KTH ROYAL INSTITUTE
OF TECHNOLOGY

Project Introduction

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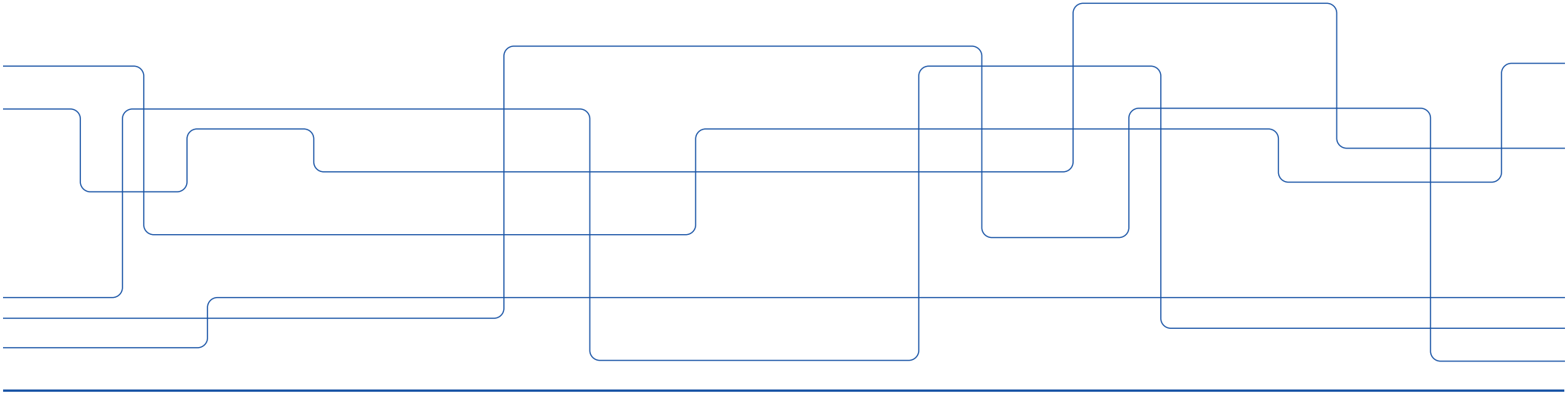


Overview

- Background
- Software support modules
- Assignment organization

NetPipe

- Java implementation of “netcat” (or “nc”)
  - See https://netcat.sourceforge.net
- Read data from system input, write to TCP socket
- Read data from TCP socket, write to system output

How to Run NetPipe Client and Server

- Base version, without security

```
$ java NetPipeClient --host=<host name> --port=<port number>

$ java NetPipeServer --port=<port number>
```

NetPipe in Terminal Window

Client terminal

```
$ java NetPipeClient --host=serverhost --port=6789
Hello are you there?
Yes, I’m here.
```

Server terminal

```
$ java NetPipeServer --port=6789
Hello are you there?
Yes, I’m here.
```

File Transfer with NetCat

Client terminal

```
$ java NetPipeClient --host=serverhost --port=6789 <infile.txt
```

Server terminal

```
$ java NetPipeServer --port=6789 >outfile.txt
```

Copy “infile.txt” on client host to “outfile.txt” on server host

Use as Client for Existing Server

```
$ java NetPipeClient --host=mx.kth.se --port=25
220 mx-3.sys.kth.se ESMTP Postfix
```

Connect to incoming mailserver on port 25 (SMTP)

Use as Server for Existing Client

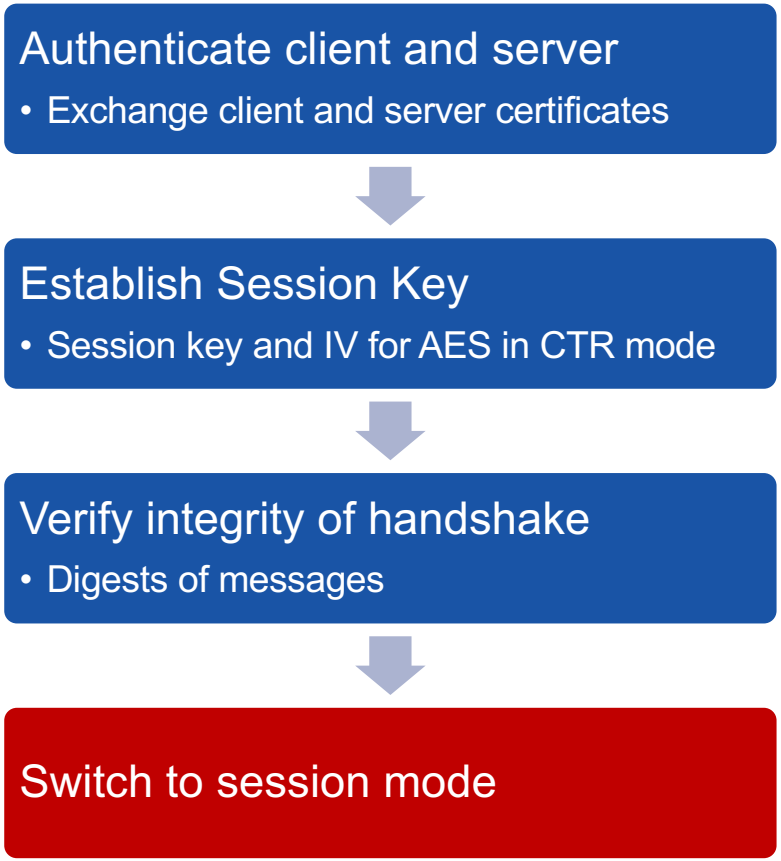
```
$ java NetPipeServer --port=8080
GET / HTTP/1.1
Host: serverhost:8080
Upgrade-Insecure-Requests: 1
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7)
AppleWebKit/605.1.15 (KHTML, like Gecko) Version/15.4 Safari/605.1.15
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Connection: keep-alive
```

Visit server “serverhost:8080” with web browser

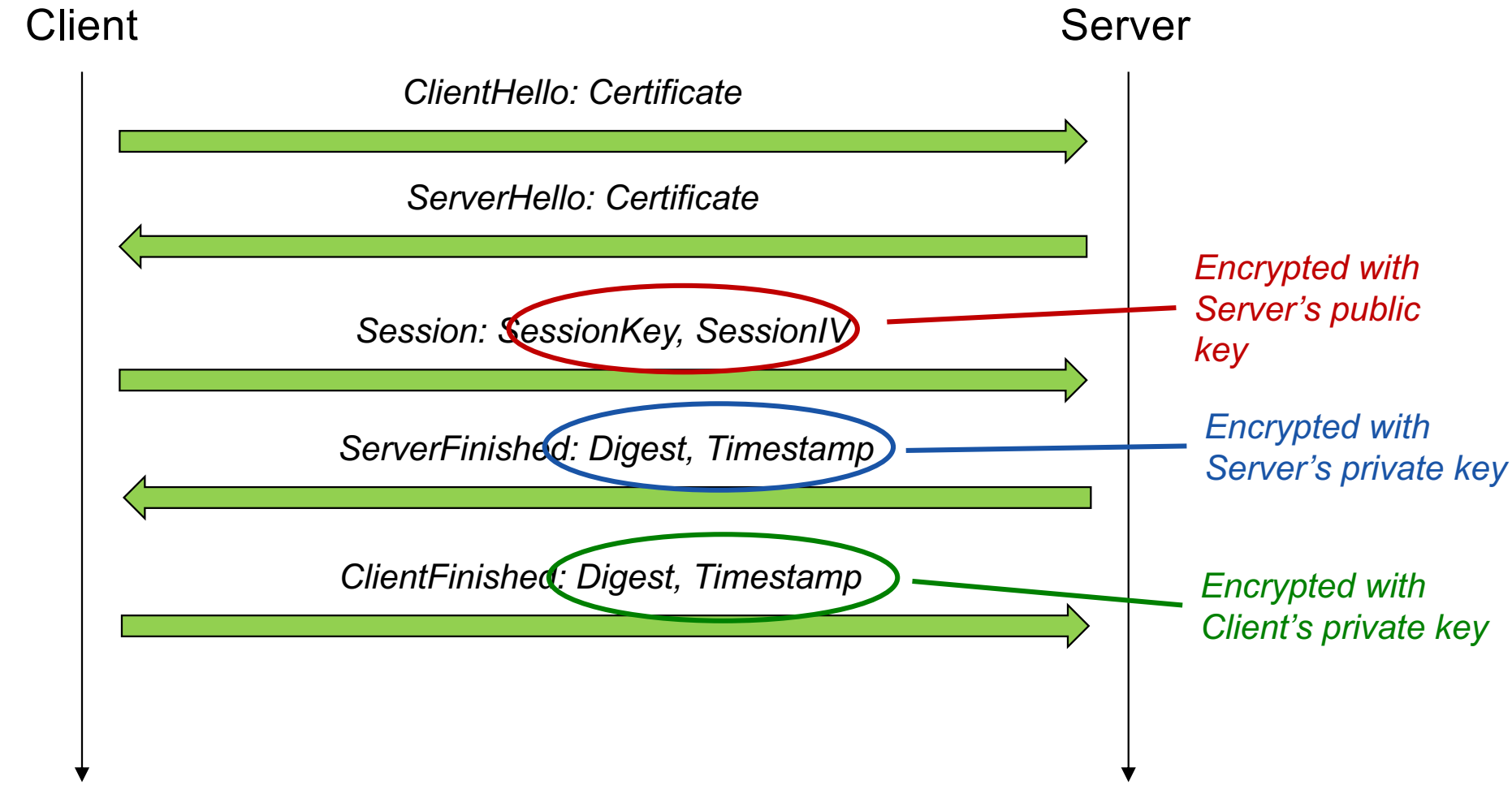
Project Assignment

- You are provided with an implementation of NetPipe without security
- Your job is to extend NetPipe with security
  - Handshake phase
  - Encrypted session

Secure NetPipe through Handshake



Handshake Protocol



HandShakeMessage class

Constructor

```
HandshakeMessage(MessageType messageType)
```

Methods

```
public MessageType getType()

public void putParameter(String parameter, String value)

public String getParameter(String parameter)

public void send(Socket socket)

public static HandshakeMessage recv(Socket socket)

public byte[] getBytes()
```

HandShakeMessage Class Example

Send a message

```
HandshakeMessage clienthello = new HandshakeMessage(HandshakeMessage.MessageType.CLIENTHELLO);
clienthello.putParameter("Certificate", encodeCertificate(clientcert));
clienthello.send(socket);
```

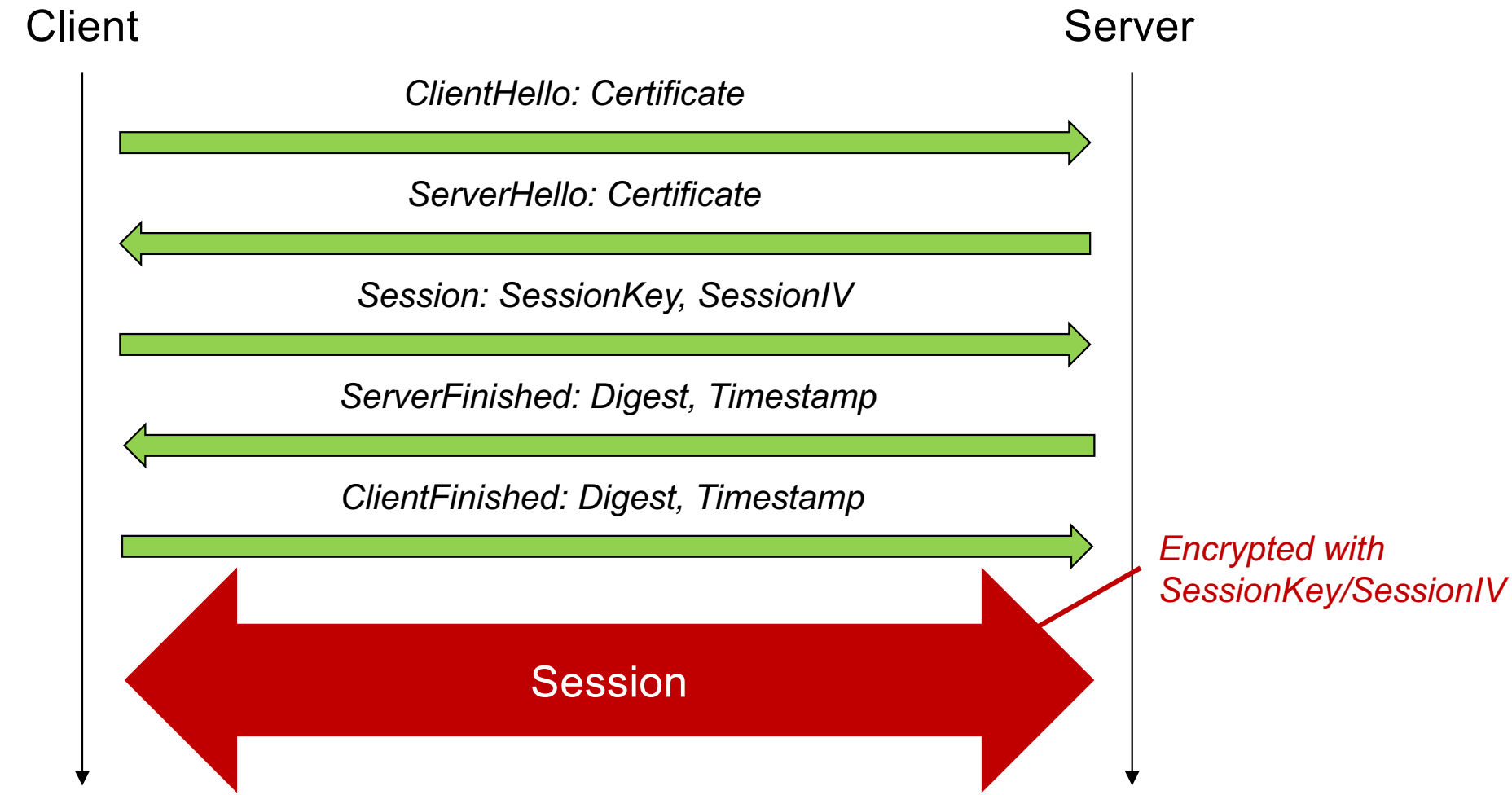
Receive a message

```
HandShakeMessage fromclient = HandshakeMessage.recv(socket);
if (fromclient.getType().equals(HandshakeMessage.MessageType.CLIENTHELLO)) {
    String encodedCertificate = fromclient.getParameter("Certificate"));
    …
}
```

Handshake Messages Implementation

- Extension of Java ”Properties” class
  - Use Properties methods for further inspection and debugging (if you need to)
- Use Java’s ObjectOutputStream and ByteArrayOutputStream for serialization
  - Turn object into byte array

Session


Client
Server
ClientHello: Certificate
ServerHello: Certificate
Session: SessionKey, SessionIV
ServerFinished: Digest, Timestamp
ClientFinished: Digest, Timestamp
Encrypted with
SessionKey/SessionIV
Session

How to Run NetPipe Client and Server

- With security

```
$ java NetPipeClient --host=<host name> --port=<port number>
     --usercert=<client certificate PEM file>
     --key=<client private key DER file>
     --cacert=<CA certificate PEM file>

$ java NetPipeServer --port=<port number>
     --usercert=<server certificate PEM file>
     --key=<server private key DER file>
     --cacert=<CA certificate PEM file>
```

Implementation

- Much code at your disposal – you job is to put it all together
- Results from preparatory tasks
  - SessionKey, SessionCrypto, HandshakeDigest, …
- NetPipe classes
  - Without encryption
  - TCP connection forwarding data between system input/output and TCP socket
    - > *bidirectional forwarding*
- HandShakeMessage class
  - Encoding, decoding, and transmission of handshake messages

Organisation of Project Assignment

- Implement secure NetPipe client and server in Java

- Individual assignment
  - You may collaborate, but each student submits his/her own solution
  - Submit according to instructions
  - Graded Pass/Fail

- Supervision sessions next two weeks if you need help
  - Sign up in Canvas
  - If no students have signed up before 18:00 the day before, we will cancel

- Make-up opportunity
  - If you made a serious attempt at submitting before the due date, you will get feedback and a chance to improve
  - Due date after exam

Evaluation

- First, your implementation will be checked for basic functionality
- However, you are really implementing a communication protocol here
- Therefore, your implementation must interoperate with other implementations
  - We will test your code against a reference implementation
  - For example, your NetPipeClient against our reference NetPipeServer
- So, make sure to follow the instructions in detail
  - Exact spelling in handshake messages, for instance

Evaluation (2)

- Organize your submission according to instructions
  - If you use some other organization, for instance with extra packages, your code will not run and you fail
- If you fail, but have made a serious attempt to solve the assignment by the due date, you will get feedback and another chance

To Consider

- In the preparatory tasks, we have “micro-managed” you with given classes, methods, etc.
- Now it is up to you to organize your implementation
- Put the different pieces together into a running systems
  - Tasks
  - Handshake messages
  - Classes, methods,
- How you do this is up to you!
  - You are free to add classes, methods, etc

To Consider (2)

- Submit in time
  - If you don’t submit before due date, you won’t get a grade
  - It is the content of your KTH GitHub repository at the due date that counts
    - > *Any changes pushed after that date will be ignored*
- Submit your own solution
  - We will check for plagiarism
    - > *Really. We will.*
- Test before you submit
- Run with reference implementation
  - Your client with reference server
  - And vice versa

Good Luck!

Questions?