Practical Magic with SSH

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Overview of Presentation

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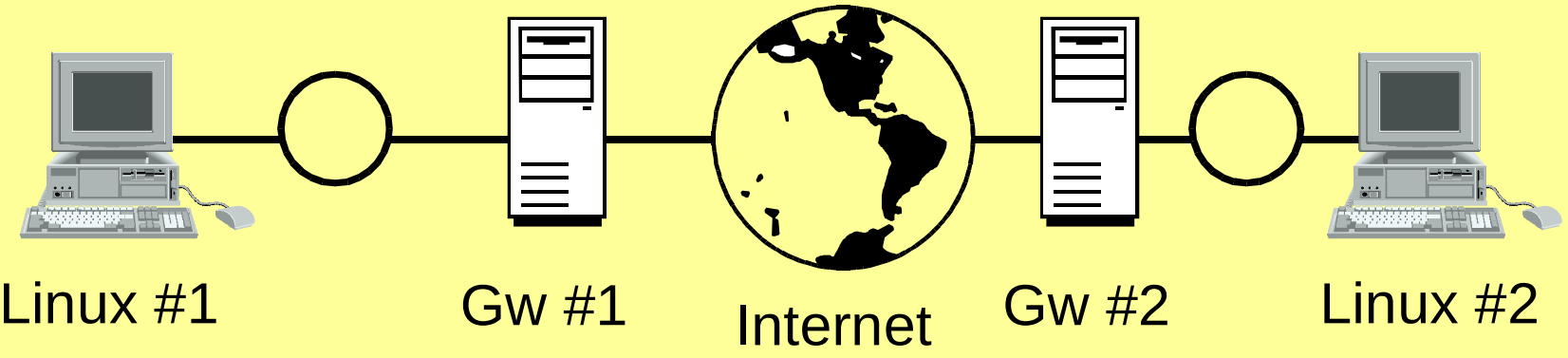
Why SSH?

- Do you care at all about privacy and security?
- Then *don't* use Telnet, rsh, rlogin and friends at all!
- Telnet: Clear−text passwords, clear−text session.
- rsh/rlogin: Even worse - hostname−based trust mechanism is trivial to spoof. (Think /etc/hosts.equiv and ~/.rhosts)

Example



If Linux #1 needs a connection to Linux #2, attackers can sniff packets on the Internet, on LAN #1, on LAN #2 or on either gateway.

Example, continued

- Therefore, we need a protocol which assumes eavesdroppers hear *everything*, but still cannot impersonate either side.
- The Secure Shell (SSH) protocols offer this capability.

Brief Digression: Crypto−on−a−Slide

- Symmetric Encryption: The *same* (secret) key is used for encryption and decryption. Ideally, arbitrary amounts of *chosen plaintext* and corresponding ciphertext will not reveal key. Symmetric encryption fast.
- Public Key Encryption: A *public* key is used for encryption and a secret *private* key for decryption. Or, the secret key for signing and public key for validation. Public key encryption slow.

SSH1 Protocol (more−or−less)

- The server has a public/private key pair.
- The client *must know* the server's public key in advance.
- The server sends its public key to the client as well as a periodically−generated server key. Client verifies that public key is known.
- The client generates a random *session key*, encrypts it with the host and server key, and sends it to the server. Everything is now encrypted with the session key.

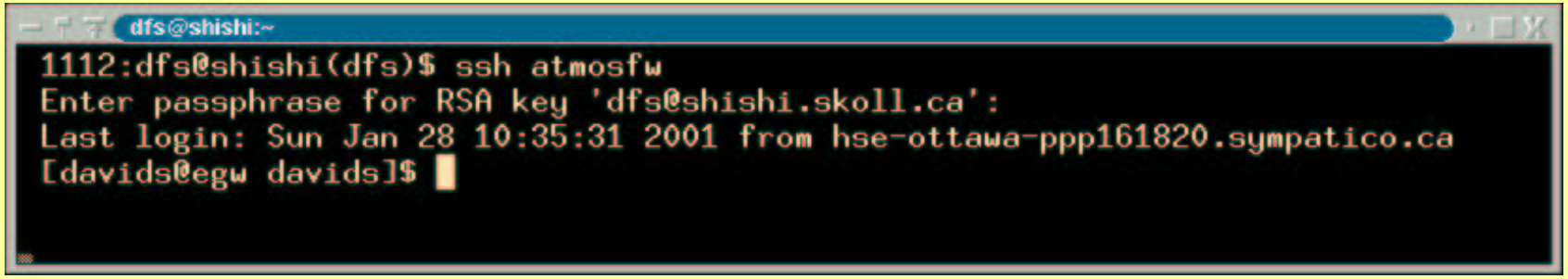
SSH2 Protocol (more−or−less)

- One of a number of *key−exchange* algorithms is run. At the end, client and server share a secret key, unknowable by eavesdroppers.
- Digital signatures verify identity of server to client.
- Everything following key exchange is encrypted with the shared secret.

Obtaining and installing SSH

- Best to use OpenSSH. It’s free and developed by OpenBSD developers who are security fanatics.
- Go to http://www.openssh.com and follow the links to "portable OpenSSH". There are Linux RPM’s available.
- You also need OpenSSL, available from the OpenSSH download sites.

Screenshot of SSH in Action



- As simple to use as rsh!
- Just use *ssh host*, enter passphrase and you have a shell.

Verify the Host Key

- If SSH does not recognize the host key, it will show the *key fingerprint* and ask if you want to continue.
- ***DO NOT*** continue unless you are absolutely sure the key fingerprint is correct.
- If SSH gets a different key than the one in its known_hosts list, it will print a huge warning and refuse to continue. Getting the wrong host key is usually because someone messed up, but could be due to spoofing.

Setting up the SSH Client

- Generate an SSH key pair: *ssh−keygen*
- Enter a pass phrase to protect the private key.
- Copy the private key to ~/.ssh/identity, mode 0600.
- Copy the public key to the remote machine in ~/.ssh/authorized_keys.
- You can also use "encrypted password authentication", but this is *not recommended.*

Password Authentication

- Just like Telnet or login, except username and password are encrypted.
- Advantage: Don’t have to generate a key pair.
- Disadvantage: Less secure. Susceptible to password−guessing attacks.

Public Key Authentication

- Uses public/private key pair for authentication.
- Disadvantage: Have to generate a key pair and put the public key in ~/.ssh/authorized_keys.
- Advantage: Defeats password−guessing attacks unless attacker has access to private key.
- Key pairs can optionally be restricted in capability. For example, one key could be limited to running a "tar" command for backup.
- Allows fine−grained access control.

X11 Forwarding

- SSH gives you an *encrypted pipe* through the Internet.
- Usually, this pipe is used for interactive shell sessions.
- However, SSH can also do *X11 Forwarding*.
- On the server side, the SSH server creates a "fake" X server (for example, remotehost:10).
- X connections to that server are forwarded through the encrypted pipe.

X11 Forwarding, cont'd

- When the SSH client sees a forwarded X connection coming through, it opens a connection to the real X server and forwards X traffic.
- Net result: You can remotely run X applications, and all X traffic is securely encrypted.
- X forwarding can be disabled by the client or the server.

Port Forwarding

- SSH can forward arbitrary TCP ports over the encrypted pipe.
- Two flavours: Forwarding of local (client−side) ports and forwarding of remote (server−side) ports.
- Example: **`ssh −L 8080:remotemach:80`**
- On the client, TCP port 8080 is forwarded through the encrypted pipe to port 80 on remotemach.

Port Forwarding, cont'd

- **`ssh -L 8080:remotemach:80`**
- SSH client listens on port 8080 on 127.0.0.1.
- When an incoming connection arrives, client notifies the server of this fact. Server opens a connection to remotemach, port 80.
- All further traffic is forwarded over this encrypted pipe.
- If the ssh server is a gateway, remotemach need not even have a routable IP address. It just has to be reachable from the ssh server.

Forwarding Remote Ports

- **`ssh –R 8080:localmach:80`**
- SSH server listens on port 8080 on 127.0.0.1.
- When an incoming connection on port 8080 arrives, server notifies the client of this fact. Client opens a connection to localmach, port 80.
- All further traffic is forwarded over this encrypted pipe.

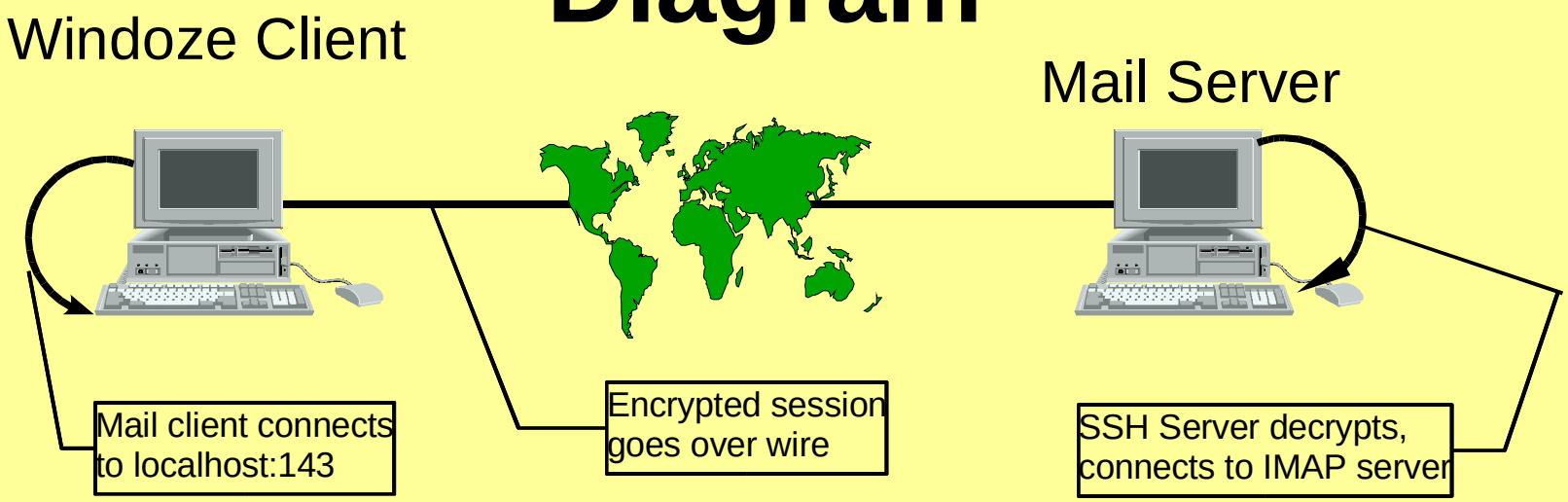
Port Forwarding Caveats

- Only *root* can port−forward privileged local ports.
- Forwarded ports only listen to 127.0.0.1 by default. This is a security feature (which can be overridden.)
- Only *root* on the remote end can forward *from* privileged remote ports. Anyone can forward *to* privileged ports.

Nice Use of Port Forwarding

- Secure access to IMAP or POP3 servers, especially for Windoze clients.
- Using a free Windoze SSH client, set up port−forwarding from local ports 25 and 143 to corresponding ports on mail server.
- On mail server, the only port open (for remote access) is SSH.
- Port−forwarding takes care of restricting access to IMAP, encryption and MTA relaying configuration.

Diagram



- Set up Windoze mail client to use 127.0.0.1 as incoming/outgoing mail server. :−)
- Wait−a−minute! Only *root* can forward privileged ports...
- On Windoze, everyone is *root*...

SSH Agent

- If you use a passphrase for your private key (recommended!), it's annoying to have to type it in each time.
- *Ssh−agent* lets you enter your passphrase once per session (e.g., at the start of an X session) and then decrypts and remembers your key. Use *ssh−add* to control the list of keys remembered by *ssh−agent*.
- When you run ssh, it contacts the ssh agent (over a named pipe) for the private key.

SSH Agent, continued

- SSH Agent is *very* convenient. You can use ssh almost like a transparent rsh. Once keys are set up, you never have to type passphrases or login passwords.
- However, anyone who can get *root* on the machine running SSH Agent can get your private key.
- So *do not* use SSH Agent unless you control the machine and trust that no−one else has *root*.

SSH Agent Forwarding

- SSH Agent can even be forwarded over the SSH pipe.
- This means that SSH sessions on remote hosts can query the SSH Agent on your local host.
- This is (IMO) even more dangerous than the normal use of SSH Agent. Don’t do it unless you trust all the machines along the way.

SCP

- SCP works just like RCP, but uses SSH for transport:

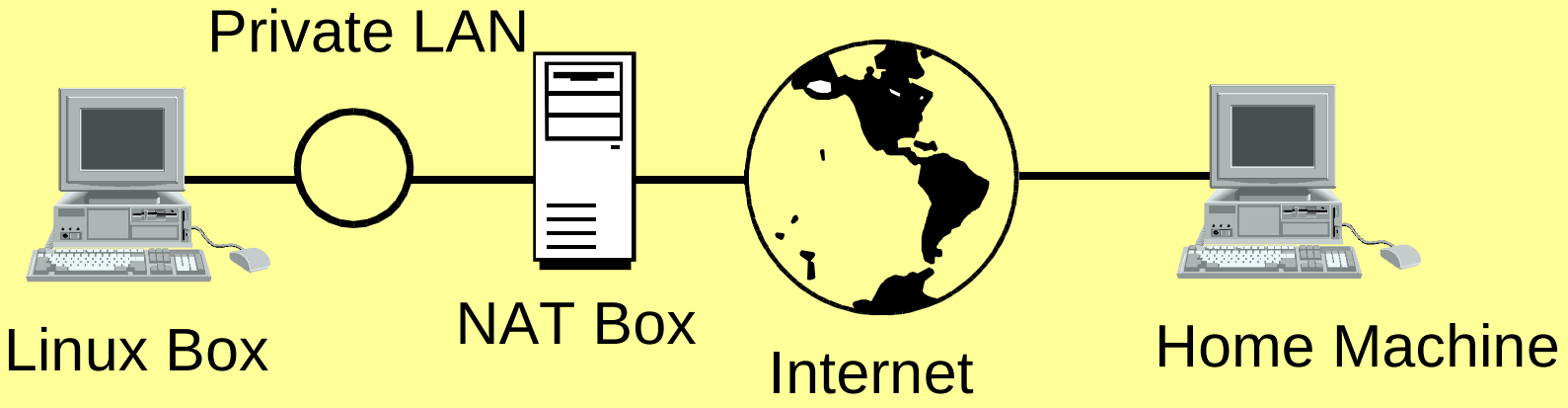
```
scp localfile remotemach:/remote/file
scp remotemach:/remote/file localfile
scp file user@remote:/path
```

RSYNC over SSH

- RSYNC (http://rsync.samba.org) is a tool for efficient mirroring.
- It tries to copy as little as possible to make the remote side match the local side. It can often achieve "compression" ratios of 100−to−1.
- The latest rsync works reliably using the latest OpenSSH as its transport.

Firewall Busting

- Don’t try this at work.
- Many companies use a masquerading firewall (NAT) with unroutable IP addresses to limit access to internal networks.



Firewall Busting, 2

- This kind of setup is *inconvenient*. There's no easy way to log on to your work Linux machine from home.
- Ahh, but... if you have a permanent or semi−permanent (or even non−permanent, if you are tricky) Internet connection at home, you can *bust through* the NAT box and log on to the Linux work machine.

Firewall Busting – Prep Work

- Install an SSH server on both your home and work machines. Have the servers start automatically at bootup.
- Write a script which runs on the work machine which periodically ssh's in to your *home* machine. It should simply run a "sleep 3600" command. Generate a key pair with no passphrase for the script to use.
- On your home machine, add the key to the authorized_keys list with a forced "sleep 3600" command.

Firewall Busting – The Magic

- Have the work machine include this argument to its ssh command: **`-R 8822:localhost:22`**
- Now the magic happens: Work machine calls up home machine. If authorized, executes sleep 3600 and port–forwards 8822 on home machine to port 22 on work machine.
- On home machine, ssh to localhost on port 8822. You'll be greeted with a login prompt from your work machine. You've busted through the NAT box.

Firewall Busting − Refinements

- NAT box limits you to certain ports? Run your home ssh server on port 80 (or 21 or whatever).
- Periodic connections are suspicious? Have work machine look for GPG−signed e−mail telling it to phone home. A fetchmail process can periodically check e−mail on your corporate server and kick in the ssh when it finds an appropriate signed e−mail.
- Moral: NAT doesn’t solve everything. Covert channels are very hard to close.

SSH vs. IPSec

- SSH works at the application layer; IPSec works at the network layer. IPSec supported by big−name router companies.
- SSH simple to set up; IPSec more complicated.
- SSH can only forward TCP ports and doesn’t work well with certain protocols (FTP); IPSec is a true VPN with transparent IP encryption.
- SSH protocol is simple; IPSec is complicated. *In general*, simplicity is preferred where security is at stake.

SSH vs. CIPE

- CIPE (Crypto IP Encapsulation) is a non−standard but very simple way of encrypting IP packets.
- Encapsulates IP in UDP.
- Much simpler than IPSec, but much less flexible. Intended for use between two routers.
- GPL’d Linux drivers; Windoze implementation under development.

Demo

- Sorry; no network. Just ssh to 127.0.0.1...

Q&A