MINA
in Real Life

Schedule

- Introduction to MINA
- Simple Use Cases
- A more complex Use Case
- Do's and Don'ts
- Summary
- Q&A

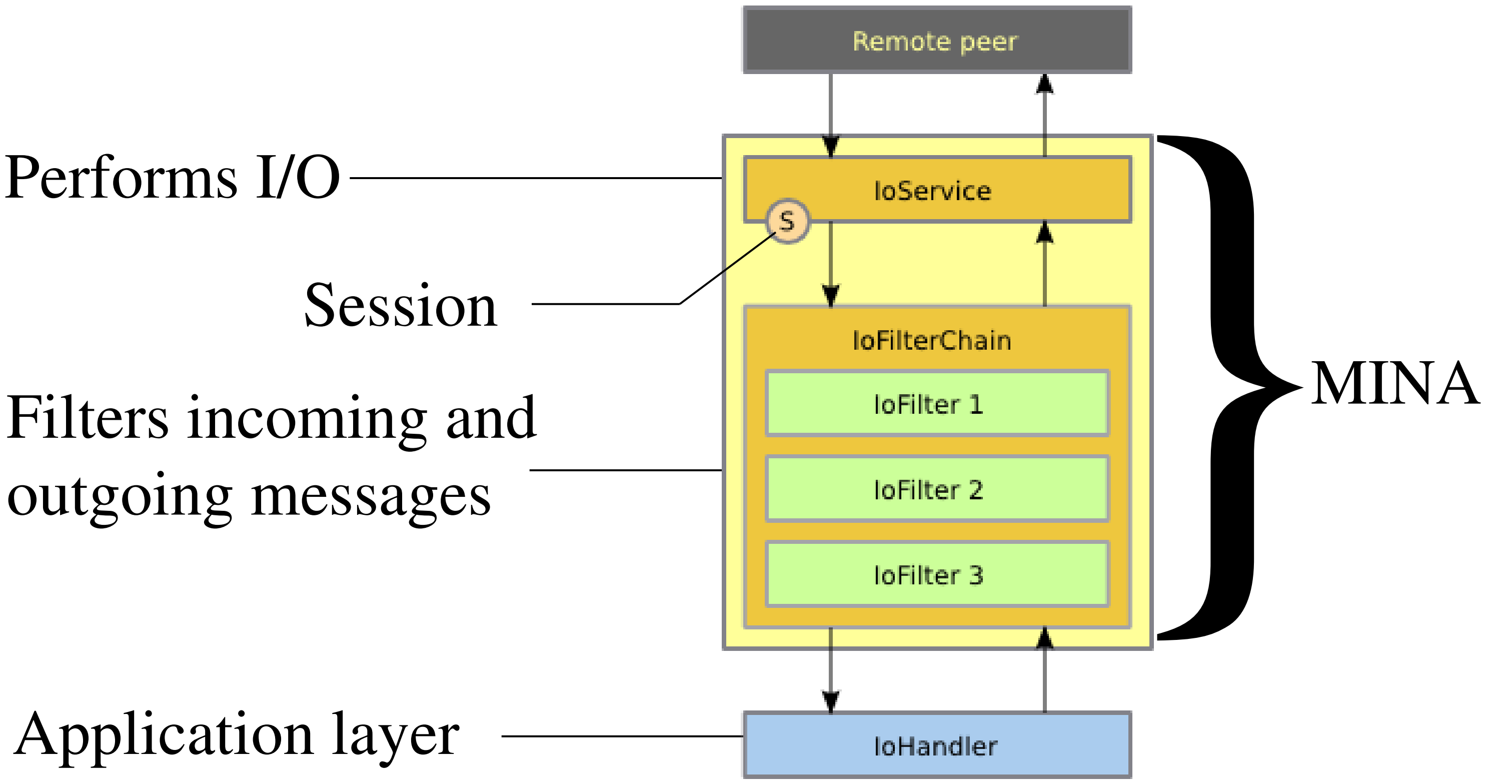
Introduction

- A framework on top of NIO 1.0
  - Asynchronous
  - Non-blocking
  - Event-Driven
  - TCP, UDP, APR, Serial ...
  - Extensible through Filters
  - Comes with a protocol framework

Built for ADS

- ADS needed a SEDA based network framework on top of NIO
  - Netty-1 sound ok, but...
  - Needed a full rewrite
  - It became MINA 1.0
  - And later, a TLP !

Key concepts



Performs I/O

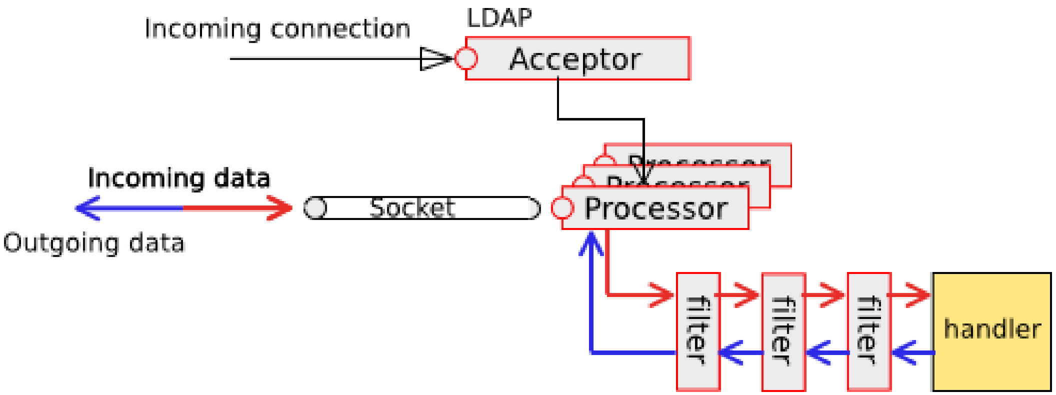
Session

Filters incoming and outgoing messages

Application layer

MINA

How it works...


Incoming connection
LDAP
Acceptor
Processor
Processor
Processor
Incoming data
Socket
Outgoing data
filter
filter
filter
handler

Simple use cases

- A Simple TCP server : EchoServer
  - Based on TCP
  - Multi-Users
  - Should be fast
  - Returns what the users sent without modification
- Ok, let's code it !

The echo server

```
public static void main(String[] args) throws Exception {
    SocketAcceptor acceptor = new NioSocketAcceptor();

    // Bind
    acceptor.setHandler(new EchoProtocolHandler());
    acceptor.bind(new InetSocketAddress(PORT));

    System.out.println("Listening on port " + PORT);
}
```

The “Business” part

```
public class EchoProtocolHandler extends IoHandlerAdapter {
    /**
     * This is where we handle incoming messages
     */
    public void messageReceived(IoSession session, Object message)
            throws Exception {
        // Write the received data back to remote peer
        session.write(((IoBuffer) message).duplicate());
    }
}
```

And that's it !

- We have created a SocketAcceptor
- Then we associated a handler to it
- And accepted incoming connections
- Last, we implemented the logic in the Handler, in the messageReceived() method.

What do we have ?

- A multithreaded server
- Accepting many parallel clients
- Roughly **4 lines** of code !
- We can extended the server easily
  - For instance, adding a logger
  - Handling more messages
  - Or adding SSL support

Adding a logging filter

```
public static void main(String[] args) throws Exception {
    SocketAcceptor acceptor = new NioSocketAcceptor();

    // Add a logging filter
    acceptor.getFilterChain().addLast( "Logger", new LoggingFilter() );

    // Bind
    acceptor.setHandler(new EchoProtocolHandler());
    acceptor.bind(new InetSocketAddress(PORT));

    System.out.println("Listening on port " + PORT);
}
```

Another simple Use Case

- NTP Server
  - UDP (port 123)
  - Fixed Message size
  - Binary protocol
  - Stateless
- The code...

A more complex use case

A more complex Use Case

- Apache Directory Server
  - TCP and UDP
  - Simple or Two levels protocols
  - Binary messages
  - Multiple handlers
  - Potentially hundred of thousands connections
  - Has to be fast

Handle many protocols

- LDAP (TCP)
- Kerberos (TCP and UDP)
- NTP (UDP)
- DHCP (UDP)
- DNS (TCP and UDP)
- ChangePassword

LDAP protocol

- Binary protocol
  - Defined using ASN.1
  - BER encoded
- TCP based
- Connected
- More than one message type

Constraints

- Support LDAP and LDAPS
- Session can last forever
  - Small memory footprint
- Messages can be quite big
  - Images
- We can receive more than one message in an incoming buffer
- It should be Client and Server side

Decoding

- Problem : it's a 2 level protocol
  - TLVs
  - Ldap
- TLV means Type/Length/Value
  - Each of those three elements can be longer than one byte
  - A Value can contains other TLVs

LDAP messages

- 10 different requests
  - Bind, Unbind, Abandon, Add, Compare, Delete, Modify, ModifyDN, Search, Extended
- 11 different responses
  - Bind, SearchResEntry, SearchResDone, SearchResRef, Add, Compare, Delete, Modify, ModifyDN, Extended, Intermediate

Server Side

- The chain will contain the SSL filter, plus an executor, and the Ldap protocol codec
- We may have expensive requests
- We want more than one handler
- Each session contains user's datas

The chain

```
SocketAcceptor acceptor = new NioSocketAcceptor( nbThreads );

IoFilterChainBuilder chain = new DefaultIoFilterChainBuilder();
chain.addLast( "sslFilter", new SslFilter( sslCtx ) );

chain.addLast( "codec", new
    ProtocolCodecFilter( getProtocolCodecFactory() ) );

chain.addLast( "executor",
    new ExecutorFilter(
        new OrderedThreadPoolExecutor( getNbThreads() ),
        IoEventType.WRITE ) );

acceptor.setFilterChainBuilder( chain );
...
```

Acceptor configuration

```
...
// Disable the disconnection of the clients on unbind
acceptor.setCloseOnDeactivation( false );

// Allow the port to be reused even if the socket is in TIME_WAIT
state
acceptor.setReuseAddress( true );

// No Nagle's algorithm
acceptor.getSessionConfig().setTcpNoDelay( true );

// Inject the protocol handler
acceptor.setHandler( getHandler() );

// Bind to the configured address
acceptor.bind();
```

Handlers

```
class LdapProtocolHandler extends DemuxingIoHandler
{
...
    public void messageReceived( IoSession session, Object message )
    {
    ... // SSL and controls Handling
        super.messageReceived( session, message );
    }
...
}

public void messageReceived(IoSession session, Object message)
{
    MessageHandler<Object> handler =
        findReceivedMessageHandler(message.getClass());

        if (handler != null) {
            handler.handleMessage(session, message);
        } else {
            throw new UnknownMessageTypeException(...);;
        }
    }
```

Back to basic...

What about XML ?

- Tagged language
- Size is unknown
- Parser are a bit a pain to use at this point
- Seems like XML is the Lingua Franca those days...
  - “a language used by people of diverse speech to communicate with one another, often a basic form of speech with simplified grammar.”

Issues

- We have to detect tags
- We have to detect text between tags
- We have to keep everything somewhere until we are done with the closing tag
- Java XML decoders don't handle fragmented tags...

An XML stripper server

- We want to extract the message in an XML message, and return it to the user
- The message can be big
- The decoder is the main concern...
- We have to validate the data before sending it to the handler.

XML server

```
public static void main( String[] args ) throws Exception {
    IoHandler xmlStripperProtocolHandler = new XmlStripperProtocolHandler();
    SocketAcceptor acceptor = new NioSocketAcceptor();
    acceptor.setReuseAddress( true );
    acceptor.setHandler( xmlStripperProtocolHandler );

    // Add the codec filter
    acceptor.getFilterChain().addLast( "codec",
        new ProtocolCodecFilter( new XmlStripperProtocolCodecFactory() ) );

    // Start the listener
    acceptor.bind(new InetSocketAddress(IP_PORT_DEFAULT));
}
```

XML handler

```
public void messageReceived( IoSession session, Object message )
{
    Document document = (Document)message;

    // Strip the XML from the <tags>
    String result = getChildren( document.getFirstChild() );

    session.write( result );
}
```

XML codec factory

```
public class XmlStripperProtocolCodecFactory implements ProtocolCodecFactory
{
    public ProtocolEncoder getEncoder( IoSession session )
    {
        // Create a new encoder.
        return new XmlStripperEncoder();
    }

    public ProtocolDecoder getDecoder( IoSession session )
    {
        // Create a new decoder.
        return new XmlStripperDecoder();
    }
}
```

XML decoder

```
protected boolean doDecode( IoSession session, IoBuffer ioBuffer,
          ProtocolDecoderOutput decoderOutput ) {
...
   decoderOutput.write( parserXML( data ) );
...
}

   public Object parserXML( IoBuffer xmlBuffer ) {
      byte[] data = new byte[xmlBuffer.limit()];
      xmlBuffer.get( data );
      String xml = new String(data).trim();

     Document document = DocumentBuilderFactory.newInstance().
          newDocumentBuilder().parse(
            new ByteArrayInputStream( xml.getBytes() ) );

      return (document);
   }
```

Do's and Don'ts

Do's !!!

- Follow the KISS principle
- Keep the chain short
- Do not use an executor if not needed
- Tune the number of IoProcessors
- Use only one codec filter
- If you have a problem, then your codec/handler probably sucks...

DON'Ts !!!

- Don't use the logging filter. Use Log4j.
- Your filter must be thread-safe
- Don't expect that you will receive data in one single block
- Don't forget about the negative impact Nagle's algorithm has on performance
- Don't use Direct buffers unless absolutely needed...

Summary

Q&A