LUG@UCLA TECH TALK

PASSWORD SECURITY

Presented by David Nguyen

AUTHENTICATION

- Passwords solve the problem of authentication: proving your identity
- Three ways of authentication
  - Something you know (e.g. passwords, pins, security questions)
  - Something you have (e.g. pgp keys, software tokens)
  - Something you are (e.g. biometrics, MAC address)
- All have drawbacks and strengths

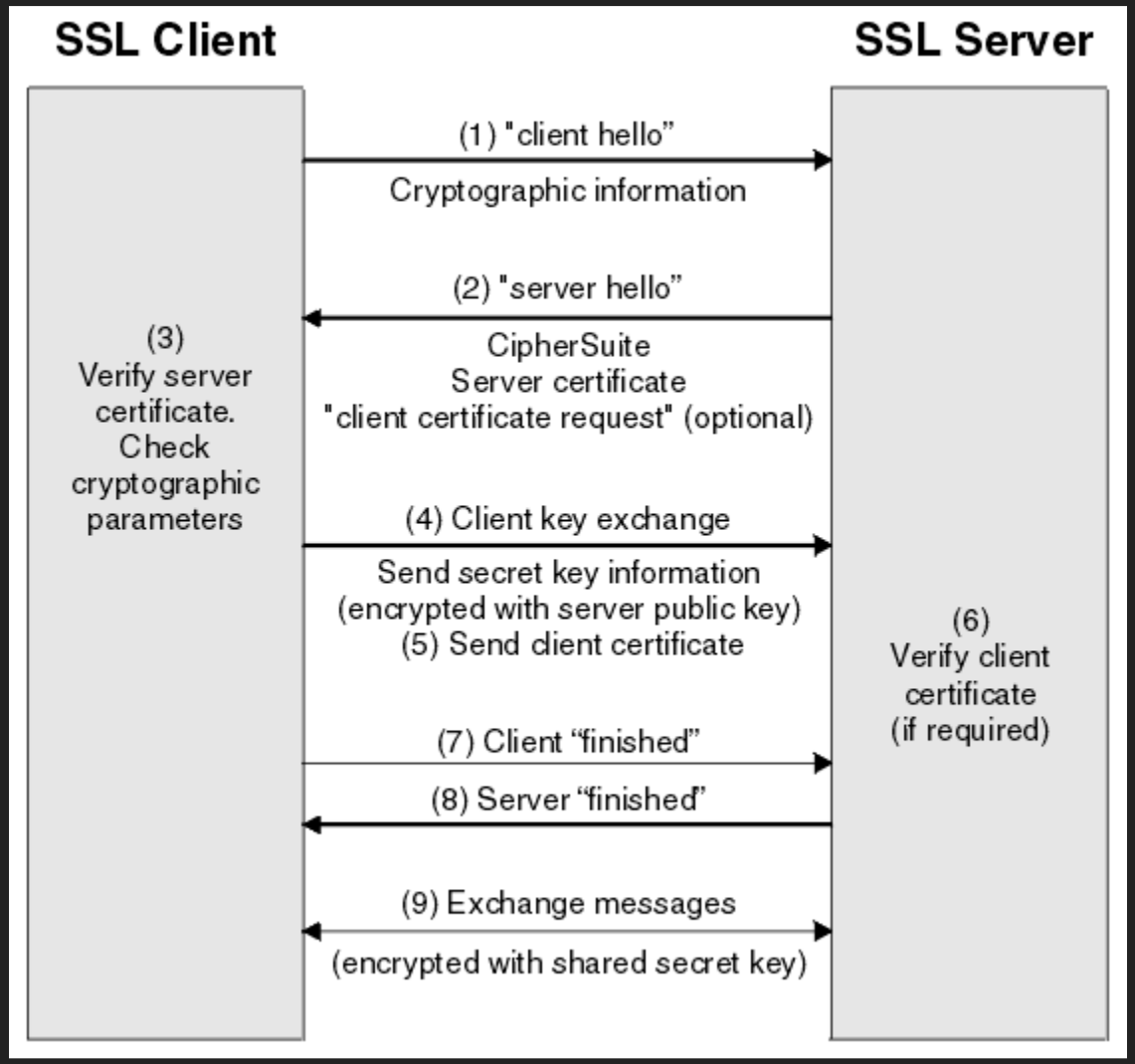
HOW DO PASSWORDS WORK

- That's easy. You just tell the server your username and password and it authenticates you, right?
- The implementation is harder. You have to do this "securely".
  - How do you send your username and password over.
  - How does the server store their usernames and passwords.

QUICK RECAP FOR ENCRYPTION

- Symmetric Encryption uses 1 key; Asymmetric Encryption uses 2 keys
  - AES-256 is popular symmetric encryption standard
    - AES is the algorithm, 256 bits is the block size
- Hashing: Maps data of arbitrary size to data of fixed size
  - Cryptographic Hashing: Hashing function is one way which is easy to compute and hard to invert
- Hashing is not encryption!

HOW TO SEND PASSWORDS SECURELY



HOW ~~SHOULD~~ SHOULDN'T SERVERS STORE PASSWORDS

- Obviously storing it in plain text is wrong
  - Anyone who has access to the file can log in as anyone
- How about encrypting the file with some symmetric (or even asymmetric) cipher?
  - Also bad! You're trusting the person with the password or private key
  - In 2013 Adobe leaked their passwords this way
- Hash
  - No! Rainbow tables will beat that.
- Hash and salt?
  - Nope. For GPUs its easy to compute billions of hashes

THE "FINAL" ANSWER

- "If at first you don't succeed, try, try again."
- Repeatedly hash your password with that salt "thousands" of times
- PBKDF2, bcrypt, scrypt are three popular ones
- This solves the problem of:
  - Trust, rainbow table attacks, and brute force attempts
- However even this is pretty outdated (2013)
- New cryptohashing standards will be created, but the end goal is the same
  - Prevent brute-force attempts on collisions

LET'S TALK ABOUT PASSWORDS

- What makes a strong password?
  - Is hunter2 really such a bad password?
- Password strength meters are misleading
  - I used http://www.passwordmeter.com/
    - The password LUGatUCLA got 32/100 (weak)
    - LUGatUCLA2 got 61/100 (strong)
- We'll measure password strength with password entropy or bits of entropy

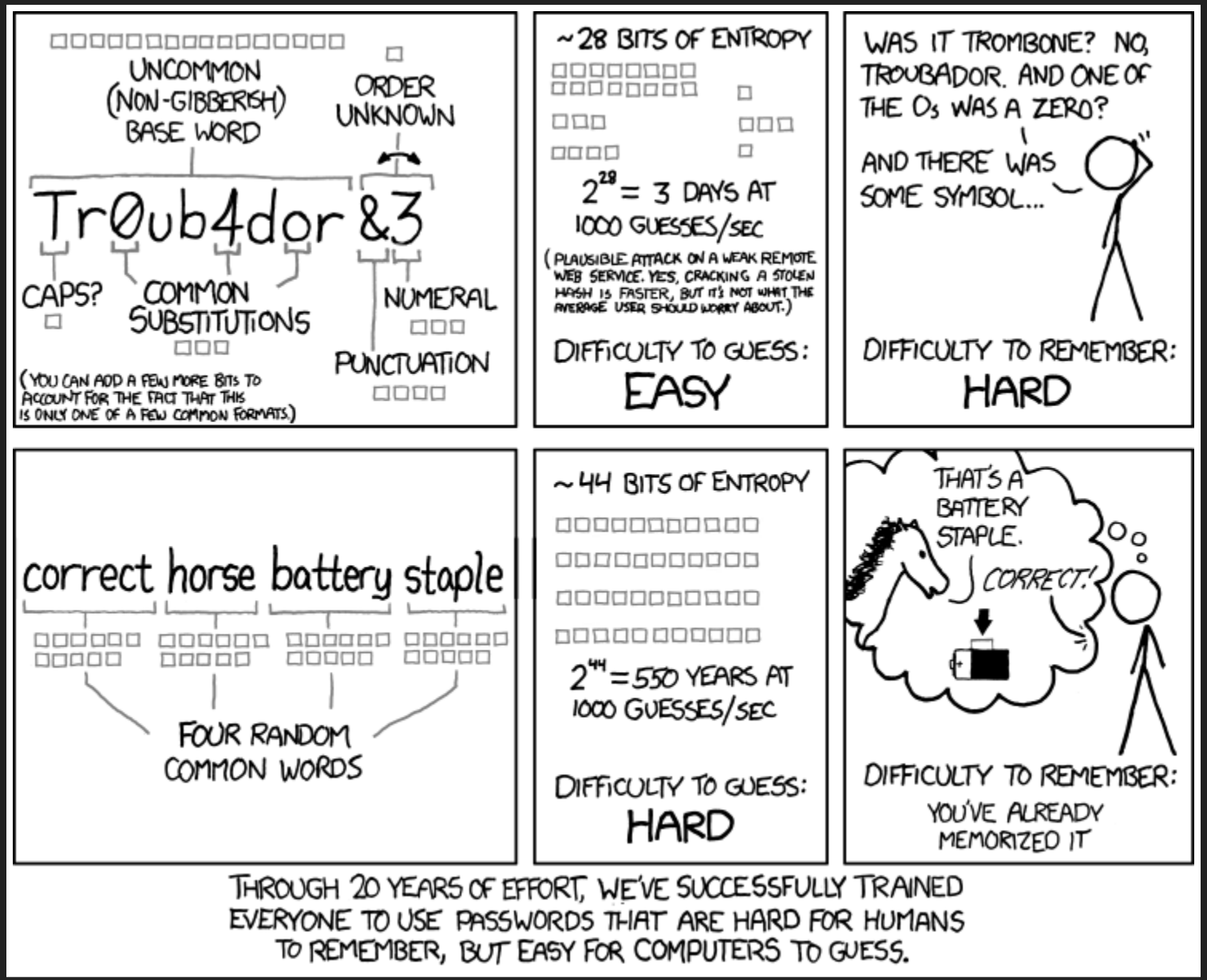
PASSWORD ENTROPY

- We measure a password's randomness in bits and say that it is the log_2 of the number of guesses needed to brute force the password
- Equation: H = log_2 (N^L)
  - H is the number of bits of entropy, N is size of set you're choosing from, and L is the length of the password in terms of the elements in the set
- For example, if we looked into /dev/urandom and asked for a password of length 10 from the set of printable ASCII characters we might get:
  - Z1-frIAtrl
  - H = log_2(95^10) = 10 x log_2(95) = 6.56 x 10 = ~65 bits of entropy

PASSWORD ENTROPY (CONTD.)

- correcthorsebatterystaple
  - each word: correct, horse, battery, staple comes RANDOMLY from a list of ~2048 words
    - Did I say RANDOMLY?! IT HAS TO BE RANDOM!
  - The length of the password is 4 in terms of these words
  - thus H = log_2(~2048^4) = 4 log_2(~2048) = 4 x 11 = ~44 bits

CORRECTHORSEBATTERYSTAPLE



HUMAN GENERATED PASSWORD ENTROPY

- Humans are predictable and have certain patterns and tendencies. We can't use our original definition.
- We look at the password process generation itself and break apart the password
- For example: bananas2
- If we pretend that a computer pulled that out of all the printable ascii characters:
  - H = log_2(95^8) = 8 x log_2(95) = 8 x 6.56 = ~52 bits of entropy
  - According to RFC4086, you need ~29 bits of entropy. So not bad!

HUMAN GENERATED PASSWORD ENTROPY (CONTD.)

- However look at it this way:
  - It's a word perpended by a single digit number: "bananas" + "2"
  - I'll give the benefit of the doubt and say that the word was found randomly out of the Oxford Dictionary (~600,000 words)
  - There are 9 single digit numbers
  - Thus H = log_2(600000^1) + log_2(9^1) = ~22 bits of entropy. Not good!

PASSWORD MANAGER

<I'm suppose to show you how to use keepass>

THANKS FOR COMING!