The Password is Dead, Long Live the Password!

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Rochester Security Summit

October 6, 2015

What, him again?

* About me…
* David C Frier, CISSP, CISM, other stuff
* InfoSec Manager for Xerox's Infrastructure
    * *…but I speak only for myself, not for Xerox!*
* Been doing Information Security for 10 years
* IT of one sort or another for 37 years
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What we Talk About when we Talk About Passwords

* What?
* Why?
* Usage
* Storage
* Complexity
* Volatility
* 2nd Factor Considerations
* Future Possibilities

What are Passwords?

* A password is a string of characters or words
  * Known by a person…
  * Kept a secret…
  * That authenticates the person as being authorized to gain access to something.

* Passwords are ancient
  * “Halt, who goes there?”

* First Computer Password (*probably*)
  * CTSS by MIT – 1961

Why Passwords?

* Cheap to implement
  * Software-only
  * Probably built-in to whatever OS they were already using.
  * No training costs or learning curve for users (mostly)

* Lowest Common Denominator
  * If diverse systems with diverse schemes were being integrated…
  * What authentication mode did they all support?

Usage

* Mainly: Authentication
* Authentication is based on one or more factor from the list:
  * something you know - that's a password
  * something you have
  * who/what you are

* Also: Encryption key
* *It's important for this to be disclosed and obvious*

Storage

Password storage ranges from bad to not-so-bad

User:

* Memorized
* Paper & pencil
* Spreadsheet, etc.
* Encrypted Vault

Server:

* Plaintext
* Reversible Encryption
* Hashed
* Salted & Hashed

Maximum Password Length

A quick digression

* Sometimes a system has a maximum password length
* Not referring to limitations of input forms, which may be as small as 255 characters…
* But if passwords are being hashed
  * Hash output is a fixed length, independent of input
  * Storage requirements are not a factor
* Storage limitations call the hashing into question

Attacks and Defenses

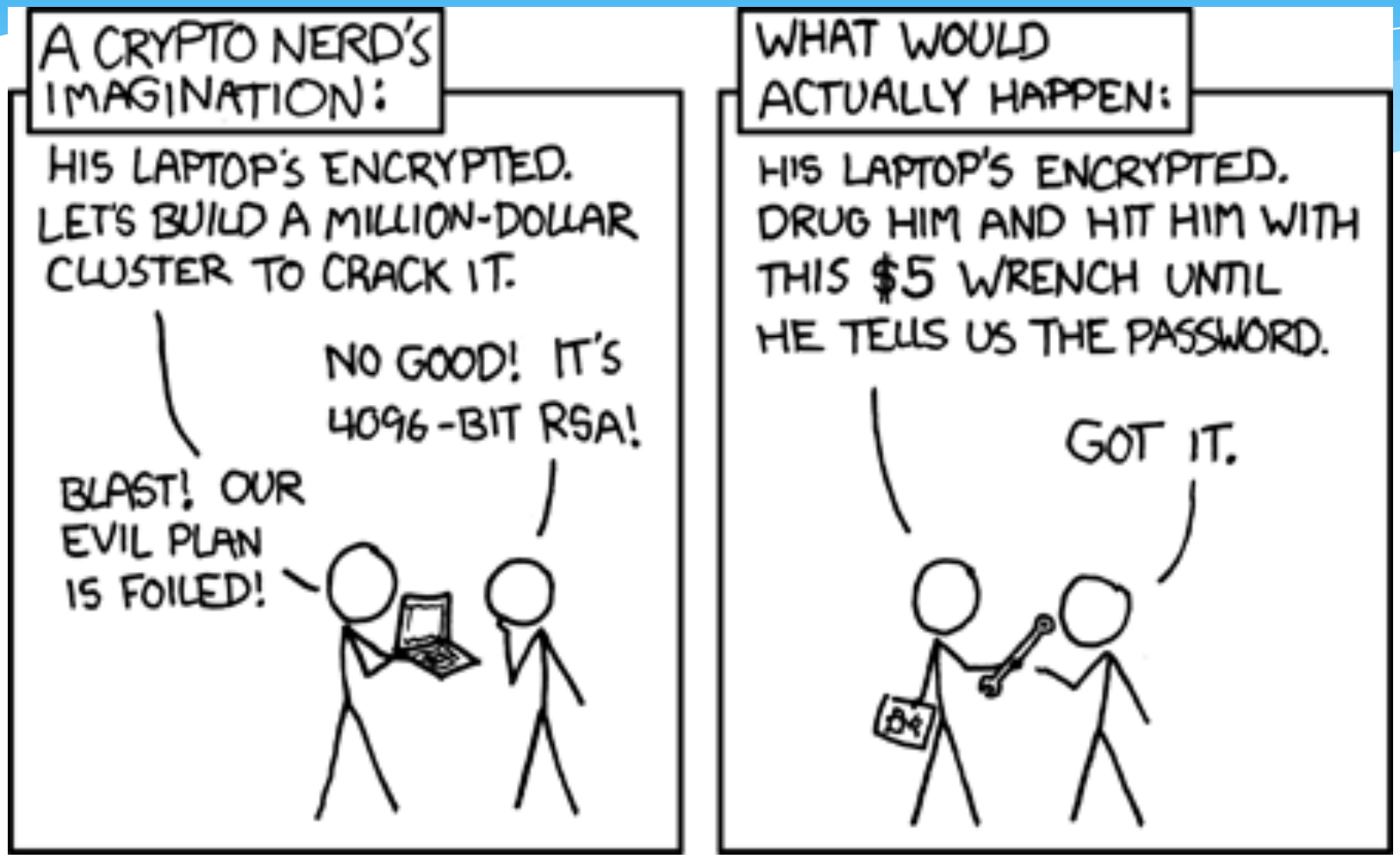
Attacks

* Rainbow Tables
* Cracking
* Dictionary
* Brute Force
    * *both flavors*

Defenses

* Hashing & Salting
* Complexity
* Response Delays
* Lockouts

The Wrench Attack



Complexity

Complexity correlates to Shannon Entropy

i.e. the expected amount of information contained in the message (string, words, phrase). For passwords, we usually count this in "bits", which is roughly the Log_2 of the range of possible values. (*The actual math behind this is **well** beyond the scope of this presentation, not to mention this presenter.*)

How to make passwords complex

* Length
* Diversity of Character Set
* Nonexistence in Dictionaries

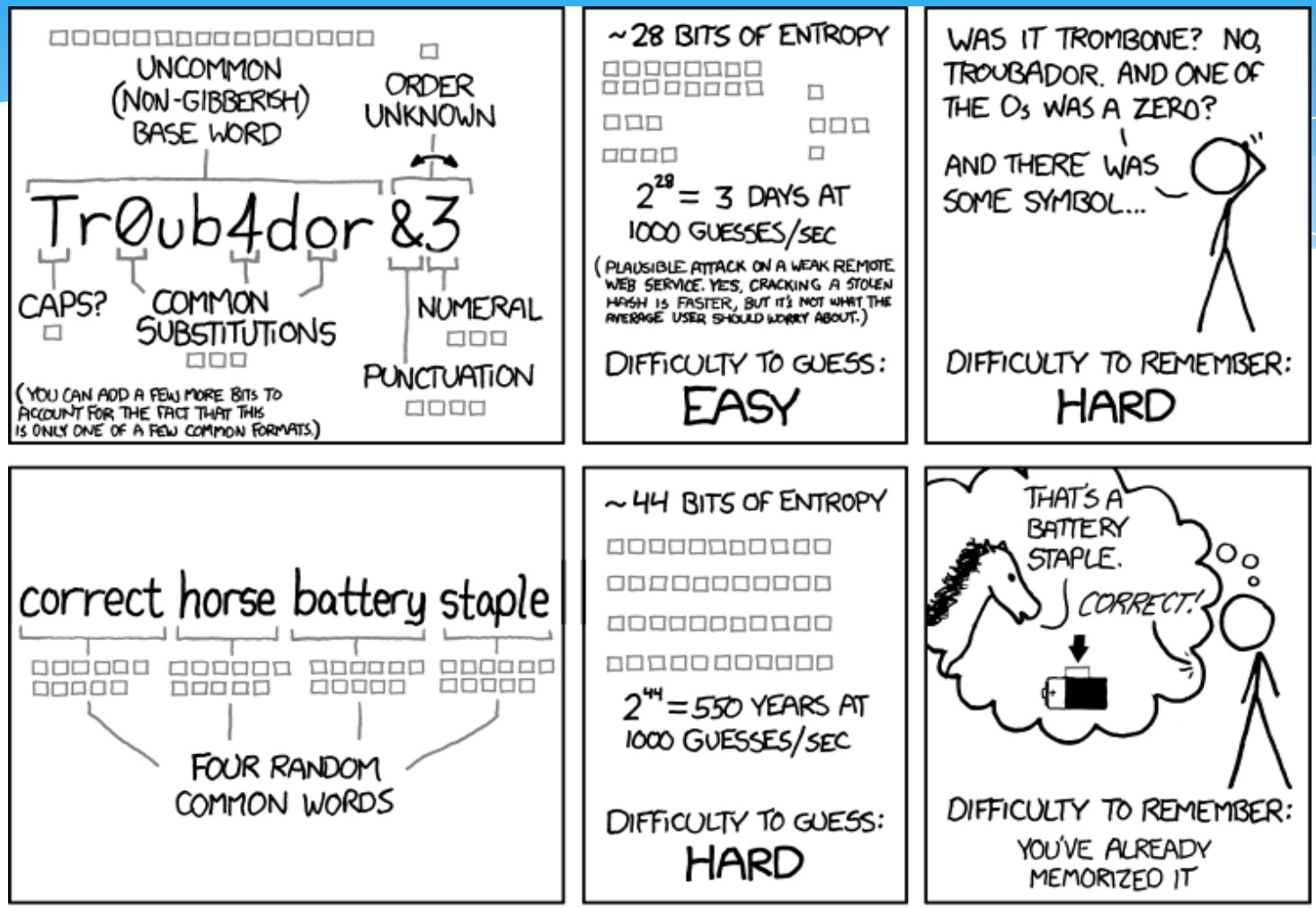
Complexity

Why passwords need to be complex

* More resistant to attacks
  * Brute force -- Resist guessing
  * Dictionary -- Resist intelligent guessing
  * Rainbow tables -- Resist pre-computation of hashes

* Additional entropy for their usage as encryption keys

Complexity & Memorability Trade-Offs



THROUGH 20 YEARS OF EFFORT, WE'VE SUCCESSFULLY TRAINED EVERYONE TO USE PASSWORDS THAT ARE HARD FOR HUMANS TO REMEMBER, BUT EASY FOR COMPUTERS TO GUESS.

Complexity

Examples of making passwords complex

* **`pAs5w0rd`** – 36 bits *nope! Too short, also probably vulnerable to a well-engineered dictionary attack.*
* **`CorrectHorseBatteryStaple`** -- 44 bits *not horrible.*
  * *If you want a tool for making these word-salad passwords, contact me for my "WordBase" spreadsheet, or try Diceware*
* **`$jCYPGuFpM*QScf$9fwHn#82kqJWRW*3TT5j2Nek`** -- 215 bits *probably overkill.*

Volatility

Changing Passwords:

* If a password is...
  * only ever used by one person
  * only ever transmitted encrypted
  * Salted-Hashed on the server, never stored as-is
* then it probably almost never needs changing

* On the other hand, consider the Cyber-Ark model for passwords that have to be passed around

Time for a 2nd Factor

* Something you Know -- *covered*

* **Something you Have**
  * Examples:
    * Google Authenticator (TOTP - RFC6238)
    * Grid cards
    * RSA Tokens

* Something you Are
  * Biometrics are shiny but probably less practical
  * Can't be changed
  * Error rates are still too high

2nd Factor Considerations

* Two-factor renders guessing and cracking attacks almost useless
* Getting infrastructure in place to support a consistent usable 2FA is the challenge
  * Even Grid Cards require changes to all apps or to SSO
  * TOTP Assumes users all have smartphones

Some Future Possibilities

* FIDO - Open Authentication Specification
  * Public/Private Key Pairs per Site
  * User signs a challenge and website validates
  * Can be managed with apps as well as hardware
* YubiKey
  * Supports FIDO U2F Challenge/Response (Neo)
  * Proprietary OTP
  * Static passwords, also
* Common challenges to all these
  * The inertia of the “installed base”
  * Cost of issuing new tech to all users

Conclusions & Recommendations

* Emphasize Complexity over Volatility
* Salt & Hash Properly
* Overcome the 2FA challenge
* Buy my snake oil… *(j/k)*

Q&A