Multifactor Authentication
Past, Present, and Future

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Audience Survey

1. How many currently deploy multifactor authentication (MFA) in some form?

2. How many have MFA on their roadmap for the next year?

3. How many would like to deploy MFA if they had unlimited time and resources?

Agenda

- **A Brief Intro to Multifactor Auth**
- The DOs and DON'Ts of MFA
- Application to Real-World Incidents
- Wrap-up

Credential Theft


COMPUTERWORLD

Michigan firm sues bank over theft of $560,000

Experi-Metal says Comerica Bank's online security practices resulted in t

February 12, 2010

A Michigan-based manufacturing firm is suing its bank after online crooks depleted company's account by $560,000 via a series of unauthorized wire transfers last ye


BusinessWeek

FDIC: Hackers took more than $120M in

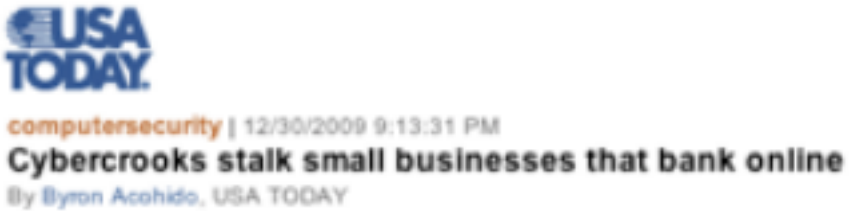
March 08, 2010, 8:24 PM EST

Online banking fraud involving the electronic transfer of funds rise since 2007 and rose to more than $120 million in the third


NETWORKWORLD

FBI investigating online school district theft

The district says $2.5 million has already been recovered but has reverted to using paper ch


USA TODAY

computersecurity | 12/30/2009 9:13:31 PM

Cybercrooks stalk small businesses that bank online

By Byron Acohido, USA TODAY

Bots, RAT, APT, SAG, phishing, vishing, smishing, pharming, whaling, ...

1. We suck at naming!

2. Attackers have discovered that stealing user credentials is the path of least resistance into an organization.

The Evolution of Threats

Snippet from the configuration file of a "Silent Banker" malware sample:

```
<dnsmask dns="chaseonline.chase.com" to="bts-trade.com/index.php" param="dateOfBirth" count="0">
    <parammask> usr_name </parammask>
    <parammask> usr_password </parammask>
</dnsmask>
```

Sophisticated credential stealing attack tools are now a commodity and are publicly available:

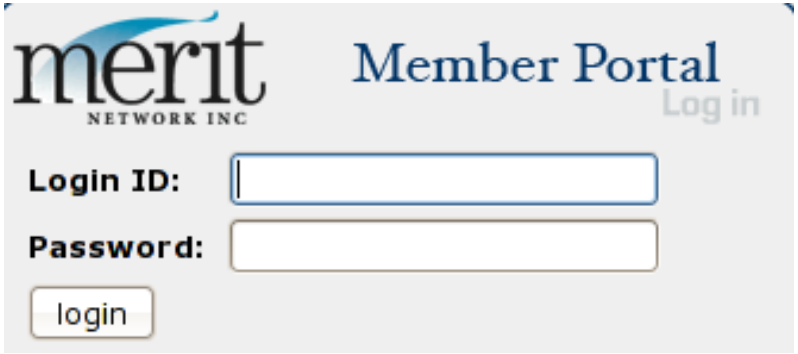
The integrity of your organization's credentials hinges on the ability for an attacker to make a 3-line modification to his configuration file.

Multifactor Authentication

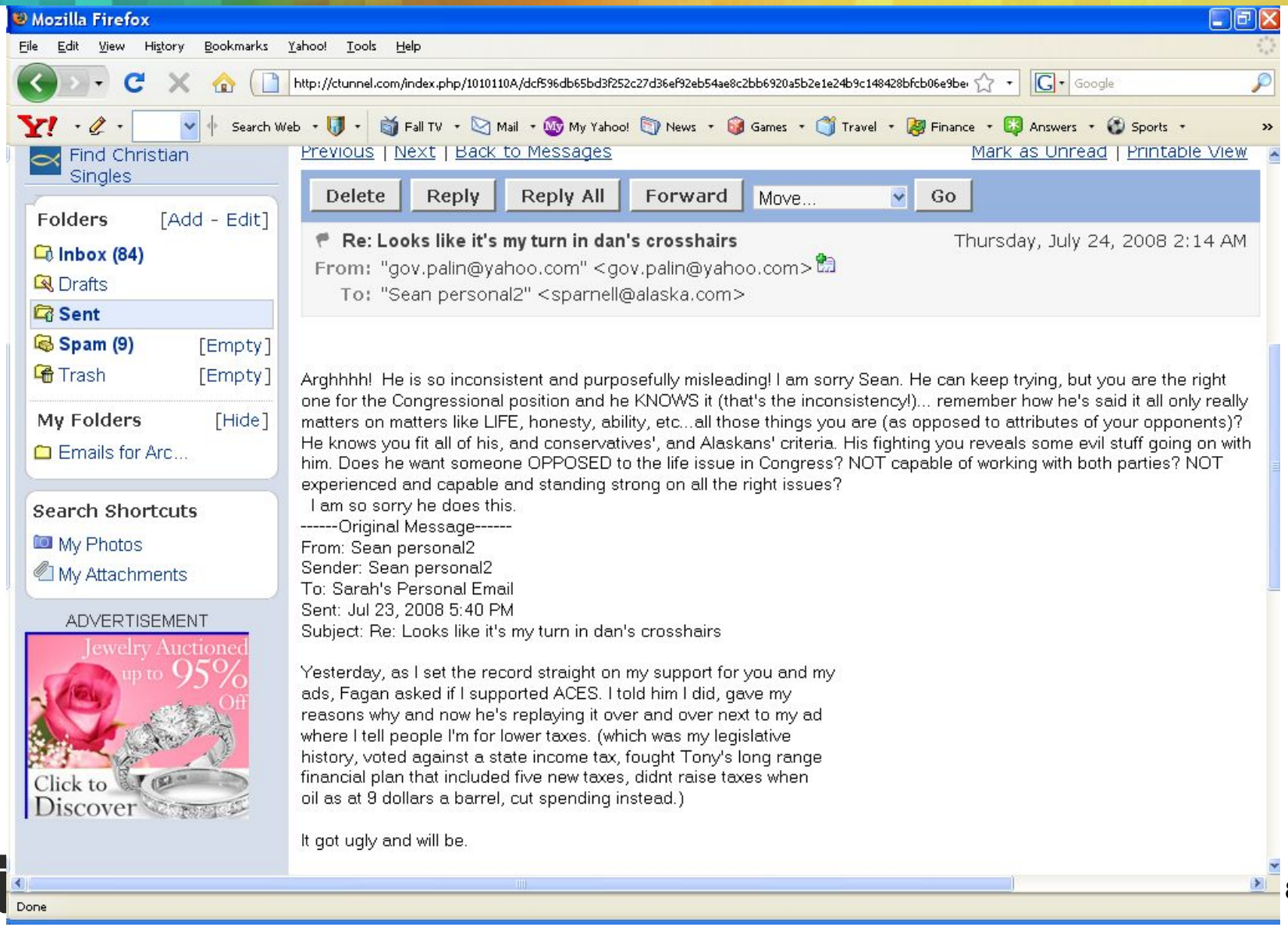
- Multiple factors → increased security
- Factor classifications
  - "What you know"
  - "What you are"
  - "What you have"

“What you know”

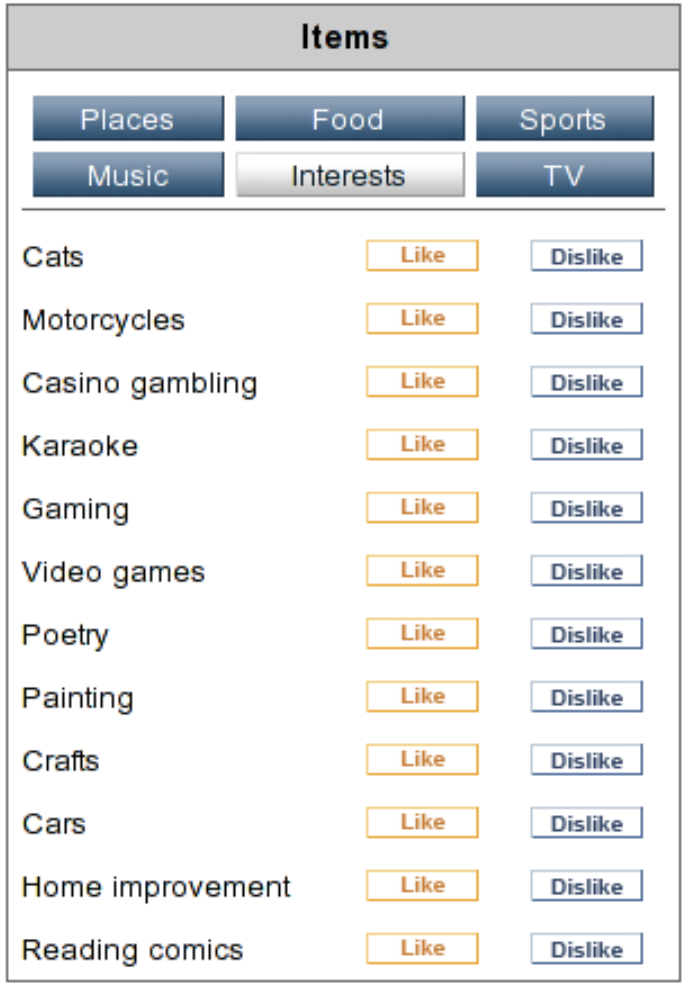
- Knowledge-based
  - “what you know”
- Common examples
  - Passwords
  - Security questions
- Pros:
  - No special equipment
- Cons:
  - Easily phishable
  - User memory burden

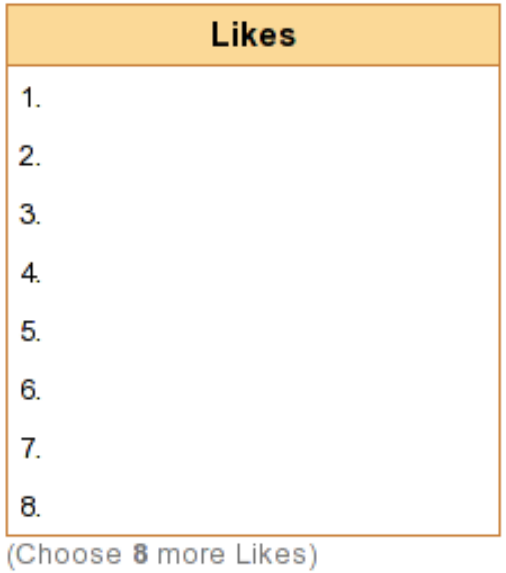


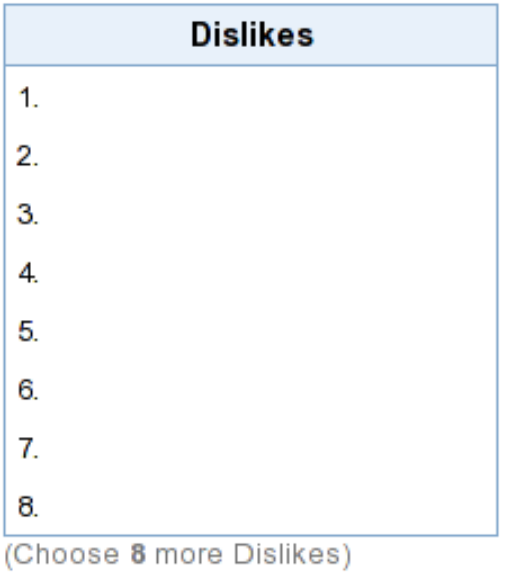
Sarah Palin's Email



Password Reset Nightmare







“What you are”

- Biometrics
  - “what you are”
- Common examples
  - Fingerprint
  - Voice recognition
  - Retina scan
- Pros:
  - No memory burden
- Cons:
  - Expensive equipment
  - Often fails when subjected to scrutiny (eg. Thinkpads)

“What you have”

- Knowledge-based: too weak
- Biometric: too expensive / unavailable

- What about a physical item you possess?
- Example: ATM access
  - Card (what you have) + PIN (what you know)
  - *Used* to be an effective combination

“What you have”

- Common examples
  - Digital certs
  - Smart cards
  - USB tokens
  - OTP generators
  - ...

- Pros:
  - *Should* be resistant to phishing, credential theft
- Cons:
  - Hardware can be costly
  - You can lose the “what you have”
  - Limited capabilities against advanced threats

Enter Mobile Devices

- Why not use a mobile phone instead for MFA?
  - Adoption is soaring (4.6 billion subscribers)
- No hardware costs
  - $50/user hardware token vs. free software token
- Wide range of capabilities
  - OTP generator via mobile apps
  - Out of band voice / SMS
  - Persistent data connection → security, usability, TIV

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Properties of Good MFA

- **Secure**

Against what threats?

Threat	MFA Defense
Passive Phishing / Keyloggers	**Soft / Hard OTP Tokens**
Active Phishing / Remote Access Trojans	**Out of Band Voice / SMS**
Man-in-the-Browser (MITB) Attacks	**OOB w/Transaction Verification**

Raising the Security Bar

DO: Raise the bar for attackers

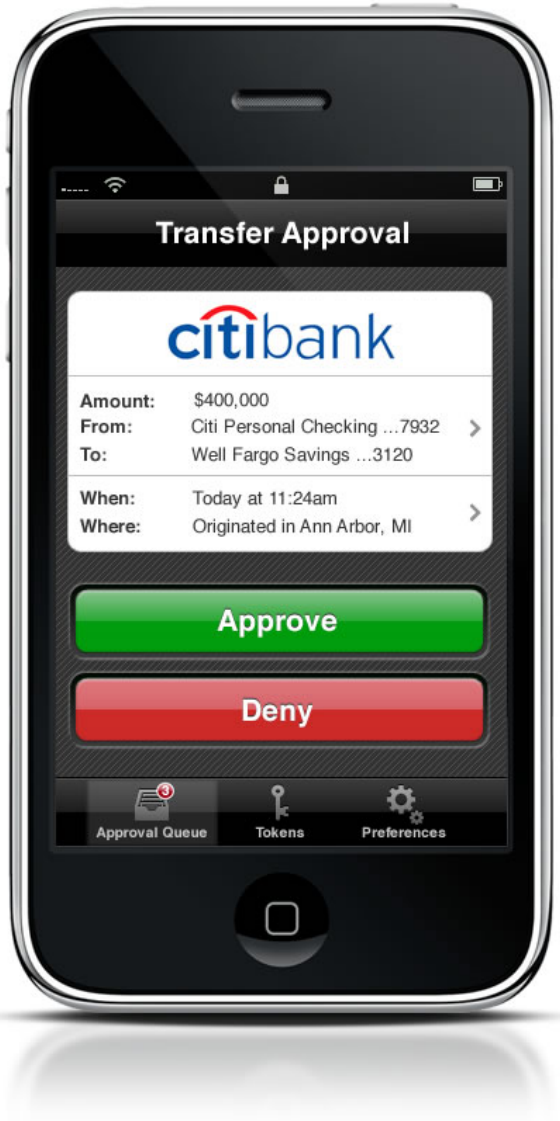
DON'T: Raise it an inch

- Based on real threat models, not obfuscation
- Beware of security theater
  - Inconvenience != security

Raising the Security Bar

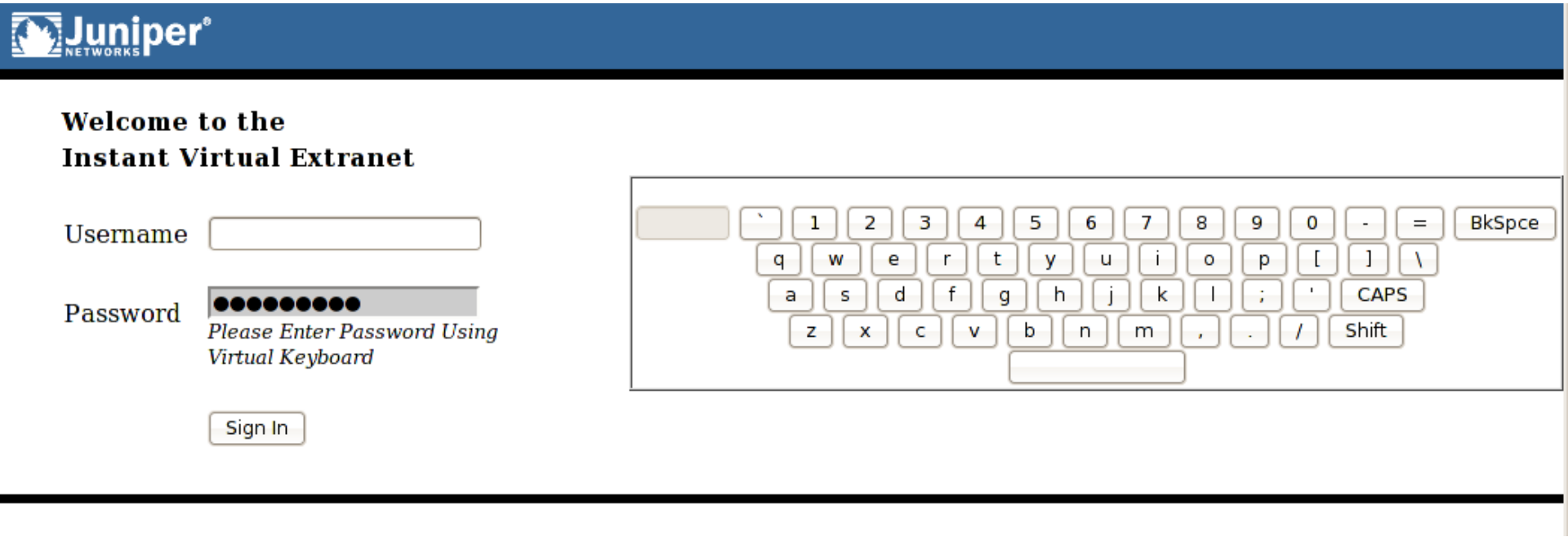
Good example:

- Mobile Auth Agent
  - Secure, real-time channel: Desktop ↔ Mobile device
- Attacker must now
  - Compromise your desktop
  - Compromise your phone
  - Collude between the two devices



Raising the Security Bar

Bad example: the bouncing keyboard



Properties of Good MFA

- Secure
- **Usable**

Users are great at bypassing annoying security mechanisms.

Make It Usable

DO: Make it usable by mere mortals

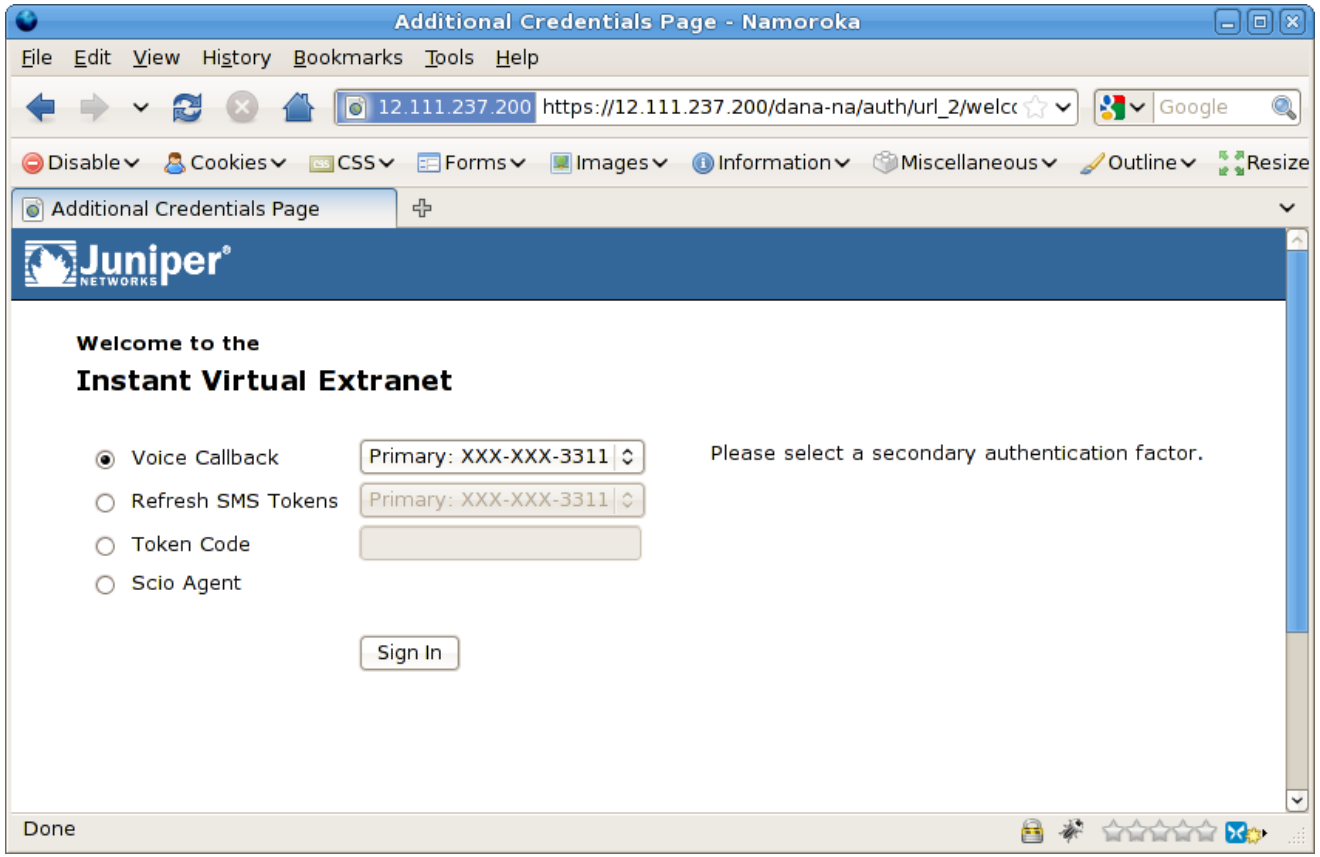
DON'T: Deploy MFA users can't understand

- Give users flexibility
  - Based on preference, environment, etc

	Dumb Device	Smart Device
Online	**Voice/SMS**	**Mobile Auth Agent**
Offline	**Hard Tokens**	**Soft Tokens**

Make It Usable

Good example: a choice of factors



Make It Usable

Bad example: what is this I don't even...

Properties of Good MFA

- Secure
- Usable
- **Low support burden and cost**

Hopefully not the size of your help desk call center

Easy on Admins

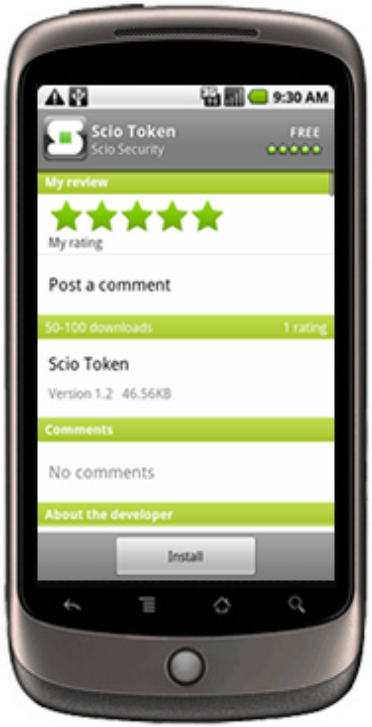
DO: Reduce TCO with a low-touch service

DON'T: Swamp your help desk / support line

- Provisioning users with new/replacement tokens can be a costly pain
- On-premise equipment can be expensive, inflexible

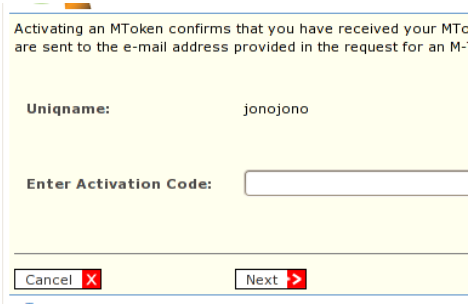
Easy on Admins

Good example:



vs.

Bad example:



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Case Studies

- **Spear phishing for remote access**
- Internal IT access control
- Protecting sensitive transactions

Spear Phishing

From: Web service Support <websupport@umich.edu>
Date: May 20, 2010 3:29:29 PM EDT
Subject: Alert : Issue On Your Webmail Services

Newsletter: Sever Upgrade

Dear Web mail User,

We have Upgraded the web mail access to a Higher Secured Server, Therefore your web mail account needs to be validated.

Please use the link below to Validate your Web mail access automatically.

Update my web mail service [LINK REMOVED]

Failure to upgrade will lead to interruption in web mail service.

Thank you.

Web mail Support
Web Services Administration unit

Spear Phishing

Legitimate site or phishing site?

Interesting Observations

- Email characteristics
  - umich.edu from address
  - Legitimate looking weblogin/webmail URL
  - UofM block-M logo
- Phishing site characteristics
  - Matches style of legitimate weblogin site
  - Redirect to real weblogin after successful phish
- Customized, but widespread targets

Attackers Getting Clever...

What's more interesting comes *AFTER* the phishing attack has succeeded.

1. Attackers phish user credentials
2. Attackers use credentials to access off-campus VPN remote access services.
3. Attackers send spam via authenticated SMTP and internal UofM IPs

These attackers have gained knowledge of specific University IT infrastructure.

VPN Remote Access

- Traditional perimeter model
  - Physical boundary to internal network
- VPN perimeter model
  - VPN gateway acts as the new boundary
  - Inside perimeter tends to be more soft and gooey...as much as we don't like to admit it
- Securing VPN remote access is ***key***

Multifactor Options?

- SSL VPNs are a great MFA integration point
  - Exposes a web interface to user
  - Allows for interaction, selection of factors

DEMO!

Case Studies

- Spear phishing for remote access
- **Internal IT access control**
- Protecting sensitive transactions

Internal IT Intrusions

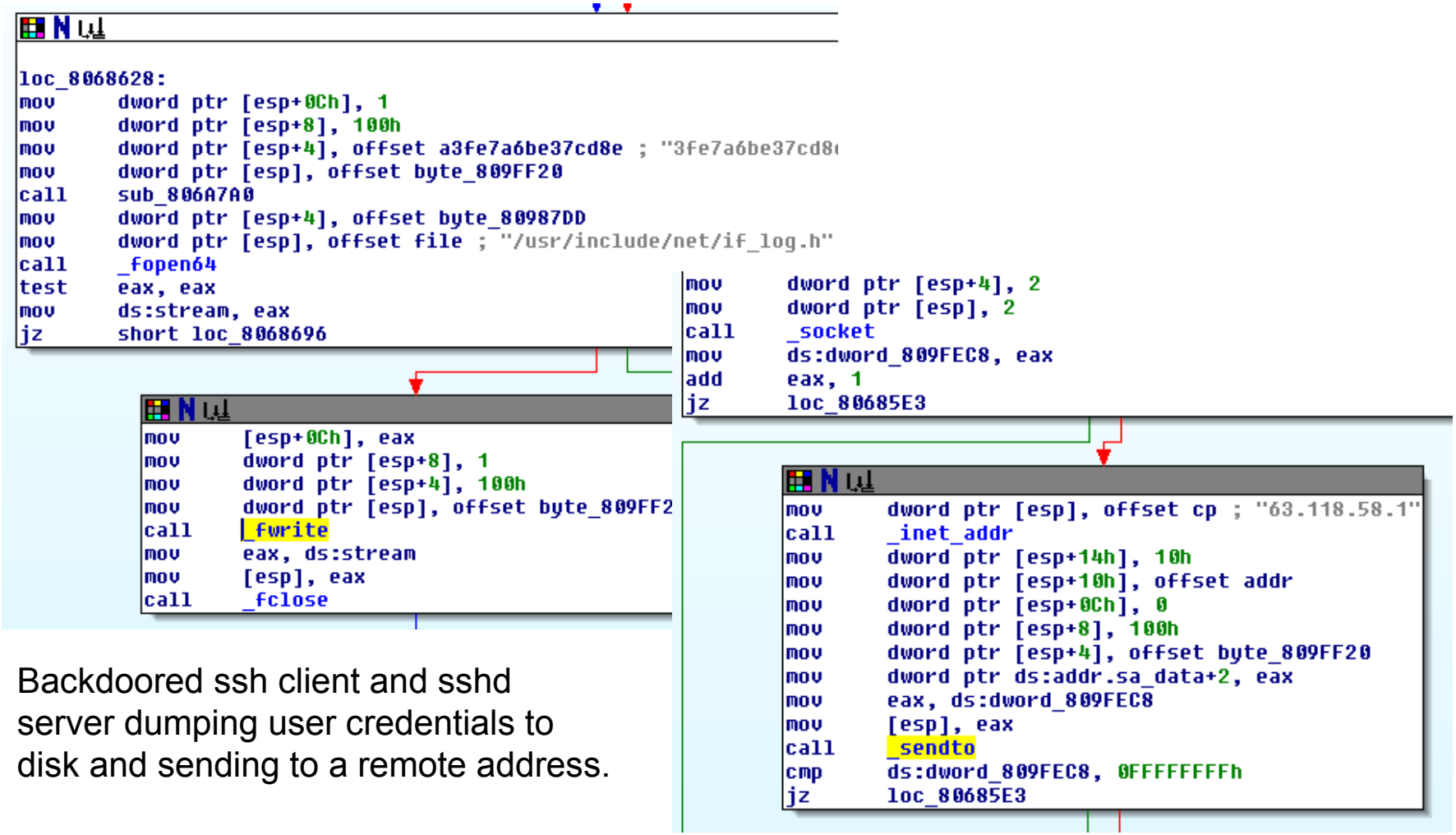
"We are suffering the mother of all security incidents here...to the extent that when I came in this morning, I unplugged the fiber from our machine room. We had to destroy X in order to save it."

- IT Administrator

Post-Intrusion Forensics

- Entry point
  - ssh brute-force attempts
  - Weak user password
- Salt in the wound
  - Privilege escalation
  - Trojaned ssh client and server

Backdoored SSH



Backdoored ssh client and sshd server dumping user credentials to disk and sending to a remote address.

Multifactor Options?

- How to protect internal servers?
  - PAM is a good integration point!

DEMO!

Case Studies

- Spear phishing for remote access
- Internal IT access control
- **Protecting sensitive transactions**

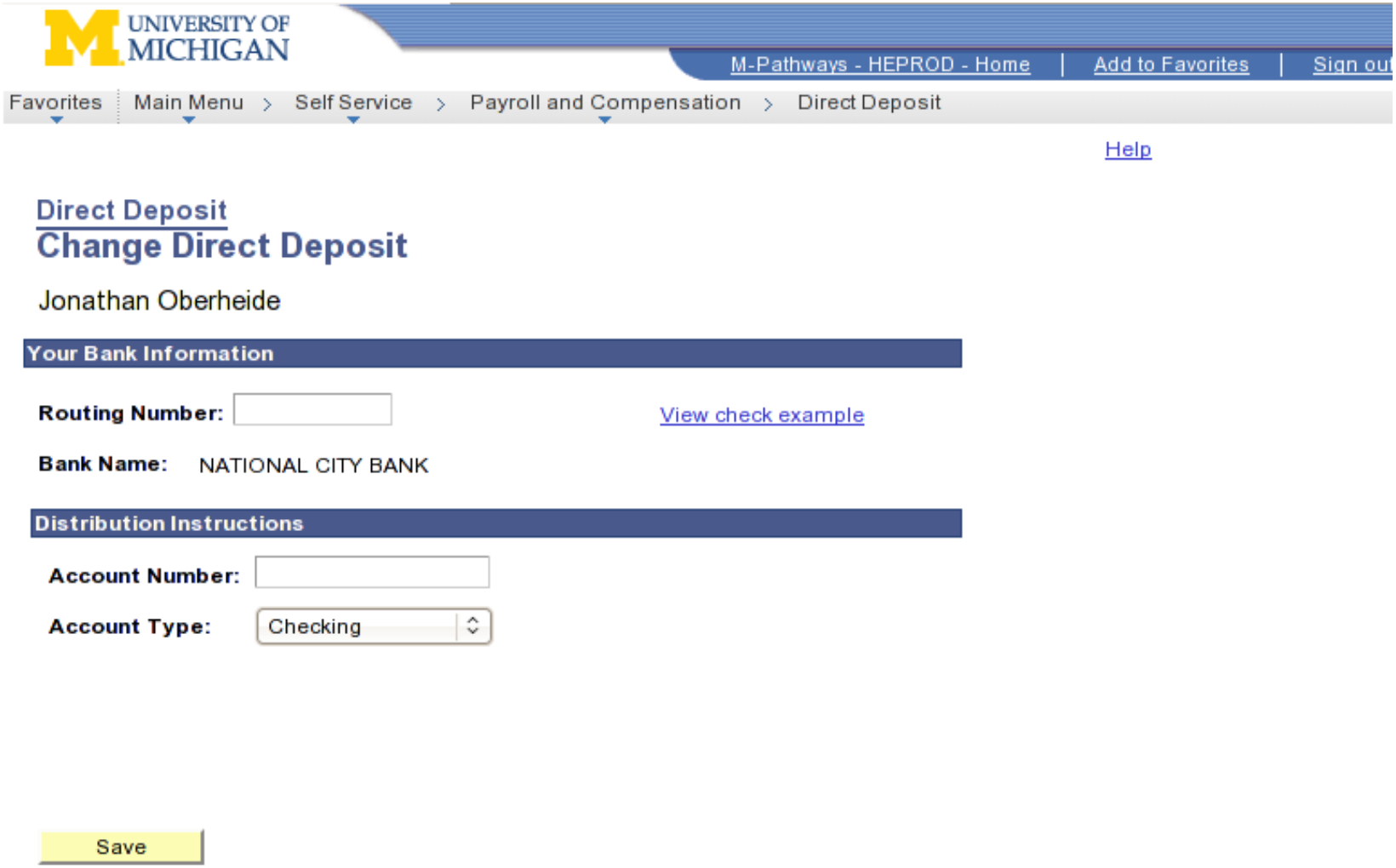
Sensitive Transactions

MFA doesn't have to be applied exclusively at a “login” stage.

Protection can instead be applied to individual sensitive transactions within an application.

- Assume entry point is completely bypassed
  - eg. Cosign Weblogin vuln
- RO vs. RW mode
  - Allow common case of RO
  - Challenge only upon sensitive RW operations

Direct Deposit Verification



Multifactor Options?

- Confirmation email?
  - No, attacker can delete it
- Require a hard/soft token?
  - Depends on frequency of transaction
- Voice callback is a good fit here
- Similar use cases:
  - Password reset, account activation, etc

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Take-Aways

- Attackers focusing on users as the weakest link instead of exploiting apps/OS
- Knowledge-based authentication alone is insufficient for protecting access
- Secure, usable, affordable MFA is possible
  - But beware the crazies!

Thank you

QUESTIONS?

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