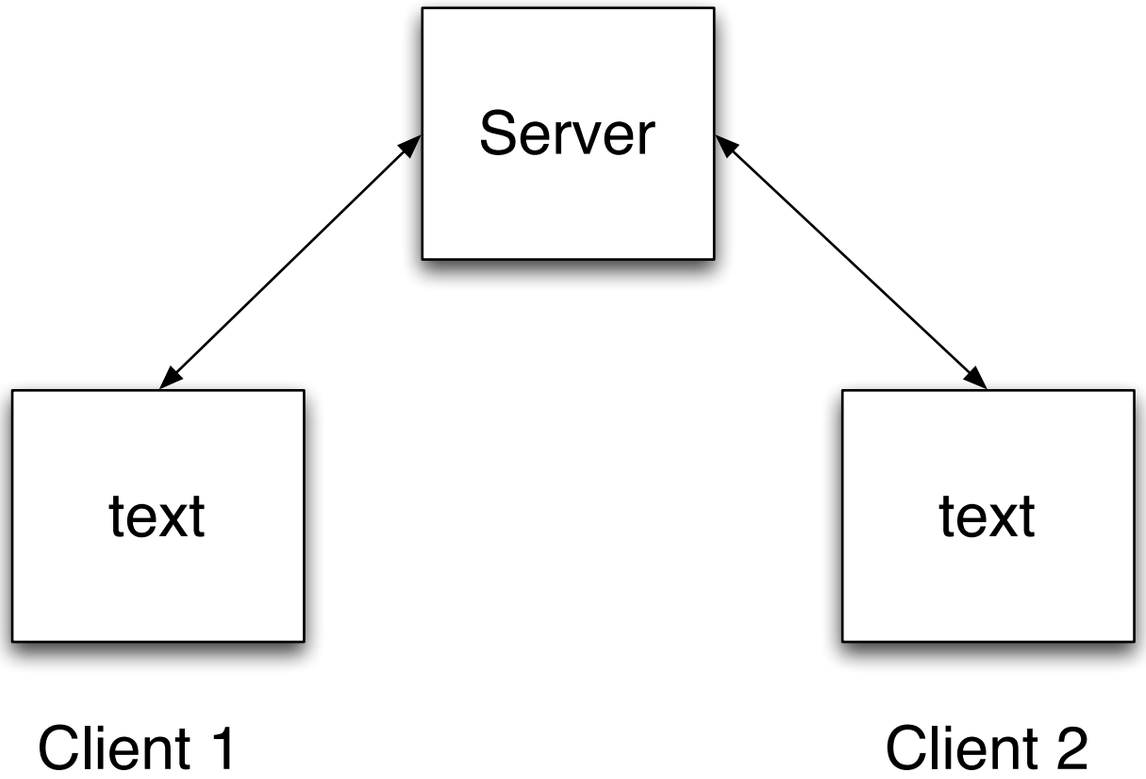
CS 580 Client-Server Programming
Spring Semester, 2009
Doc 5 SDChat, Streams, Parsing
9 Feb, 2010

Chat



SDChat Commands

"available"
"login"
"register"
"nickname"
"startconversation"
"quit"
"waitinglist"
"acceptconversation"
"message"
"rejectconnection"
"endconversation"

Command & Response Structure

identifier;key:value;key2:value2;;

identifier;;

identifier:value;;

identifier:value;key:value;;

login;nickname:foo;password:foopass;;

quit;;

ok:quit;;

ok:1;nickname:bar;

Metacharacters

character with special meaning to a computer program

SDChat metacharacters

\ : ;

Metacharacters & values

What happens when a nickname contains metacharacter?

nickname = foo;password:cat;

How to parse:

login;nickname:foo;password:cat;;password:foopass;;

Metacharacters & values

Metacharacters in values must be escaped with "\"

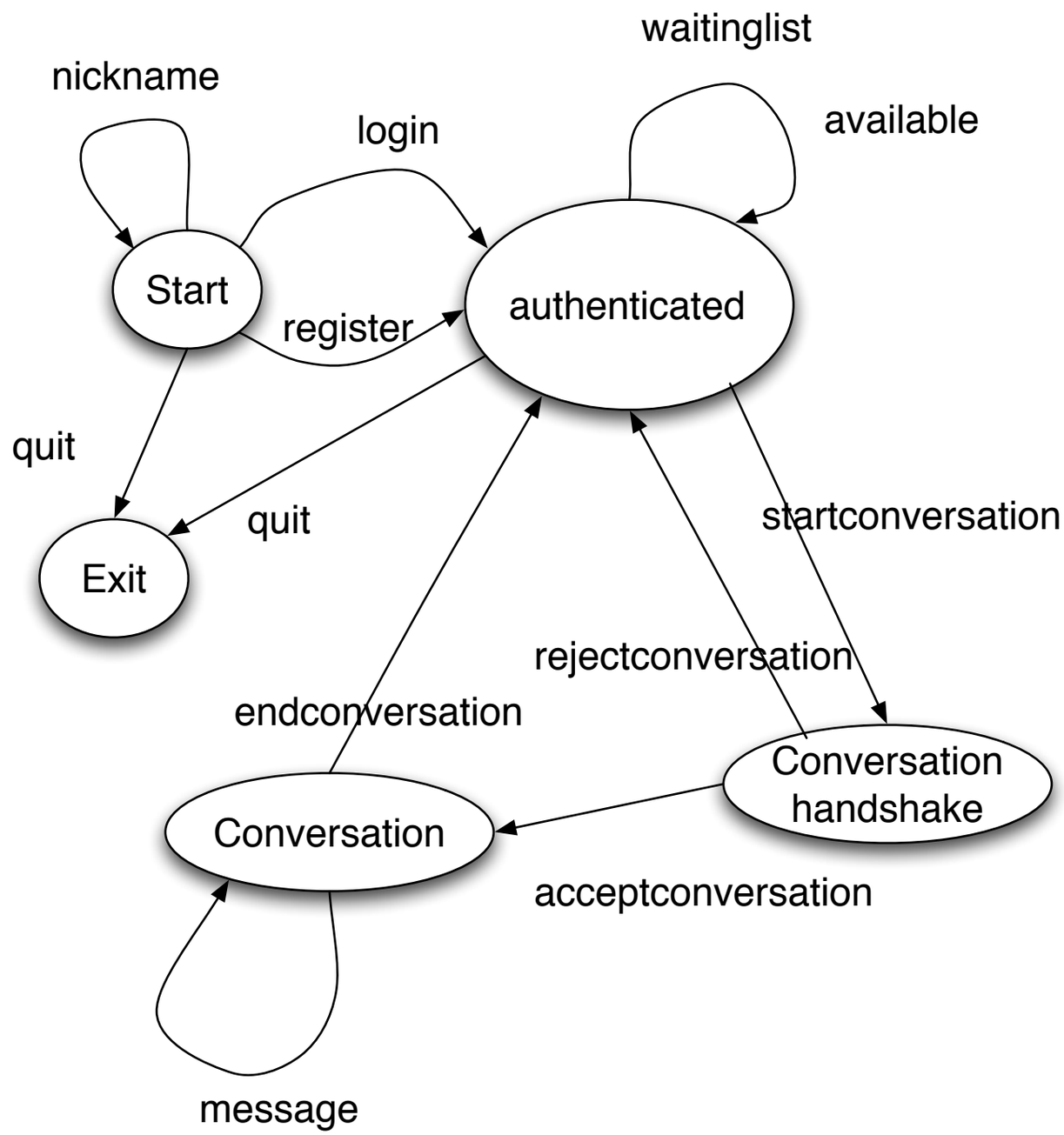
login;nickname:foo\;password\:cat\;;password:foopass;;

Before sending command/response clients & server have to escape values
When reading from network clients need to unescape values

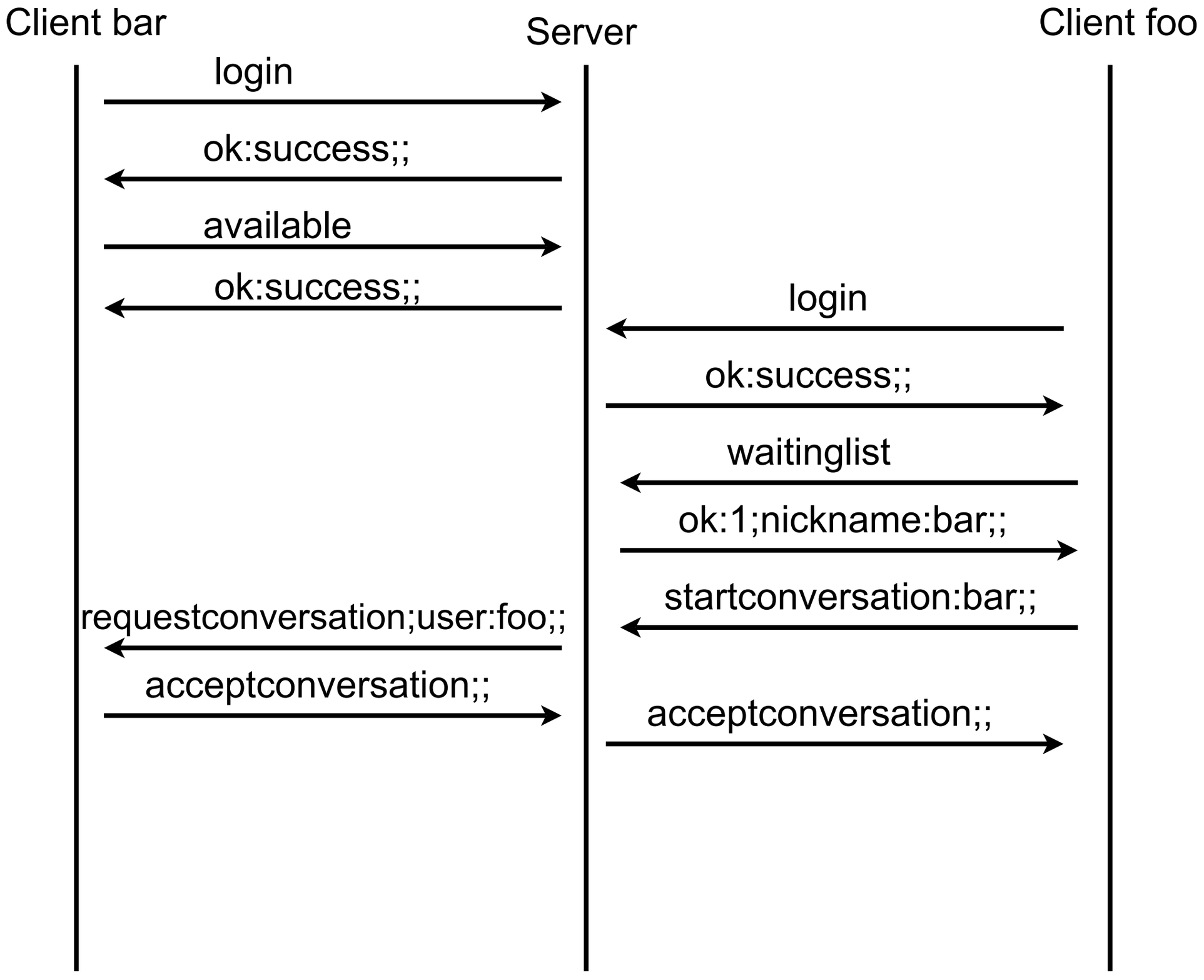
Metacharacters, Identifiers & keys

Identifiers & keys do not contain metacharacters

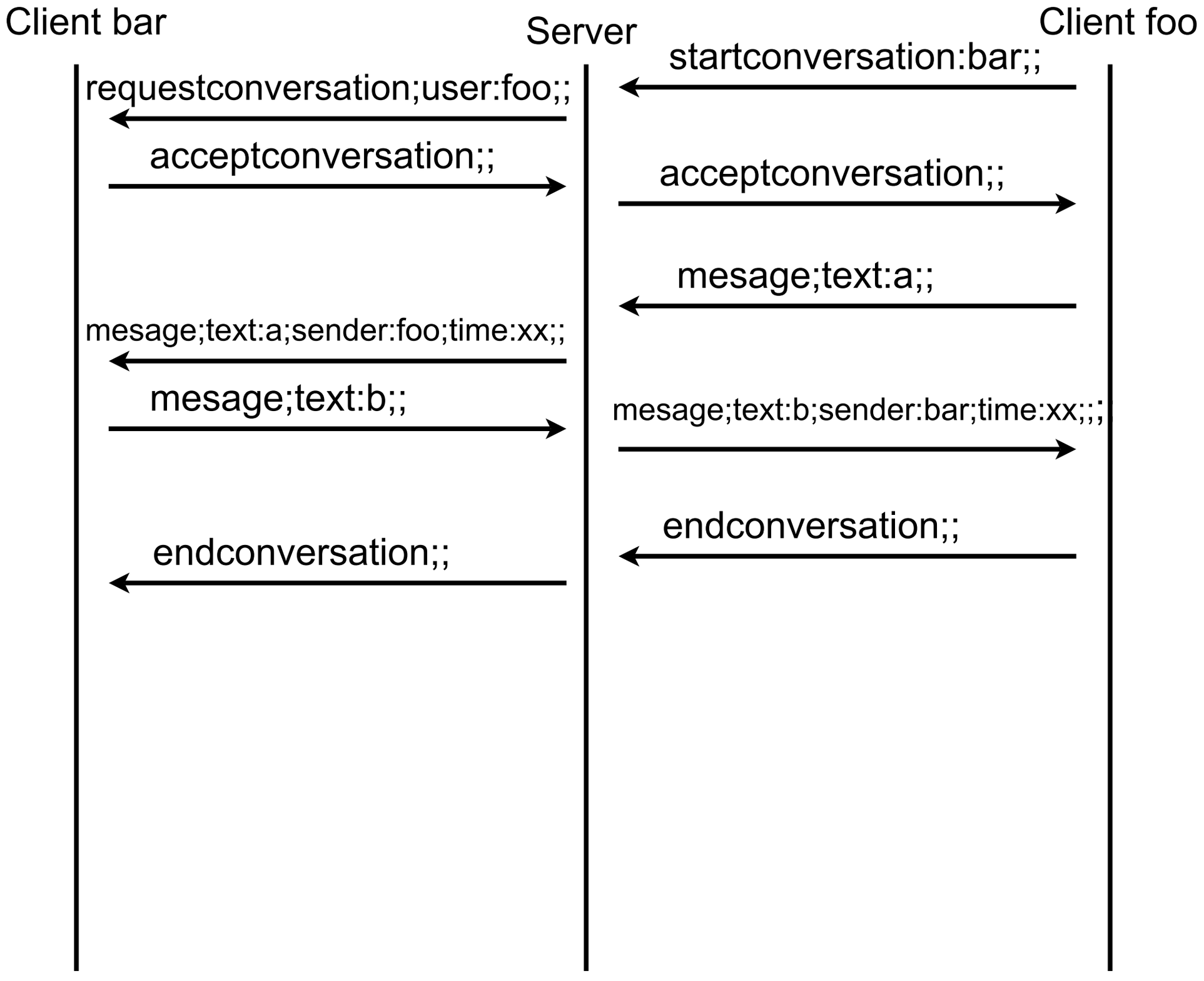
Connection (server) States



Sample Timeline



Sample Timeline Continued



No newline in protocol

message end in ";;"

So readline will not work

ok:1;nickname:bar;;

Entire protocol is in text

The "1" is the string representation of the number one

Timestamp format

02/08/2010 20:13:37

Java Streams

InputStream & Bytes

Read just bytes

```
int available()
void close()
abstract  int read()
int read(byte[] b)
int read(byte[] b, int off, int len)
long skip(long n)
```

```
void mark(int readlimit)
boolean markSupported()
void reset()
```

```
byte[] intput = new byte[10];
for (int k = 0; k < input.length; k++) {
    int b = in.read();
    if (b == -1) break;
    input[k] = (byte) b;
}
```

Issue - byte verses int

read returns an int

casts to signed byte

-128 to 127

Works fine if value is between 0 and 127

```
byte[] intput = new byte[10];
for (int k = 0; k < input.length; k++) {
    int b = in.read();
    if (b == -1) break;
    input[k] = (byte) b;
}
```

```
int shifted = b >= 0 ? b : 256 + b;
```

Issue - Performance

Reading one byte at a time is slow

```
int bytesRead = 0;
int bytesToRead=1024;
byte[ ] input = new byte[bytesToRead];
while (bytesRead < bytesToRead) {
    int readSize = in.read(input, bytesRead, bytesToRead - bytesRead);
    if (readSize = -1 ) break;
    bytesRead += readSize;
}
```

Issue - How far to read?

Normally don't know the size of a message

Some protocols allow multiple requests to be sent as same time

Issue - Mark

void mark(int readlimit)
boolean markSupported()
void reset()

Most streams don't support mark

Be careful

Peek (look ahead) is Useful

login;nickname:foo;password:foopass;;

ok:1;nickname:bar;;

When we read a ";" are we

- done with the message
- Just done with one segment

Don't know until we read next character

Would Be Nice

But you need "peek"

```
while (!atEndOfMessage(in)) {
    messageText += readUpto(";", in);
}
```

atEndOfMessage(stream)

- returns true if next character in stream is ";"
- Does not remove characters from the stream

readUpto(char, stream)

- reads up through the next occurrence of character

How do we get peek, readUpto?

PushbackInputStream - helps for peek

Subclass FilterReader, FilterInputStream

Some Smalltalk ReadStream Methods

peek
upTo: aCharacter
upToAll: aCollection
through: aCharacter
throughAll: aCollection
next
next: anInteger

PrintStream

"PrintStream is evil and network programmers should avoid it like the plague!"

Elliotte Harold

Readers & Writers

Java's streams do not handle unicode.

If protocol uses unicode use readers and writers.

Java's Data Streams

Read/Write binary

Do not use if protocol is text based

If protocol is binary DataStreams format may not be correct

Parsing

Some low level Java Parsing

"cat;man;ran".split(";");

Returns an array of String [“cat”, “man”, “ran”];

StringTokenizer

```
parts = new java.util.StringTokenizer("cat,man;ran;,fan", ",;");
while (parts.hasMoreElements())
      {
      System.out.println( parts.nextToken());
      }
```

Output

```
cat
man
ran
fan
```

java.util.Scanner

```
String input = "1 fish 2 fish red fish blue fish";
Scanner s = new Scanner(input).useDelimiter("\\s*fish\\s*");
System.out.println(s.nextInt());
System.out.println(s.nextInt());
System.out.println(s.next());
System.out.println(s.next());
s.close();
```

Output

```
1
 2
red
blue
```

Java UpToReader?

```
Socket connection = new Socket(server, port);
InputStream rawIn = connection.getInputStream();
UpToReader in = new UpToReader(
            new InputStreamReader(rawIn));
String answer = in.upTo(';');
```

sdsu.io.ChunkReader

```
read = new sdsu.io.ChunkReader("catEOMmatEOM", "EOM")
while (read.hasMoreElements() )
        {
        System.out.println( read.readChunk());
        }
```

Output

```
cat
mat
```

Subclass FilterInputStream

```
public class UpToInputStream extends FilterInputStream {
        public UpToInputStream(InputStream stream)
                { super(stream); }

        public byte[] upto(char end) throws IOException {
                int EOF = -1;
                ByteBuffer buffer = new ByteBuffer();
                int c;
                while (( c = super.read()) != EOF )  {
                        buffer.append( (byte)c);
                        if (c == end )
                                break;
                }
                if (c == EOF & (buffer.isEmpty()))
                        return new byte[0];

                return buffer.getBytes();
                }
}
```

Issue - What if User's text contains ";"

password = trou;;ble

text = duh;now what

login;nickname:whitney;password:trou\;\;ble;;

message:duh\;now what;;

You need to escape/unescape the ";"

UpTo has to know about escaped characters

Relax

Clear your mind

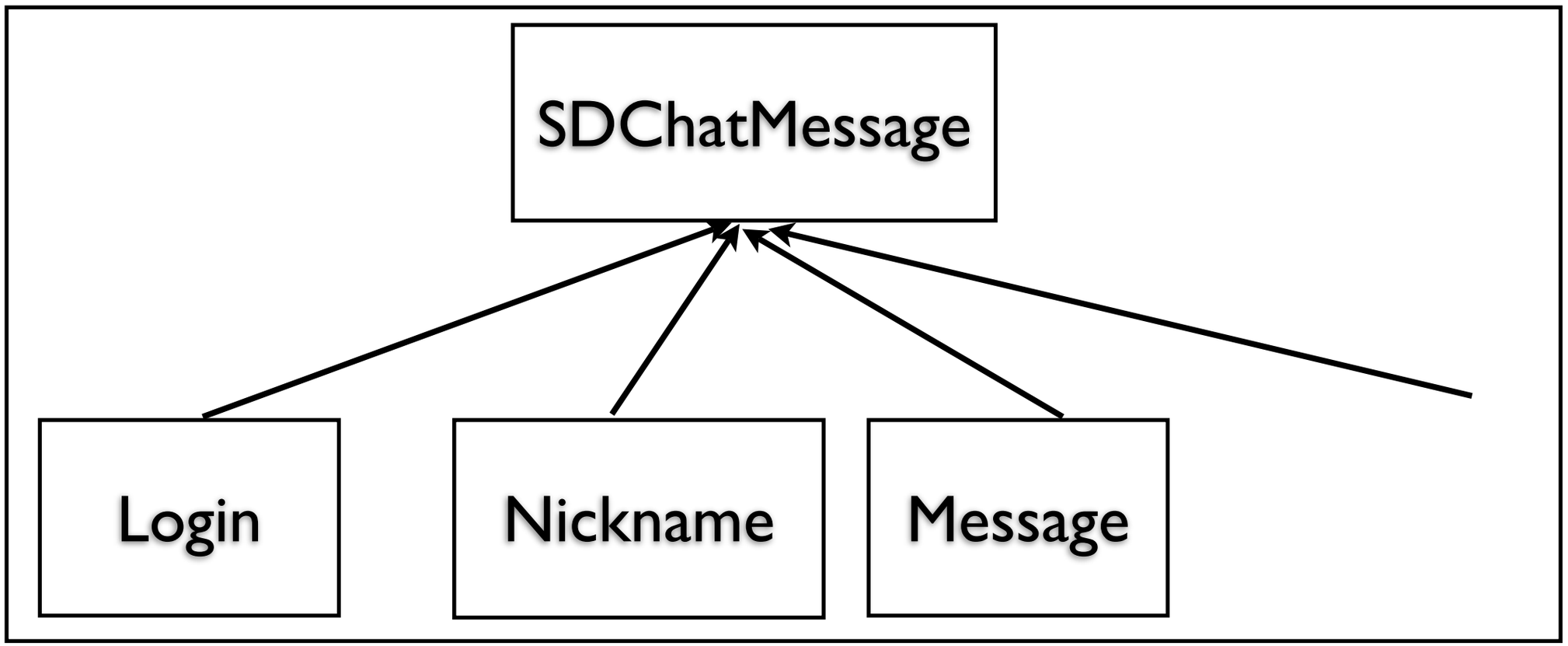
Get ready for big idea

Well maybe not so big, but it may take some getting used to

Why limit reading to characters?

Why not read Message Objects?

```
InputStream rawIn = connection.getInputStream();
SDChatReader in = new SDChatReader(rawIn);
Message answer = in.next();
```


SDChatMessage
Login
Nickname
Message

Message Responsibilities

Hide all message syntax

Read message and convert to object

```
Message message =
Message.from(“message:duh\;now what;;”);
```

Create message from values

```
Message message = new Message("duh;now what);
```

Convert object to required protocol string

```
message.toString()  // returns “message:duh\;now what;;”
```

Access information about message

```
message.isLogin();
message.name();
```

Client Side

```
Socket connection = new Socket(server, port);
OutputStream rawOut = connection.getOutputStream();
PrintWriter out = new PrintWriter(new BufferedOutputStream(rawOut));
InputStream rawIn = connection.getInputStream();

SDChatReader in = new SDChatReader(rawIn);
SDChatMessage login = new LoginMessage(“whitney”, "foo");
out.print(login.toString());
out.flush();

SDChatMessage result = in.next();
if (result.isError() ) then
      deal with error
else
      blah
```

Server Side

```
SDChatMessage request = in.next();
if (request.isLogin() ) {
            etc
}
else if (request.isTransmit() ) {
       etc
}
 blah
```

Consequences

Main code operates at higher level

Isolates protocol syntax

Testing becomes easier

More Classes

Logic is spread across multiple classes

Testing

Can test more parts without using network

```
public void testAdd() {
        Message add = new Message("cat");
        assertTrue( add.toString() == "message:cat;";
        }
```

Testing Servers

```
public class DateServer {

        public void run(int port) throws IOException {
                ServerSocket input = new ServerSocket( port );

                while (true) {
                        Socket client = input.accept();
                        BufferedReader parsedInput =
                                new BufferedReader(new InputStreamReader(client.getInputStream()));

                        boolean autoflushOn = true;
                        PrintWriter parsedOutput = new PrintWriter(client.getOutputStream());

                        String inputLine = parsedInput.readLine();

                        if (inputLine.startsWith("date")) {
                                Date now = new Date();
                                parsedOutput.println(now.toString());
                        client.close();
                }
        }
```

Testing DateServer

Must use network to test server

OK for date server, but not for more complex servers

Idea 1 - Keep Network Layer Thin

```
public class DateServer {
        private static Logger log = Logger.getLogger("dateLogger");

        public void run(int port) throws IOException {
                ServerSocket input = new ServerSocket( port );

                while (true) {
                        Socket client = input.accept();
                        log.info("Request from " + client.getInetAddress());
                        processRequest(
                                client.getInputStream(),
                                client.getOutputStream());
                        client.close();
                }
        }
}
```

```
void processRequest(InputStream in,OutputStream out)
        throws IOException {

        BufferedReader parsedInput =
                new BufferedReader(new InputStreamReader(in));

        boolean autoflushOn = true;
        PrintWriter parsedOutput = new PrintWriter(out,autoflushOn);
        etc.
        }
}
```

Idea 1 - Keep Network Layer Thin

```
public class TestDateServer {
    public void testDate() {
        InputStream in = new ByteArrayInputStream("date;".getBytes()));
        ByteArrayOutputStream fakeOut = new ByteArrayOutputStream();
        DateServer counter = new DateServer();
        counter.processRequestOn(in, fakeOut);
        assertTrue(fakeOut.toString() == "2006 02 14;")
    }
}
```

Idea 2 - Separate IO from Action

```
class SDChatServer {
    boolean login(String name, String password) {
        code here
    }

    boolean transmit(String message) {
        code here
    }
}

etc.
```

Now can test action without going through protocol strings

Scale Changes Everything

As a Server grows in complexity testing through sockets/streams is too hard

Idea 3 Fake it

Create a fake Socket class that

- returns fixed output
- records input

Build class from scratch or use Mock Objects

Ruby FlexMock
http://onestepback.org/software/flexmock/

Mock Object Home
http://www.mockobjects.com/

Example of Mock Object

```
require 'flexmock'
require 'test/unit'

class TestExample < Test::Unit::TestCase
  def testShowMockObject()
    a = FlexMock.new
    a.should_receive(:foo).with(4).returns{|x| x + 1}
    a.should_receive(:foo).with(10).returns{'cat'}
    a.should_receive(:bar).returns{'dog'}
    assert( a.bar == 'dog')
    assert( a.foo(4) == 5)
    assert( a.foo(10) == 'cat')
    assert( a.foo(4) == 5)
    assert( a.bar == 'dog')
  end
end
```

Idea 4 - Run Client & Server in test case

```
require 'flexmock'
require 'test/unit'
require 'server'
require 'client'

class TestExample < Test::Unit::TestCase
  def setup()
    @server = Server.new(4444)
    @serverThread = Thread.new { @server.run }
  end

  def teardown()
    @serverThread.terminate
  end

  def testServer()
    client = Client.new("localhost", 4444)
    result = client.count("/foo")
    blah
  end
end
```

Look out for deadlock

Worry about scaling