CS 580 Client-Server Programming
Fall Semester, 2012
Doc 13 Server Types & Password Security
Oct 9, 2012

Types of Servers

Connectionless(UDP) verse Connection-Oriented (TCP)

Iterative verses Concurrent

Stateless verse stateful

Iterative

Single process

Handles requests one at a time

Good for low volume & requests that are answered quickly

Concurrent

Handle multiple requests concurrently

Normally uses thread/processes

Needed for high volume & complex requests

Harder to implement than iterative

Must deal with currency

State information

Information maintained by server about ongoing interactions with clients

State information cause problems

- Consumes resources
- How long does one maintain the state?

Stateless verses Stateful Servers

Stateless server

Server that does not maintain state information

Stateful server

Server that does maintain state information

HTTP & Server State

HTTP is stateless protocol

But need state for shopping carts etc.

Use Cookies to save state on client site

- Privacy issues
- Security issues

Stateless Protocols are easier

So students often transform stateful protocol into stateless protocol

- Use cookie idea
- Replay requests each time

Modes of Operation

Stateful servers sometimes have different modes of operation

Each mode has a set of legal commands

In Login mode only the commands password & username are accepable

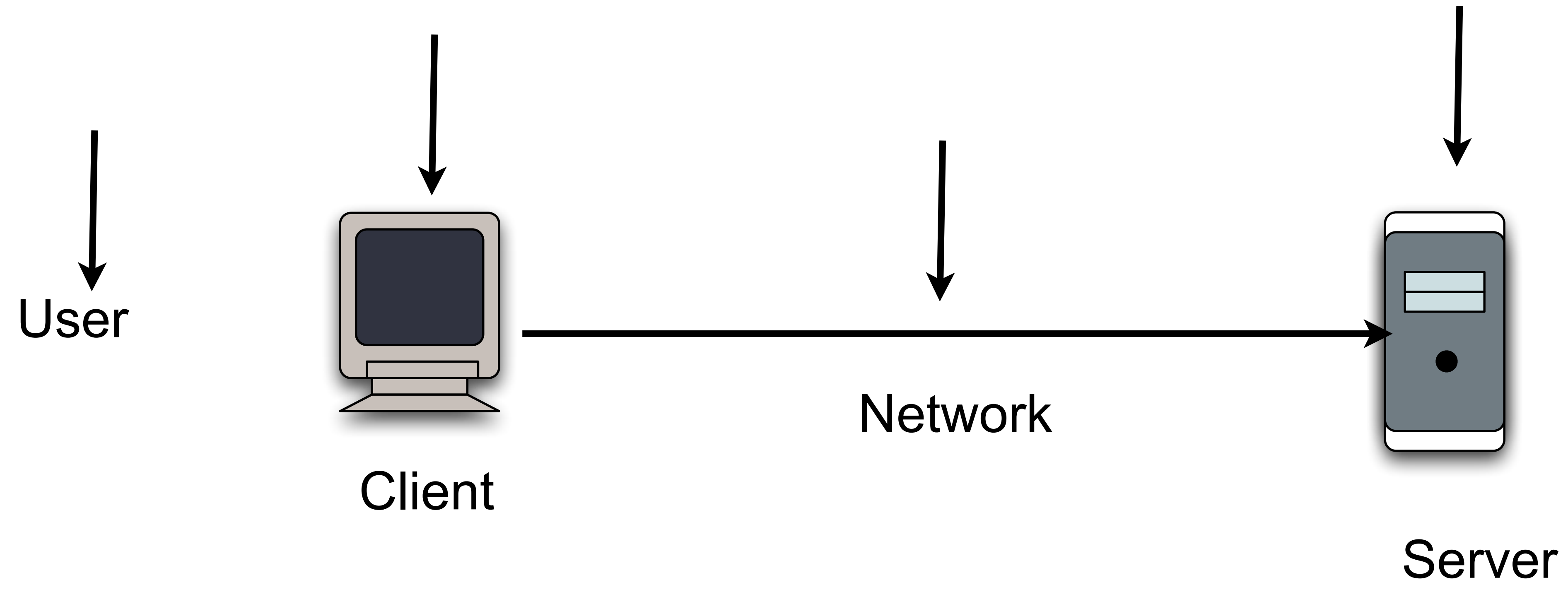
After successful login client-server connection in transaction mode

In transaction mode command X, Y Z are legal

These modes are also called server states or just states

Some Security

Places to attack



User Attacks

Users select passwords that are easy to quess

Just ask the user for their password

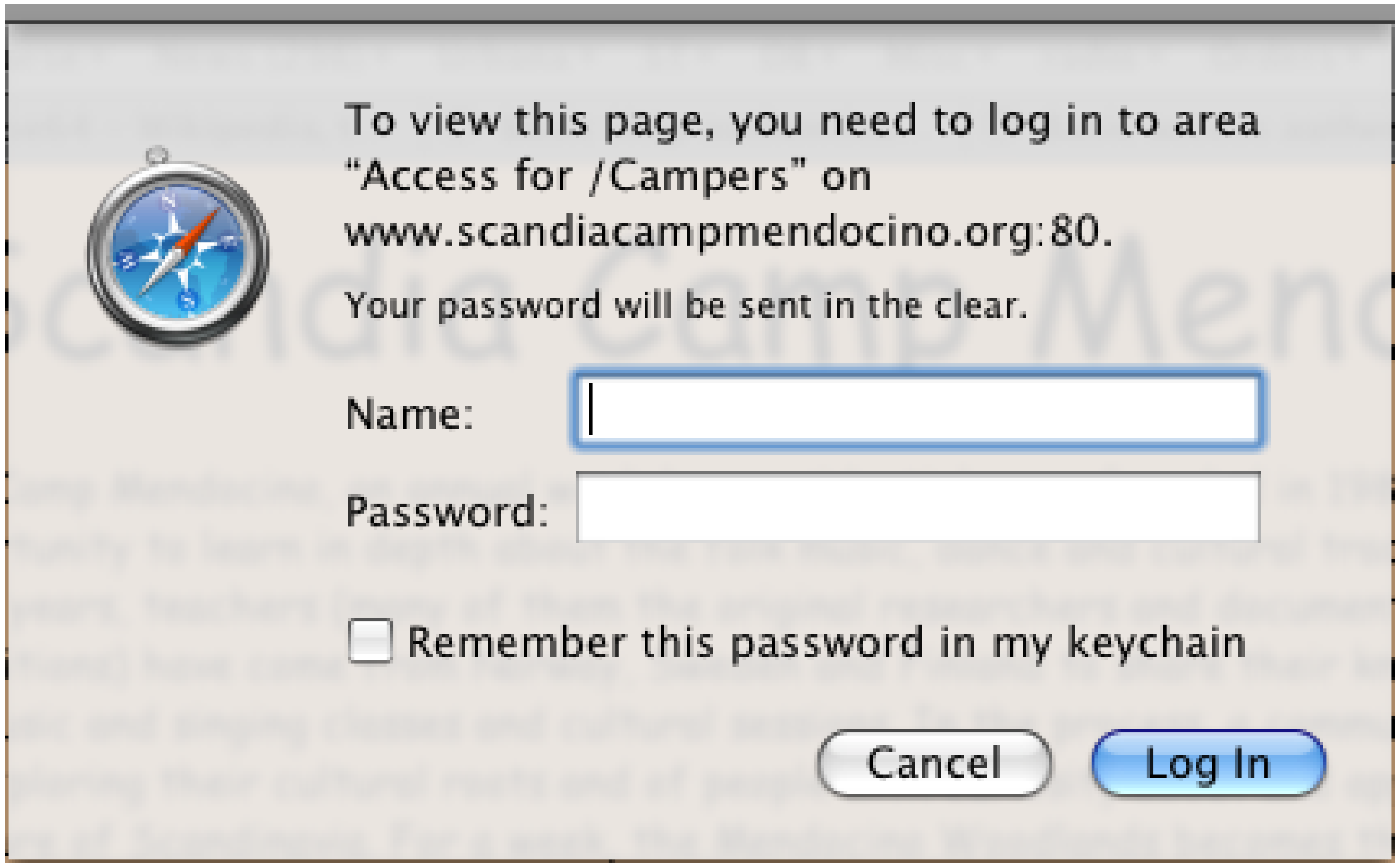
Network attacks

Sniff network traffic

When user logs on view their password

- telnet
- HTTP
- etc.

Basic Http Authentication



To view this page, you need to log in to area "Access for /Campers" on www.scandiacampmendocino.org:80.

Your password will be sent in the clear.

Name:

Password:

□ Remember this password in my keychain

Requesting password protected page

Client Request

```
GET /private/index.html HTTP/1.0
Host: localhost
```

Server Response

```
HTTP/1.0 401 Authorization Required
Server: HTTPd/1.0
Date: Sat, 27 Nov 2004 10:18:15 GMT
WWW-Authenticate: Basic realm="Secure Area"
Content-Type: text/html
Content-Length: 311

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
 "http://www.w3.org/TR/1999/REC-html401-19991224/loose.dtd">
<HTML>
  <HEAD>
    <TITLE>Error</TITLE>
    <META HTTP-EQUIV="Content-Type" CONTENT="text/html; charset=ISO-8859-1">
  </HEAD>
  <BODY><H1>401 Unauthorised.</H1></BODY>
</HTML>
```

User enters name and password

User enters (name "Aladdin", password "open sesame")

Browser sends

```
GET /private/index.html HTTP/1.0
Host: localhost
Authorization: Basic QWxhZGRpbjpvcGVuIHNlc2FtZQ==
```

Server response:

```
HTTP/1.0 200 OK
Server: HTTPd/1.0
Date: Sat, 27 Nov 2004 10:19:07 GMT
Content-Type: text/html
Content-Length: 10476
```

Base64 Encoding

Encodes any byte sequence into sequence of printable characters

Encoded sequence can be decoded

Used to encode MIME contents for transport

- Email Attachments

Base 64 Algorithm

Divide input into parts each part 24 bits long (3 bytes)

Convert each 24 bit sequence as follows:

- Divide the 24 bits into four groups of 6 bits
- Use the table to convert each 6 bits

Value	Encoding
0	A
1	B
...	...
25	Z

Value	Encoding
26	a
27	b
...	...
51	z

Value	Encoding
52	0
53	1
...	...
61	9

Value	Encoding
62	+
63	/

pad with =

Example

cats   text

001111111   00111101   01001010   01001001   binary

001111   111001   111010   100101   001001   001   6 bit groups

001111   111001   111010   100101   001001   001000   6 bit groups padded

15   57   58   37   9   8   As decimal

P   5   6   l   J   I = =   Converted

Base64 Encoding & HTTP Authentication

Use Base64 encoding for user name and password

user name "Aladdin"
password "open sesame"

Aladdin:open sesame

↓

QWxhZGRpbjpvcGVuIHNlc2FtZQ==

↓

Authorization: Basic QWxhZGRpbjpvcGVuIHNlc2FtZQ==

Base64 Decoding

Base 64 is designed to be decoded

Just reverse steps

So HTTP Authentication is not secure

- Same as sending user name and password as plain text

How to send passwords over network?

Use secure connection

- SSL, TSL

Use one-way hash

One-Way Hash Functions

Let M be a message (sequence of bytes)

A one-way hash function f() such that:

f maps arrays of bytes to arrays of bytes
f(M) is always the same length
Given an M it is easy to compute f(M)
Given f(M) it is very hard/impossible to compute M
Given M it is very hard/impossible to find N such that f(M) = f(N)

MD5 - Message Digest 5
SHA - Secure Hash Algorithm

```
import java.security.MessageDigest;
import java.security.NoSuchAlgorithmException;

public class OneWay
    {
    public static void main(String args[])
        throws NoSuchAlgorithmException
        {
        MessageDigest sha = MessageDigest.getInstance("SHA");
        sha.update("Hi mom".getBytes());
        byte[] shaHash = sha.digest();
        System.out.println(new String(shaHash));

        MessageDigest md5 = MessageDigest.getInstance("MD5");
        md5.update("Hi mom".getBytes());
        byte[] md5Hash = md5.digest();
        System.out.println(new String(md5Hash));
        }
    }
```

Hex Representation

Usually one converts sha/md5 hash to

- Base 64
- Hex

```
static final String HEXES = "0123456789ABCDEF";
   public static String getHex( byte [] raw ) {
     if ( raw == null ) {
       return null;
     }
     final StringBuilder hex = new StringBuilder( 2 * raw.length );
     for ( final byte b : raw ) {
       hex.append(HEXES.charAt((b & 0xF0) >> 4))
          .append(HEXES.charAt((b & 0x0F)));
     }
     return hex.toString();
   }
```

lost the reference to the source of this code, but it is fairly common

Using one-way hash to send password

Client

- Requests nonce from server
- Client computes hash(password + nonce)
- Client sends hash(password + nonce) & nonce back to server

Server

- Gets hash(password + nonce) & nonce
- Reads password from file
- Computes hash(password + nonce)
- Compares value with one client sent

nonce

- String that is used only once
- Should be longer that 48 bits

What the attacher sees

nonce
hash(password + nonce)

but hash is one way so can not reverse it

How they can break this system

They know

nonce

hash(password + nonce)

Compute table containing

word hash(word + nonce)

Do it for all

words in dictionary

List of potential passwords

Now do reverse look up on hash(password + nonce)

How to defeat look up trick

Use good password

- multiple words
- Mix cases
- Use numbers and other characters

Use Key stretching

Key Stretching

Compute hash more than once

```
key = ""
for 1 to 65536 do
  key = hash(key + password + nonce)
```

Then client sends key

This means it will take a lot longer for attacher to build table

reference http://en.wikipedia.org/wiki/Key_stretching

Password Files

If password files contains password then attacher just breaks into server

and gets all the passwords

Salting the Password File

Password File

name	hash	salt
foo	hash(password1+salt1)	salt1
bar	hash(password2+salt2)	salt2

Client sends server password over secure connection

Server validates buy computing hash(password+salt)