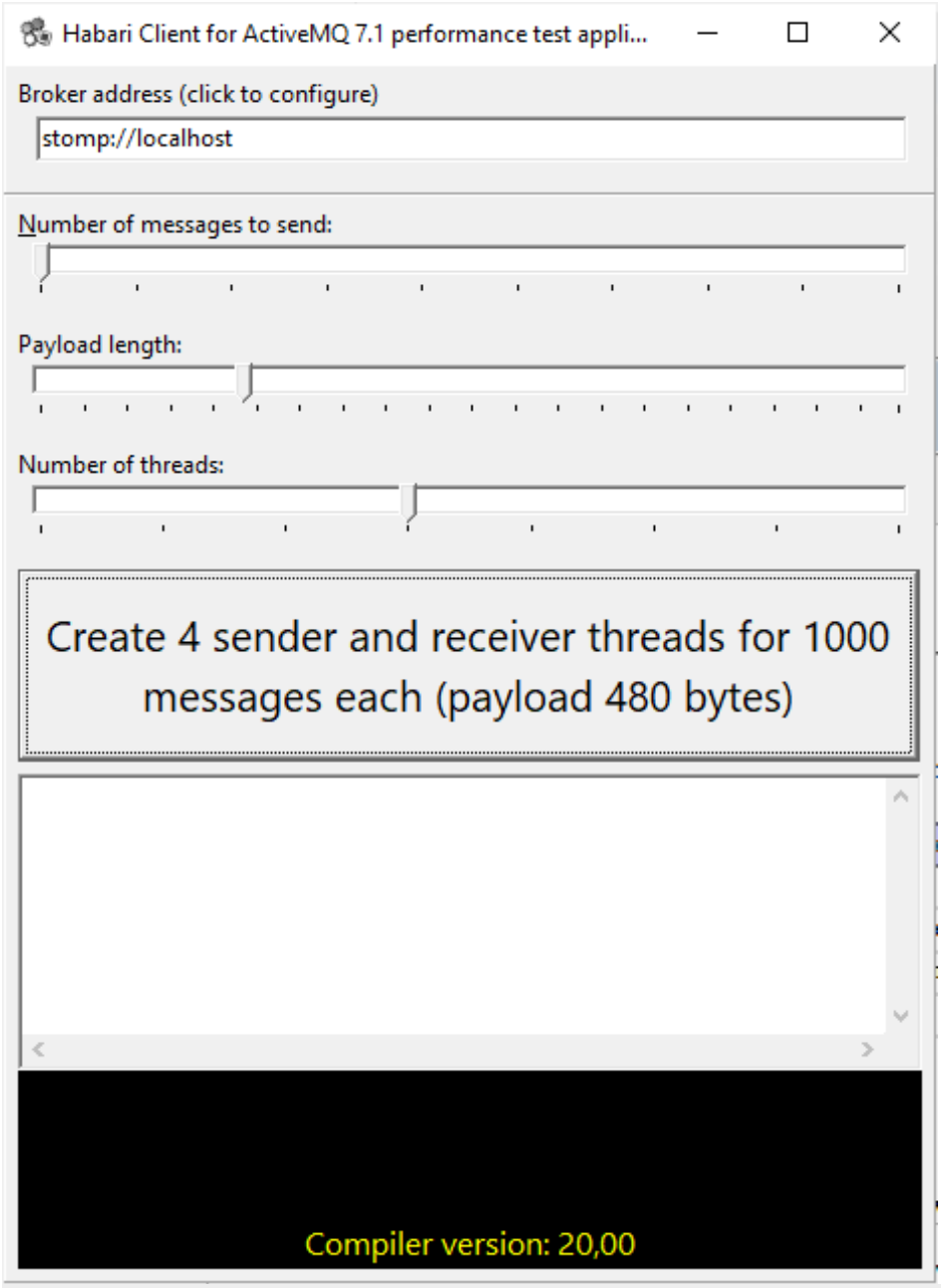


Figure 3. Performance test example application

- A broker configuration dialog can be invoked by clicking the URL field
- Number and length of messages and thread number can be adjusted using the sliders

For every thread a message queue with the name ExampleQueue.<n> will be used.

24.6. PingBroker

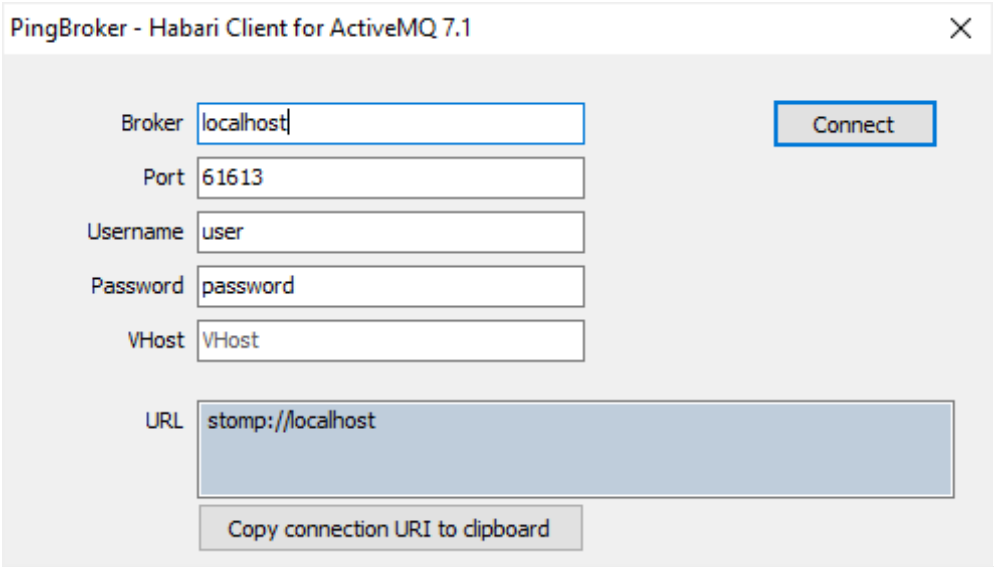


Figure 4. PingBroker example application

This graphical tool tries to create a connection to the specified message broker.

24.7. Throughput test

This example application is configurable by command line parameters, all are optional.

Table 7. Throughput test tool command line options

Parameter	Default value	Description
Password	(broker-specific)	Password
Subject	ExampleTopic	Topic name
URL	(broker-specific)	Connection URL
User	(broker-specific)	User name

24.7.1. Examples

Use remote broker 'mybroker' and specify user and password

```
tptest --url=stomp://mybroker --user=test1 --password=secret
```

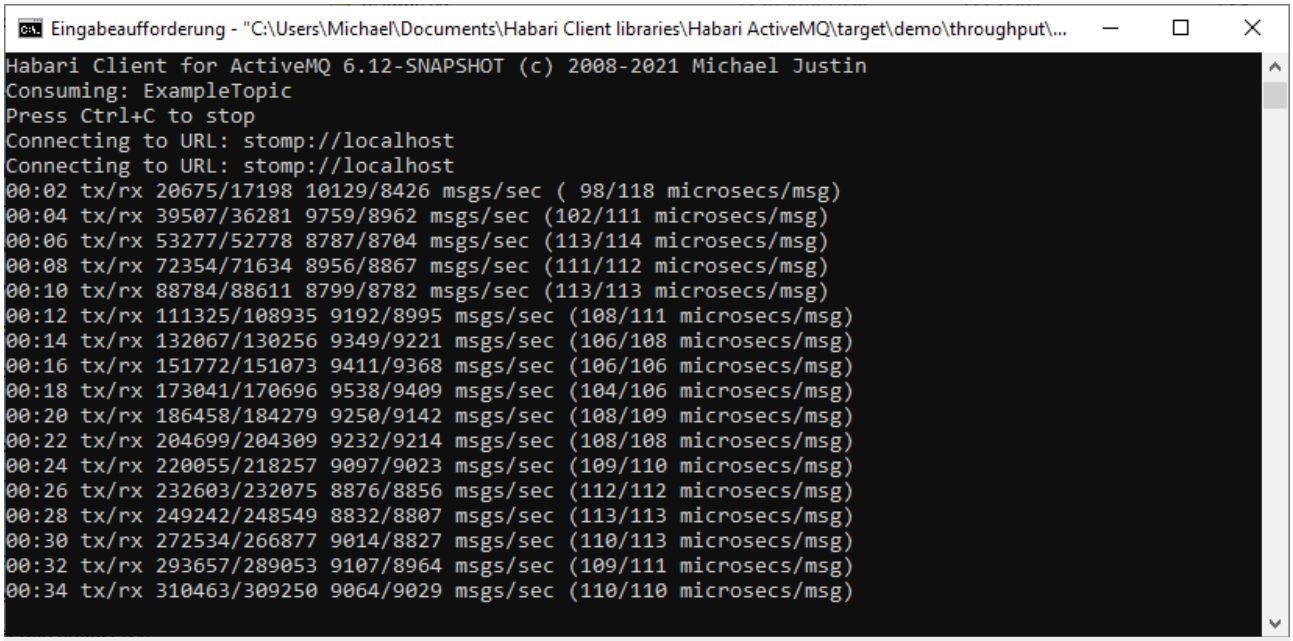


Figure 5. Throughput test tool output

[1] The screenshots were taken with an earlier version of Habari Client for Artemis. The window title differs, but the application works the same way with the current version and with all four brokers.

Chapter 25. Unit tests

25.1. Introduction

Habari STOMP Client libraries include DUnit and FPCUnit tests. They require the classic DUnit framework (included in Delphi 2009) or FPCUnit (included in Lazarus).

The test projects are installed in the common-tests and common-tests-fpc folders.

25.2. Test project configuration

25.2.1. Logging

To switch on SLF4P logging, add the conditional symbol HABARI_LOGGING (see Chapter 21, *Logging with SLF4P*) and rebuild the project. Set the DEFAULT_LOG_LEVEL constant in unit TestHelper to a valid SLF4P level.

25.2.2. Optional units

To switch on tests for optional units (connection builder and failover support), add the conditional symbol HABARI_TEST_OPTIONAL_UNITS and rebuild the project.

25.3. Test units

The common-tests folder contains these units:

Test setup and test case base classes	
TestHelper	Main test set-up and utility unit, contains no tests
HabariTestCase	Test case base classes used for most tests

Unit tests	
ApiTests	Tests Habari Client core API methods – part 1
BasicTests	Tests Habari Client core API methods – part 2

Unit tests	
BrokerExtensionsTests	Tests broker-specific features and extensions of the STOMP protocol
HabariExtensionsTests	Tests non-standard features provided by the Habari Client library
HabariTypesTests	Tests internal data types
MapMessageTransformerTests + ObjectMessageTransformerTests	Tests map and object message exchange with a message transformer
MessageListenerTests	Tests asynchronous receive with IMessageListener (new in 10.3; compiled only if HABARI_BROKEN_MESSAGELISTENER is defined)
Stomp12Tests	Tests features introduced with version 1.2 of the STOMP standard
StubServerTests	Tests using a simple local STOMP server

Free Pascal-specific test units are in the folder common-tests-fpc.

25.4. Test execution

25.4.1. Requirements

The test projects require a message broker running on the local system, which accepts STOMP connections on the default port, with the default user credentials. User name and password for the default user are defined in unit BTBrokerConsts.

25.4.2. Test destinations

Most tests create a test-specific destination (a queue or a topic) to reduce the risk of side effects.

The name of the destination is the combination of the test class name and the unit test name.

NOTE The unit tests will not clean up or remove these destination objects after usage.

25.5. STOMP 1.2

Since Habari STOMP Client for RabbitMQ 5.0, the unit tests use STOMP 1.2 for connections.

Part IV: Reference

Chapter 26. Broker differences

The four Habari STOMP Client libraries share one code base, and most features work the same way with every broker. This chapter lists only what differs. A feature that is not listed here works the same with ActiveMQ, Artemis, OpenMQ and RabbitMQ.

Tested broker versions: Apache ActiveMQ 6.3.2, Apache ActiveMQ Artemis 2.57.0, Eclipse OpenMQ 6.9.0 and RabbitMQ 4.3.6.

Each limitation names its origin:

- **Broker:** the broker, or its STOMP connector, does not support the feature or does not handle it correctly. The client library cannot work around it.
- **Client:** the client library does not implement the feature for this broker, although the broker might support it.

Where the library detects an unsupported feature, it raises an exception when the feature is used instead of sending a request the broker would ignore.

26.1. Defaults

	ActiveMQ	Artemis	OpenMQ	RabbitMQ
STOMP port	61613	61613	7672	61613
Default user / password	user / password	*(none)*	admin / admin	guest / guest
Message priority: default / maximum	4 / 9	4 / 9	4 / 9	0 / 255 [1]

1. RabbitMQ applies priorities only to queues declared with `x-max-priority` (see the RabbitMQ broker-specific notes). The library rejects values above 255.

26.2. Features and limitations

	ActiveMQ	Artemis	OpenMQ	RabbitMQ
Heartbeating	Yes	Yes	No (broker)	Yes
Negative acknowledgement (`Nack`)	Yes	Partly (broker)	No (broker)	Yes

	ActiveMQ	Artemis	OpenMQ	RabbitMQ
Acknowledgement as part of a transaction	Yes	Partly (broker)	No (broker)	Yes
Message selectors	Yes	Yes	Yes	No (broker)
XPath selectors	Yes	Yes	No (broker)	No (broker)
NoLocal (ignore own messages)	Yes	Yes	Yes	No (broker)
Queue browser	Yes	Yes	No (broker)	No (broker)
Temporary queues and topics	Yes	No (broker)	Yes	Partly (broker)
Custom `content-type` header	Yes	Yes	No (broker)	Yes
Wildcards in queue names	Yes	No (broker)	No (broker)	No (broker)
Wildcards in topic names	Yes	Yes, own syntax	Yes	Yes
Composite destinations	Yes	No (broker)	No (broker)	No (broker)
Exclusive consumer	Yes	Partly (broker)	No (broker)	No (broker)
Message groups (`JMSXGroupID`)	Yes	Yes	No (broker)	No (broker)
Streams (`x-queue-type: stream`)	No (broker)	No (broker)	No (broker)	Yes

26.2.1. Notes

Heartbeating

The OpenMQ STOMP connector does not support heartbeating. Detect connection loss by other means, for example with a periodic request.

Negative acknowledgement

Artemis accepts `Nack` but discards the message instead of delivering it again. The STOMP specification allows this, but the message is lost. **OpenMQ** does not know the NACK frame: it answers with an error (“Unknown STOMP command: NACK”) and closes the connection. Do not call `Nack` with OpenMQ.

Acknowledgement as part of a transaction

Artemis applies the acknowledgement at once and ignores its transaction: after a rollback, the message is not delivered again. **OpenMQ** never acknowledges a message that was received in a

transacted session, neither with `Acknowledge` nor with `Commit`, so the message is delivered again later. With OpenMQ, do not receive messages in a transacted session.

Message selectors, NoLocal

The RabbitMQ STOMP plugin has neither. The library raises `EIllegalArgumentException` when a consumer is created with a selector or with NoLocal. ActiveMQ and Artemis additionally support XPath selectors, and ActiveMQ supports numeric expressions in selectors (see the broker-specific notes of these two guides).

Queue browser

Neither the OpenMQ nor the RabbitMQ STOMP connector can browse a queue: RabbitMQ ignores a browse request and consumes the messages. `CreateBrowser` therefore raises an exception with these two brokers.

Temporary queues and topics

Artemis has no temporary destinations for STOMP clients, so `CreateTemporaryQueue` and `CreateTemporaryTopic` raise “Feature not supported”. Use a normal queue with a unique name for replies instead. **RabbitMQ** has temporary queues but no temporary topics, so `CreateTemporaryTopic` raises “Feature not supported”. A RabbitMQ temporary queue can only be used as a reply-to destination, and the broker subscribes to it when the first message with this reply-to is sent, so its consumer receives nothing before that. The broker acknowledges its messages automatically: create temporary queues in a session with `amAutoAcknowledge`. In a session with `amClientAcknowledge` or `amClientIndividual`, `CreateTemporaryQueue` raises `EIllegalStateException`.

Custom `content-type` header

The OpenMQ STOMP connector does not accept header names that contain hyphens. The library therefore marks text and bytes messages with its own `messagetype` header (see Section 26.3, “Protocol details”).

Wildcards, composite destinations, exclusive consumer, message groups, streams

These are broker extensions. The library passes the destination name and the headers through unchanged, so they work where the broker supports them. **Artemis** uses its own wildcard syntax (`#` and `*`); the delimiter is configured in `broker.xml`, and the configuration in the Artemis broker-specific notes sets it to `/`. With queues they do not work: a queue consumer with a wildcard receives nothing. Artemis has exclusive queues, but they are configured on the broker (`default-exclusive-queue` or the queue’s `exclusive` property). A STOMP client cannot request an exclusive consumer, as it can with ActiveMQ’s `activemq.exclusive` header.

Streams

A RabbitMQ stream keeps its messages after they have been read, and every consumer chooses

where it starts reading. A stream subscription needs a `prefetch-count` and client acknowledgement, and a message sent on another connection must repeat the stream's arguments as message properties, or it is lost. See Section 31.11, "Streams".

26.3. Protocol details

These differences matter when your application builds destination names or headers itself, or exchanges messages with clients in other languages.

	ActiveMQ	Artemis	OpenMQ	RabbitMQ
Destination names	`/queue/`, `/topic/`, `/temp-queue/`, `/temp-topic/`	`queue/`, `topic/` (no leading slash; routing configured in `broker.xml`)	`/queue/`, `/topic/`, `/temp-queue/`, `/temp-topic/`	`/queue/`, `/topic/`, and also `/exchange/`, `/amq/queue/`, `/temp-queue/`, `/reply-queue/`
Durable subscription	`activemq.subscriptionName` header, client ID required	`durable-subscription-name` header, client ID required	`durable-subscriber-name` header, client ID required	`persistent:true` and `auto-delete:false` on the subscription; no client ID needed
NoLocal header	`activemq.noLocal`	`no-local`	`no-local`	—
Expiration header	`expires`: absolute time	`expires`: absolute time	`expires`: time to live	`expiration`: time to live
How a received message is recognised as text	no `content-length` header	STOMP 1.1 and later: `content-type` starts with `text/`; STOMP 1.0: no `content-length` header	`messagetype:text` header	`content-type` starts with `text/`

	ActiveMQ	Artemis	OpenMQ	RabbitMQ
Flow control: how many unacknowledged messages the broker sends to a consumer	`activemq.prefetchSize`, in **messages**. Default 1000 for queues, 100 for persistent and 32766 for non-persistent topic subscriptions. 0 is not allowed.	`consumer-window-size`, in **bytes**. Default 10 KB with client acknowledgement; unlimited with automatic acknowledgement. `activemq.prefetchSize` is accepted, but also counts bytes.	No client setting. The broker property `imq.bridge.stomp.consumerFlowLimit` (default 1000 messages) applies to transacted subscriptions only.	`prefetch-count`, in **messages**. Default unlimited.

Set these options as a parameter of the destination name, for example `CreateQueue('orders?activemq.prefetchSize=10')` or `CreateQueue('orders?consumer-window-size=0')`. The library adds them as headers to the SUBSCRIBE frame.

Moving from ActiveMQ to Artemis: `activemq.prefetchSize=10` means ten messages with ActiveMQ, but ten **bytes** with Artemis, which is less than one message. Use `consumer-window-size` with Artemis, and give it in bytes. A window of `0` delivers one message at a time: the next one arrives only after the previous one is acknowledged.

For the RabbitMQ destination types and the Artemis routing configuration, see the broker-specific notes of these products.

Chapter 27. Library limitations

27.1. MessageConsumer

27.1.1. How do I implement synchronous receive from multiple destinations?

The library does not support synchronous receive from more than one destination over a single connection.

To receive messages synchronously (using Receive and ReceiveNoWait) from two or more destinations, create one connection per destination. Alternatively, one connection can deliver messages from several destinations to message listeners (see Chapter 11, *Asynchronous receive (IMessageListener)*).

Background: all pending messages in a connection are serialized in one TCP stream, so reading only the messages which come from one of the destinations would require 'skipping' all messages for other destinations.

27.2. Message properties

27.2.1. Only string data type supported

The STOMP protocol uses string type key/value lists for the representation of message properties. Regardless of the method used to set message properties, all message properties will be interpreted as Java Strings by the Message Broker.

As a side effect, the expressions in a Selector are limited to operations which are valid for strings.

Timestamp properties are converted to a Unix timestamp value, which is the internal representation in Java. But still, these values cannot be used with date type expressions.

Broker-specific exceptions

Apache ActiveMQ 5.6 introduced support for numeric expressions in JMS selectors.

27.3. Multithreading

A session supports transactions and it is difficult to implement transactions that are multi-threaded; a session should not be used concurrently by multiple threads.

27.4. Free Pascal specific restrictions

- *the test suites run on Windows only; on Linux, a client compiled with Free Pascal 3.2.2 has been smoke-tested (connect, send, receive) with Indy, Synapse and mORMot2*
- *the included unit test project uses FPCUnit for Free Pascal / Lazarus instead of DUnit*
- *the ready-made map and object message transformers in source/optional do not support Free Pascal; message transformers written for the application work with both compilers*
- *the library source code uses the Delphi mode switch {$MODE DELPHI}*
- *other limitations or restrictions may apply*

27.5. Broker-specific limitations

27.5.1. Other broker-specific limitations

For broker-specific notes, please read Chapter 31, Broker-specific notes.

Chapter 28. Frequently asked questions

28.1. Technical questions

28.1.1. Why am I getting “undeclared identifier IndyTextEncoding_UTF8”?

Short answer

Your Indy version is too old.

Long answer

The library requires a current Indy 10.6.2 (or newer) version.

Solution

Please download a newer Indy version.

28.1.2. Why am I getting “Undeclared identifier: 'TimeSeparator'”?

Short answer

Your Synapse version does not support your version of Delphi.

Long answer

Delphi XE4 removed twenty deprecated global variables. For more details, see https://docwiki.embarcadero.com/RADStudio/XE4/en/Global_Variables.

Solution

Either use Internet Direct (Indy) or use a compatible version of Synapse.

28.1.3. Why am I getting “unexpected subscription id” or “Found no matching consumer” errors?

Short answer

A message arrived for a subscription that the receiving consumer does not own. Usually the client closed a consumer while messages for it were still on the wire, and then received them with a new consumer.

Long answer

If the client subscribes to a destination, it creates a unique subscription identifier and passes it to the broker. Messages which the broker sends to the client always include this subscription identifier in their header properties. The client verifies that the subscription id in the incoming message matches the consumer.

If the client closes the consumer before all messages waiting on the wire have been consumed, and creates a new subscription (which has a new unique id), the remaining messages which are waiting on the wire will have a subscription id which does not match the id of the new subscription. Which error you see depends on how you receive:

- With `Receive`, the consumer raises an `EIllegalStateException`: “Received a MESSAGE frame with unexpected subscription id. Received "..." but expected "...".”
- With a message listener (`HABARI_BROKEN_MESSAGELISTENER`), the session finds no consumer for the message and raises “Found no matching consumer for message with subscription ...”. This also happens when a connection with listeners has several sessions (see Section 11.4, “Rules”, rule 1).

Solution

Do not create another consumer on the same connection while there are still pending messages for the first consumer. To discard all pending messages which are still waiting on the wire, the client can simply close the connection and create a new consumer on a new connection.

The `Receive` check can be turned off with the connection URL parameter `message.subscription_check=false`. Do this only if you understand why the ids differ: the consumer then accepts messages of other subscriptions.

Example

Here is a small code example which causes this error[1]:

Code example

```
procedure TErrorHandlingTests.TestReceiveMessageForOtherSubscription;
var
  Factory: IConnectionFactory;
  Conn: IConnection;
  Session: ISession;
  Destination: IDestination;
  Producer: IMessageProducer;
  Consumer: IMessageConsumer;
  Msg: IMessage;
begin
  Factory := TBTConnectionFactory.Create;
  Conn := Factory.CreateConnection;
  Conn.Start;
  Session := Conn.CreateSession(amAutoAcknowledge);
  Destination := Session.CreateQueue(GetQueueName);
  Consumer := Session.CreateConsumer(Destination);
  Producer := Session.CreateProducer(Destination);
  Msg := Session.CreateMessage;
  Producer.Send(Msg);
  Consumer.Close;
  Consumer := Session.CreateConsumer(Destination);
  Consumer.Receive(1000);
end;
```

The consumer is closed and a new consumer is created for the same destination (`Consumer.Close` and the second `CreateConsumer`).

The final `Receive` detects that the incoming message does not have a matching subscription id and raises an `EIllegalStateException`.

28.1.4. Does the library support non-Unicode Delphi versions?

Short answer

No, the library does not support non-Unicode Delphi versions.

Long answer

The library uses language features which have been added in Delphi 2009 / Free Pascal 3.2.2. Support

for non-Unicode Delphi ended in April 2017.

28.1.5. How can the client application detect network connection loss?

Short answer

Use STOMP heartbeating.

Long answer

By enabling heartbeating, the client can request server-side sending of heartbeat bytes.

Even if the client only wants to consume messages and never send messages, the server should continuously send heartbeat bytes within the negotiated time.

To detect if the server has sent a heartbeat, the client calls the method ReceiveHeartbeat.

For more details, please check the section "Reading server-side heartbeats".

With an IMessageListener, call CheckHeartbeat instead (for example from a timer). A listener's receive thread already reads the connection, so ReceiveHeartbeat, which also reads it, would compete with it for incoming data and can take part of a message. CheckHeartbeat does not read the connection: it raises EBTStompServerHeartbeatMissing when nothing has arrived for more than twice the server's heartbeat interval, which also happens when the receive thread has ended. See Section 11.7, "Connection loss".

[1] This code example is included in the library unit test project.

Chapter 29. Online resources

29.1. Third-party libraries

29.1.1. Indy

Indy is an open source client/server communications library that supports TCP/UDP/RAW sockets, as well as over 100 higher level protocols including SMTP, POP3, IMAP, NNTP, HTTP, FTP, and many more. Indy is written in Delphi but is available for C++Builder, Delphi, and Free Pascal.

GitHub	https://github.com/IndySockets

29.1.2. Ararat Synapse

GitHub	https://github.com/geby/synapse

29.1.3. Synopse mORMot 2

GitHub	https://github.com/synopse/mORMot2

29.1.4. DUnit

SourceForge	https://sourceforge.net/projects/dunit/files/dunit/9.3.0/

29.1.5. SLF4P

Simple logging facade for Object Pascal

GitHub	https://github.com/michaelJustin/slf4p

29.2. Specifications

STOMP – Simple (or Streaming) Text Oriented Messaging Protocol[1]	
STOMP home	https://stomp.github.io/index.html
STOMP 1.2	https://stomp.github.io/stomp-specification-1.2.html
STOMP 1.1	https://stomp.github.io/stomp-specification-1.1.html
STOMP 1.0	https://stomp.github.io/stomp-specification-1.0.html
Broker-specific STOMP documentation	
ActiveMQ	https://activemq.apache.org/components/classic/documentation/stomp
Artemis	https://artemis.apache.org/components/artemis/documentation/latest/stomp.html
RabbitMQ	https://www.rabbitmq.com/docs/stomp

29.3. Online articles

Title	Broker
Firebird Database Events and Message-oriented Middleware[2]	All
Discover ActiveMQ brokers with Delphi XE4 and Indy 10.6[3]	ActiveMQ
How to use the RabbitMQ Web-STOMP Plugin[4]	RabbitMQ
RPC with Delphi client and Java server using RabbitMQ[5]	RabbitMQ

29.4. Online videos

Title	Broker
Introduction to Messaging With Apache ActiveMQ[6]	ActiveMQ
GlassFish Message Queue – High Availability Clusters[7]	OpenMQ

[1] https://en.wikipedia.org/wiki/Streaming_Text_Oriented_Messaging_Protocol

[2] https://mikejustin.wordpress.com/2012/11/06/firebird-database-events-and-message-oriented-middleware/

[3] https://mikejustin.wordpress.com/2013/07/07/discover-activemq-brokers-with-delphi-xe4-and-indy-10-6/

[4] https://mikejustin.wordpress.com/2013/11/27/how-to-use-the-rabbitmq-web-stomp-plugin-with-delphi-and-free-pascal/

[5] https://mikejustin.wordpress.com/2013/05/21/rpc-with-delphi-client-and-java-server-using-rabbitmq/

[6] https://vimeo.com/12654513

[7] https://www.youtube.com/watch?v=RHUJBsy3udU

Chapter 30. Support

30.1. Bug reports and support inquiries

Please send bug reports and support inquiries to Habarisoft (https://www.habarisoft.com/support.html) and specify your message broker type and version.

To allow fast processing of your inquiry, please provide a detailed problem description, including configuration and environment, or code examples which help to reproduce the problem.

30.1.1. Advanced support

Advanced and experimental features such as SSL/TLS, third-party libraries, Free Pascal, Linux, non-Unicode Delphi versions and message broker configuration are not covered by the free basic support plan.

Part V: RabbitMQ

Chapter 31. Broker-specific notes

31.1. Online resources

The web page https://www.rabbitmq.com/docs/stomp documents details of the STOMP implementation in RabbitMQ, including broker-specific extensions.

NOTE	If you use broker-specific extensions, be aware that moving to a different broker and a different version of Habari Client library later will require more than a simple recompilation of source code.

31.2. RabbitMQ STOMP plugin

RabbitMQ ships with the STOMP plugin disabled — nothing listens on port 61613 until it is enabled with

```
>rabbitmq-plugins enable rabbitmq_stomp
```

31.3. Message type detection

The library determines the type (binary or text) of incoming messages based on the **content-type** header:

- If the header starts with 'text/', the message will be treated as a text message.
- Otherwise, it will be treated as a binary message (IBytesMessage.

Other STOMP clients (for example Node.js) may not be aware of this RabbitMQ-specific rule. If they send a text message without setting content-type to 'text/plain', Habari STOMP Client for RabbitMQ will misinterpret them as binary messages.

To fix this, adjust the producer client code to include the content-type header with value 'text/plain'.

31.4. Prefetch count

The RabbitMQ STOMP documentation explains that

"The prefetch count for all subscriptions is set to unlimited by default. This can be controlled by setting the **`prefetch-count`** header on SUBSCRIBE frames to the desired integer count."

With Habari STOMP Client for RabbitMQ, the prefetch-count header can be set using a parameter on the destination name for a message consumer:

Code example

```
// create a queue with a prefetch count of 3
Queue := Session.CreateQueue('ExampleQueue?prefetch-count=3');

// create a consumer for this queue
Consumer := Session.CreateConsumer(Queue);

Msg := Consumer.Receive(1000);
```

31.5. Destination types

The RabbitMQ STOMP documentation describes these destination types:

- `/exchange` – SEND to arbitrary routing keys and SUBSCRIBE to arbitrary binding patterns;
- `/queue` – SEND and SUBSCRIBE to queues managed by the STOMP gateway;
- `/amq/queue` – SEND and SUBSCRIBE to queues created outside the STOMP gateway;
- `/topic` – SEND and SUBSCRIBE to transient and durable topics;
- `/temp-queue/` – create temporary queues (in reply-to headers only).

Habari STOMP Client for RabbitMQ supports all these types: for the special RabbitMQ destination names with `/amq/queue` or `/exchange`, the prefixes can be used in the Session.CreateTopic / Session.CreateQueue methods.

Code example

```
// effective destination address: /queue/myqueue
Queue := Session.CreateQueue('myqueue');

// effective destination address: /topic/mytopic
Topic := Session.CreateTopic('mytopic');

// effective destination address: /exchange/myexchange/key
Queue := Session.CreateQueue('/exchange/myexchange/key');
// or
Topic := Session.CreateTopic('/exchange/myexchange/key');

// effective destination address: /amq/queue/rpc_queue
Queue := Session.CreateQueue('/amq/queue/rpc_queue');
```

31.6. Header properties

Habari STOMP Client for RabbitMQ does not process these RabbitMQ-specific[1] STOMP headers:

amqp-message-id the AMQP message-id property

content-encoding the content-encoding property

31.7. Broker-specific example code

Small example projects are included in the demo-brokerspecific folder, which cover broker-specific features.

- The examples are not tested every time a release of the library appears, so they may fail with newer versions of the broker.
- The examples are not covered by the basic support plan, and may be changed or removed at any time.

Table 8. Broker-specific examples

Folder	Description / feature	Further information
dead-letter-exchange	Creates a queue, specifying dead letter exchange and message time to live. Uses `x-dead-letter-exchange` and `x-message-ttl` header	
exchange-destination	Uses the `/exchange/` destination prefix	
message-ttl	Message time-to-live. Uses `x-message-ttl` header	
non-durable-queue	Uses `exclusive`, `auto-delete` and `durable` header	See https://habarisoft.wordpress.com/2021/10/22/non-durable-queue-example-for-rabbitmq/
priority-queue	Uses `x-max-priority` header	

queue-ttl	Create a queue which will be removed after 10 seconds of inactivity. Uses the `x-expires` header	
routing-delphi-java		See https://www.rabbitmq.com/tutorials/tutorial-four-java.html
routing-java-delphi		
rpc-delphi-java	Usage of temp queue for RPC. Delphi client, Java server. Uses `/amq/queue/` destination prefix.	See https://mikejustin.wordpress.com/2013/05/21/rpc-with-delphi-client-and-java-server-using-rabbitmq/
rpc-java-delphi	Usage of temp queue for RPC. Java client, Delphi server.	
stream	Creates the stream `my-stream`, fills it and reads ten messages from a random offset. Uses `x-queue-type=stream`, `x-stream-offset` and `prefetch-count`	See Section 31.11, “Streams”
stream-event-log	A bank account event log on a stream: three views are built from the same log, and each can be paused, resumed and replayed from the first offset. A VCL application with message listeners; with its in-memory broker it also runs without RabbitMQ. Uses `x-stream-offset=first`, `x-stream-offset=offset=<n>` and the `x-stream-offset` message property	Requires `HABARI_BROKEN_MESSAGELISTENER`, see Chapter 11, *Asynchronous receive (IMessageListener)*. See Section 31.11, “Streams”

stream-filter	Creates the stream `my-filtered-stream` and reads it with a stream filter. Uses `x-stream-filter-value` and `x-stream-filter`	Requires RabbitMQ 3.13.0 or newer. See Section 31.11.5, "Filtering"
x-queue-name	Bind AMQP queues to exchanges. Use `x-queue-name` header	See https://habarisoft.wordpress.com/2022/09/07/how-to-use-stomp-to-bind-rabbitmq-amp-queues-to-exchanges/

31.8. Auto-delete queues

The RabbitMQ STOMP plugin supports advanced queue features, which can be defined in the management interface but also from clients when the queue is created. No matter how these features have been declared, RabbitMQ requires that the client specifies the same feature settings whenever this queue is used.

If a queue has been created with the auto-delete flag set, the queue is deleted when all consumers have finished using it.[2]

31.8.1. Creation of an auto-delete queue

If the queue does not exist yet, it may be created dynamically by subscribing:

Code example

```
ClientCallbackQueue := Session.CreateQueue('Callback?auto-delete=true');

Consumer := Session.CreateConsumer(ClientCallbackQueue);
```

The admin interface will show that the **auto-delete** feature is enabled.

31.8.2. Sending a message to the auto-delete queue

Sending a message to this queue requires specifying that the auto-delete feature is enabled:

Code example

```
Msg := Session.CreateTextMessage;

Msg.SetStringProperty('auto-delete', 'true');

Producer.Send(Msg);
```

31.9. Queues with x-max-priority

As with auto-delete queues, RabbitMQ requires that the client specifies the same feature settings whenever this queue is used.

31.9.1. Creation of the queue

If the queue does not exist yet, it may be created dynamically by subscribing:

Code example

```
PriorityQueue := Session.CreateQueue('Priority?x-max-priority=20');

Consumer := Session.CreateConsumer(PriorityQueue);
```

The admin interface will show that the **maximum priority** is 20.

31.9.2. Sending a message to the queue

Sending a message to this queue requires specifying that the maximum priority is 20:

Code example

```
Msg := Session.CreateTextMessage;

Msg.SetIntProperty('x-max-priority', 20);

Producer.Send(Msg);
```

31.9.3. Hint: check the broker log

If your STOMP client code works with special destination features and does not work as expected, always check the RabbitMQ broker log file. On Windows, you may find it in %APPDATA%\RabbitMQ\log. On Unix, it is located in ${install_prefix}/var/log/rabbitmq (file locations

documentation).

31.10. Quorum queues

Quorum queues can be read if the type is specified in the SUBSCRIBE frame. To do this, append the x-queue-type parameter to the queue name:

Code example

```
// create a destination
Queue := Session.CreateQueue('my-queue?x-queue-type=quorum');

// read the quorum queue value
Consumer := Session.CreateConsumer(Queue);
Msg := Consumer.Receive(10000);
```

31.10.1. Send a value to a quorum queue

As with auto-delete queues, the broker checks the queue type when a message is sent: specify it as a message property. A message sent without it on a connection that did not create the queue is lost: RabbitMQ 4 rejects it (“inequivalent arg 'x-queue-type'”) and closes the connection, and the client does not notice (see Section 31.11.3, “Sending to a stream”).

Code example

```
// create a destination (the queue type goes into the message)
Queue := Session.CreateQueue('my-queue');

// send the quorum queue value
Msg := Session.CreateTextMessage('42');
Msg.SetStringProperty('x-queue-type', 'quorum');
Producer := Session.CreateProducer(Queue);
Producer.Send(Msg);
```

31.11. Streams

A stream is a RabbitMQ queue type that keeps its messages after they have been read. A consumer starts reading at a position (an *offset*), and any number of consumers can read the same messages, as often as they like.[3] The RabbitMQ STOMP plugin supports streams.[4] Habari STOMP Client for RabbitMQ passes the stream options in the destination name and in message properties to the broker unchanged.

The behaviour described here was tested with RabbitMQ 4.3.6 and 4.4.0.

31.11.1. Creation of a stream

A subscription creates the stream if it does not exist yet. Use a plain queue name with the option `x-queue-type=stream`. A stream subscription also needs a `prefetch-count` and client acknowledgement:

Code example

```
Context := Factory.CreateContext(amClientAcknowledge);

// creates the stream on first use and reads it from the start
Stream := Context.CreateQueue('my-stream?x-queue-type=stream'
  + '&x-stream-offset=first&prefetch-count=10');
Consumer := Context.CreateConsumer(Stream);

Msg := Consumer.Receive(1000);
if Assigned(Msg) then
  Msg.Acknowledge;
```

Do not use the `/amq/queue/` prefix to create a stream: it refers to an existing queue only (see Section 31.5, “Destination types”).

The broker answers a subscription asynchronously. If it rejects one, `CreateConsumer` does not fail: the next `Receive` raises `EBTStompServerErrorMessage`, and the broker closes the connection.

Table 9. Stream subscriptions the broker rejects (error texts of RabbitMQ 4.4.0)

Cause	Error
No `prefetch-count`	precondition_failed – consumer prefetch count is not set for stream queue ...
Automatic acknowledgement (`amAutoAcknowledge`)	not_implemented – automatic acknowledgement not supported by stream queue ... (RabbitMQ 4.3: only “Processing error”; the reason is in the broker log)
The name belongs to a classic queue	precondition_failed – invalid arg 'x-stream-offset' ... of queue type rabbit_classic_queue
`/amq/queue/` prefix, and the stream does not exist	not_found – no queue ...

31.11.2. Stream offsets

The option `x-stream-offset` sets where a subscription starts reading:

Table 10. Values of x-stream-offset

Value	Start
`first`	the first message in the stream
`last`	the last chunk. The broker stores messages in chunks, so this can be more than one message.
`next` (default)	after the last message: only messages sent after the subscription arrive
`offset=<n>`	the message at offset *n*, for example `offset=40000`
`timestamp=<t>`	the first message written at or after *t*, a Unix time in seconds (UTC), for example `timestamp=1792310400`

Every message from a stream carries its offset in the `x-stream-offset` header. Offsets are 64-bit values, so read the header as a string:

Code example

```
Offset := StrToInt64(Msg.GetStringProperty('x-stream-offset'));
```

Reading does not remove messages from a stream, and neither does an acknowledgement: it only makes room for the next message within the `prefetch-count`. Old messages are removed by the stream's retention settings, for example `x-max-age=7D` or `x-max-length-bytes`, which are set when the stream is created. The stream itself stays on the broker until it is deleted there, for example in the management interface; STOMP has no way to delete a queue.

31.11.3. Sending to a stream

Send to the plain queue name. When a connection sends to a queue for the first time, the RabbitMQ STOMP plugin declares the queue again, and the declaration must match the settings the queue was created with. So a message sent on a connection that did not create the stream must repeat every argument of the stream: `x-queue-type=stream`, and `x-max-age` or any other argument the stream was created with.

Code example

```
Msg := Context.CreateTextMessage('42');
Msg.SetStringProperty('x-queue-type', 'stream');
// repeat every other argument of the stream, for example
// Msg.SetStringProperty('x-max-age', '7D');

Producer := Context.CreateProducer;
Producer.Send(Context.CreateQueue('my-stream'), Msg);
```

WARNING

If an argument is missing or different, the broker rejects the message with PRECONDITION_FAILED ("inequivalent arg") and closes the connection. **The client does not notice:** Send and `Close` succeed, and the message is lost. A long series of messages ends with a socket error (10054, connection reset by peer). Check the broker log (see Section 31.9.3, "Hint: check the broker log").

31.11.4. Acknowledgement and NACK

Stream subscriptions work with `amClientAcknowledge` (an acknowledgement covers all earlier messages of the subscription) and `amClientIndividual` (it covers only the acknowledged message).

`Nack` raises no error, but a stream does not deliver the message again: the next message of the stream follows. To read a message again, create a new consumer with an `x-stream-offset` that includes it.

31.11.5. Filtering

With RabbitMQ 3.13 or newer, the broker can skip messages a consumer does not need. The sender sets a filter value in the message property `x-stream-filter-value`; the consumer lists the values it needs in the option `x-stream-filter` (comma-separated). With `x-stream-match-unfiltered=true`, the consumer also receives messages without a filter value.

The broker filters per chunk: it skips a chunk only if none of its messages matches. So a consumer receives non-matching messages too and must check the filter value itself:

Code example

```
Consumer := Context.CreateConsumer(Context.CreateQueue('my-stream'
  + '?x-queue-type=stream&x-stream-offset=first&prefetch-count=10'
  + '&x-stream-filter=red'));

Msg := Consumer.Receive(1000);
while Assigned(Msg) do
begin
  if Msg.GetStringProperty('x-stream-filter-value') = 'red' then
    Process(Msg); // your code
  Msg.Acknowledge;
  Msg := Consumer.Receive(1000);
end;
```

31.11.6. Known issue: subscribing while messages are written

With RabbitMQ 4.3.6, a subscription that starts while messages sent just before are still being written to the stream sometimes fails with “Processing error”. The broker log then shows `unexpected_delivery_and_no_default_consumer`. In our tests this happened in about one of ten attempts when a consumer subscribed immediately after a series of messages had been sent. Subscribe before sending where you can, or handle the error by subscribing again on a new connection.

31.12. Temporary queues

RabbitMQ supports temporary queues (`/temp-queue/`) for replies, but no temporary topics. `CreateTemporaryTopic` raises “Feature not supported”.

A temporary queue can only be used as a reply-to destination: set it as the `ReplyTo` of a request message. The consumer that the application creates for it sends no SUBSCRIBE frame. The broker subscribes when the first message with this reply-to is sent, so the consumer receives nothing before that.

RabbitMQ acknowledges the messages on a temporary queue automatically. Create temporary queues in a session with `amAutoAcknowledge`. In a session with `amClientAcknowledge` or `amClientIndividual`, `CreateTemporaryQueue` raises `EIllegalStateException`.

31.13. Special character encoding in STOMP headers

If a client sends a STOMP header to the RabbitMQ message broker which contains a colon character,

the broker will escape it according to the STOMP 1.1 specification as \c.

However, this happens independently of the STOMP version – even if the library uses STOMP 1.0 for the connection.

The Habari STOMP Client for RabbitMQ will not translate this non-standard escape sequence back to the colon character.

As a workaround, client applications should prefer STOMP 1.2 as this will activate correct escape sequence conversion.

[1] https://www.rabbitmq.com/docs/stomp

[2] https://www.rabbitmq.com/amqp-0-9-1-reference.html

[3] https://www.rabbitmq.com/docs/streams

[4] https://www.rabbitmq.com/docs/stomp

Chapter 32. Durable subscriptions with RabbitMQ

32.1. Description

If a client needs to receive all the messages published on a topic, including the ones published while the subscriber is inactive, it uses a durable `TopicSubscriber`.

The broker retains a record of this durable subscription and ensures that all messages from the topic's publishers are retained until they are acknowledged by this durable subscriber or they have expired.[1]

In RabbitMQ, the combination of **the topic name and the durable subscriber name** uniquely identifies the durable topic subscription.[2]

> **AMQP Semantics**
>
> For SUBSCRIBE frames, a *shared* queue is created for each distinct subscription ID x destination pair, and bound to the amq.topic exchange with routing key <name>. A subscription is created against the queue.

After you restart your program and re-subscribe, the broker will know which messages you need that were published while you were away.

NOTE If the same combination of topic name and durable subscriber name is used by more than one client, the broker behaviour is undefined – messages can be distributed between clients, or one client will receive all messages and other clients never see a message.

32.1.1. Creation

The ISession interface contains the CreateDurableSubscriber method which creates a durable subscriber to the specified topic.

A durable subscriber MessageConsumer is created with a unique durable subscriber name.

Code example

```
// create a durable subscription

Topic := Session.CreateTopic('ExampleTopic');

Consumer := Session.CreateDurableSubscriber(Topic, 'my-subscription-id');
```

32.1.2. Deletion

To delete a durable subscriber, RabbitMQ requires that the client first subscribes and then unsubscribes.

Code example

```
// first subscribe, then unsubscribe

Topic := Session.CreateTopic('ExampleTopic');
Session.CreateDurableSubscriber(Topic, 'my-subscription-id');

Session.Unsubscribe('ExampleTopic', 'my-subscription-id');
```

32.1.3. Test tool example

With the ProducerTool and ConsumerTool demo applications, you can send messages to a durable topic:

```
ProducerTool --MessageCount=1000 --Topic --Persistent --Subject=test-durable
```

and receive them from a client:

```
ConsumerTool --MaximumMessages=1000 --Topic --Subject=test-durable --Durable
--ConsumerName=12345 --Verbose
```

[1] https://docs.oracle.com/javaee/5/api/javax/jms/TopicSession.html

[2] https://www.rabbitmq.com/docs/stomp

Chapter 33. Connection troubleshooting

33.1. Performance demo

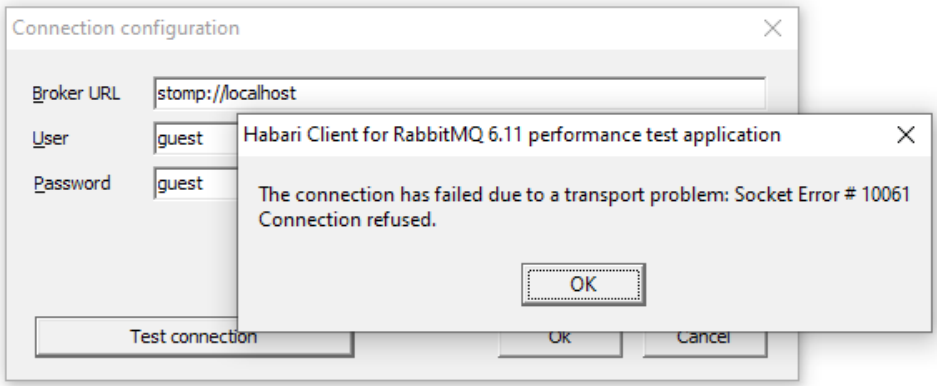
33.1.1. Socket error 10060 (connection timed out)

If the specified host is unreachable, a “Connection timed out” error will occur.

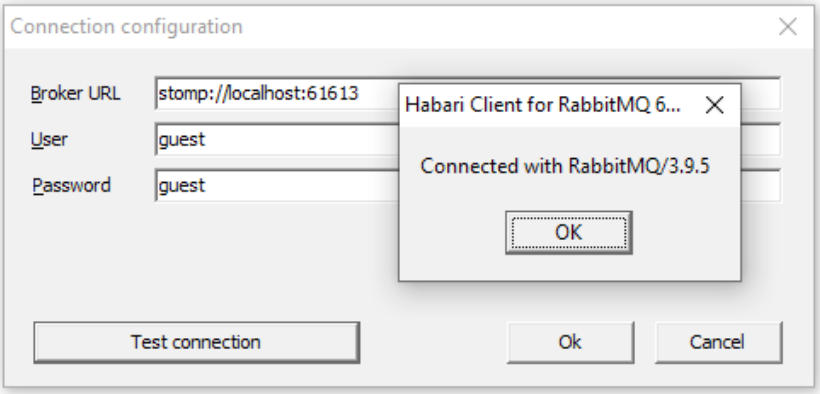
33.1.2. Socket error 10061 (connection refused)

If the broker service is not running on the specified host and port, a “Connection refused” error will occur:

The default port for STOMP on RabbitMQ is 61613. The port can be specified in the Broker URL:



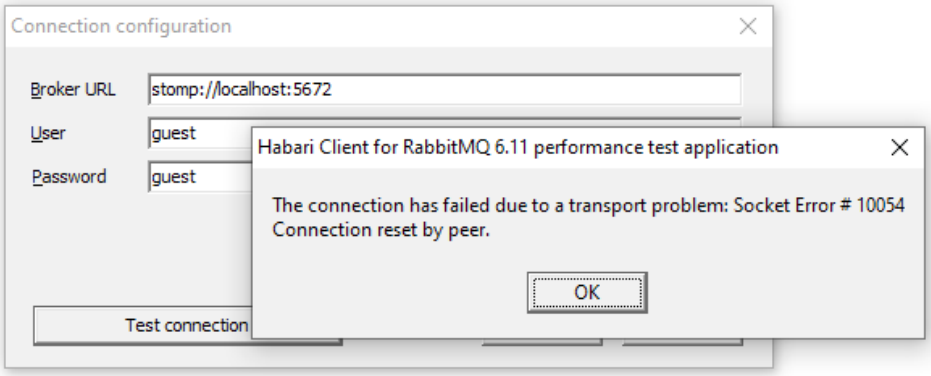
NOTE The STOMP plugin must be enabled, see RabbitMQ STOMP plugin



33.1.3. Socket error 10054 (connection reset by peer)

If the broker service is running on the specified host and port, but the port does not accept STOMP client connections, a “Connection reset by peer” error will occur:

In this case the broker log contains a ‘bad_header’ \<<”CONNECT\n”>> error message. The IP address of the client and the port number used by the client are included in the log messages, so they can be identified.



Note that in the example below, client and host are on localhost (127.0.0.1).

```
... [info] <0.1233.0> accepting AMQP connection <0.1233.0> (127.0.0.1:56184 ->
127.0.0.1:5672)
... [error] <0.1233.0> closing AMQP connection <0.1233.0> (127.0.0.1:56184 ->
127.0.0.1:5672):
... [error] <0.1233.0> {bad_header,<<"CONNECT\n">>}
```

33.1.4. Refused login

By default, the guest user is prohibited from connecting from remote hosts; it can only connect over a loopback interface (localhost). If user guest tries to connect, the broker logs:

```
PLAIN login refused: user 'guest' can only connect via localhost
```

Fix: see documentation for `rabbitmqctl add_user` / `set_permissions` for remote use

33.1.5. References

See also:

- https://www.rabbitmq.com/networking.html
- https://www.rabbitmq.com/docs/stomp

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