Everything You Know about Password-Stealing is Wrong

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What do we know?
How do we know it?

- Black Market In Credit Cards Thrives on Web
  - ''Want drive fast cars?'' asks an advertisement, in broken English, atop the Web site iaaca.com. ''Want live in premium hotels? Want own beautiful girls? It's possible with dumps from Zo0mer.''‘

The New York Times

- The Underground Economy: priceless
  - “Even those without great skills can barter their way into large quantities of money they would never earn in the physical world.”

TEAM CYMRU

- Symantec Underground Economy Survey
  - “Symantec has calculated that the potential worth of all credit cards advertised during the reporting period was US$5.3 billion.”

symantec.

- A Field Day for Financial Cyber-Scammers
  - “Total losses from cyber-related crime at financial institutions topped $20 billion last year, estimates security consultant Lance James”

BusinessWeek

- Phishing losses up to $3.2bn
  - “An online survey has pegged the soaring losses from phishing attacks this year at $3.2 billion, according to new research from Gartner.”

Gartner.

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SUMMARY: THE SHOCKING SCALE OF CYBERCRIME

THE SHOCKING SCALE OF CYBERCRIME

PLAY AGAIN

$388 BILLION

THE TOTAL BILL FOR CYBERCRIME FOOTED BY ONLINE ADULTS IN 24 COUNTRIES TOPPED USD $388BN OVER THE PAST YEAR

THE DIRECT CASH COSTS OF CYBERCRIME - MONEY STOLEN BY CYBERTHUGS/SPENT ON RESOLVING CYBERATTACKS - TOTALLED $114BN

CYBERCRIME IS BIGGER THAN...

...the global black market in **marijuana, cocaine and heroin** combined ($288bn) and approaching the value of all **global drug trafficking** ($411bn) [i]

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Outline

- Consumers are not liable for losses
- Emptying accounts is hard
- Passwords are not the bottle-neck
- Underground markets are not thriving
- Credential stealing is a terrible business

Consumers are not liable for losses

FBI Director Robert Mueller was banned by his wife from doing online banking after he nearly fell for a phishing scam. “No more Internet banking for you” she said.

Regulation E

- US Federal Reserve *Regulation E* limits user liability to $50
  - ``any electronic transfer that is initiated through an electronic terminal, telephone, computer or magnetic tape.''
  - *“Consumer negligence.* Negligence by the consumer cannot be used as the basis for imposing greater liability than is permissible under Regulation E. Thus, consumer behavior that may constitute negligence under state law, such as writing the PIN on a debit card or on a piece of paper kept with the card, does not affect the consumer's liability for unauthorized transfers.”

"Bank of America's Zero Liability Guarantee, for example, guarantees zero liability for any unauthorized activity originating from Online Banking or Bill Pay."

Source: www.bankofamerica.com

"We guarantee that you will be covered for 100% of funds removed from your Wells Fargo accounts in the unlikely event that someone you haven't authorized removes those funds through our Online Services."

Source: www.wellsfargo.com

"We will reimburse your Fidelity account for any losses due to unauthorized activity."

Source: www.fidelity.com

"Under HSBC's $0 Liability, Online Guarantee, you are covered 100% and liable for $0."

Source: www.us.hsbc.com

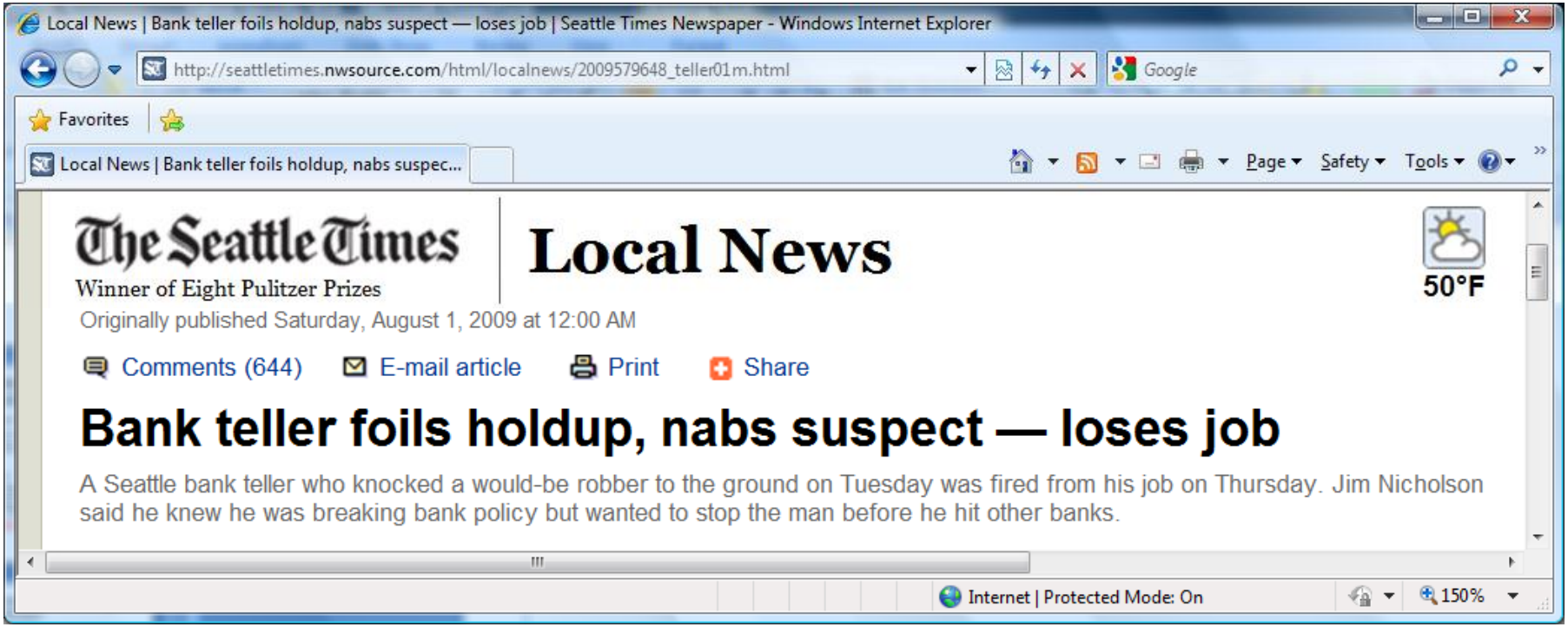
"PayPal currently voluntarily reimburses consumers for all financial losses from transactions not authorized by the consumer, not just losses above $50."

Source: Dec. 2009 10-K filing

Other jurisdictions etc

- EU Directive 61: 150 euros
- Canadian banks: zero liability

Idea that consumers suffer irreversible financial harm is incorrect.



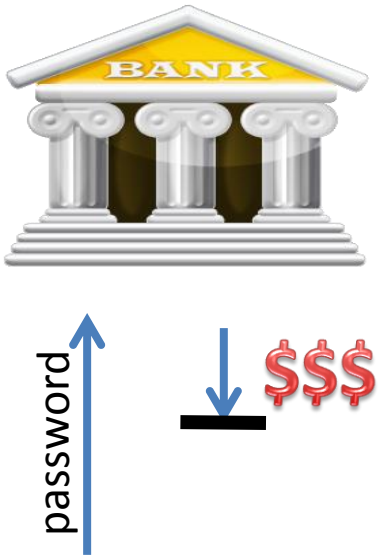
Banks understand:

1. Fear is bad for business
2. Getting money not the same as keeping it
3. Non-repudiation

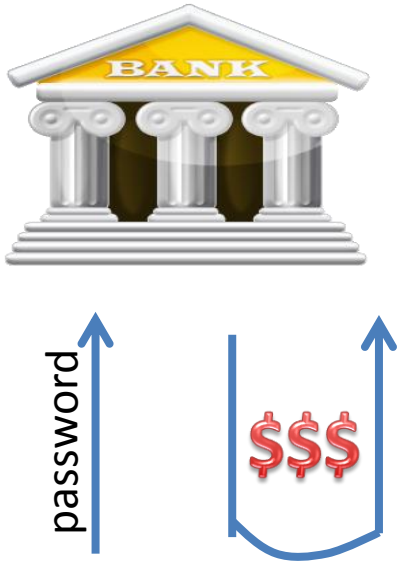
Emptying Accounts is Hard

Thief gets nothing if transfer is:

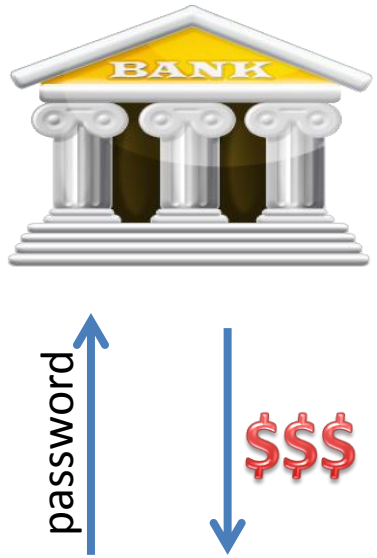
Detected



Reversed



Traced



Untraceable Irreversible transactions are hard to repudiate

- Suppose not: banks have no protection against first part fraud (self-theft).
  - E.g. Alice wires life savings to another acct
  - Claims “I’ve been robbed!!!”
  - Demand refund under Regulation E, Zero Liability
- This only works if transaction can’t be
  - Traced or reversed.

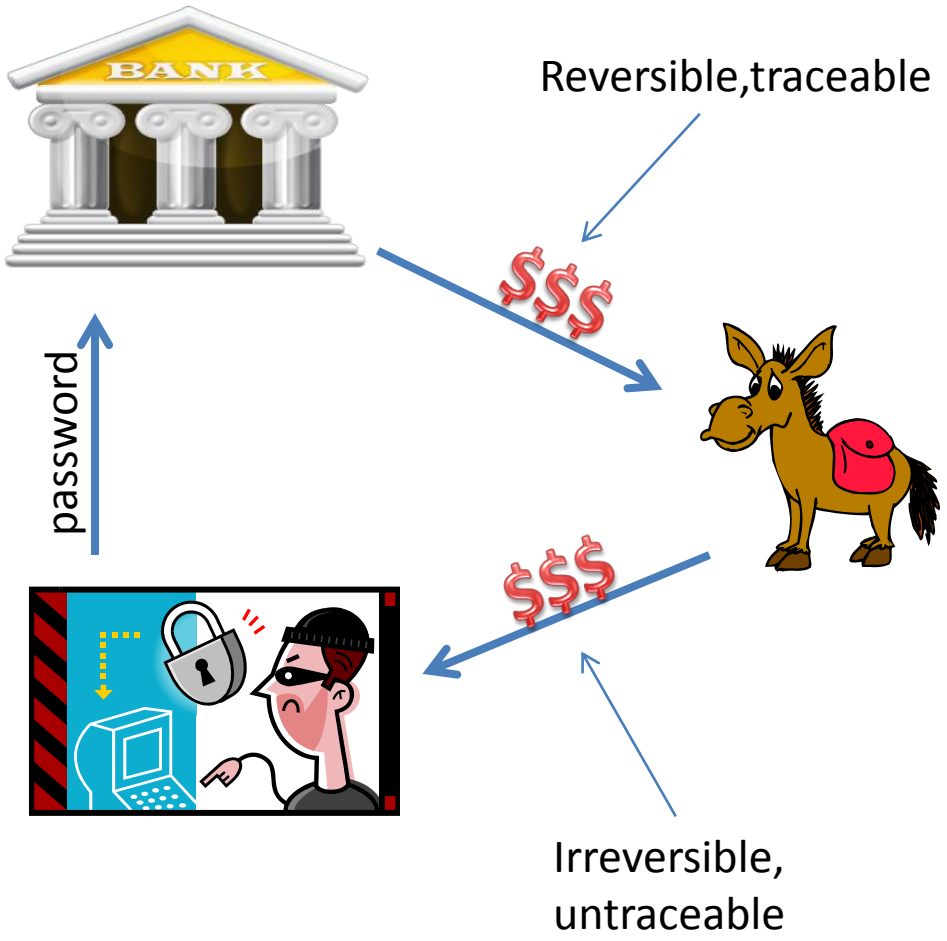
So transaction must be

- Irreversible
- Untraceable
- But this is hard in the banking system
  - Bank Secrecy Act (1970)
  - US Patriot Act (2001)

"All problems in computer science can be solved by another level of indirection"

B. Lampson

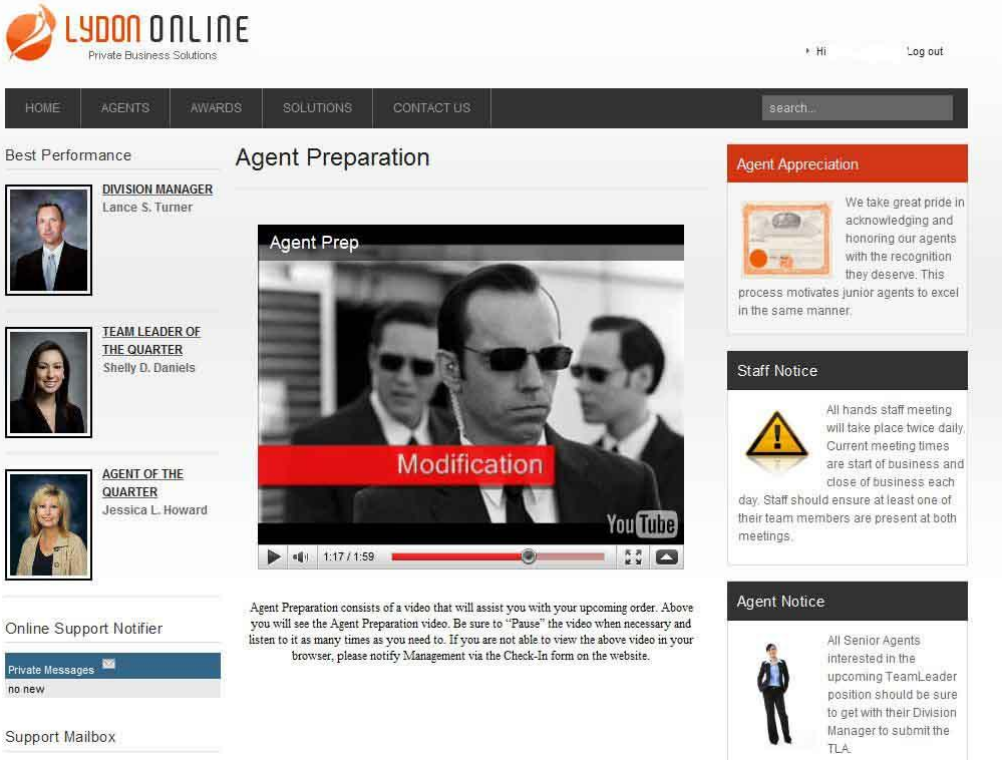
Mule: turn reversible/traceable transaction into irreversible/untraceable



- Wire money to mule
- Mule uses
  - WesternUnion
  - VirtualGold
  - eCash etc
- Trace only to mule
- Reverse only from mule

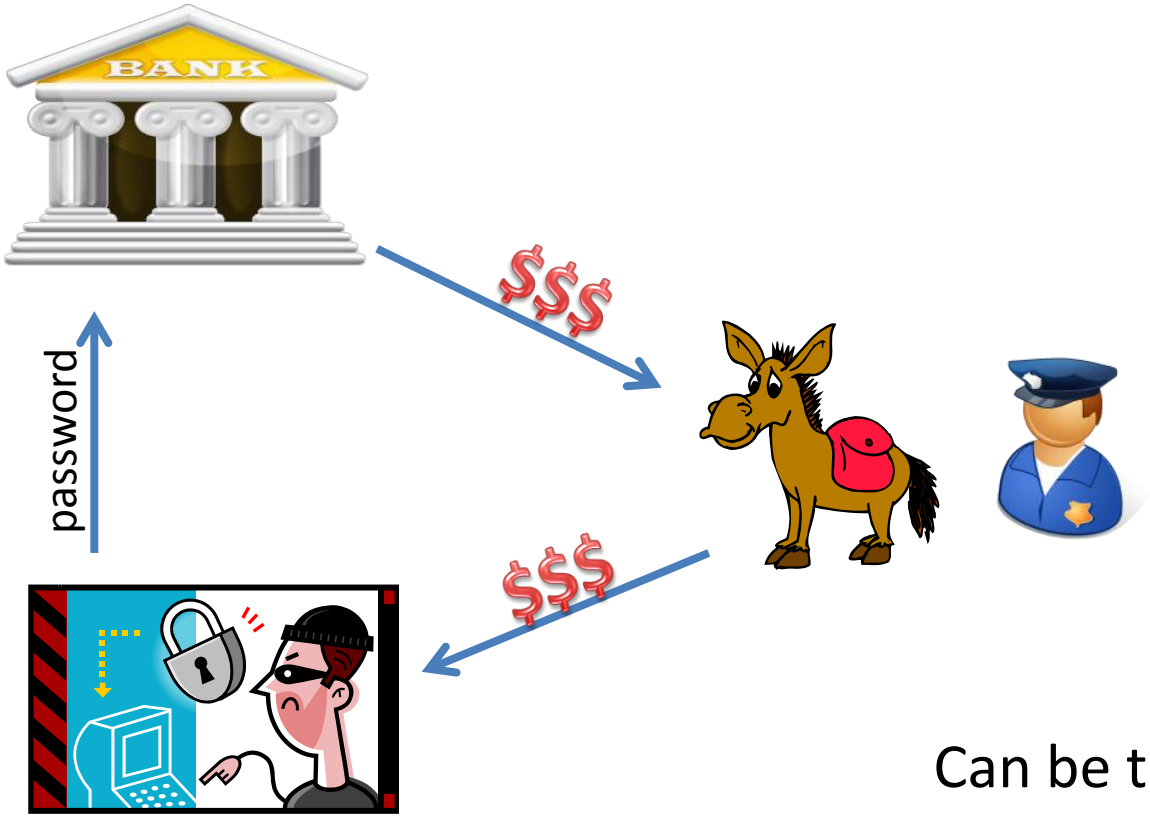
Mule (aka work-at-home schemes)

- Mule is given semi-plausible reason to “process transactions”
- Receive funds from victim acct
  - Reversible
  - Traceable
- Send funds to attacker
  - Irreversible
  - Nontraceable
- Mule gets 10-20% “commission”
- Mule never meets “employer”
  - Uses only cash, unstoppable transfers
  - Urgency is a common theme



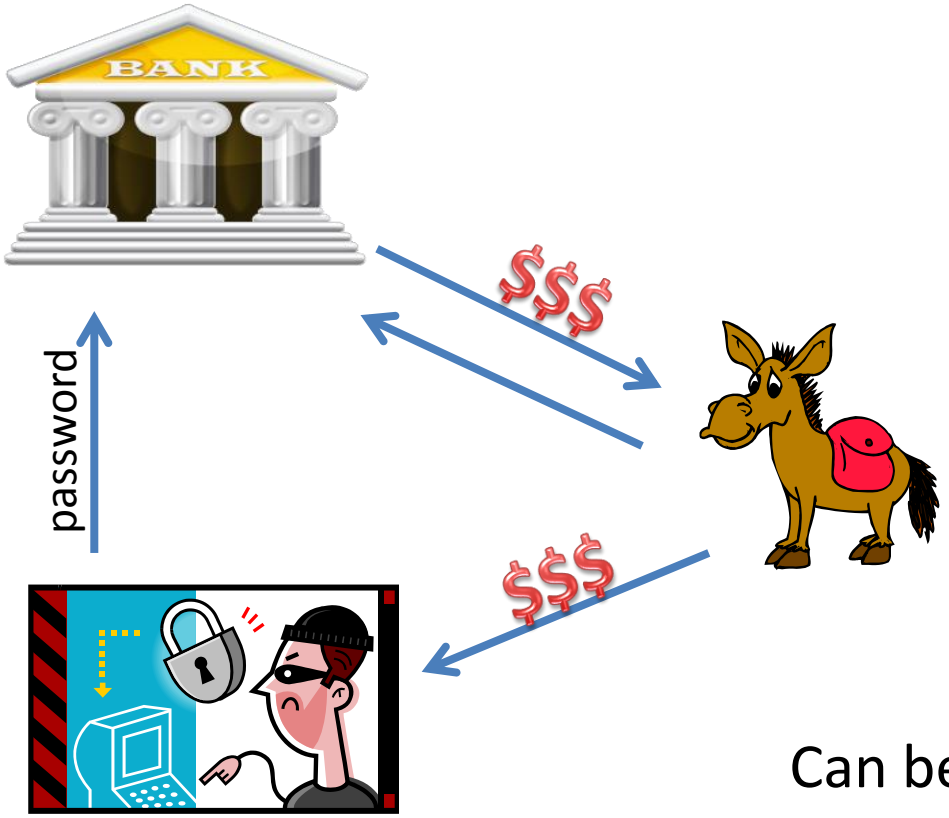
Q: Why doesn’t attacker just use, e.g., Western Union directly?
A: Requires ID or signature on victim acct

When Transaction is traced



Can be traced only to mule

When Transaction is reversed



Can be reversed only from mule

Start to finish

Phisher steals $10k from victim acct

	Before discovery	After discovery
Victim	**-$10000**	**$0**
Bank	**$0**	**$0**
Mule	**+$1000**	**-$9000**
Attacker	**+$9000**	**+$9000**

Attacker stole From mule not victim!

- Attacker stole from mule, not from victim or bank!!
- Mule has no consumer protection
  - (Reg E doesn't apply: initiated the transfer)

Banks understand non-repudiation

Claim*: if can be repudiated it can be reversed

Sketch of Proof: Multiply any repudiable non-reversible transaction by 100m/day.

	Reversible	Non-reversible
Repudiable	My CC payment Checks ETF	?
Non-repudiable		Cash at ATM Western Union Moneygram

* US consumer accts only, Your mileage may vary.

Passwords are not the bottle-neck

- “Most money mules get a single transfer” Krebs (May 11, 2010)
- “Ratio of stolen credentials to mule capacity could be as high as 10000 to 1” Cisco Annual Security Report

- Recruiting/running mules is high-touch

Passwords are not the bottleneck

- Stealing passwords is easy
- Cashing out is hard
- Oversupply of credentials on underground economy

- Harm done α outflow, not inflow

Underground Markets are not Thriving

"In the Underground Economy even those without great skills can barter their way into large quantities of money they would never earn in the physical world."

[Thomas and Martin, ;login 2006]

Why do Credentials sell for pennies on dollar?

- Symantec: “CCN’s sell for $0.5 to $12”
- Cymru: $500 for face value $10million creds
- Franklin etal.: 465 free CCNs/day on single channel

- Offered Explanations:
  - More supply drives price down [Symantec]:
    - But demand for free money is infinite?
  - Volume Sellers don’t care [Cymru]:
- **Nobody sells gold for the price of silver**

Offers to Buy, Offers to Sell

- Published accounts on underground economy:
  - No observed transactions
  - $0 changing hands
- Offers to sell greatly outnumber offers to buy
- Participantion:
  - Anonymous
  - Scriptable
  - Cheating is ubiquitous
- Sort of like netnews w/o the quality control

How Can Market Function when Cheating is Common?

- Thomas & Martin [;login 2006]
  - "Each IRC network will normally have a channel, such as #help or #rippers, dedicated to the reporting of those who are known to conduct fraudulent deals."
- Symantec: [Underground Econ Report]
  - Many IRC servers have channels listing current rippers
- Franklin et al [CCS 2007]
  - 22% of posted CCNs failed Luhn checksum
  - Utilities provided by channel admin designed to steal CCNs
- Dhanjani and Rios [Blackhat 2008]:
  - Backdoors common in for-sale phishing kits/tutorials
- Cova et al [WOOT 2008]
  - Obfuscated backdoored phishing kits

- Countermeasures ought to be easy. (Franklin et al [CCS 2007])

Symantec:

"Potential value of CCNs stolen $5.3bn"

- Sum of asking prices: $163 million
- [Total offered for sale] x
  FTC Avg CCN fraud $5.3 billion
- So Symantec estimate = [Sum of asking prices] x 32
- **This assumes:**
  - 100% of goods offered on IRC channels sell (at asking price)
  - Banks detect 0% of attempted fraud
  - Rippers account for 0% of sales
  - Sellers give buyers 30x return

A Simpler Explanation

- Buyers demand 5x return
- Final price 50% of ask
- Assume 10% of offered creds sell *and* are good

- Total CC fraud from channels:

  $163 \times 5 \times .5 \div 10 = \$41$ million

- **Factor difference with Symantec: 128x**
  - Extrapolating from $0 to $5.3 bn is a big jump

Credential Stealing as a Business

"We try to buy businesses with intrinsic durable competitive advantages." Charlie Munger

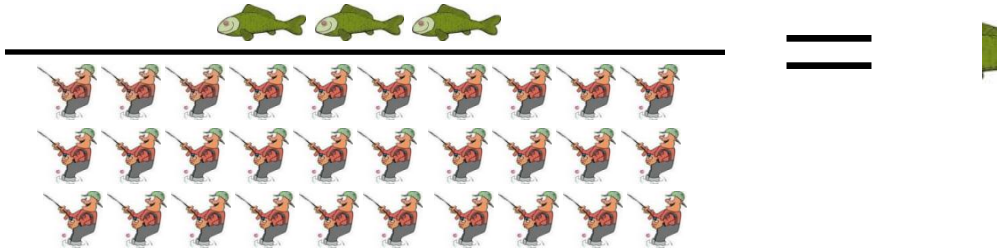
- No barrier to entry
- No protection for
  - Intellectual property
  - Brand loyalty
  - Customer lockin
- No contract enforcement

Open Access Resources

- ***Open access to the resource***, i.e. no barrier
  - Anyone who wants to fish/phish can exploit
- Tragedy of the Commons
  - Fishing ground yields far less than it is capable of
  - Phishing yields far fewer dollars than possible

A Quick lesson in Competition

Return = $\frac{\text{Victims}}{\text{Phishers}}$



More Phishers

Less Phish?

The squeeze on phishing

- Return = Victims/Phishers

- Denominator increasing (“free money!!!!”)
- Numerator decreasing. Why?
  - ***Because*** the denominator is increasing
  - Technical measures: browser warnings etc
  - Fraud detection: banks get better
  - Users learn: nobody gets phished 10 times.

“If it sounds too good to be true then it is.”

NIST advice on cyber-scams

Sound advice when counseling users on mule recruitment, Nigerian scams etc. How come we forget it when considering the prospects for scammers?

“But, they wouldn’t be doing this if they weren’t making money”

Effort ≠> Dollars

Attempt to reach: 100000
Reach Klondike: 20000
Pan for gold: 12000
Find any gold: 4000
Get rich (> $5k): 300

Gold extracted: $50 million
Goods sold: $100 million

Prospectors on the way to the Klondike 1897

“They wouldn’t be doing it if they weren’t making money”

- No. They think they’re going to make money
- Where would they get that idea?
  - Black Market In Credit Cards Thrives on Web
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When we encourage overestimation of returns we make things worse.

Sex, Lies and Cyber-crime Surveys

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Cyber-crime: “the largest transfer of wealth in history.” K. Alexander, Dir. NSA

- Cybercrime estimates come from surveys

$$Estimate = \frac{|\boldsymbol{X}|}{|\boldsymbol{R}|} \sum_{i \in \boldsymbol{R}} f[r_i]$$

- Surveys are reliable, right?

“You should never trust user input”

Writing Secure Code, Howard et al.

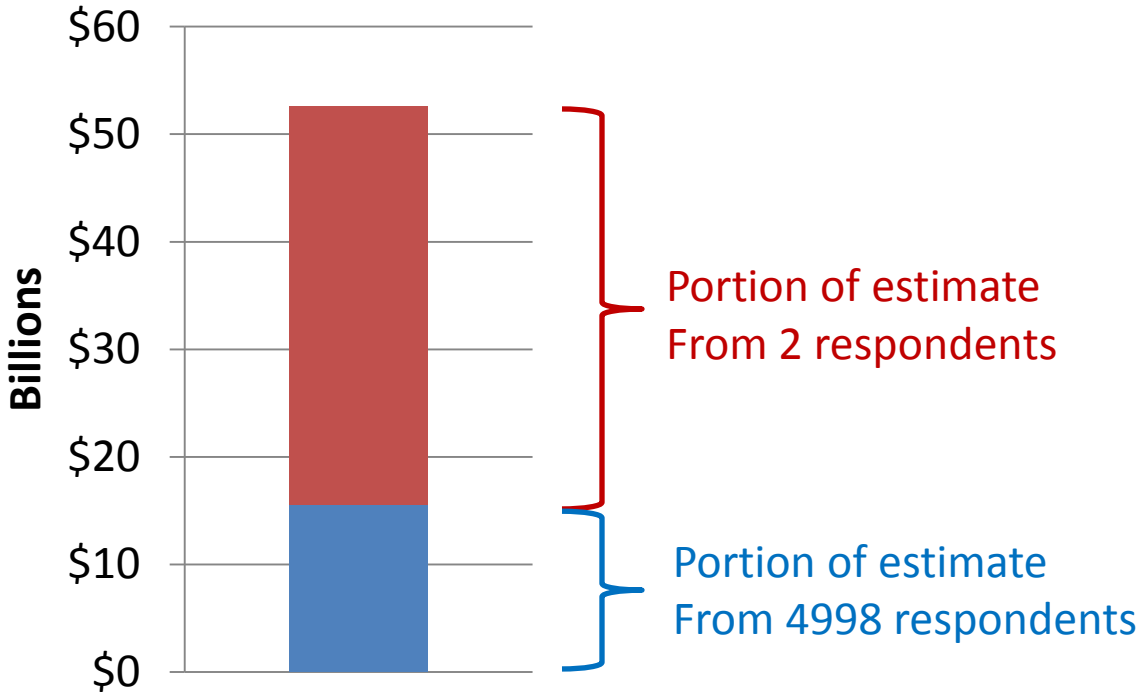
- Importance of input validation in security
  - SQL Injection
  - Buffer overflows

$$\frac{|\boldsymbol{X}|}{|\boldsymbol{R}|}\sum_{i\in\boldsymbol{R}} f[r_i] \quad \equiv$$

```
total = 0.0;
for (i=0; i < survey_size; i++){
        total += (double) strcpy(user_input[i]);
}
estimate  = total * population_size/survey_size
```

- Practice unacceptable in writing code ubiquitous in forming estimates

FTC '06 ID Theft Survey



- Two respondents contribute a factor of

$$\frac{37}{2} \Big/ \frac{15.6}{4998} = 5927 \text{ more than average}$$

- Two vote at 6000x strength of everyone else.

Conclusions

- Banks understand non-repudiation
- Passwords are not the bottle-neck

- If it sounds too good to be true then it is
  - Cyber-crime is not easy money
- Never trust user input
  - Most cyber-crime estimates you've seen are junk

Supporting Documents

- D. Florêncio and C. Herley, "Is Everything We Know about Password-Stealing Wrong?", IEEE Security&Privacy magazine, to appear

- D. Florêncio and C. Herley, "Sex, Lies and Cyber-crime Surveys", WEIS 2011