CSE 543 - Computer Security (Fall 2004)

Lecture 21 - Web Security

November 18, 2004

URL: http://www.cse.psu.edu/~cg543/

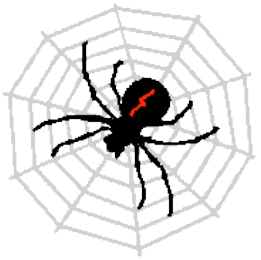
Another bedtime story …

What is the web?

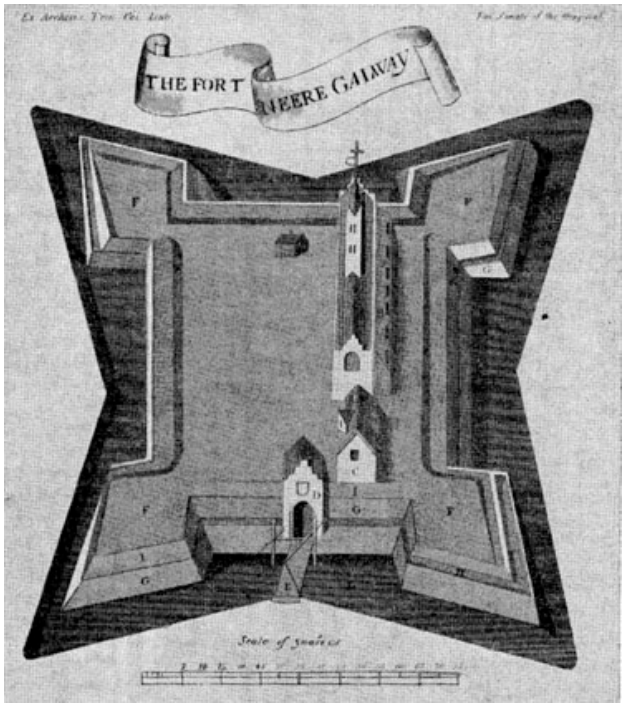
- A collection of application-layer services used to distribute content
  - Web content (HTML)
  - Multimedia
  - Email
  - Instant messaging
- Many applications
  - News outlets, entertainment, education, research and technology, …
  - Commercial, consumer and B2B

Web security: the high bits

- The largest distributed system in existence
  - threats are as diverse as applications and users
  - But need to be thought out carefully …
- The stakeholders are …
  - Consumers (users, businesses, *agents*, …)
  - Providers (web-servers, IM services, …)
- Another way of seeing web security is
  - Securing the web infrastructure such that the integrity, confidentiality, and availability of content and user information is maintained

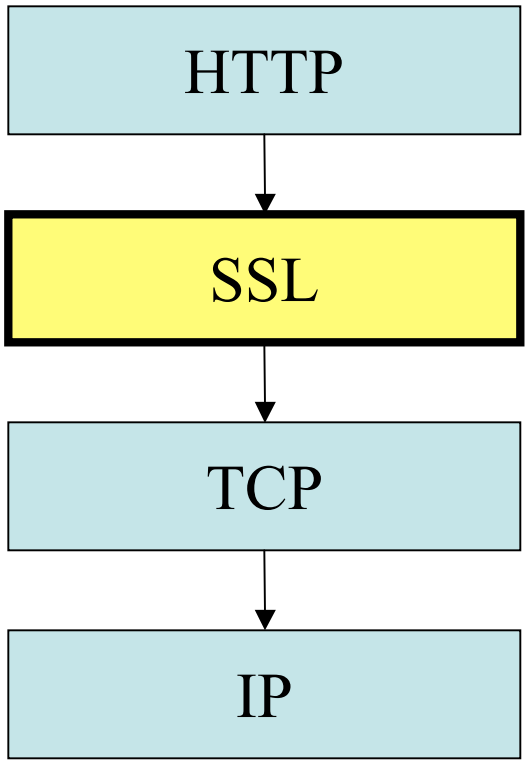


Network vs. Web Security



Secure socket LAYER

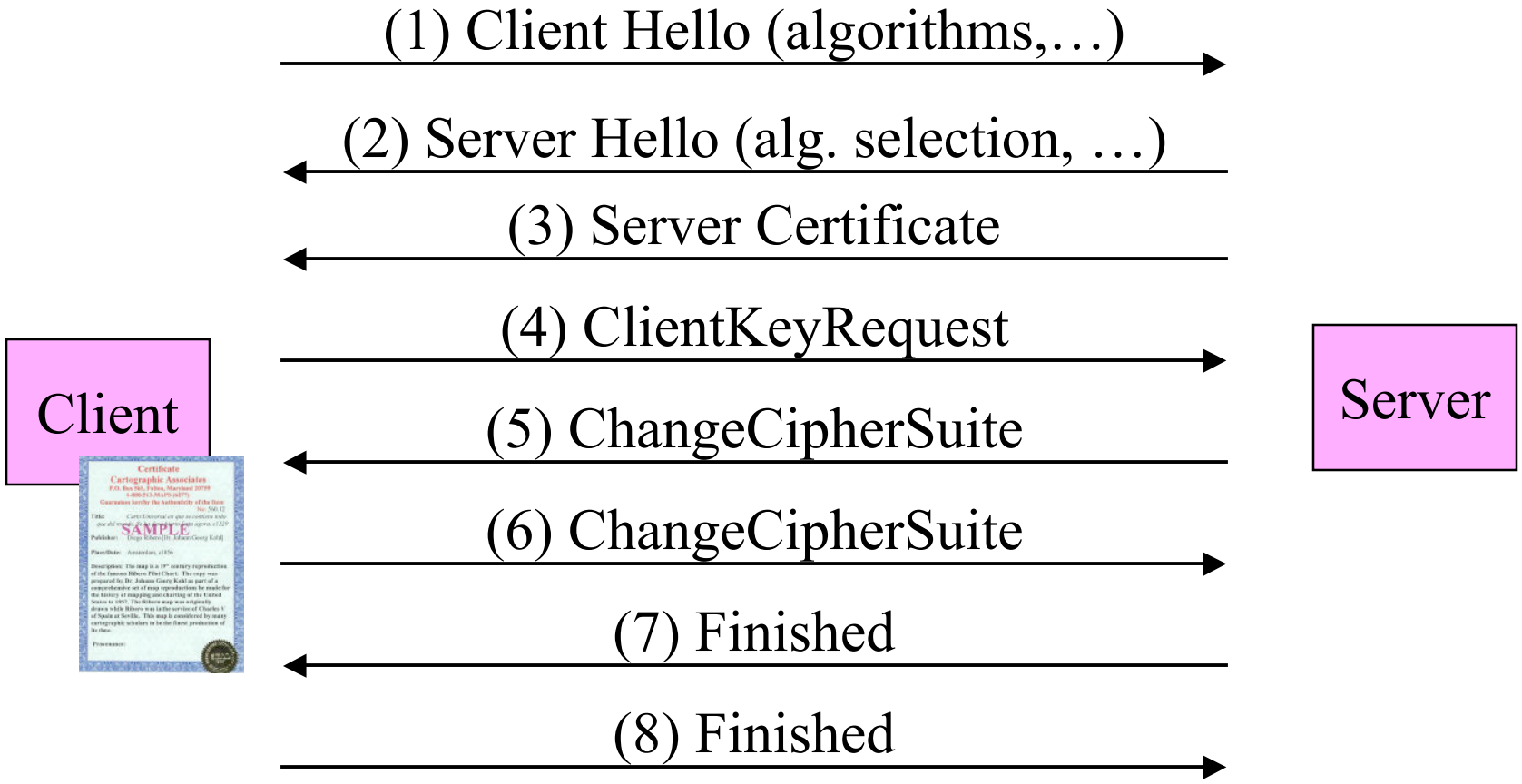
- Used to authenticate servers
  - Uses certificates, “root” CAs
- **Can** authenticate clients
- Inclusive security protocol
- Security at the socket layer
  - Transport Layer Security



SSL Operation

- Phase 1: the SSL Handshake
  - Establishes algorithms used throughout
  - Authenticates parties
  - Establishes master secret
    - Used to create other secrets
      1. Encryption Key (client-server)
      2. Encryption Key (server- client)
      3. Authentication Key (client-server)
      4. Authentication Key (server-client)

SSL Handshake



Advantages of SSL

- Confidential session
- Server authentication*
- GUI clues for users
- Built into every browser
- Easy to configure on the server
- Protocol has been analyzed like crazy
- Seems like you are getting security “for free”

Disadvantages of SSL

- Users don't check certificates
  - most don't know what they mean
- Too easy to obtain certificates
- Too many roots in the browsers
- Default settings are terrible
  - ssl v2 is on
  - totally insecure cipher suites are included
- very little use of client-side certificates
- performance! sites turning off
  - getting better (crypto coprocessors, etc.)

Reality of SSL

- SSL is here to stay no matter what
- credit card over SSL connection is probably safer than credit card to waiter
- biggest hurdles:
  - performance
  - user education (check those certificates)
  - too many trusted sites (edit your browser prefs)
  - enabled version 2 (disable it on the server too)
  - misconfiguration (turn off bad ciphersuites)

Cookies

- Cookies were designed to offload server state to browsers
  - Not initially part of web tools (Netscape)
  - Allows users to have cohesive experience
  - E.g., flow from page to page,
- Someone made a design choice
  - Use cookies to *authenticate* and *authorize* users
  - E.g. Amazon.com shopping cart, WSJ.com

Cookie Issues …

- New design choice means
  - Cookies must be protected
    - Against forgery (integrity)
    - Against disclosure (confidentiality)
- Cookies not robust against web designer mistakes
  - Were never intended to be
  - Need the same scrutiny as any other tech.

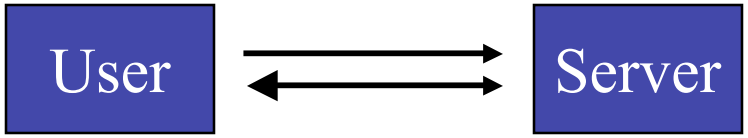
Many security problems arise out of a technology built for one thing incorrectly applied to something else.

Cookie Design 1: mygorilla.com

- Requirement: authenticate users on site

mygorilla.com

- Design:
  1. use digest authentication to login user
  2. set cookie containing hashed username
  3. check cookie for hashed username



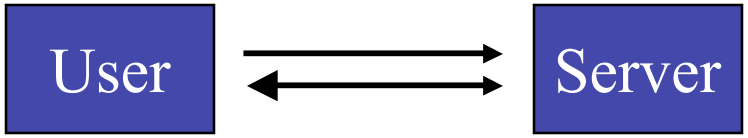
- Q: Is there anything wrong with this design?

Cookie Design 2: mygorilla.com

- Requirement: authenticate users on site

mygorilla.com

- Design:
  1. use digest authentication to login user
  2. set cookie containing encrypted username
  3. check cookie for encrypted username



- Q: Is there anything wrong with this design?

Library Attack ….

- I am sitting in the local library using the computer …
- … to buy some stuff …
- … and walk away …

Dynamic Content

- Server generates content at run time
  - For time-sensitive information (stock ticker)
  - For user customization (Amazon.com)
  - Provide HTML interface to complex system (e.g., course management system)

Dynamic Content: CGI

- Common Gateway Interface (CGI)
  - Generic way to call out to external applications on the server
  - Passes URL to external program (e.g., form)
  - Result is captured and return to requestor
- Historically
  - "shell" scripts used to generate content
    - Very, very dangerous
  - NOTE: "perl" is no better (in some ways worse)

DC: Embedded Scripting

- Program placed directly in content,

  run at during request time and output returned in content
  - MS active server pages (ASP)
  - PHP
  - mod_perl
  - server-side JavaScript
- Nice at generating output
  - Dangerous if tied to user input

Warning: Cross-Site Scripting

- Note Assume the following is posted to a message board on your favorite website:

```
Hello message board.
<SCRIPT>malicious code</SCRIPT>
This is the end of my message.
```

- Now a reasonable ASP (or some other dynamic content generator) uses the input to create a webpage (e.g., blogger nonsense).
- Now a malicious script is now running
  - Applet, ActiveX control, …

Dynamic Content Security

- Largely just applications
  - Inasmuch as application are secure
  - Command shells, interpreters, are dangerous
- Three things to prevent DC vulnerabilities
  - Validate input
    - Input often received as part of user supplied data
    - E.g., cookie
  - Limit program functionality
    - Don't leave open ended-functionality
  - Execute with limited privileges