

ICS 351: Today's plan

- https
- certificates (review)
- cookies
- DNS examples
- SNMP

secure HTTP

- HTTP by itself is very insecure: any man-in-the-middle attacker can observe all the content sent and received
- some people wish to use HTTP to send sensitive data, e.g. credit card numbers, personal email
- instead of layering HTTP over TCP, HTTP can be layered over a secure protocol that runs over TCP
- the choice of secure protocols for HTTPS (secure HTTP) is SSL (older) or TLS (newer)

certificates

- a *certificate* is a digital signature by entity CA verifying that the enclosed public key authenticates server S
- there are a few (~100) certificate authorities (CAs) that are widely known and recognized by many web browsers
- when presenting its public key, a server S also presents the certificate signed by a CA as evidence that S indeed is the server the user wants to talk with

certificate vulnerabilities

- certificates protect against man-in-the-middle attack (including DNS attacks), but are still vulnerable to misspellings (e.g. gogg1e.com)
- if the certificate authority is compromised, and DNS or the routing infrastructure subverted, an attacker can impersonate any website
- this may have happened – the dutch CA diginotar may have had its keys stolen and misused

self-signed certificates

- if I have a website for private use, I don't need a certificate from a CA
- I can use a *self-signed* certificate instead
- as before, the crucial step is giving the browser the correct public key for the desired server
- this requires hand-configuration of all the browsers that will use this server

HTTP cookies

- HTTP is a stateless protocol: a server has no real way to identify a client, so a request may or may not be connected with prior requests
- instead, a server may offer a client a *cookie*, a small amount of data that is only meaningful to the server
- on subsequent related requests to the same server, the client will send back the cookie, to confirm that the requests are connected
- cookies have an expiration time -- most cookies used for authentication expire quickly

HTTP cookies

- cookies can also be used to attempt to track users as they visit multiple sites, by embedding in the several sites a small image (or other content) served from the same server
- these cookies are often long-lived
- similar tracking can be done by tracking accesses based on the IP number of the connecting client

Cookie Persistence

```
HTTP/1.1 200 OK
Date: Wed, 02 Nov 2016 03:29:26 GMT
Expires: -1
Cache-Control: private, max-age=0
Content-Type: text/html; charset=ISO-8859-1
P3P: CP="This is not a P3P policy! See
https://www.google.com/support/accounts/answer/151657?hl=en
for more info."
Server: gws
X-XSS-Protection: 1; mode=block
X-Frame-Options: SAMEORIGIN
Set-Cookie:
NID=90=Q6WBNlGTLHoMiM6U2Ye7gIgJndTzEEhbackYUQAU6ErzDqYj-
3LszdPQ4ojrBF1r1x98TbdEKQQA0JsgUr7Zc3rssioM-
7NoysweYJDGG88epNN2O8ErlFqz4Cc_Ij0nKpkEgpMULWD-Q8A;
expires=Thu, 04-May-2017 03:29:26 GMT; path=/;
domain=.google.com; HttpOnly
Accept-Ranges: none
Vary: Accept-Encoding
Connection: close
```

DNS reminder

- DNS provides name to IP address resolution
- Domain names are grouped into zones
- a DNS server provides translation (resolution) for the names in one zone
- a DNS query contains *question* Resource Records
- a DNS response may contain *answer* RRs, *name server* RRs, and *additional* RRs

example of using dig

```
dig hawaii.edu
;; QUESTION SECTION:
;hawaii.edu.      IN  A
;; ANSWER SECTION:
hawaii.edu.      1800  IN  A   128.171.224.100
;; AUTHORITY SECTION:
hawaii.edu.      1800  IN  NS  dns4.hawaii.edu.
hawaii.edu.      1800  IN  NS  dns2.hawaii.edu.
hawaii.edu.      1800  IN  NS  dns1.hawaii.edu.
;; ADDITIONAL SECTION:
dns1.hawaii.edu. 1800  IN  A   128.171.3.13
dns1.hawaii.edu. 1800  IN  A   128.171.1.1
dns2.hawaii.edu. 1800  IN  A   128.171.3.13
dns2.hawaii.edu. 1800  IN  A   128.171.1.1
dns4.hawaii.edu. 1800  IN  A   130.253.102.4
```

example of using dig for MX

```
dig mx hawaii.edu
;; QUESTION SECTION:
• ;hawaii.edu.          IN  MX
• ;; ANSWER SECTION:
• hawaii.edu.          1434  IN  MX  10  aspmx.l.google.com.
• hawaii.edu.          1434  IN  MX  20  alt1.aspmx.l.google.com.
• ;; AUTHORITY SECTION:
• hawaii.edu.          936 IN  NS  dns2.hawaii.edu.
• hawaii.edu.          936 IN  NS  dns1.hawaii.edu.
• hawaii.edu.          936 IN  NS  dns4.hawaii.edu.
• ;; ADDITIONAL SECTION:
• aspmx.l.google.com.  281 IN  A   74.125.25.27
• aspmx.l.google.com.  283 IN  AAAA  2607:f8b0:400e:c04::1a
• alt1.aspmx.l.google.com. 131  IN  A   173.194.196.27
• alt1.aspmx.l.google.com. 283  IN  AAAA  2607:f8b0:4001:c1a::1b
• alt2.aspmx.l.google.com. 131  IN  A   173.194.219.27
• alt2.aspmx.l.google.com. 283  IN  AAAA  2607:f8b0:4002:c03::1b
• aspmx2.googlemail.com. 131 IN  A   173.194.196.27
• ...
```

system administration

- suppose a system administrator has to manage a large number of machines
- for example, three web servers, a DHCP server, a backup server, a Network Attached Storage (NAS) server, a mail server, and a few printers
- a large KVM might be useful, but also has limitations:
 - all the servers must be in close physical proximity
 - there cannot be multiple, remote consoles
 - there is no way to get alerts from systems that need attention

Simple Network Management Protocol

- SNMP uses the network to report status information and alerts about remote systems
- SNMP messages are carried over UDP
- values can be loaded on demand (pull model), but when needed and configured appropriately, alerts are sent independently by the systems being managed (push)

SNMP

Management Information Base

- SNMP needs a machine-independent way to indicate which item of information is being requested or sent
- logically, the entire universe of information that can be accessed is built into a large tree: the Management Information Base or MIB
- the tree is extensible so individuals and organization can add their own subtrees -- private MIBs
- the tree is universal and known to all

navigating the MIB

- the path through the tree is sufficient to indicate one specific item (corresponding to a variable in a programming language)
- the path through the tree can be indicated by a sequence of numbers, the number of left siblings of the path being taken
- for example, 0.2.7.5.14.1.7.0 is such an Object Identifier (OID)
- OIDs are useful for enumerating arrays of objects, e.g., network interfaces, routing table entries

SNMP programs

- a network management station is used by the system administrator to monitor multiple systems
- a management agent must run on every managed device, get the required information, and provide it on request

SNMP basic operation

- the network management station may send GET requests to get one or more objects from specific agents
- the network management station may also send SET requests to modify one or more objects on specific agents
- agents will send TRAP or INFORM alerts to network management stations that they have been configured to alert
- because it uses UDP, SNMP (like DNS) cannot assume that its operations will be successful¹⁷