Internet Discussion

Theme: “Death by TLAs”

Slides with “*” are not testable material

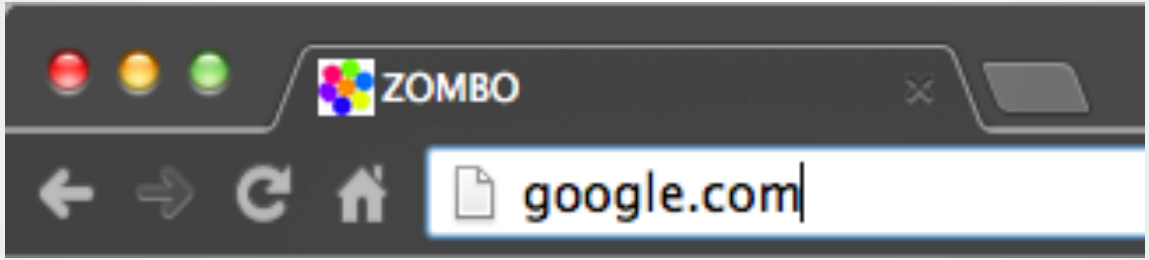
Theme of the Day - An analysis:

Well, technically most are “initialisms”, because we say each letter as opposed to sounding them out as one word.

Photo credit to xckd.com

Breakdown

- Review of DNS lookup
- Priorities in Internet Communication
- Review of Information Transfer
- DDoS Attacks
- MITM (Man-In-The-Middle) Attacks



What happens when we type an address into the URL bar?

DNS

Turn www.google.com into 74.125.239.113

- https://www.youtube.com/watch?v=BCjUbpIzRs8
- Like an address, DNS “zooms in” by analyzing parts of the URL before others
  - Before sending a package to the correct address, packages are first sent to the correct city
- What are the steps?
  - Send request to “.” root DNS server
  - Send request to returned “.com” DNS server
  - Send request to returned “google.com” DNS server
  - This issues the location of “www.google.com” as 74.125.239.113
  - Save address and continue communication with the correct ip

DNS

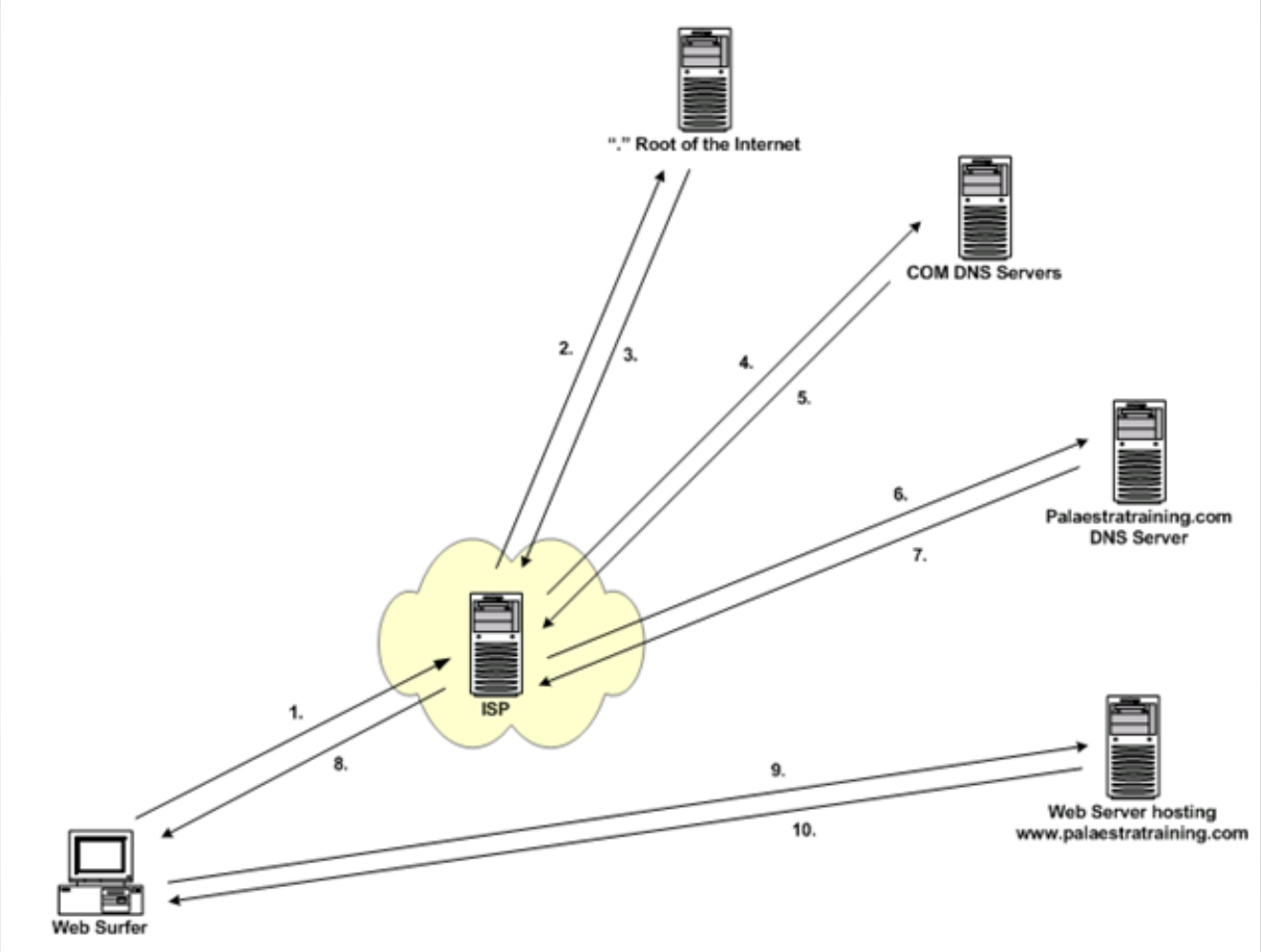


Photo Credit:

www.palaestratraining.com

Question: What kind of vulnerabilities can you see with this system?

Question: What can we do to prevent such an attack?

Question: What do we care about in regards to secure communication over the internet?

Aspects of Internet Communication Security

- **Reliability**: Ensure that information arrives uncorrupted
- **Confidentiality**: Ensure only the intended reader can read the message
- **Integrity**: Ensure that the message delivered is not manipulated or changed
- **Authenticity**: Ensure that you are communicating with the desired party

Review of Information Transfer

How does Alice send a message to Bob over the internet?

```
Last login: Wed Oct 30 10:26:07 on ttys000
Macintosh-002332d5a0ba-2:~ iMax$ traceroute www.google.com
traceroute: Warning: www.google.com has multiple addresses; using 74.125.239.50
traceroute to www.google.com (74.125.239.50), 64 hops max, 52 byte packets
 1  * * *
 2  xe-1-2-0-1981.inr-306-sut.berkeley.edu (136.152.36.1)  1.335 ms  1.023 ms  1.303 ms
 3  t5-4.inr-202-reccev.berkeley.edu (128.32.0.58)  1.365 ms  1.501 ms  1.089 ms
 4  xe-5-1-0.inr-001-sut.berkeley.edu (128.32.0.66)  1.079 ms  1.220 ms  1.362 ms
 5  dc-sfo-agg-1--ucb-10ge.cenic.net (137.164.50.16)  1.777 ms  1.825 ms  1.792 ms
 6  oak-agg2--sfo-agg1-10g.cenic.net (137.164.22.25)  5.161 ms  5.625 ms  3.371 ms
 7  dc-paix-px1--oak-core1-ge.cenic.net (137.164.47.174)  4.206 ms  3.938 ms  3.892 ms
 8  google--paix-px1-2.cenic.net (198.32.251.130)  23.455 ms  4.179 ms  4.345 ms
 9  216.239.49.250 (216.239.49.250)  7.378 ms  5.209 ms  6.913 ms
10  72.14.232.35 (72.14.232.35)  5.059 ms  5.340 ms  5.030 ms
11  nuq04s19-in-f18.1e100.net (74.125.239.50)  4.763 ms  4.822 ms  4.921 ms
Macintosh-002332d5a0ba-2:~ iMax$
```

Traceroute from Lab shows all the computers your information crosses before reaching the designated website “www.google.com”

Question: How could more “hops” increase the vulnerability of your communication?

Packets

- Akin to a letter containing an address with “delivery instructions” and some amount of information ~128 bytes total
- Used to carry pieces of your data in discrete packets.
- Statistics:
  - 3MB song file requires about 24000 packets to send!
  - Over 700 billion packets sent every single second worldwide!*

*Based on ~21 Exabytes global data transfer each month

```
Last login: Wed Oct 30 19:20:54 on ttys000
Macintosh-002332d5a0ba-2:~ iMax$ ping www.google.com
PING www.google.com (74.125.239.49): 56 data bytes
64 bytes from 74.125.239.49: icmp_seq=0 ttl=54 time=4.886 ms
64 bytes from 74.125.239.49: icmp_seq=1 ttl=54 time=5.588 ms
64 bytes from 74.125.239.49: icmp_seq=2 ttl=54 time=5.147 ms
64 bytes from 74.125.239.49: icmp_seq=3 ttl=54 time=7.401 ms
64 bytes from 74.125.239.49: icmp_seq=4 ttl=54 time=7.276 ms
64 bytes from 74.125.239.49: icmp_seq=5 ttl=54 time=7.356 ms
^C
--- www.google.com ping statistics ---
6 packets transmitted, 6 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 4.886/6.276/7.401/1.089 ms
Macintosh-002332d5a0ba-2:~ iMax$
```

From lab, Ping times how long it takes to send and receive a packet from a website.

Delays

- Packets are fast
- But not instantaneous
- Delays open window for sneaky attacks
- Packet delays limit how much information can be transferred
- Question: Can this delay compromise...
  - Reliability?
  - Confidentiality?
  - Integrity?
  - Authenticity?

THE AUTHOR OF THE WINDOWS FILE COPY DIALOG VISITS SOME FRIENDS.

Photo credit to xkcd.com

Compromised Reliability?

DDoS (Compromised Reliability)

- Goal: Cut off communication between Alice and Bob
- Packet delays limit how much information can be transferred
- Too much communication leads to a Denial of Service
  - Think of a traffic jam!
- https://www.youtube.com/watch?v=OhA9PAfkJ10
- Attack Map: bit.ly/1b7EYDk
- Question: How can we protect against this?

Use More Servers!*

- Use scalable server resources which allow you to use more servers only when you need them

Compromised Confidentiality?

Eavesdropping*

- Remember how many “hops” we saw in TraceRoute
- Each of these computer’s along the path sees this internet traffic
- http://www.pcworld.com/article/209333/how_to_hijack_facebook_using_firesheep.html

Firesheep allows a user to see all unprotected communication on a network. This included sending passwords and financial data!

Eavesdropping*

- Remember how many “hops” we saw in TraceRoute
- Each of these computer’s along the path sees this internet traffic
- http://www.pcworld.com/article/209333/how_to_hijack_facebook_using_firesheep.html
- **Question: How can we protect against this type of attack?**

Encryption

We can protect our information by encoding our traffic with a special key that only lets the owner of that key to read the message.

Look for 

in the URL before entering passwords or any other information you want kept private.

Compromised Integrity?

Data Modification (Compromised Integrity)*

- Alice wants to make a deposit in Bob's Bank Account by sending the amount and Bob's bank account to the bank website
- Eve as usual has access to all communication between Alice and Bob
- Eve can intercept and change the account number from Bob's to her own!
- http://money.cnn.com/2013/10/28/technology/barack-obama-twitter-hack/
- Question: How can we protect against this?

Encryption!

- Again encryption can help by making it impossible for Eve to know what part of the message to modify

Compromised Authenticity?

Spoof!*

- As an attacker, we can alter communication to act as someone else
- http://www.csmonitor.com/World/Middle-East/2011/1215/Exclusive-Iran-hijacked-US-drone-says-Iranian-engineer-Video
- How can we ever know that the person we are communicating with is really them?
- Question: How could you try to protect against an attack like this?

Key Signing Parties! (Extreme example) *

- Authenticity is a very difficult aspect to ensure and some go to great lengths to achieve it
- At key signing parties participants exchange encryption information in person.