PGPuam

Public Key Authentication for AppleShare

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Overview

- Existing User Authentication Methods
  - Common attacks & weaknesses
- Getting beyond passwords
  - Cryptographic signatures
- PGPuam
  - Enhancing AppleShare authentication

Who this talk is for

- System Administrators
- Security conscious users
- Mac OS developers

See also

- AppleShare Authentication Architecture
  (Weds)
- PGPticket - A Secure Authorization Protocol
  (Thurs)

Background

Who is Vinnie Moscaritolo?

- Apple Developer Services
- (formerly Chief Consulting Engineer, PGP)
- Hosts the Mac-Crypto Workshop

- Not a Cryptographer
- Not a Lawyer

- Lots of "real world" security experience
- <http://www.vmeng.com/vinnie>

What has changed?

Secure Networks → Open Networks

Insecure Comm → Secure Comm

= New threat model

Attacks to Network Services

- Packet Sniffing
- Automated Password Guessing
- Replay Attacks
- Session Stealing
- Infrastructure Penetration
- Device Penetration
- Social Engineering & Rubber Hose

Packet Sniffing

- Packet sniffing SW is widely available.
- Cleartext passwords are common.
  - POP
  - FTP
  - PPC Toolbox

Automated Password Guessing

- Brute force vs dictionary attacks
- Online attacks
  - Easily detectable
- Offline attacks
  - Targets password databases
  - Accessed through other holes (cgi)
  - Many utilities available for cracking `/etc/passwd`

Replay Attack

- Capture previous session
- Replay later.

Session Stealing

- Wait for user to initiate login.
- Denial of service attack to client
  - Forge TCP reset, closes clients connection
- Hijack already authenticated session
  - (with victims authentication & privs)

Infrastructure Penetration

- Target name-servers or routers
  - Force reload with infected sw
- Initiate Man-in-the-middle attack
  - User notices no loss of service
  - Attacker monitors all traffic (even encrypted)

Device Penetration

- Virus or Trojan Horse
- Keystroke capture
- Spoofed downloads
  - Sign your distributions!

Social Engineering & Rubber Hose

- People are weakest link.
  - Easily fooled, coerced or intimidated.
  - Shoulder surfing
- Difficult to defend against
  - Requires management acknowledge the threat, and support threat awareness education for users.

User Authentication Methods

- Local Authentication
  - Authentication material never exits user's control
  - e.g. Mounting local a PGPdisk volume
- Remote Authentication
  - "A secret shared, isn't."
  - e.g. remote server password

Authentication Methods

- Something one has.
- Something one knows.
- Something one is.

Or a combination of the above

Something one has

- Hardware token
  - Personal, mobile & convenient
  - Corp Badge, ATM card, Car Keys
- Passive = Key storage
- Active = On-board crypto, Key never leaves device

- Hardware tokens are subject to theft.
  - Combine with password or biometric.

Something one is.

- Biometrics
  - Fingerprints, Retina scans, Voice recog
    - Records measurement of human traits and later compares to a stored template.
  - Subject to Replay Attack
  - Fuzzyness is unsuitable for key storage
  - Returns (True or False)
  - Combine with password or biometric.

Something One Knows

- Secret Password, PIN,
- Oldest form of authentication
- Easiest method to breach

What's wrong with Passwords ?

- Passwords in transit are subject to sniffing & replay attacks.
  - Never send passwords in clear-text (use APOP, SPEKE, etc)
- Simple passwords vulnerable to dictionary attack
- Complex passwords are difficult for user to manage.
  - Vulnerable to social engineering
- Remotely stored passwords are out of user's control.
  - Can be attacked at server.
  - "A secret shared, isn't."

Too much to remember.

- Most corp. IS policies require that passwords:
  - Complex variation of alpha, numeric or punctuation
  - Change periodically.
- Limitation of human memory
  - "Unrealistic to expect that users will reliably memorize more than one or two passwords"
  - Typically written down in convenient location
- Single sign-on to the rescue

Single Sign-on Systems

- User authenticates to proxy
  - "Gives authority to negotiate all subsequent authentication to remote services autonomously"
- Password Caches & Keychains
- Remote Systems. (ldap, Jade)
- Kerberos

Password Caches & Keychains

- Intercepts server logins & records passwords
- Introduced in PowerTalk (sys 7.1.1)
- Issues:
  - Key database must be kept synced across multiple machines.
  - Database file must be strongly encrypted
  - No guarantee that file server login isn't in clear-text.
  - API needs to prevent rouge export of passwords
  - Integration with multi-factor systems can be awkward.

Kerberos

- Popular among higher Ed
- Based on Secret Key encryption
- Depends on trusted servers
  - Requires physically secure location
  - Synchronized clocks
- "Inappropriate for small biz or large scale Internet deployment".

Multi Factor Systems

- Combine password, biometric or token
- Most secure method
- Requires separate attacks on each method.
- Eg: SecurID
  - Requires servers in physically secure locations
  - Open to other attacks
  - See <ftp.secnet.com/pub/papers/securid.ps>

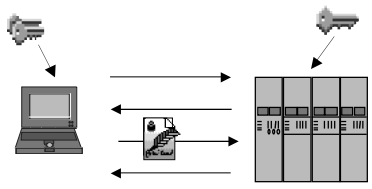
Beyond Passwords

- Provide Single Sign-On experience
- Strong user authentication
- No dependency on trusted servers
- A compromised server, doesn't effect others.
- Builds on existing infrastructure
- Scales to large user base.

Authentication with Cryptographic Signatures

- Public Key Cryptography
  - Holder of private-key is only entity that can sign.
  - Holder of public-key can verify signature.
- Public key functions as principles identity in cyberspace

Cryptographic Challenge - Response



- Client requests access.
- Server generates random challenge string.
- Client signs challenge with private key
- Server verifies signature with public key & grants or denies access.

Why Crypto Authentication?

- Same key is also used to sign e-mail
  - User has only one passphrase to remember.
  - Existing key management infrastructure
- Strong user authentication.
  - Expensive Crypto operations are OK
  - Random challenge prevents replay attack
- User maintains all secret material
  - Compromised server results in limited damage

PGPuam

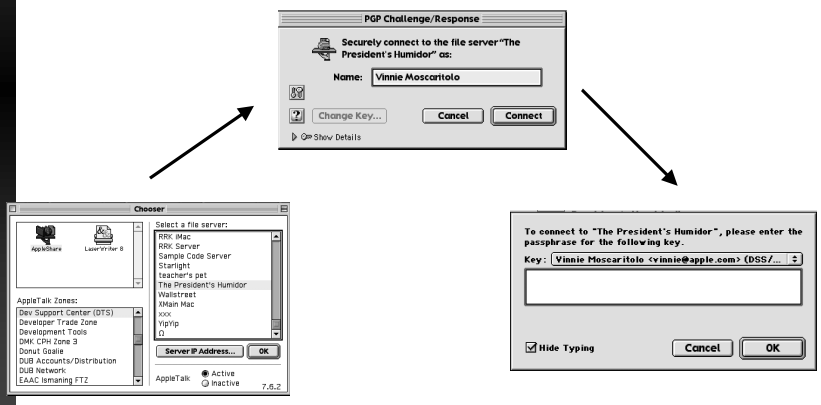
- AppleShare User Authentication Module
- DTS Sample Code (CW3 C, C++)
- AppleShare client 3.8.1
- AppleShare IP 6.1
- PGPsdk 1.5


PGPuam client


PGPuam

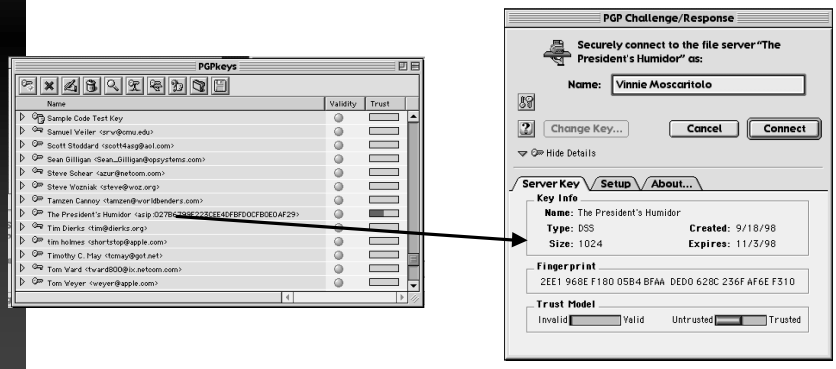
PGPuam

Enables users to securely connect to AppleShare IP servers



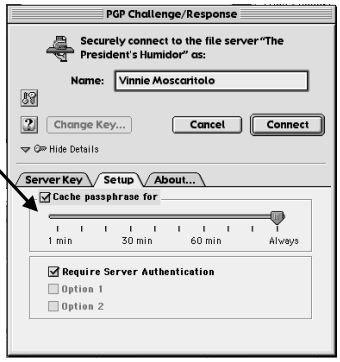
PGPuam

- Two way authentication
  - Client has copy of server public key



PGPuam

- Single Sign-On



Design Decisions

- PGPsdk
  - Leverage existing key infrastructure
  - Needs to work at defered task time
  - Trust model not critical
- Random challenge / counter challenge
  - Prevent sign-this attack
- Sign Only
  - Export Control issues

Protocol Details (login)

FPLogin	1 byte
<AFP Version>	p-string
“PGPuam 1.0”	p-string
<username>	p-string
<challenge>	p-string (16-20 bytes)

AuthContinue	1 byte
<total challenge len>	p-string
<offset to orig challenge>	1 byte
<counterchallenge>	64 bytes
<sig>	20 bytes
<user key fingerprint>	p-string

Protocol Details (login cont)

FPLoginCont	1 byte
0000	1 byte
<ID number>	2 bytes
<signature>	p-string

<status>

DEMO

Learning Experience

- Getting keys to server (bootstrapping)
- PGPsdk improvements
  - Working with raw key material
  - Key database

What's next?

- Server Manager
  - User Interface
- Security
  - Prevent Session Stealing, HMAC
  - Encrypt sessions
  - Macsbug attack of passphrase cache
- PGPticket
  - Authorization Certificates

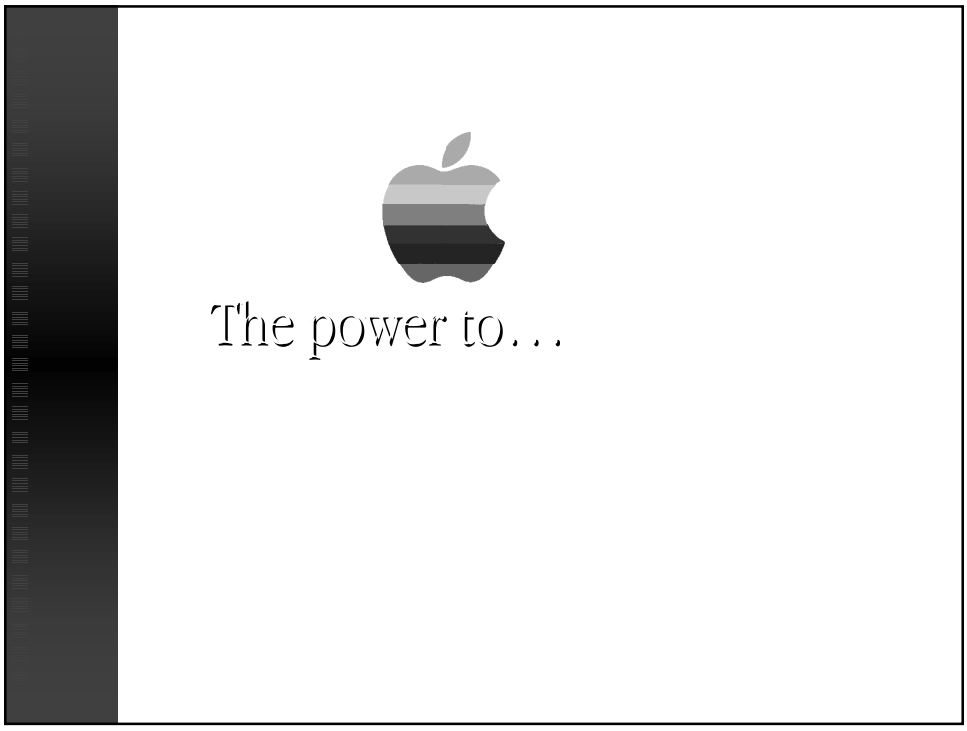
Summary

- Cryptography is more than secret messages

For More Info

- PGPuam
  - <http://www.vmeng.com/vinnie/pubs.html>
- PGPsdk
  - <http://www.pgp.com/sdk/>
- Appleshare IP
  - <http://www.apple.com/appleshare/>

Q & A


The power to…