Impersonation

HOW DO THEY DO IT?

"When the first just and friendly man appeared on the earth, from that day a fatal Waterloo was visible for all the men of pride and fraud and blood."

Charles Fletcher Dole (1845 - ?)

Introduction

- Impersonation
  - The ability of one person to take on the identity of another and thereby subsume their role in society.
  - Affects an estimated 750,000 people annually
  - The #1 consumer complaint filed with the Federal Trade Commission (US)
- "Cyber Impersonation" is even easier than in the physical world
  - Few understand the risks; few take the proper precautions

Session Hijacking

- A stolen identity & a broken date
  - Alice meets Charles in a chat room
  - Arrangements are made for a date
  - Alice is stood up by Charles at a fancy Italian restaurant
  - But what does Bob have to do with all this?
  - Actually, quite a bit! Welcome to the Session Hijacking Love Triangle!
  - Bob wanted to ask Alice out but had not yet (wimp!)

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Session Hijacking

- A stolen identity & a broken date (cont)
  - Bob is the company security administrator
  - Let's run the whole process to see what really happened…
- March 5, 7:00AM – Alice's Residence
  - Alice logs on to her personal email provider, `http://ewebmail.example.com`.
  - She emails Charles accepting his invitation to dinner & a movie
  - Ewebmail is similar to Gmail or Yahoo! Mail…

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Session Hijacking

- March 5, 7:00AM – Alice's Residence (cont)
  - Login mechanism uses typical username & password via HTML form
  - Alice uses the "Compose" screen to write the email and sends the note
  - Alice realizes she is late and hurries off to work…

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Session Hijacking

- March 5, 8:30AM – Alice's Workplace
  - In her work lobby, she tells Nichole, her "friend" about the date
  - Nichole tells Bob; Bob upset; tries to sabotage the date
  - Bob knows Alice uses eWebMail for personal email
  - His first step is to create his own eWebMail account: bob@ewebmail.com

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Session Hijacking

- March 5, 10:00AM – Bob's Office
  - The features offered by eWebMail were similar to those offered by other email providers
  - Bob studied how eWebMail was written…
    - Used Java servlets and JSP
    - Sent cookies to the browser
  - Bob uses "Cookie Pal" (www.kburra.net) to manage cookies
  - Discovers eWebMail sends a cookie named `uid` with a long, maybe hex value

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Session Hijacking

- March 5, 10:00AM – Bob's Office (cont)
  - Bob knew that some Web Apps. used cookies to manage session identifiers
  - To see if this is the case, Bob creates 3 more accounts, bob1, bob2 & bob3
  - Bob logs in to each to retrieve the cookie
  - Bob compares the cookies to see if there is some way to "decode" it.

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Session Hijacking

- March 5, 10:00AM – Bob's Office (cont)
  - 2 things become obvious when the cookies are laid out:
    1. The number of bytes are exactly the same
    2. There is only a 1 byte difference between the last 3 email addresses

```
C8C5C8EACFDDCFC8C7CBC3C684CFD2CBC7DAC6CF84C9C5C7:1
C8C5C89BEACFDDCFC8C7CBC3C684CFD2CBC7DAC6CF84C9C5C7:1
C8C5C898EACFDDCFC8C7CBC3C684CFD2CBC7DAC6CF84C9C5C7:1
C8C5C899EACFDDCFC8C7CBC3C684CFD2CBC7DAC6CF84C9C5C7:1
```

  - It seemed that the email addresses were somehow encoded into the cookie
  - Simply using the ASCII encoding of the email address seemed (and was) not done

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Session Hijacking

- March 5, 10:00AM – Bob's Office (cont)
  - The cookie could be an encrypted email address, though
  - Since the strings were almost identical, Bob tried a simple XOR encryption technique to decode
  - A simple Perl script does the trick by XORing all the bytes of the cookie by all 256 values
  - 0xAA did the trick! The cookie strings were encoded by XORing every character in the email address with 0xAA

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Session Hijacking

- March 5, 10:00AM – Bob's Office (cont)
  - Bob's not sure what the ":1" is for…
  - Bob also noticed that the cookie expiration is set to 1 hour past the time the cookie was set.
  - Bob has all he needs to try to hack into Alice's email account!
  - Bob creates a cookie string using the above info for Alice's email address

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Session Hijacking

- 11:00AM – Bob's Office
  - Bob logs in to his eWebMail account in Netscape
  - Closes Netscape
  - He then edits his Netscape cookies file, cookies.txt
    - Searches for the eWebMail cookie
    - Replaces the value of `uid` with his computed `uid` value
  - Reopens Netscape and requests `http://ewedmail.example.com`
  - Voila! Alice's eWebMail account!

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Session Hijacking

- 11:00AM – Bob's Office (cont)
  - Bob sees Charles' replay suggesting a different restaurant
  - Bob deletes it… Alice will never meet Charles!
- 12:30PM – Alice's Office
  - Alice's meeting lasts longer than she thought
  - She checks her personal email before she goes to lunch
  - She thinks all is well for the Italian restaurant…

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Session Hijacking

- 9:30PM – Bertolini's Italian Cuisine
  - She is waiting for him…
  - He's waiting for her at Las Brisas
  - Alas, the 2 shall not meet!
- What really is wrong here?!?
  - Despite all the changes that have happened to the Web over the years, HTTP remained exactly the same: stateless!
  - Poorly implemented state-maintaining schemes result in hacks like session hijacking

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HTTP & Session Tracking

- So, if HTTP is stateless how is session tracking achieved over HTTP?
- Example: Alice's use of eWebMail
- Look at the state diagram…

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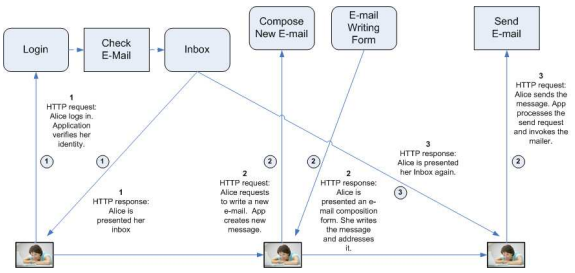

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HTTP & Session Tracking

- State: Login (1)
  - Alice:
    - Starts at the login state
    - Credentials are verified
    - Transition out to "Check Email", then to "Inbox" state
  - App:
    - Creates a "UID" and returns it as a cookie
    - Sets expiration of the cookie
    - Now, cookie sent with each HTTP request
    - Sends an HTTP response with the Inbox view as the data

Note: the user and the app. are only logically connected; no ongoing connection

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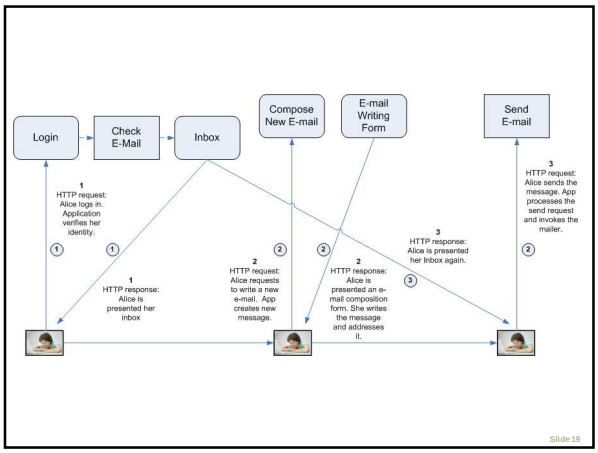

HTTP & Session Tracking

- State: Inbox (2)
  - Alice clicks “Compose” to write a new email
  - Browser sends request w/ cookie
  - Server gets request, decodes cookie w/ XOR algorithm and learns the request is from Alice
  - Q: how does the app. Know Alice was in the Inbox?
  - A: Remember the “`:1`”? It’s the state number!
  - In eWebMail, each state was assigned a number
  - The state # is passed between client & server

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HTTP & Session Tracking

- State: Inbox (2) (cont)
  - 1=Inbox, 2=Read Email, 3=Compose, etc.
  - The app. sees the `:1`, and knows how to transition, to state 3 in this case
  - App. internally sets the state to 3
  - Sends response containing the Compose form and a cookie post-fixed with `:3`

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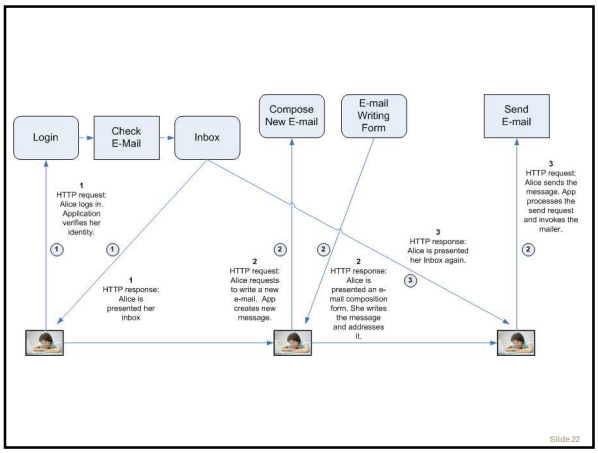

HTTP & Session Tracking

- State: Compose (3)
  - When finished Alice clicks “Send”
  - HTTP request is sent containing the cookie
  - App. transitions from state 3 to state 1
  - Cookie has a `:1` again

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Stateless vs. Stateful Apps.

- So, cookies were used to retain state information as the app executed
- Is this a *truly stateful* app.?
  - Here, truly stateful means that the app. keeps track of sessions and states independently
- To be truly stateful, the session tracking should be performed server-side

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Stateless vs. Stateful Apps.

- But here, the entire burden of the session tracking is handed over to the client
  - Cookies are an easy way of passing info back and forth
  - Client-side session tracking is easy for the app!
  - In this fashion, app programmers tend to forget the golden rule: thou shalt not trust data coming from the client
  - A cookie is data coming from the client!
  - Bob tampered with the cookie thus tampering with the app input

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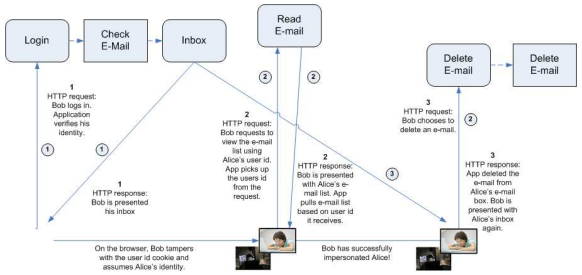

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Implementing Session & State Tracking

- Session hijacking is possible mainly because the session and state tracking is entirely on the client
- Unfortunately, even if session and state tracking done server-side, the ids can be spoofed with the same results
- Predictable session ids also lead to session hijacking
- So… what to do?

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Implementing Session & State Tracking

- Following is an incomplete list of "rules"
  1. Session ids should be unique
     - A logical session must be established between client and server app
     - The session id is composed of a string or number of pieces of data
     - All session ids must be unique
     - Do not reuse even for a return user

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Implementing Session & State Tracking

- Following is an incomplete list of "rules" (cont)
  2. Session ids should not be "guessable"
     - Serial incrementing or time stamp ids are cause for concern
     - Can be guessed by rapidly generating user sessions
     - Fix? Use a random number + current time stamp + secret number to generate a hash

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Implementing Session & State Tracking

- Following is an incomplete list of "rules" (cont)
  3. Session ids should be independent
     - Do not derive ids from usernames, passwords or app states
     - Use a lookup table server-side to match session id with user credentials

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Implementing Session & State Tracking

- Following is an incomplete list of "rules" (cont)
  4. Session ids should be mapped with client-side connections
     - Keep track of the clients IP address and time of session creation
     - This will help prevent sniffing and reusing of session ids by an attacker
     - Every time a request is received from the client, compare the current client info to the stored info

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Summary

- Session hijacking is a bit more difficult to perform
- But, attacks are just as serious!
- Session hijacking attacks are purely an app development issue
- Oversights in the server apps development or implementation of session tracking are to blame
- No Op Sys, patch, firewall or server configuration can stop session hijacking

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