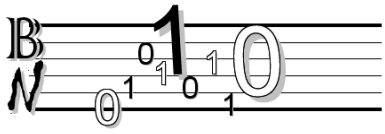
BinaryNotes

Developers Guide



http://bnotes.sourceforge.net

Table of Contents

1.Overview.....3
2.Introduction.....4
3.Requirements.....4
4.BinaryNotes Compiler.....5
  4.1.Generating process.....5
  4.2.BNCompiler command line options.....9
  4.3.Extending/Customization of BNCompiler.....10
5.BinaryNotes Library.....11
  5.1.Metadata and type mapping.....12
  5.2.Prepared elements (High performance encoding mode).....13
6.BinaryNotes Message Queues (BinaryNotesMQ).....14
  6.1.BinaryNotesMQ architecture.....15
  6.2.BinaryNotesMQ API quick overview.....16
  6.3.BinaryNotesMQ RPC-style message processing.....17
  6.4.BinaryNotesMQ Point-to-Point lightweight messaging/RPC model.....17
  6.5.BinaryNotesMQ message format.....18
7.License.....19

e-mail : abdulla.abdurakhmanov@gmail.com

1. Overview

BinaryNotes is the Open Source ASN.1 (Abstract Syntax Notation One) framework for Java and .NET.

In telecommunications and computer networking, Abstract Syntax Notation One (ASN.1) is a standard and flexible notation that describes data structures for representing, encoding, transmitting, and decoding data. It provides a set of formal rules for describing the structure of objects that are independent of machine-specific encoding techniques and is a precise, formal notation that removes ambiguities.

ASN.1 is a joint ISO and ITU-T standard, originally defined in 1984 as part of CCITT X.409:1984. ASN.1 moved to its own standard, X.208, in 1988 due to wide applicability. The substantially revised 1995 version is covered by the X.680 series.

ASN.1 defines the abstract syntax of information but does not restrict the way the information is encoded. Various ASN.1 encoding rules provide the transfer syntax (a concrete representation) of the data values whose abstract syntax is described in ASN.1.

The standard ASN.1 encoding rules include[1]:

* Basic Encoding Rules (BER)
* Canonical Encoding Rules (CER)
* Distinguished Encoding Rules (DER)
* XML Encoding Rules (XER) and Extended XML Encoding Rules (EXER)
* Packed Encoding Rules (PER)
* Generic String Encoding Rules (GSER)

ASN.1 together with specific ASN.1 encoding rules facilitates the exchange of structured data especially between application programs over networks by describing data structures in a way that is independent of machine architecture and implementation language.

Application layer protocols such as X.400 electronic mail, X.500 and LDAP directory services, H.323 (VoIP) and SNMP use ASN.1 to describe the PDUs they exchange. It is also extensively used in the Access and Non-Access Strata of UMTS. There are many other application domains of ASN.1

Materials from http://en.wikipedia.org/wiki/ASN.1 are used for writing this section. For more details please go to at this reference.

[1] CER, XER/EXER, GSER is not supported by BinaryNotes.

2. Introduction

The framework contains:

- Encoding/decoding library. The library has BER (Basic Encoding Rules), PER (Packet Encoding Rules) and DER (experimental) implementation.
- BNCompiler - the extensible based on XSL the ASN.1 compiler which is able to generate the simple Java or C# classes for the specified ASN.1 input file. The generated code has annotations/attributes that uses the compiler in runtime. You can customize the generated files by change the original XSL-templates or create your own templates.
- Message Queues – the own simple high performance MQ implementation based on ASN.1 encoding.

3. Requirements

BinaryNotes required:

- Java Platform Standard Edition v1.6 (.NET developer may use JRE instead JDK[2]).
- .NET 2.0 (Only for .NET developers)

Java developers can use Java 1.5, but it's needed the recompilation BinaryNotes with additional libraries in Dist\lib\depends\java5.

[2] .NET developer needs JVM too. The compiler run only under Java and haven't implementation for .NET. But the runtime library is native for .NET

e-mail : abdulla.abdurakhmanov@gmail.com

4. BinaryNotes Compiler

BinaryNotes Compiler (BNCompiler) is tool for generating the class/method declarations for specified ASN.1 specification (input file). The compiler generates the class declarations for ready to use with by runtime BinaryNotes library. But the developer may not use the compiler and implement own classes but usually this is more difficult.

4.1. Generating process

The generated classes has annotations/attributes and simple properties which uses the runtime library. For Java it's JavaBean properties, for .NET using native C# language properties[3].

For example using the following simple ASN.1 declaration:

```
FOOBAR
DEFINITIONS IMPLICIT TAGS ::= BEGIN
  TestSequence ::= SEQUENCE {
        field1 INTEGER,
        field2 PrintableString,
        field3 UTF8String OPTIONAL,
        field4 BOOLEAN DEFAULT false,
        field4 CHOICE {
                field1    INTEGER,
                field2    REAL
        }
  }
END
```

BNCompiler generates for Java:

```
package foobar;
//
// This file was generated by the BinaryNotes compiler.
// See http://bnotes.sourceforge.net
// Any modifications to this file will be lost upon recompilation of the source ASN.1.
//

import org.bn.*;
import org.bn.annotations.*;
import org.bn.annotations.constraints.*;
import org.bn.coders.*;
import org.bn.types.*;

   @ASN1Sequence ( name = "TestSequence", isSet = false )
   public class TestSequence {

         @ASN1Integer( name = "" )
         @ASN1Element ( name = "field1", isOptional =  false , hasTag =  false  , hasDefaultValue =  false  )
         private Long field1 = null;

         @ASN1String( name = "", stringType =  UniversalTag.PrintableString , isUCS = false )
         @ASN1Element ( name = "field2", isOptional =  false , hasTag =  false  , hasDefaultValue =  false  )
         private String field2 = null;

         @ASN1String( name = "", stringType = UniversalTag.UTF8String , isUCS = false )
         @ASN1Element ( name = "field3", isOptional =  true , hasTag =  false  , hasDefaultValue =  false  )
        private String field3 = null;

         @ASN1Boolean( name = "" )
         @ASN1Element ( name = "field4", isOptional =  false , hasTag =  false  , hasDefaultValue =  true  )
        private Boolean field4 = null;
```

[3] This documentation doesn't describe annotation using declaration now. Maybe in later version this will be fixed.

e-mail : abdulla.abdurakhmanov@gmail.com

```
        @ASN1Choice ( name = "field4" )
        public static class Field4ChoiceType {
                @ASN1Integer( name = "" )
                @ASN1Element ( name = "field1", isOptional =  false , hasTag =  false  , hasDefaultValue =  false  )
                private Long field1 = null;

                @ASN1Real( name = "" )
                @ASN1Element ( name = "field2", isOptional =  false , hasTag =  false  , hasDefaultValue =  false  )
                private Double field2 = null;

                public Long getField1 () {
                        return this.field1;
                }

                public boolean isField1Selected () {
                        return this.field1 != null;
                }

                private void setField1 (Long value) {
                        this.field1 = value;
                }

                public void selectField1 (Long value) {
                        this.field1 = value;
                        setField2(null);
                }

                public Double getField2 () {
                        return this.field2;
                }

                public boolean isField2Selected () {
                        return this.field2 != null;
                }

                private void setField2 (Double value) {
                        this.field2 = value;
                }

                public void selectField2 (Double value) {
                        this.field2 = value;
                        setField1(null);
                }
          }

          @ASN1Element ( name = "field4", isOptional =  false , hasTag =  false  , hasDefaultValue =  false  )
           private Field4ChoiceType field4 = null;

      public Long getField1 () {
         return this.field1;
      }

      public void setField1 (Long value) {
         this.field1 = value;
      }

      public String getField2 () {
         return this.field2;
      }

      public void setField2 (String value) {
         this.field2 = value;
      }

      public String getField3 () {
         return this.field3;
      }

      public boolean isField3Present () {
         return this.field3 == null;
      }
```

```
      public void setField3 (String value) {
         this.field3 = value;
      }

      public Boolean getField4 () {
         return this.field4;
      }

      public void setField4 (Boolean value) {
         this.field4 = value;
      }

      public Field4ChoiceType getField4 () {
         return this.field4;
      }

      public void setField4 (Field4ChoiceType value) {
         this.field4 = value;
      }

      public void initWithDefaults() {
         Boolean param_Field4 = new Boolean (false);
         setField4(param_Field4);
      }

   }
```

And BNCompiler generates for C# (.Net):

```
//
// This file was generated by the BinaryNotes compiler.
// See http://bnotes.sourceforge.net
// Any modifications to this file will be lost upon recompilation of the source ASN.1.
//

using System;
using org.bn.attributes;
using org.bn.attributes.constraints;
using org.bn.coders;
using org.bn.types;

namespace foobar {


   [ASN1Sequence ( Name = "TestSequence", IsSet = false  )]
   public class TestSequence {

        private long field1_ ;
        [ASN1Integer( Name = "" )]
        [ASN1Element ( Name = "field1", IsOptional =  false , HasTag =  false  , HasDefaultValue =  false )  ]
        public long Field1
        {
                        get { return field1_; }
                        set { field1_ = value;  }
        }

        private string field2_ ;
        [ASN1String( Name = "", StringType =  UniversalTags.PrintableString , IsUCS = false )]
        [ASN1Element ( Name = "field2", IsOptional =  false , HasTag =  false  , HasDefaultValue =  false )  ]
        public string Field2
        {
                        get { return field2_; }
                        set { field2_ = value;  }
        }

        private string field3_ ;
        private bool  field3_present = false ;
        [ASN1String( Name = "", StringType =  UniversalTags.UTF8String , IsUCS = false )]
        [ASN1Element ( Name = "field3", IsOptional =  true , HasTag =  false  , HasDefaultValue =  false )  ]
        public string Field3
        {
```

```
                        get { return field3_; }
                        set { field3_ = value; field3_present = true;  }
    }

    private bool field4_ ;
    [ASN1Boolean( Name = "" )]
    [ASN1Element ( Name = "field4", IsOptional =  false , HasTag =  false  , HasDefaultValue =  true )  ]
    public bool Field4
    {
                        get { return field4_; }
                        set { field4_ = value;  }
    }

    private Field4ChoiceType field4_ ;
    [ASN1Choice ( Name = "field4" )]
    public class Field4ChoiceType {

            private long field1_ ;
            private bool  field1_selected = false ;

            [ASN1Element ( Name = "field1", IsOptional =  false , HasTag =  false  , HasDefaultValue =  false )  ]
            [ASN1Integer( Name = "" )]
            public long Field1
            {
                                get { return field1_; }
                                set { selectField1(value); }
            }

            private double field2_ ;
            private bool  field2_selected = false ;

            [ASN1Element ( Name = "field2", IsOptional =  false , HasTag =  false  , HasDefaultValue =  false )  ]
            [ASN1Real( Name = "" )]
            public double Field2
            {
                                get { return field2_; }
                                set { selectField2(value); }
            }

            public bool isField1Selected () {
                                return this.field1_selected ;
            }

            public void selectField1 (long val) {
                                this.field1_ = val;
                                this.field1_selected = true;
                        this.field2_selected = false;
            }

            public bool isField2Selected () {
                                return this.field2_selected ;
            }

            public void selectField2 (double val) {
                                this.field2_ = val;
                                this.field2_selected = true;
                        this.field1_selected = false;
            }
    }

   [ASN1Element ( Name = "field4", IsOptional =  false , HasTag =  false  , HasDefaultValue =  false )  ]
   public Field4ChoiceType Field4
   {
      get { return field4_; }
      set { field4_ = value;  }
   }

   public bool isField3Present () {
       return this.field3_present == true;
   }

   public void initWithDefaults() {
```

```
        bool param_Field4 = false;
        Field4 = param_Field4;
      }
    }
}
```

And this class (classes) can be used for in your code as usually. For Java:

```
TestSequence sequence = new TestSequence();
sequence.setField1(10L);
sequence.setField3("Hello");
// Inner class for implicity ASN.1 type declaration
TestSequence.Field4ChoiceType choice = new TestSequence.Field4ChoiceType();
choice.selectField2(0.5);
sequence.setField4(choice);
```

For C#:

```
TestSequence sequence = new TestSequence();
sequence.Field1  = 10L;
sequence.Field3 = "Hello";
// Inner class for implicity ASN.1 type declaration
TestSequence.Field4ChoiceType choice = new TestSequence.Field4ChoiceType ();
choice.selectField2(0.5);
sequence.Field4 = choice;
```

4.2. BNCompiler command line options

BNCompiler can be executed by bncompiler.cmd script (Win32) or may be fork from ANT-tool (Compiler main class is *org.bn.compiler.Main*).

The compiler is processing the following command line options:

Long option name	Short name	Mandatory	Description	Example
--file	-f	Yes	The source input ASN.1 file	-f mytest.asn
--moduleName	-m	Yes	The translate module name (must be available directory in modules path)	-m java -m cs
--modulesPath	-mp	No	Path to modules directory which contains XSL templates for translating. Default is current directory + "modules/"	-mp d:\modules
--outputDir	-o	No	Output path for generating files. Default is current directory + "output/"	-o org/my/superpackage
--namespace	-ns	No	Namespace/Package name for generated files. Default is ASN.1 module name.	-ns org.my.superpackage

Example of use compiler for C# (Win32):

```
D:\BinaryNotes\Dist\bin\bncompiler.cmd –m cs –o test/org/company –ns test.org.company –f test.asn
```

Example of use complier with ANT-tool:

```
  <path id="library.BN">
    <pathelement location="${dist.path.lib}/binarynotes.jar"/>
  </path>
  <path id="classpath">
    <path refid="library.BN"/>
  </path>
  <path id="bndepends.path">
    <pathelement path="classes"/>
    <pathelement path="${depends.libs.path}/lineargs.jar"/>
    <pathelement path="${depends.libs.path}/antlr.jar"/>
    <pathelement path="${depends.libs.path}/activation.jar"/>
    <pathelement path="${depends.libs.path}/java5/jaxb-api.jar"/> <!-- Only for Java5 -->
    <pathelement path="${depends.libs.path}/java5/jaxb-impl.jar"/> <!-- Only for Java5 -->
    <pathelement path="${depends.libs.path}/java5/jaxb1-impl.jar"/> <!-- Only for Java5 -->
```

```
  <pathelement path="${depends.libs.path}/java5/jsr173_1.0_api.jar"/> <!-- Only for Java5 -->
  <pathelement path="${dist.path.lib}/java/binarynotes.jar"/>
  <pathelement path="${dist.path.bin}/bncompiler.jar"/>
</path>
<target name="bncompile" depends="init">
  <java classname="org.bn.compiler.Main" fork="true">
    <classpath refid="bndepends.path"/>
    <arg value="-mp"/>
    <arg value="${dist.path.bin}/modules"/>
    <arg value="-m"/>
    <arg value="java"/>
    <arg value="-o"/>
    <arg value="src/org/bn/mq/protocol"/>
    <arg value="-ns"/>
    <arg value="org.bn.mq.protocol"/>
    <arg value="-f"/>
    <arg value="../asn/test.asn"/> <!-- Input file path to your ASN.1 declaration -->
  </java>
</target>
```

4.3. Extending/Customization of BNCompiler

The compiler has predefined templates (translation modules) for C#/Java. But you can create own translation modules.
Translation modules is XSL-scripts with predefined structure. BNCompiler, depending on moduleName command line option, execute specified translation module.
Warning: The predetermined (standard) modules periodically changes, and if you want customize please create own module and don't change standard modules. But no forget about bugfix updates.

e-mail : abdulla.abdurakhmanov@gmail.com

5. BinaryNotes Library

The library supports various encodings standards.
The version 1.3 supports:

- BER
- DER
- PER (Aligned/Unaligned)

The factory for creating Encoder/Decoder implementation is *org.bn.CoderFactory.* An encoder interface is defined as *org.bn.IEncoder,* and decoder as *org.bn.IDecoder.*

CoderFactory is Singleton[4] and can create Encoder/Decoder by specified encoding schema name:

- "BER" for BER encoding
- "DER" for DER encoding
- "PER" or "PER/Aligned" or "PER/A" for PER Aligned encoding
- "PER/Unaligned" or "PER/U" for PER Unaligned encoding

The following code describes creating encoder and decoder.
For Java:

```
// Encoder for Java
IEncoder<DataSeq> encoder = CoderFactory.getInstance().newEncoder("BER");

// Decoder for Java
IDecoder decoder = CoderFactory.getInstance().newDecoder("BER");
```

For C#:

```
// Encoder for C#
IEncoder encoder = CoderFactory.getInstance().newEncoder("BER");

// Decoder for C#
IDecoder decoder = CoderFactory.getInstance().newDecoder("BER");
```

IEncoder contain primary method <T> encode(T obj, OutputStream stream), and IDecoder contain primary method decode<T>(InputStream stream, Class<T> objClass).

Java example:

```
...
// Encoding for Java
TestSequence sequence = new TestSequence();
sequence.setField1(10L);
sequence.setField3("Hello");
// Inner class for implicitly ASN.1 type declaration
TestSequence.Field4ChoiceType choice = sequence.new Field4ChoiceType();
choice.selectField2(0.5);
sequence.setField4(choice);
IEncoder< TestSequence> encoder = CoderFactory.getInstance().newEncoder("BER");
ByteArrayOutputStream outputStream = new ByteArrayOutputStream();
encoder.encode(sequence, outputStream);

...
// Decoding for Java
IDecoder decoder = CoderFactory.getInstance().newDecoder("BER");
// Decoding the specified input stream
TestSequence seq = decoder.decode(stream, TestSequence.class);
System.out.println(seq.getField1());
if(seq.isField3Present())
```

[4] From the GoF (Gang-Of-Four) Design Pattern Book definitions

e-mail : abdulla.abdurakhmanov@gmail.com

```
        System.out.println(seq.getField3());
...
```

C# example:

```
...
// Encoding for C#
TestSequence sequence = new TestSequence();
sequence.Field1  = 10L;
sequence.Field3 = "Hello";
// Inner class for implicity ASN.1 type declaration
TestSequence.Field4ChoiceType choice = new TestSequence.Field4ChoiceType ();
choice.selectField2(0.5);
sequence.Field4 = choice;
IEncoder encoder = CoderFactory.getInstance().newEncoder("BER");
ByteArrayOutputStream outputStream = new ByteArrayOutputStream();
encoder.encode<TestSequence>(sequence, outputStream);

...
// Decoding for .NET
IDecoder decoder = CoderFactory.getInstance().newDecoder("BER");
// Decoding the specified input stream
TestSequence seq = decoder.decode<TestSequence>(stream);
System.Console.Writeln(seq.Field1);
if(seq.isField3Present()) {
        System.Console.Writeln(seq.Field3);
}
...
```

5.1. Metadata and type mapping

The library supported following Java/.NET types and annotations/attributes:

ASN1 type	Java	.NET	Metadata must be specified	Metadata (annotation / attribute)	Constraints supports	Definition Examples

INTEGER	Integer
	Long
		int
		long
			no	ASN1Integer
				(@ASN1Integer for Java,
				[ASN1Integer] for .NET)
					ASN1ValueRangeConstraint	1. int value; // .net
						2. Integer value; // java
						3. // Java with annotation
						
						@ASN1Integer(name=”fieldName”)
						private Integer value; // field declaration
						
						public int getValue() { return this.value};
						public void setValue(int param) { this.value = param};
						
						4. // .NET with constraints attribute
						
						@ASN1Integer(name=”fieldName”)
						[ASN1ValueRangeConstraint(Min = 120, Max = 1000]
						public int Value { ... } ; // Property

REAL	Double	Double	no	ASN1Real	-	1. Double value; // java
						2. double value; //.net
						3. // .net with attributes
						[ASN1Real name=”fieldName”]
						public double Value { ... }; // property

PrintableString
UTF8String
TeletexString
VideotexString
IA5String
VisibleString
GeneralString
UniversalString
NumericString
BMPString
	String	string	No, by default is expected Printable String	ASN1String	ASN1SizeConstraint	1. String value; // java
						2. // .net
						[ASN1String name=”filedName” stringType=UniversalTags.UTF8String]
						public string Value { ... }; // property

BOOLEAN	Boolean	bool	No	ASN1	-	
SEQUENCE	class ...	class ...	Yes	ASN1Sequence	-	See to 4.1 for example
CHOICE	class ...	class ...	Yes	ASN1Choice	-	See to 4.1 for example
SEQUENCE OF	Collection<...>	ICollection<...>	Yes	ASN1SequenceOf	ASN1SizeConstraint	1. // Java @ASN1SequenceOf private Collection<String> myCollection; 2. // .NET @ASN1SequenceOf public ICollection<String> myCollection

ASN1 type	Java	.NET	Metadata must be specified	Metadata (annotation / attribute)	Constraints supports	Definition Examples
						{ ... }; // property
ANY	byte[]	byte[]	Yes	ASN1Any	-	-
OCTET STRING	byte[]	byte[]	No	ASN1OctetString	-	-
ENUMERATED	class with Enum	class with Enum	Yes	ASN1Enum	-	-
BITSTRING	special class org.bn.types.BitString	special class org.bn.types.BitString	No	ASN1BitString	ASN1SizeConstraints	
OBJECT IDENTIFIER	special class org.bn.types.ObjectIdentifier	special class org.bn.types.ObjectIdentifier	No	ASN1ObjectIdentifier	-	

5.2. Prepared elements (High performance encoding mode)

The annotations/attributes have problems with performance and for critical application can use new feature (begin from 1.4) – Prepared Elements.
The BNCompiler now for generated files has some declarations for increase performance. If you don't use BNCompiler and coding classes manually, you may use the following declaration for increase performance (example for .NET):

```
[ASN1PreparedElement]
[...]
class MyClass : IASN1PreparedElement {
        public void initWithDefaults() {
                // initialization object with default values when decoding
        }

        ...

        // Creating static class metainformation
        private static IASN1PreparedElementData preparedData =
                CoderFactory.getInstance().newPreparedElementData(typeof(MyClass));

        public IASN1PreparedElementData PreparedData {
                get { return preparedData; }
        }
}
```

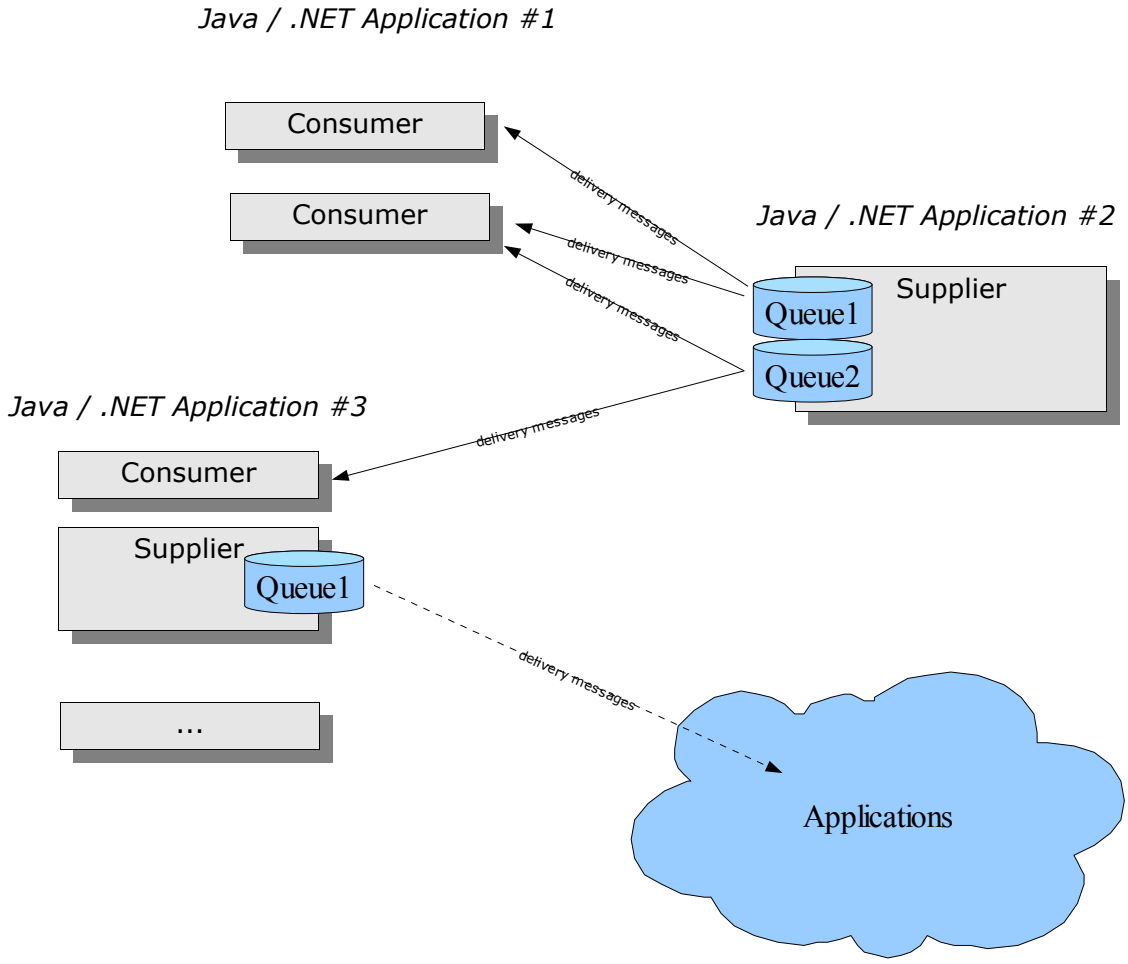
6. BinaryNotes Message Queues (BinaryNotesMQ)

BinaryNotes Message Queues (BNMQ) v1.0 is the main and new feature for BinaryNotes v1.3.
Functionality:

- Simple & fast Messages Queues based on ASN.1 encoding.
- Compact ASN.1 encoded messages (default encoding is PER/Unaligned)
- Flexible subscription procedure with filtering on server support
- Persistence (mandatory) messages and subscription supported (based on HSQLDB for Java, and SQLite for .NET)
- Framework hide all networking infrastructure. For BNMQ version 1.0 only supported auto-restore connection feature. But has plans to support more progressive Fault-Tolerant and Load-Balancing Features (v1.1 MQ).
- The flexible design which allows to simple extend default implementation.
- Supports for RPC-style interaction. Support async-call paradigm too.

e-mail : abdulla.abdurakhmanov@gmail.com

6.1. BinaryNotesMQ architecture



There is main subjects which operates the BinaryNotesMQ library:

- **Message** – content that delivering from Supplier to Consumer. Message contains system parameters (message id, priority, address information, etc) and custom body with user content.
- **Queue (Message Queue)** – it's queue of messages from Supplier to Consumer.
- **Consumer** - the client of Message Queues and are receiving messages from these queues. Consumer can subscribe to concrete Queue with the specified ConsumerId. The subscription maybe also specified as persistence and if connection with Queue is unavailable then all (mandatory) messages from supplier will be stored and delivered later.
- **Supplier –** the supplier for queues. It's can register some Queues for various user messages types, handling subscriptions, and can delivery messages to Consumer. Supplier may also create persistence storage for Queue and has other auxiliary functions.

For all this subjects BinaryNotesMQ has simple direct interface definition.
The library fully hide transport level, and developer doesn't coding this level.

6.2. BinaryNotesMQ API quick overview

The main factory for create interface implementations is org.bn.mq.MQFactory. With the factory you can create IMessagingBus. IMessagingBus is abstraction for transport layer.
With MessagingBus you can create new transport session (client connection, or server listener). Abstraction for this session is interface IMQConnection[5]:

```
IMessagingBus bus = MQFactory.Instance.createMessagingBus();
IMQConnection connection = bus.connect(new URI("bnmq://remotehost.test:3333")); // for client
// ...
IMQConnection connection = bus.create(new URI("bnmq://127.0.0.1:3333")); // for server

// start connection
connection.start(); // starting connection
```

The concrete IMQConnection instance can listen with IMQConnectionListener interface user implementation (see to addListener method). After prepare the connection, you must call start() method.

With IMQConnection you can register a local message supplier or lookup a remote supplier:

```
IRemoteSupplier remoteSupplier = connection.lookup("ExampleSupplier"); // lookup
// ...
ISupplier supplier = connection.createSupplier("MySupplier"); // create own message supplier
```

For consumer you can lookup & subscription to remote queue over remote supplier:

```
IRemoteQueue<UserMessageType> remoteQueue = remoteSupplier.lookup("MyQueue");
remoteQueue.addConsumer(new MyConsumer()); // subscription procedure

//... You must define your implementation for IConsumer<T> interface
class MyConsumer implements IConsumer<UserMessageType> {
        public String getId() {
                return "MyConsumer";
        }

        UserMessageType onMessage(IMessage<UserMessageType> message) {
                // ...
        }
}
```

Where you must define implementation handling messages using interface IConsumer<>.
This interface has two methods:

- getId – method invoke for determinate ConsumerId
- onMessage – code for processing received message. Method can return result value if supplier using RPC-style.

For specified example UserMessageType is type of message which uses for this queue. This class must define developer with BNCompiler or manually created.

For **supplier** you can create queue:

```
// For Java
IQueue<UserMessageType> queue =  supplier.createQueue("MyQueue", UserMessageType.class);

// For .NET
IQueue<UserMessageType> queue =  supplier.createQueue<UserMessageType>("MyQueue");
```

[5] From start here samples specified only for Java and for .NET stipulates necessarily because .NET has similar to Java API.

e-mail : abdulla.abdurakhmanov@gmail.com

```
// and now we can send messages to queue
IMessage<UserMessageType> message = queue.createMessage();
message.setBody(new UserMessageType()); // filling user body content
queue.sendMessage(message);
```

6.3. BinaryNotesMQ RPC-style message processing

BinaryNotesMQ supports RPC-style message processing. Supplier can invoke method on queue call or callAsync instead of sendMessage:

```
UserMessageType  result = queue.call(new UserMessageType()); // Synchronized call (awaiting result in the current thread)

// more progressive & fast async call also supported
queue.callAsync(new UserMessageType(), new CallAsyncListener()); // Async call with handler

// for .NET you can also use delegates
queue.callAsync(new UserMessageType(), callResultDelegate, callTimeoutDelegate);
```

Consumer doesn't need any special coding for RPC style instead returning result when handling event onMessage().

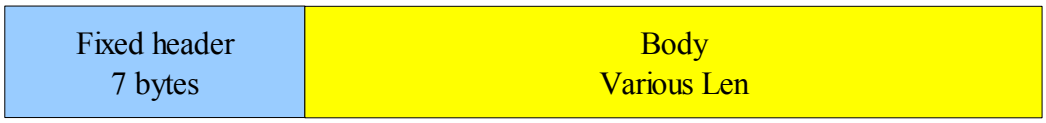
6.4. BinaryNotesMQ Point-to-Point lightweight messaging/RPC model

BNMQ supported PTP model when two remote points has equals rights and may send and receive messages (two-way messaging) or use two-way RPC-model:

```
        serverConnection  = bus.create(new URI("bnmq://127.0.0.1:3333"));
        ptpServerSession = serverConnection.createPTPSession("serverPTP","ptpSimpleSession",String.class);
        ptpServerSession.addListener(new TestPTPSessionListener());
        serverConnection.start();

        clientConnection  = bus.connect(new URI("bnmq://127.0.0.1:3333"));
        ptpClientSession = clientConnection.createPTPSession("clientPTP","ptpSimpleSession",String.class);
        ptpClientSession.addListener(new TestPTPSessionListener());
        clientConnection.start();

        String result = ptpClientSession.call("Hello from PTP Client",20);

       ITransport clientTransport = ...; // client transport after connected over MQConnection (see to IMQConnectionListener).
        ptpServerSession.callAsync("Hello from Server 2", clientTransport, new TestRPCAsyncCallBack(),20);
```

6.5. BinaryNotesMQ message format

BinaryNotesMQ on transport layer uses own type of message format:



The BinaryNotesMQ potential may support another encoding instead like ASN.1, and header has simple format:

1 (first byte)	2	3	4	5	6	7
Encoder schema id	Encoder schema subtype id	Protocol version	Body length Network ordered 32bit integer			

- **Encoder schema / encoder schema subtype –** type (identifier) of encoder schema:

Encoder schema id	Encoder schema subtype id	Encoding definition
0x00	0x00	ASN.1 BER encoded body
0x01	0x00	ASN.1 PER aligned encoded body
0x01	0x01	ASN.1 PER unaligned encoded body

- **Protocol version –** body protocol version (for tracking protocol changes and compatibility MQ)
- **Body length –** Length of message body. Value encoded as network ordered 32-bit integer.

After header following body encoded as specified in header.
Body encoded using BinaryNotesMQ ASN.1 declaration (see to BinaryNotesMQ\asn\ directory) and define message types:

- **UserBody –** delivering user content
- **Subscribe** – consumer subscription command
- **Lookup –** lookup supplier
- **AliveRequest –** system messages for controlling availability transport layer

7. License

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e-mail : abdulla.abdurakhmanov@gmail.com